Sunshine Coast Council

Shorebird Conservation Plan 2025-30

Attachment 2: Background Paper

Sunshine Coast COUNCIL

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Introduction

The Sunshine Coast provides important habitat for migratory and resident shorebirds, where they share limited coastal areas with a fast-growing urban community. Much of the region's rapidly growing population (predicted to exceed 500,000 by 2041) lives along the urban growth corridor between Caloundra and Maroochydore (ELS 2023). Delivering the Shorebird Conservation Plan 2025-30 is an action in the *Sunshine Coast Council Operational Plan 2025/26* and a transformational action in the *Environment and Liveability Strategy 2023* for the long-term conservation of our biodiversity (ELS 2023).

Shorebirds, or waders, are among the world's most threatened group of birds. The global destruction of tidal ecosystems and increasing human disturbance are major factors contributing to their population declines. Their complex ecology means they depend exclusively on wetlands while in Australia, with most species restricted to coastal intertidal habitats for feeding and roosting.

Of the 55 regularly occurring shorebird species in Australia, 37 are migratory. They make an annual return journey of thousands of kilometres between their breeding grounds in the arctic tundra of Russia, China, and Alaska and their non-breeding habitat in Australia. They migrate along the East Asian-Australasian Flyway (EAAF), which is home to 50 million migrating waterbirds (including shorebirds) and spans 22 countries. The remaining 18 species are resident shorebirds which spend their entire life in Australia. Although not migrating internationally, many species move to inland wetlands or disperse along the coast.

Between 2020 and 2025, surveys by Sunshine Coast Council recorded 14 migratory and 6 resident shorebird species on the Sunshine Coast, including the critically endangered Far Eastern Curlew and Curlew Sandpiper (Sunshine Coast Council 2025).

To help Australia's threatened shorebirds recover, we need to understand their population trends and challenges they face, both locally and globally. Because these birds travel vast distances, effective conservation must consider their movements, ecology, and life cycle. Local actions play a vital role in supporting global efforts to protect this diverse and remarkable group of birds.

Migratory Shorebirds

Each year, around 2 million migratory shorebirds make their way from their breeding grounds in the Arctic tundra to Australia and New Zealand. They fly more than 10,000 km along the East Asian-Australasian Flyway (EAAF) via stopover sites in Asia to their non-breeding grounds in the southern hemisphere (Figure 1).

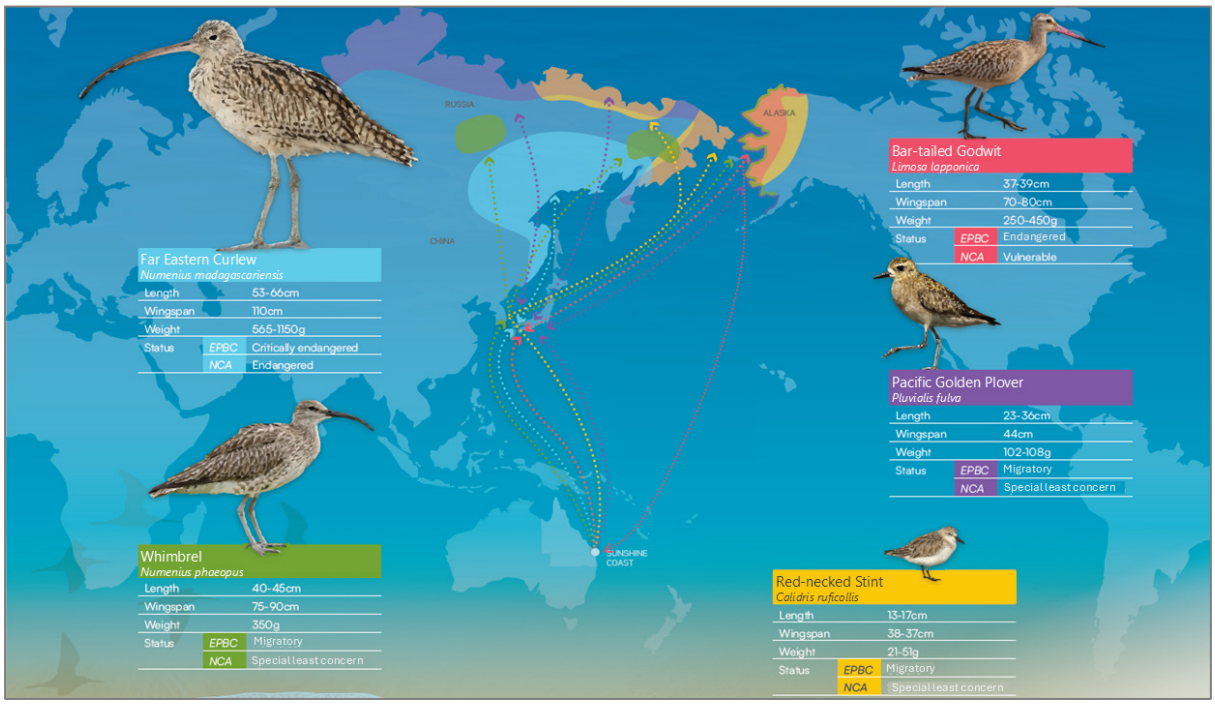


Figure 1: East Asian-Australasian Flyway (EAAF) and five migratory shorebirds commonly seen on the Sunshine Coast.

Migratory shorebirds live in a continuous cycle of breeding and migration, with times in between spent to prepare for, or recover from, these extraordinary flights. They have adapted to living completely different lifestyles in their breeding and non-breeding seasons, affecting their choice of food, habitat, and behaviour. From living in flocks in a warm to hot climate and feeding on aquatic invertebrates on Australia's coastal and freshwater wetlands, they can switch to living in pairs in the cool boreal forests or tundra while feeding on insects. Their extraordinary ability to fly continuously for thousands of kilometres enables this remarkable lifestyle.

Breeding

Migratory shorebirds breed in the tundra, grasslands, and forests of Alaska, Siberia, China, and Mongolia during the short northern summer. They arrive in their high latitude breeding grounds around late May to early June when the snow cover is disappearing, and their invertebrate prey starts to emerge. The abundance of insects during the short Arctic summer provides the birds with the energy needed for breeding and chick development.

The birds attempt to breed as early as possible and often mate within a few days of arrival. Migratory shorebirds are commonly monogamous and tend to return to the same location each year to breed. Typically, they only lay one clutch per year, however they may lay a second clutch if the first one is lost early in the season. Both males and females incubate the clutch and defend the nest against predators.

The nests, eggs, and chicks of shorebirds are well camouflaged from predators. Chicks leave their nest sites within hours of hatching and are highly mobile. If threatened, they hide or remain motionless on the spot. The parents display distraction behaviours to draw predators away from chicks and nests to minimise the risk of detection and predation. Data on egg and chick survival rates are sparse, although breeding success is known to depend on predation and environmental parameters such as temperature and prey availability (Saalfeld et al. 2021).

The chicks must feed and grow quickly to be able to fly south before the snow and icy winds return. Within just eight weeks, the chicks increase their body mass by 80%, learn how to fly, and start their first migration. Most of the adult birds leave the young when they are just six weeks old, leaving the young birds to complete their six-to-eight-week journey without adult guidance.

Migration

Adult migratory shorebirds leave their breeding grounds around July and arrive in Australia from late August. Species that breed further south, such as the Far Eastern Curlew, generally arrive first, followed by species breeding further north. Young birds are the last ones to leave the northern hemisphere and arrive in Australia. The migration takes several weeks for most species and includes several stopovers to rest and feed, with the main stopover sites being in the Yellow Sea and northern Australia. Bar-tailed Godwits, however, fly non-stop across the Pacific Ocean from Alaska to Australia or New Zealand, completing this extraordinary journey in a little over a week.

To survive the migration, shorebirds need to increase their feeding rate to store fat as fuel for migration. Over as little as six weeks, they almost double their body weight. Flight muscles increase in size in preparation for the migration to carry the extra weight. The stored fat is used up within a few days of constant flying during the migration. As the fat is metabolised and the weight reduced, the birds then start to metabolise part of the flight muscles to fuel the remaining journey.

Shorebirds can reduce the size of their digestive organs and leg muscles before the migration to reduce extra weight and create room to store fat. Their heart increases in size and their blood thickens to equip them for their long flight. Departure times are often dependent on local weather conditions, and shorebirds can fly higher than 5000 m to find favourable winds, allowing them to fly at speeds of up to 50 km/h (Geering et al. 2007).

Non-breeding season

Migratory shorebirds spend most of their lives at the non-breeding grounds, where coastal and freshwater wetlands are essential habitats providing high-quality food sources. They generally exhibit high site fidelity and return to the same habitat each year. Upon arrival they start moulting their body feathers from their colourful breeding plumage into their inconspicuous non-breeding plumage. They then start moulting their all-important flight feathers which have been worn out by the migration. Moulting is a slow and energy-consuming process which occurs in stages throughout the summer. Before their northward migration begins, shorebirds begin to moult their body feathers into breeding plumage.

During their time in the southern hemisphere, the lives of the shorebirds are governed by the tides. They feed day and night during low tide on exposed sandbanks and mudflats, probing for energy-rich invertebrates in the benthic substrate. During high tide, they congregate on dry and open roost areas to rest, digest, and preen. Shorebirds prefer high tide roosts located close to

feeding areas to minimise time and energy spent travelling between locations. Migratory shorebirds often roost and feed in mixed flocks with other species, including resident shorebirds.

Resident Shorebirds

Resident shorebirds do not migrate internationally; they live and breed locally in Australia, although some are nomadic and may move relatively long distances between suitable habitats. They breed in a variety of habitats, utilising inland wetlands (permanent or ephemeral), grasslands, or coastal habitats such as beaches or rocky foreshores. Breeding opportunities and success of some species depend on inland rainfall and the appearance of ephemeral wetlands. In contrast, beach-nesting birds are generally able to breed more consistently. Throughout Australia, resident shorebirds have been recorded breeding almost all year round (Geering et al. 2007).

Beach-nesting birds occur year-round on Australia's coast. The foreshore provides habitat for their entire life cycle: roosting, foraging, and breeding (Maguire 2008). Local beach-nesting birds such as Sooty and Pied Oystercatchers, Red-capped Plover, and Beach Stone-curlew tend to breed in early spring and summer (Figure 2). They lay their eggs on dunes or rocky shores above the high tide mark. The well-camouflaged eggs blend in perfectly with the sand, rock, and shell substrate, protecting them from native predators. Beach-nesting birds nest close to their food source, as the tiny, well-camouflaged chicks start foraging themselves straight after hatching (Maguire 2008).

Beach-nesting birds produce few young and their breeding success is naturally affected by high tides, storms, and native predators such as birds of prey. However, human-induced habitat destruction and modification, introduced predators, and the extent of recreational activities along the coast severely impact breeding success of these birds, leading to population declines and local extinctions (Maguire 2008).



Figure 2: Juvenile Pied Oystercatcher at Caloundra. Image credit: Simone Bosshard.

Feeding Ecology and Habitat Selection

Important habitat for migratory shorebirds

Australia's coastline and islands are a major terminal destination for migratory shorebirds in the East Asian-Australasian Flyway. Australia provides important habitat for migratory shorebirds during their non-breeding season, as well as for young migratory shorebirds over winter. Non-breeding juveniles often spend their first few years in Australia after their first southward migration (Clemens et al. 2016). Resident shorebirds depend on suitable habitat to breed and raise chicks in Australia.

Important habitat for migratory shorebirds is a key concept for the protection of migratory species under the EPBC Act. Important habitats in Australia for migratory shorebirds under the Act include those recognised as internationally and nationally important. Locally and internationally, the approach to identify important shorebird habitat has been using criteria adopted under the Ramsar Convention (Weller et al. 2020).

Wetland habitat is considered **internationally significant** if it regularly supports:

- 1% of the individuals of one species or subspecies of waterbird, or
- A total abundance of at least 20,000 waterbirds.

Shorebird habitat is considered **nationally significant** if it regularly supports:

- 0.1% of the flyway population of a single species of migratory shorebirds, or
- 2000 migratory shorebirds, or
- 15 migratory shorebird species.

Three important habitats areas are located in the Sunshine Coast local government area (Weller et al. 2020):

- Pumicestone Passage (internationally significant)
- Maroochy River (nationally significant)
- Yandina Creek Wetland (nationally significant).

Habitat selection

While in their non-breeding habitats, the daily lives of shorebirds are governed by the tides. At high tide, they roost in flocks above the high tide line. As the tide drops, the birds move onto adjacent intertidal flats to feed in the soft benthic substrate. Both high-tide roost sites and low-tide feeding areas are critical to the survival of shorebirds. To minimise energy expenditure, shorebirds prefer regions where roosting and feeding areas are relatively close together, thus minimising the time and energy required to travel back and forth between the tides.

Feeding behaviour and habitat

Shorebirds, especially in the lead up to their migration, have an enormous daily food requirement, consuming as much as 30% of their body weight daily. Smaller-bodied shorebirds spend more time feeding than larger-bodied ones, likely because large birds can eat larger, energy-rich prey. Different species employ different feeding strategies. Plovers (*Charadriidae*) locate prey visually, which is helped by their large eyes and short, robust bill. Birds of the sandpiper family (*Scolopacidae*) hunt their prey by probing the substrate with their sensory bills (Figure 3). However, they can also forage visually, making them more versatile foragers. Shorebirds with longer bills are generally able to use a wider variety of habitats for feeding (Geering et al. 2007). To maximise their feeding time, most shorebirds feed during low tide irrespective of the time of day or night. The ability of different species to feed at different depths as determined by the length and shape of their bills allows them to coexist without spending energy on food competition or defending a territory (Jessop, 1987, Geering et al. 2007).

High value feeding areas are usually near good quality high tide roost sites, minimising the flight distance between feeding and roosting areas. Shorebirds generally prefer sheltered but open intertidal flats without vegetation or seagrass, providing clear views to approaching predators (Metcalfe, 1984). The exception are certain species which are specialised to very specific habitats such as rocky foreshores.



Figure 3: Far Eastern Curlew feeding at Maroochy River. Image credit: Simone Bosshard.

Roosting habitat

On the incoming and high tide when feeding areas are submerged, most shorebirds roost on open, dry sandy spits or beaches. High quality roost sites are close to intertidal feeding areas and free of vegetation or other visual obstructions, providing a clear view of potential predators. Good roost sites provide protection from extreme weather conditions and experience little disturbance, allowing the birds to conserve energy while sleeping and preening. In hot conditions, shorebirds may roost near or in shallow water to thermoregulate. Some species, such as Whimbrel or Grey-tailed Tattler, roost in mangroves near their feeding habitat (Minton, 2000; Figure 4). Where natural roost sites are limited, anthropogenic structures such as aquaculture ponds, saltworks, training walls or breakwaters can provide alternative sites for the birds at high tide.

Shorebirds are particularly vulnerable to disturbance on high tide roost sites where they are concentrated on a limited number of small, dry areas above the high tide line. In certain locations there may be few or no alternative sites available if they are disturbed on their primary roost site. Repeated disturbance may cause the birds to abandon a roost site. Having multiple suitable roost sites available in any one habitat area is a key requisite to improve the resilience of shorebird populations.



Figure 4: Grey-tailed Tattler roosting on mangroves in the Maroochy River. Image credit: Simone Bosshard.

Breeding habitat for beach-nesting birds

While many resident shorebird species move to inland wetland areas to breed, there are a few species that rely on foreshore areas for nesting. Those beach-nesting birds depend on the coast for their entire life cycle.

Breeding habitat extends from the high tide line on sandy beaches up into the dunes, or, in the case of the Sooty Oystercatcher, on rocky shores above the high tide mark. Beach-nesting birds prefer open, vegetation-free areas that provide clear visibility to detect approaching predators. Rather than building elaborate nests, these birds lay their well-camouflaged eggs in a simple shallow scrape in the sand, often lined with shells, twigs, pebbles, or seagrass (Figure 5). They generally breed in pairs and defend their territory against intruders. They tend to nest close to their feeding areas to minimise distance to travel for their flightless chicks, which start feeding immediately after hatching.

Beach-nesting birds are highly vulnerable due to the exposure of their habitat to natural and anthropogenic impacts. The availability of undisturbed, intact habitat above the high tide mark is essential for their breeding success and survival.



Figure 5: Red-capped Plover incubating eggs at Caloundra. Image credit: Simone Bosshard.

Global Threats to Shorebirds

Shorebirds favour open landscapes such as grassland, tundra, beach, and wetland habitat for breeding, roosting, and feeding. Globally, these habitats have been altered dramatically in the last century (Hassan et al. 2005). Migratory shorebirds are highly faithful to a few, discrete breeding, feeding, and non-breeding sites across their annual migrations, making them particularly vulnerable to anthropogenic and environmental impacts and changes. The birds' ability to complete long migration flights depend on the availability of a series of wetland and coastal habitats that provide sufficient foraging and roosting opportunities to rebuild energy reserves (Piersma et al. 2015).

Due to their long migrations and complex life history, migratory shorebird populations are often impacted by multiple threats throughout their annual cycle (Runge et al. 2014) requiring local management action in addition to international conservation actions along the EAAF.

Habitat loss

Rapid habitat loss and alteration along the Flyway is the most significant threat affecting migratory shorebirds, having caused significant declines in as many as 45% of arctic-breeding shorebird populations (Zöckler et al. 2013, Melville et al. 2016). Particularly concerning is the loss of intertidal habitat in the Yellow Sea region, a key region bordered by China, the Democratic People's Republic of Korea, and the Republic of Korea, where birds stop and refuel on their migration (Amano et al. 2010; Melville et al. 2016; Studds et al. 2017). The Yellow Sea region is the major staging area for many species of shorebirds flying between Australia and Asia (Barter. 2002; Bamford et al. 2008). Extensive coastal reclamation and changes in sediment deposition from

major rivers have changed the shoreline of the Yellow Sea, leading to a loss of around 65% of intertidal habitat in the last 50 years (Murray et al. 2014). Habitat loss of such magnitude is the key driver of decreases in biodiversity and ecosystem services in the intertidal zone (MacKinnon et al. 2012). Habitat loss in the Yellow Sea region is now widely recognised as the principal driver behind the significant population declines in migratory shorebirds (Rogers et al. 2023).

Coastal development and urban expansion in coastal areas also occur in Australia, Japan, and Singapore, as well as most other countries along the Flyway. Habitat loss also occurs in breeding areas. The construction of hydroelectric dams and conversion of marshland into agricultural areas impact large expanses of potential nesting habitat for the critically endangered Far Eastern Curlew (Brown et al. 2014; Liu et al. 2004).

Habitat degradation

Wetland modification resulting in increased pollution, weed and pest invasion, and siltation stems from different activities such as aquaculture, fishing, agricultural practices, mining, changes to hydrology, or development near wetlands (Lee et al. 2005; Sutherland et al. 2012; Melville et al. 2016). These impacts can change the ecological character of a shorebird area and potentially affect the quality and quantity of resources available for shorebirds (Sutherland et al. 2012, Ma et al. 2014, Murray et al. 2015, Melville et al. 2016). A reduction of suitable habitat leads to issues such as overcrowding, food competition and subsequent depletion of food sources, and increased risk of disease transmission in the remaining areas. The areas identified as shorebird habitat today are likely the majority of suitable stopover sites and are irreplaceable for the survival of migratory shorebird species (SSAP 2017).

Disturbance

Disturbance from human activities such as recreation, fishing, bait collection, research, and monitoring has a high energetic cost to shorebirds and can significantly impact the ability of shorebirds to feed and rest adequately. This may affect their ability to build sufficient energy reserves for migration (Weston et al. 2012; Lilleyman et al. 2016). Disturbance can lead to functional habitat loss when it becomes great enough for shorebirds to completely avoid the area. Increases in recreational use have been shown to significantly reduce the number of shorebirds and coastal birds in an area, as well as reducing the amount of time the birds were feeding (Martin et al. 2014). Shorebirds show limited habituation to human disturbance, indicating that the negative effects of human presence persist as long as the disturbance continues. However, these impacts may be reversible through effective management strategies that reduce human activity and minimise disturbance in key habitats (Martin et al. 2014).

Recreational use of the coast also impacts resident shorebirds breeding on beaches and rocky shores. Eggs and chicks are vulnerable to predation by native, feral, and domestic animals, crushing by people and traffic, and habitat modification.

Climate change

Climate change predictions suggest likely increased temperatures, rising sea levels, and more erratic and extreme weather patterns (Nicol et al. 2015). These changes are expected to significantly reduce the extent of coastal ecosystems and wetlands, as well as shorebird breeding habitat (Chambers et al. 2005; Iwamura et al 2013).

Acute and chronic pollution

The extent of exposure of shorebirds to chronic pollution from local and distant sources is poorly understood. Shorebirds are at risk from bioaccumulation of chemicals from herbicides, pesticides, and industrial waste. Agricultural runoff carrying excess nutrients, sediments and heavy metals impacts waterways and wetlands (SSAP 2017). Shorebirds are affected by microplastics, as they prey on invertebrates known to ingest microplastics by filter-feeding (Liu et al. 2023).

Acute pollution is generally caused by accidents leading to oil or chemical spills. Shorebirds may be affected directly by the chemical, and the suitability of important habitat may be negatively impacted for many years through the loss of benthic food sources (SSAP 2017).

Artificial light at night

Artificial light at night poses several challenges for shorebirds, particularly during nesting and migration. It disrupts their natural behaviour by increasing nighttime activity and interfering with rest and foraging patterns. Bright lights can also disorient migrating birds, leading to collisions with lit structures or causing them to fly off course (DCCEEW 2023, Gaston 2013).

For nesting shorebirds, artificial light at night increases the visibility of eggs, chicks, and breeding adults to predators, thereby increasing the risk of predation. It can also cause birds to avoid otherwise suitable nesting sites, contributing to habitat loss (Nagendrasai 2024).

Hunting and poaching

Migratory shorebirds are protected in Australia and New Zealand and hunting these species is prohibited. Hunting still occurs along the Flyway, although studies indicate declined hunting activity in most areas (SSAP 2017). However, considering the conservation status of many species, even small numbers of shorebirds taken can have a devastating impact on a species.

High Pathogenicity Avian Influenza (HPAI) H5N1

Avian influenza ("bird flu") is an infectious disease of birds that affects wild and domestic birds and can spread to mammals, including humans. Large-scale outbreaks of the high pathogenicity avian influenza (HPAI) H5N1 clade 2.3.4.4b in the past two years have killed millions of wild birds and thousands of mammals around the world. As of August 2025, Oceania is the only continent free of the HPAI H5N1 strain, but experts predict it may arrive with the spring migration of shorebirds and seabirds from the Northern Hemisphere.

The understanding of infection and effects of HPAI H5N1 in shorebirds is limited. Currently available research to date shows shorebirds can survive infection after exposure to the virus, subsequently potentially dispersing the virus over long distances during their migration (Reperant et al., 2011, Wille et al. 2019). To effectively support wild birds, including shorebirds, during avian influenza outbreaks, it is essential to address and minimise other environmental and human-induced threats. Improving habitat quality and minimising disturbance will enhance the birds' overall resilience and ability to withstand disease-related stress.

Prey availability

Shorebirds specialise in feeding on benthic invertebrates living in the intertidal substrate of estuaries. The availability and accessibility of benthic prey in high value feeding areas is an important predictor of foraging success for shorebirds (Zharikov and Skilleter 2003, 2004). Studies in Moreton Bay revealed large differences in benthic communities between different intertidal

flats (Fuller et al., 2021, Skilleter 1998, Zharikov and Skilleter 2003), implying some intertidal areas are more valuable for feeding shorebirds than others.

Legal Frameworks and Conservation Mechanisms

The protection of migratory shorebirds is complex and involves multiple stakeholders across many jurisdictions, countries, and political boundaries.

Australia's statutory commitments

Migratory shorebirds are identified as matters of national environmental significance (MNES) under the *Environment Protection and Biodiversity Conservation (EPBC) Act 1999*, Australia's key piece of environmental legislation. The EPBC Act requires approval for any proposed action likely to have a significant impact on MNES. It is Australia's main legal instrument to implement the Commonwealth's obligations under the international agreements it is signatory to. As per January 2024, 16 species of migratory shorebirds were listed as threatened with extinction under the EPBC Act.

As a signatory to the *Convention on Conservation of Migratory Species of Wild Animals* (CMS or Bonn Convention), all migratory species listed on Appendix I or Appendix II are protected under the EPBC Act. Appendix I lists endangered species, while Appendix II species have an unfavourable conservation status. All of Australia's migratory shorebirds are listed on Appendix II, with two species also listed on Appendix I.

Australia has entered bilateral agreements to conserve migratory birds with Japan (JAMBA, 1974), China (CAMBA, 1986), and the Republic of Korea (ROKAMBA, 2007). Signatories to these agreements commit to take appropriate measures to preserve and enhance the environment of migratory birds, in particular by preventing damage to those birds and their environment.

Australia's obligation under these international agreements is to ensure no adverse effects on listed migratory species and their habitats occur in Australia.

All migratory and resident shorebirds in Queensland are protected under the *Nature Conservation Act 1992* (Qld), and under the *Marine Parks (Moreton Bay) Zoning Plan 2019* within the Moreton Bay Marine Park.

Other conservation mechanisms

Ramsar Convention on Wetlands

Australia is a signatory to the *Convention of Wetlands of International Importance* (Ramsar Convention), an international treaty dedicated to the conservation and 'wise use' of wetlands. Parties to this convention identify internationally significant wetlands and ensure the maintenance of the ecological character of these listed sites. Moreton Bay, which includes the Pumicestone Passage, is one of Australia's Ramsar Wetlands of International Importance.

East Asian-Australasian Flyway Partnership (EAAFP)

The EAAF is a journey for migratory birds across habitats from breeding grounds to non-breeding grounds and back. The East Asian-Australasian Flyway Partnership (EAAFP) is a non-binding, voluntary partnership to promote cooperation and collaboration between stakeholders, as no

one country can conserve migratory birds alone. The fundamental concept of the EAAFP is the protection of shared biodiversity, focusing on identifying and protecting a Flyway network of important habitat sites, enhancing research and monitoring, and developing flyway-wide conservation approaches. The last decade of international conservation efforts has led to a halt of most coastal reclamation projects in China, and the declaration of World Heritage Sites along the Yellow Sea coastline, protecting much of the remaining shorebird stopover habitat.

Local government obligations

Under these international, national, and state level regulatory frameworks, local governments have an obligation to protect shorebirds and their habitat within their respective local government areas. Sunshine Coast Council's *Environment and Liveability Strategy 2023* outlines the following policy positions in *Part A: Strategic Directions* which directly relate to the conservation of shorebirds:

Biodiversity policy positions

2.1 Natural ecosystems and the native plants and animals they support are preserved.
2.2 Priority habitat areas are protected, enhanced, connected and responsive to changing environmental conditions.
2.3 Biodiversity is valued, respected, and used sustainably to support our lifestyle, livelihoods, and sense of place.

Waterways and wetlands policy positions

3.1 Natural waterways and wetlands are preserved and enhanced to support healthy and diverse aquatic habitats and species.
3.3 Waterways and wetlands are valued, respected, and used sustainably to support our lifestyle, livelihoods and sense of place.

Coastal policy positions

4.1 The natural values and functions of coastal environments are preserved.
4.2 A healthy coast is preserved to sustain our valued coastal lifestyle and economy.

The development of the Shorebird Conservation Plan is an action in the *Sunshine Coast Council Operational Plan 2025/26* and directly contributes to the following Transformational Actions of the *ELS 2023 Part B: Five-year Implementation Plan*:

Strategic Pathway 2. Protection and enhancement of our natural assets and distinctive landscapes	
6. Conserving our biodiversity Connect and protect our valued habitat areas to support our native flora and fauna and providing the community with opportunities to participate in conservation and to experience the natural environment.	6.2 Develop and implement conservation/management plans for key threatened and iconic species.
	6.5 Deliver community conservation partnerships, education and stewardship programs.
8. Celebrating our landscape and character Identify, understand and plan for the defining landscapes, character and history of the Sunshine Coast to enable growth and development to be respectful and complementary for the future.	8.2 Work collaboratively with our traditional owners to recognise connection to country, protect values and knowledge, build stronger relationships and enrich our collective response for a sustainable future.

Strategic Pathway 3. Responsive, accessible, and well managed assets and infrastructure	
9. Growing our natural economy Strengthen the economic base around our natural assets and distinctive landscape features by enhancing a network of nature-based and cultural experiences supported by overnight accommodation and day visitor options.	9.1 Continue to build our understanding of our natural assets and the services they provide as we advocate for and grow the natural economy.
Strategic Pathway 5. A reputation for innovation and sustainability	
18. Building our knowledge Enable evidence-based decisions for a healthy environment and liveable Sunshine Coast.	18.2 Undertake targeted monitoring, modelling, research and other data collection.
	18.4 Maintain and enhance partnerships and initiatives with research institutions, government and the community to grow our collective knowledge.
	18.5 Develop and trial new and emerging tools and technologies to improve knowledge, data capture and business integration.

Table 1: Strategic Pathways and transformational actions relevant to shorebird conservation (ELS 2023).

Why Protect Shorebirds?

Shorebirds are some of the most mobile groups of animals in the world. Like all migratory species, their movements across the globe make them particularly vulnerable to natural and anthropogenic impacts along their migratory route. Like links in a chain, an intact network of quality sites along the migration route is crucial for the survival of migratory shorebirds, making them a key indicator of a well-functioning ecosystem. Healthy and functional coastal ecosystems provide benefits and services to human populations such as coastal protection, water filtration, nursery grounds for fisheries, or carbon sequestration. Shorebirds act as indicator species of changes to the coastal environment, which eventually flow on to affect human lifestyle and livelihood. Observing these remarkable birds in their natural environment or watching them take off on their incredible journey across the globe evokes human emotional, intellectual, and spiritual needs. Festivals celebrating shorebirds and ecotourism make up important contributions to the economy of many communities (Senner et al. 2016). For all these reasons, shorebirds deserve and need our attention on a local, national, and international level, to ensure these values are preserved for future generations.

Sunshine Coast Council Context

Local Shorebird Habitat

Primary shorebird habitat on the Sunshine Coast occurs in the estuaries of the Pumicestone Passage at Caloundra and the lower Maroochy River in Maroochydore (Figure 6). The Pumicestone Passage is recognised as an internationally significant shorebird habitat, while the Maroochy River is considered nationally significant (Weller et al. 2020). Additional habitat can be found along rocky foreshores, Mudjimba Island, other estuaries, lakes and lagoons, as well as freshwater wetlands.

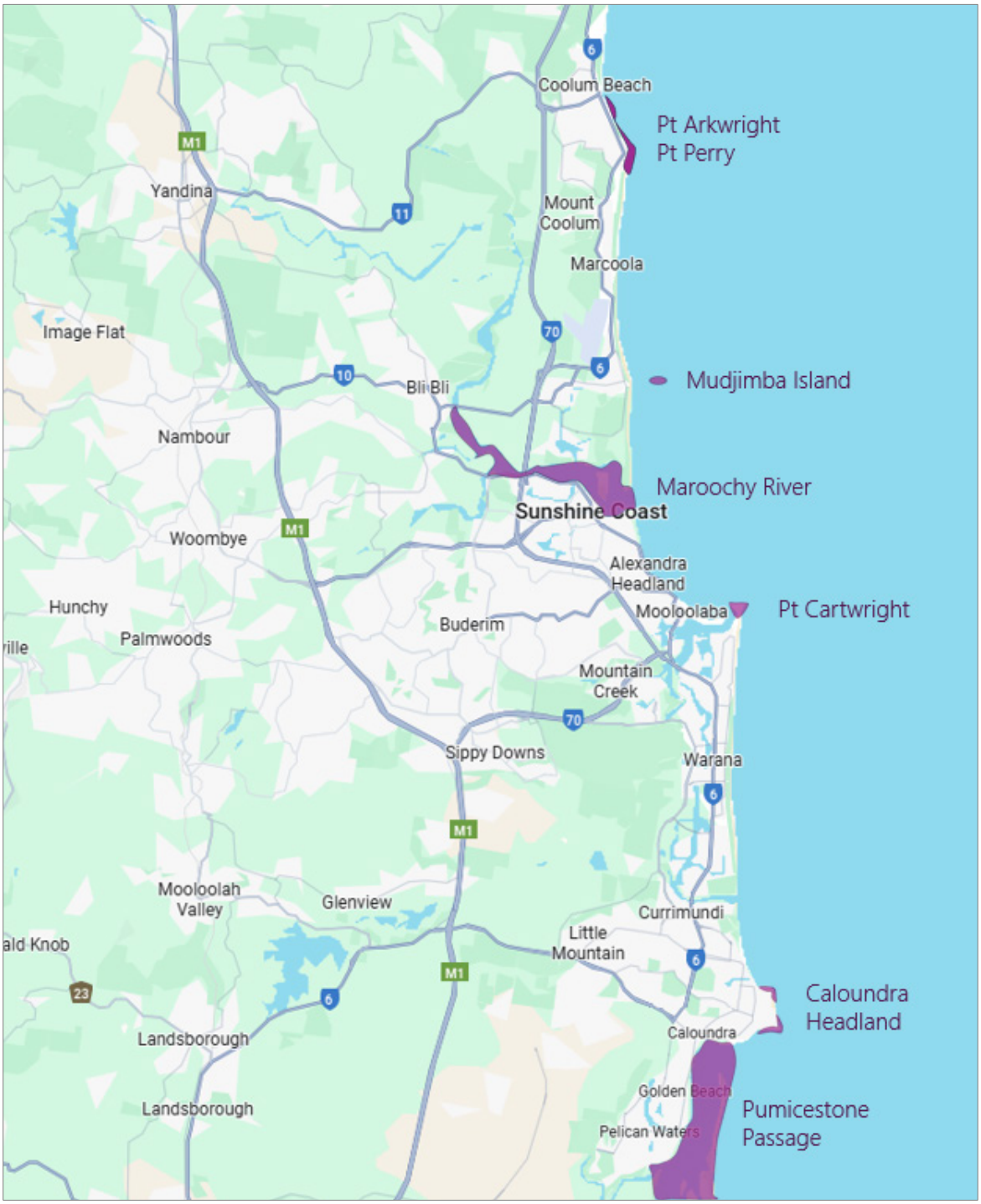


Figure 6: Main shorebird habitat areas on the Sunshine Coast.

Identifying high value shorebird areas

The most important or high value shorebird areas across the local government area can be assessed according to the following criteria (based on: Qld Guideline Marine Management 2022):

- Abundance and diversity in the context of local distribution and flyway populations
- Conservation significance of the species supported by the site
- Presence of nesting
- Distance to other suitable shorebird habitat.

High value shorebird habitat includes:

- High tide roost sites
- Important feeding areas with high abundance and diversity
- Nesting sites (actual and potential)
- Sites supporting endangered and vulnerable species.

The location and extent of high value shorebird areas can change over time as the characteristics of intertidal areas and roost areas in an estuary change due to coastal and fluvial processes.

High tide roost sites

High tide roost sites are small, dry, and open areas of sand or rocks where shorebirds congregate during high tide. Because of the limited number of suitable high tide roost sites available in any one habitat area, it is essential that the shorebirds remain undisturbed in these locations.

Maroochy River

Historically, five high tide roost sites were identified in the Maroochy River since monitoring by the Queensland Wader Study Group started in 1998: Goat Island, Nojoor Road, Maroochy North Shore, a sand bar near Cotton Tree, and a mangrove tree roost on the northern shoreline of the Maroochy River (Lloyd et al. 2024). During all high tide surveys conducted by Sunshine Coast Council since 2020, roosting was observed only on Goat Island and the mangrove tree roost. A small raised sandbank on the eastern side of Goat Island has become the main high tide roost in the lower Maroochy River (Figure 7); some Whimbrel and Grey-tailed Tattler appear to move between Goat Island and the mangrove tree roost, particularly in response to disturbance (Lloyd et al. 2024). Maroochy North Shore was the most important roost site for migratory shorebirds in the Maroochy River area until 2004. As public use of the North Shore dog off-leash area increased, resulting in more disturbance, migratory shorebirds gradually abandoned the site as a viable roosting site (Figure 8). Relying on a single roost site limits shorebirds' resilience to disturbance, as the absence of alternative sites leaves them vulnerable if they are forced to leave the main site because of disturbance.

The average number of roosting birds in 2024/25 was similar to the overall averages over the period from 2020/21-2023/24 (Table 2; Sunshine Coast Council 2025).

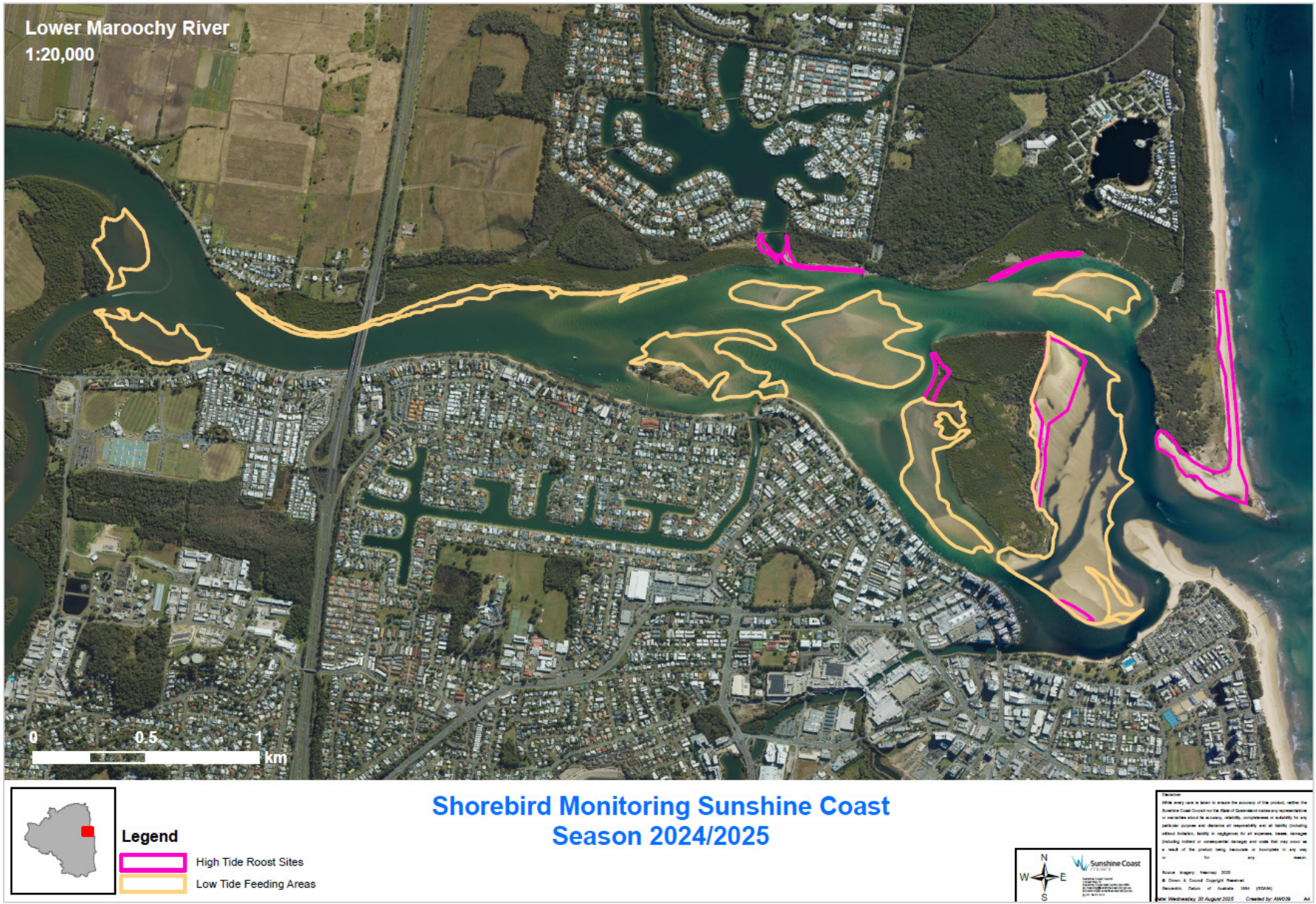


Figure 7: High tide roost sites (current and historic) and low tide feeding areas in the Maroochy River.

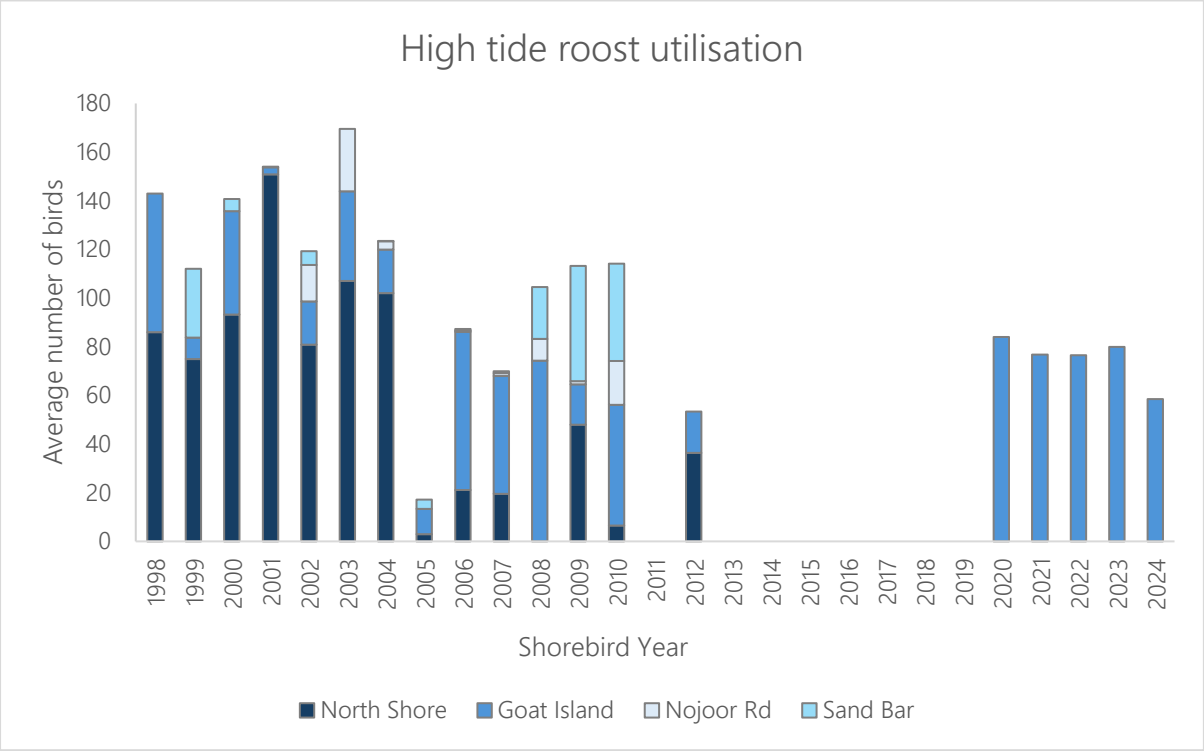


Figure 8: Average annual summer-season (October to mid-March) count of migratory shorebirds at high tide (within 2 hours either side of high tide) at each of four roost sites in the Lower Maroochy River since 1998 based on data from the Queensland Wader Study Group and Sunshine Coast Council. MRNS: Maroochy River North Shore; MRGI: Maroochy River Goat Island; Maroochy River Nojoor Road; Maroochy River Sand Bar (Lloyd et al. 2024).

Species	2024/25			2020/21 to 2023/24		
	Average	SD	Maximum	Average	SD	Maximum
Far Eastern Curlew	3.8	0.5	4	3.9	1.1	6
Eurasian Whimbrel	49.0	8.4	59	46.2	13.4	72
Bar-tailed Godwit	11.8	0.5	12	19.2	18.0	71
Pacific Golden Plover	0.0	0.0	0	1.2	3.6	13
Red-necked Stint	0.5	1.0	2	0.5	1.1	4
Grey-tailed Tattler	7.5	3.1	11	7.4	5.3	12
Total migratory	**72.5**	**10.9**	**86**	**78.3**	**18.7**	**109**
Beach Stone-curlew	0.0	0.0	0	0.5	1.0	3
Pied Oystercatcher	2.0	0.8	3	3.0	2.0	7
Sooty Oystercatcher	0.0	0.0	0	0.2	0.6	2
Red-capped Plover	2.8	3.2	6	2.0	2.6	8
Total resident	**4.8**	**2.8**	**8**	**5.7**	**3.2**	**12**

Table 2: Comparison of the average, standard deviation (SD, a measure of variability) and maximum counts of migratory and resident shorebirds roosting at Maroochydore at high tide between the summer of 2024/25 (n = 4 surveys) and 2020/21 to 2023/24 (n =16 surveys) (Sunshine Coast Council 2025).

Pumicestone Passage

The Pumicestone Passage is an internationally significant shorebird habitat (Weller et al. 2020). Eight shorebird roost sites are currently recognised in Caloundra: Caloundra Bar, the northern tip of Bribie Island, Sandbanks 1-3, a mangrove tree roost near Bells Creek, a mangrove tree roost on the western side of Bribie Island, and Wickham Point on Caloundra headland (Figure 10). The system has been highly dynamic after the Bribie Island breakthrough and formation of a new bar in January 2022. A second breakthrough formed in early 2025, further changing the system. The formation of new sandbars created new high tide roost areas, although some of them were only transient (Sunshine Coast Council 2025). The changes in the estuary also allowed easier access from the mainland to these roosting areas, increasing the risk and frequency of disturbance. Sandbanks 2 and 3 have been the preferred roost sites for the birds since 2022, however, they are submerged during the highest tides of the year, forcing the birds onto the northern tip of Bribie Island, where they are pressured by people and dogs to move into the vegetated area (Figure 9). The observations of shorebirds moving between roost sites in response to tides and disturbance confirm the importance of a local network of suitable roost sites.

The average number of shorebirds roosting in Caloundra during summer 2024/25 was similar to the averages over the previous four years (Table 3) and includes a nationally significant population of the critically endangered Far Eastern Curlew.



Figure 9: Whimbrel and Bar-tailed Godwit on the northern tip of Bribie Island during high tide. Image credit: Simone Bosshard.



Figure 10: High tide roost sites (current and historic) and low tide feeding areas in the Pumicestone Passage in Caloundra.

Species	2024/25			2020/21 to 2023/24		
	Average	SD	Maximum	Average	SD	Maximum
Bar-tailed Godwit	67.0	23.6	94	63.7	42.2	135
Curlew Sandpiper	0	0	0	0.7	2.3	9
Eurasian Whimbrel	69.3	11.1	81	61.9	39.1	132
Far Eastern Curlew	42.5	4.9	48	36.2	16.6	68
Pacific Golden Plover	0	0	0	14.8	21.6	66
Red Knot	0	0	0	0.2	0.8	3
Red-necked Stint	0	0	0	0.1	0.5	2
Grey-tailed Tattler	9.0	18.0	36	0	0	0
Total migratory	**187.8**	**39.2**	**243**	**177.5**	**91.7**	**324**
Beach Stone-Curlew	0.3	0.5	1	0	0	0
Masked Lapwing	0.5	1.0	2	1.4	1.8	5
Pied Oystercatcher	3.5	3.7	9	5.5	2.4	11
Pied Stilt	40.0	14.1	53	13.1	31.8	110
Red-capped Plover	6.8	8.1	16	2.4	3.5	9
Total resident	**51.0**	**11.8**	**68**	**22.4**	**33.3**	**123**

Table 3: Comparison of the average, standard deviation (SD, a measure of variability) and maximum counts of migratory and resident shorebirds roosting at Caloundra at high tide between the summer of 2024/25 (n=4 surveys) and 2020/21 to 2023/24 (n=16) (Sunshine Coast Council 2025).

Feeding areas

Feeding areas are intertidal flats located near high tide roost sites. Feeding areas are larger than high tide roost sites, allowing shorebirds to move around and avoid disturbance to a certain extent. However, it is still necessary to minimise disturbance in high quality feeding areas to ensure shorebirds can feed sufficiently to meet their high energy requirements.

Maroochy River

There are seven different areas of tidal flats exposed at low tide in the lower Maroochy River, running along the northern shoreline and sandbanks around Chambers and Goat Islands. The most important feeding area is a large sandbank on the eastern side of Goat Island. Other important areas for foraging shorebirds are two tidal flats on the western side of Goat Island (Figure 7). Large mixed flocks of thousands of terns, including the vulnerable Little Tern, also roost on these sandbanks. Shorebirds and terns on these sandbanks are often pressured by large numbers of people crossing over from Cotton Tree or from boats pulling up on the sandbanks, both occasionally with dogs (Sunshine Coast Council 2025).

Abundance of shorebirds since 2011 on tidal flats in the Maroochy River has declined significantly for Pacific Golden Plover, Grey-tailed Tattler, Double-banded Plover, and Red-capped Plover (Lloyd et al. 2024).

Pumicestone Passage

Six main tidal flat feeding habitat areas currently occur in the northern Pumicestone Passage at Caloundra (Figure 10). The area has changed substantially following the Bribie Island breakthrough in January 2022, creating new feeding areas, and connecting existing separate tidal flats. Two large sandbanks between Golden Beach and northern Bribie Island are the most important feeding areas for shorebirds, but increasing numbers of shorebirds are starting to use the new sandbank on the south side of the new Bribie Bar. The change in sedimentation allows for easy access on foot from the mainland to many of the feeding areas, increasing pressure on foraging shorebirds from people, and occasionally dogs. The substantial changes of the tidal flats introduce a high degree of uncertainty in a direct comparison with long term monitoring data of the area.

The data suggest a decline in total migratory shorebirds foraging on tidal flats in Caloundra from 1992-2010, with no apparent trend since then (**Figure 11**, Sunshine Coast Council 2025).

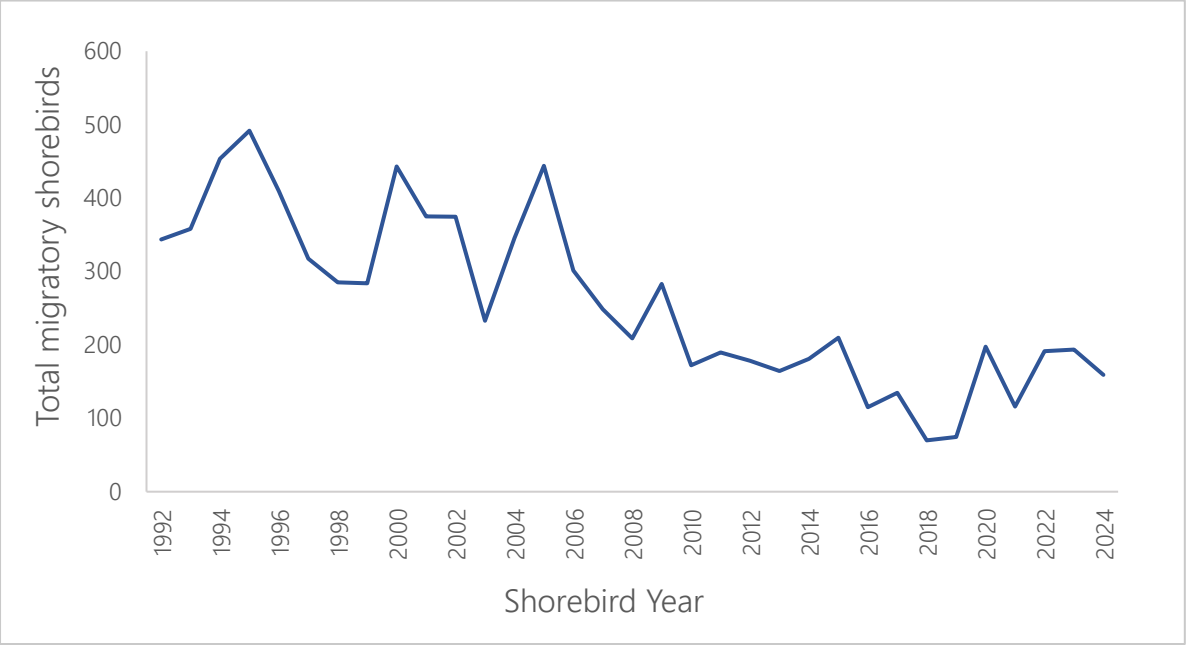


Figure 11: Average annual total migratory shorebird counts at Golden Beach at low tide during the summer non-breeding period from 1992/93 to 2024/25 (Sunshine Coast Council 2025).

Breeding areas

Breeding areas are above the high tide mark along beaches all the way into the dunes, or on rocky shores for certain species. Records of breeding by resident shorebirds on the Sunshine Coast are limited, but the continuous presence of these species suggest they breed locally.

Confirmed breeding areas are located on Maroochy North Shore, Goat Island (Maroochy River Conservation Park), Outrigger Park, Bribie Island, and high sandbanks in the Pumicestone Passage at Caloundra.

Rocky foreshores and Mudjimba Island are potential breeding areas for Sooty Oystercatcher.

Nests and chicks of resident shorebirds are highly vulnerable to trampling, predation and disturbance in all those locations, due to the high pressure of recreational use.

Rocky foreshores

Rocky foreshores provide important roosting and feeding habitat for some specialised shorebird species (i.e., Wandering Tattler, Sooty Oystercatcher; Figure 12). The intertidal habitat supports mussels, barnacles, oysters, tubeworms, and other invertebrates that provide a rich protein source for shorebirds. Sooty Oystercatcher breed on rocky foreshores, where they lay a small clutch of camouflaged eggs in a crevice or small hollow on the ground.

Important rocky foreshore habitat on the Sunshine Coast is located at Caloundra Headland, Point Cartwright, Point Perry to Point Arkwright, Mudjimba Island, and to a lesser extent at Alexandra Headland.

Local species

The Sunshine Coast hosts hundreds of migratory and resident shorebirds from at least 20 different species throughout the year (Sunshine Coast Council 2025). Some species are transient and only spend a few weeks here on their way to their final habitat destination. This plan provides actions to support conservation for all shorebird species present on the Sunshine Coast, including the regularly occurring species listed in Table 4. These actions will also benefit other coastal bird species that rely on the same intertidal habitats, including the recently listed vulnerable Little Tern.



Figure 12: Sooty Oystercatchers at Caloundra Headland. Image credit: Simone Bosshard.

Common Name	Scientific Name	Qld NCA listing	EBPC listing
Far Eastern Curlew	*Numenius madagascariensis*	Critically endangered	Critically endangered, migratory, marine
Western Alaskan Bar-tailed Godwit	*Limosa lapponica baueri*	Endangered	Endangered, migratory, marine
Eurasian Whimbrel	*Numenius phaeopus*	Special least concern	Migratory, marine
Pacific Golden Plover	*Pluvialis fulva*	Special least concern	Migratory, marine
Grey-tailed Tattler	*Tringa brevipes*	Special least concern	Migratory, marine
Wandering Tattler	*Tringa incana*	Special least concern	Migratory, marine
Double-banded Plover	*Charadrius bicinctus*	Special least concern	Migratory, marine
Curlew Sandpiper	*Calidris ferruginea*	Critically endangered	Critically endangered, migratory, marine
Red-necked Stint	*Calidris ruficollis*	Special least concern	Migratory, marine
Pied Oystercatcher	*Haematopus longirostris*	Least concern	Not listed
Sooty Oystercatcher	*Haematopus fuliginosus*	Least concern	Not listed
Red-capped Plover	*Charadrius ruficapillus*	Least concern	Marine
Beach Stone-curlew	*Esacus magnirostris*	Vulnerable	Marine
Pied Stilt	*Himantopus himantopus*	Least concern	Marine
Little Tern	*Sternula albifrons*	Special least concern	Vulnerable, migratory, marine
Common Tern	*Sternula hirundo*	Special least concern	Migratory, marine
Greater Crested Tern	*Thalasseus bergii*	Special least concern	Migratory, marine
Lesser Crested Tern	*Thalasseus bengalensis*	Least concern	Marine
Australian Tern	*Gelochelidon nilotica*	Least concern	Migratory, marine
Caspian Tern	*Hydroprogne caspia*	Special least concern	Migratory, marine

Table 4: Regularly occurring species and their conservation status under the Queensland *Nature Conservation Act 1992* (NCA) and the Commonwealth *Environment Protection and Biodiversity Act 1999* (EBPC *Act*).

Threat Assessment

All locally relevant threats have been assessed to determine the risk posed to shorebirds on the Sunshine Coast. This in turn has informed the priority for actions outlined in Attachment 1 of the Shorebird Conservation Plan.

The risk matrix considers the likelihood of an incident occurring and its consequences on shorebird individuals as well as local and global populations. A qualitative assessment of expert opinion and peer reviewed literature was used for the assessment. Threats may act differently on different species and populations at different times of the year, but the precautionary principle dictates that the threat category is determined by the group at highest risk (i.e. Far Eastern Curlew).

Levels of risk were defined as follows:

Very High	Immediate mitigation action required
High	Mitigation action and adaptive management required
Moderate	Obtain additional information and develop mitigation action if required
Low	Monitor the threat occurrence and reassess threat level if likelihood or consequences change

The categories for likelihood were assessed as follows:

Almost certain	Expected to occur locally every year
Likely	Expected to occur locally at least once every five years
Possible	Might occur locally at some time
Unlikely	Events known to have occurred globally but only rarely
Rare or unknown	May occur only in exceptional circumstances or is currently unknown how often it will occur

The categories for consequences were assessed as follows:

Not significant	No long-term effects on individuals or population
Minor	Some individuals are adversely affected but no effect on local population level
Moderate	All individuals of the local population are adversely affected
Major	Significant impacts on local population, reduced abundance, and diversity
Catastrophic	Global population decrease

Likelihood	Consequences				
	Not significant	Minor	Moderate	Major	Catastrophic
Almost certain		Avian Influenza HPI H5N1	Habitat loss (feeding) through anthropogenic disturbance Climate change & Sea level rise	Habitat loss (roosting) through anthropogenic disturbance	
Likely		Habitat loss (feeding) through erosion Marine debris & Chronic pollution Artificial Light at Night	Habitat loss (roosting) through erosion		
Possible		Habitat degradation	Feral animals		
Unlikely				Acute pollution	
Rare or unknown				Prey availability	

References

Agreement between the Government of Australia and the Government of Japan for the Protection of Migratory Birds in Danger of Extinction and their Environment (Tokyo, 6 February 1974). https://www.austlii.edu.au/au/other/dfat/treaties/1981/6.html

Agreement between the Government of Australia and the Government of the People's Republic of China for the Protection of Migratory Birds and their Environment (Canberra, 20 October 1986). https://www.austlii.edu.au/au/other/dfat/treaties/1988/22.html

Agreement between the Government of Australia and the Government of the Republic of Korea on the Protection of Migratory Birds and Exchange of Notes (Canberra, 6 December 2006). https://www.austlii.edu.au/au/other/dfat/treaties/2007/24.html

Amano T, Székely T, Koyama K, Amano H & Sutherland WJ (2010) A framework for monitoring the status of populations: An example from wader populations in the East Asian–Australasian flyway. Biological Conservation, 143, 2238-2247.

Bamford, M., Watkins, D., Bancroft, W., Tischler, G., & Wahl, J. (2008). Migratory Shorebirds of the East Asian – Australasian Flyway; Population Estimates and Internationally Important Sites. Wetlands International – Oceania. Canberra, Australia.

Barter, M. (2002). Shorebirds of the Yellow Sea: Importance, threats and conservation status. Wetlands International Global Series 9, International Wader Studies 12. Canberra, Australia.

Brown, D., Crockford, N., & Sheldon, R. (2014). Drivers of population change and conservation priorities for the Numeniini population of the world. Conservation statements for the 13 species and 38 biogeographic populations of curlews, godwits and the upland sandpiper. The Royal Society for the Protection of Birds.

Chambers, L.E., Hughes, L., & Weston M.A. (2005). Climate change and its impact on Australia's avifauna. *Emu* 105: 1-20.

Clemens, R.S., Rogers, D.I., Hansen, B.D., Gosbell, K., Minton, C.D.T., Straw, P., Bamford, M., Woehler, E.J., Milton, D.A., Weston, M.A., Venables, B., Weller, D.R., Hassell, C., Rutherford, B., Onton, K., Herrod, A., Studds, C.E., Choi, C.Y., Dhanjal-Adams, K.L., Murray, N.J., Skilleter, G., & Fuller, R.A. (2016). Continental-scale decreases in shorebird populations in Australia. Emu 116: 119-135.

Convention on the Conservation of Migratory Species of Wild Animals. https://www.cms.int/

Convention of Wetlands of International Importance. www.ramsar.org

DCCEEW 1999. *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). https://www.dcceew.gov.au/environment/epbc

DCCEEW EPBC Act Species Profile and Threats Database (SPRAT). https://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

DCCEEW 2023. *National Light Pollution Guidelines for Wildlife*, Department of Climate Change, Energy, the Environment and Water, Canberra, May. CC BY 4.0 https://www.dcceew.gov.au/environment/biodiversity/publications/national-light-pollution-guidelines-wildlife

East Asian-Australasian Flyway Partnership. www.eaaflyway.net

Environment and Liveability Strategy 2023, Sunshine Coast Council.

https://els.sunshinecoast.qld.gov.au/

Fuller RA, Clemens RS, Woodworth BK, Moffitt D & Simmons BA (2021) Managing Threats to Migratory Shorebirds in Moreton Bay. Final report to Healthy Land and Water. University of Queensland, Brisbane.

Gaston, K.J., Bennie, J., Davies, T.W. and Hopkins, J. (2013), The ecological impacts of nighttime light pollution: a mechanistic appraisal. Biol Rev, 88: 912-927. https://doi.org/10.1111/brv.12036

Geering, A., L. Agnew, and S. Harding (2007) Shorebirds of Australia. CSIRO Publishing, Victoria.

Guideline Marine Management 2022. Local government dog off-leash areas in State Marine Parks. Queensland Government, Brisbane. QPW/2022/5918 v1.00. https://parks.des.qld.gov.au/management/resources?a=272936%3Apolicy_registry%2Fgl-pk-mm-dog-off-leash-areas-state-mp.pdf

Hassan, R., R. Scholes and N. Ash (Eds.). 2005. Millennium ecosystem assessment: current state and trends. Island Press, Washington, D.C., USA.

International Single Species Action Plan for the Conservation of Far Eastern Curlew Numenius madagascariensis (2017). UNEP/CMS/COP12/Doc.24.1.7 23 May 2017

Iwamura, T., Possingham, H.P., Chadès, I., Minton, C., Murray, N.J., Rogers, D.I., Treml, E.A. & Fuller, R.A. (2013). Migratory connectivity magnifies the consequences of habitat loss from sea-level rise for shorebird populations. *Proceedings of the Royal Society B* 281: 20130325.

Jessop, A. E. (1987). Foraging strategies of the family Recurvirostridae. The Stilt 10, 15-8.

Lee, S.Y., Dunn, R.J.K., Young, R.A., Connolly, R.M., Dale, P.E.R., Dehayr, R., Lemckert, C.J., McKinnon, S., Powell, B., Teasdale, P.R., & Welsh, D.T. (2006). Impact of urbanization on coastal wetland structure and function. *Austral Ecology* 31: 149-163.

Lilleyman, A., Franklin, D.C., Szabo, J.K., & Lawes, M.J. (2016). Behavioural responses of migratory shorebirds to disturbance at a high-tide roost. *Emu* 116: 111-118.

Liu, H., Zhang, S., Li, Z., Lu, X. & Yang, Q. (2004). Impacts on wetlands of large-scale land-use changes by agricultural development: The small Sanjiang Plain, China. *Ambio* 33: 306-310.

Liu W, Chen X, Liang T, Mu T, Ding Y, Liu Y, Liu X (2023). Varying abundance of microplastics in tissues associates with different foraging strategies of coastal shorebirds in the Yellow Sea. Sci Total Environ. 2023 Mar 25;866:161417.

Lloyd, P., Driscoll, P.V. and Bosshard, S. (2024). Changes in shorebird use of the Maroochy River estuary, Sunshine Coast, Queensland over 25 years. Corella 48: 39-48.

Maguire, G.S (2008). A practical guide for managing beach-nesting birds in Australia. Birds Australia.

Martin, B., Delgado, S., de la Cruz, A., Tirado, S., & Ferrer, M. (2014). Effects of human presence on the long-term trends of migrant and resident shorebirds: evidence of local population declines. Animal Conservation 18: 73-81.

Melville, D.S., Chen, Y. & Ma, Z. (2016). Shorebirds along the Yellow Sea coast of China face an uncertain future – a review of threats. Emu 116: 100-110

Metcalfe, N. B. (1984). The effects of habitat on the vigilance of waders: is visibility important? Animal Behaviour 32, 981-5.

Minton, C. (2000). Waders roosting on mangroves. The Stilt 37, 23-4.

Murray, N.J., Clemens, R.S., Phinn, S.R., Possingham, H.P., & Fuller, R.A. (2014). Tracking the rapid loss of tidal wetlands in the Yellow Sea. *Frontiers in Ecology and the Environment*. 12: 267-272.

Nagendrasai, K., Kadam, R.V., Savaliya, B., & Kumar, S. (2024). Blinded by the light: The hidden perils of artificial illumination for shorebirds. *The Science of the World*. Vol. 4(11), 5194-5198.

Nicol, S., Fuller, R.A., Iwamura, T., & Chadès, I. (2015) Adapting environmental management to uncertain but inevitable change. *Proceedings of the Royal Society of London B: Biological Sciences* 282(1808): 20142984.

Piersma, T., Lok, T., Chen, Y., Hassell, C.J., Yang, H.-Y., Boyle, A., Slaymaker, M., Chan, Y.-C., Melville, D.S., Zhang, Z.-W., & Ma, Z. (2015). Simultaneous declines in summer survival of three shorebird species signals a flyway at risk. Journal of Applied Ecology 53: 479-490.

Queensland *Nature Conservation Act 1992*.
https://www.legislation.qld.gov.au/view/pdf/inforce/current/act-1992-020

Queensland NCA 1992 WildNet species database. https://wildnet.science-data.qld.gov.au/

Reperant LA, van de Bildt MW, van Amerongen G, Buehler DM, Osterhaus AD, Jenni-Eiermann S, Piersma T, Kuiken T. Highly pathogenic avian influenza virus H5N1 infection in a long-distance migrant shorebird under migratory and non-migratory states. PLoS One. 2011;6(11):e27814.

Rogers A, Fuller RA & Amano T (2023) Australia's migratory shorebirds: Trends and prospects. Report to the National Environmental Science Program. University of Queensland, Brisbane.

Runge CA, Martin TG, Possingham HP, Willis SG & Fuller RA (2014) Conserving mobile species. Frontiers in Ecology and the Environment, 12, 395–402.

Saalfeld ST, Hill BL, Hunter CM, Frost CJ, Lanctot RB. Warming Arctic summers unlikely to increase productivity of shorebirds through renesting. Sci Rep. 2021 Jul 27;11(1):15277.

Senner, S. E., B. A. Andres and H. R. Gates (Eds.). 2016. Pacific Americas shorebird conservation strategy. National Audubon Society, New York, New York, USA. Updated and corrected, November 2017.

Skilleter GA (1998) Ecology of benthic invertebrates in Moreton Bay. Pp. 365-394 in Tibbetts I, Hall NJ & Dennison WC (eds) Moreton Bay and Catchment. University of Queensland, Brisbane.

Studds CE, Kendall BE, Murray NJ, Wilson HB, Rogers DI, Clemens RS, Gosbell K, Hassell CJ, Jessop R, Melville DS, Milton DA, Minton CDT, Possingham HP, Riegen AC, Straw P, Woehler EJ & Fuller RA (2017) Rapid population decline in migratory shorebirds relying on Yellow Sea tidal mudflats as stopover sites. Nature Communications, 8, 14895.

Sunshine Coast Council (2025). SCC Shorebird Surveys and Assessments 2020-2025. https://www.sunshinecoast.qld.gov.au/environment/native-animals/shorebirds/reports-and-publications

Sunshine Coast Council Operational Plan 2025/26.
https://publicdocs.scc.qld.gov.au/hpecmwebdrawer/RecordHtml/26347055

Sutherland, W.J., Alves, J.A., Amano, T., Chang, C.H., Davidson, N.C., Finlayson, C.M., Gill, J.A., Gill, R.E., González, P.M., Gunnarsson, T.G., Kleijn, D., Spray, C.J., Székely, T., & Thompson, D.B.A. (2012). A horizon assessment of current and potential future threats to migratory shorebirds. *Ibis* 54: 663-679.

Weller, D., Kidd, L., Lee, C., Klose, S., Jaensch, R. and Driessen, J. 2020. Directory of Important Habitat for Migratory Shorebirds in Australia. Prepared for Australian Government Department of Agriculture, Water and the Environment by BirdLife Australia, Melbourne.

Wildlife Health Australia (2023). High Pathogenicity Avian Influenza (HPAI) clade 2.3.4.4b incursion risk assessment for Australia (Abridged Version).

Wille M, Lisovski S, Risely A, Ferenczi M, Roshier D, Wong FYK, Breed AC, Klaassen M, Hurt AC. Serologic Evidence of Exposure to Highly Pathogenic Avian Influenza H5 Viruses in Migratory Shorebirds, Australia. Emerg Infect Dis. 2019 Oct;25(10):1903-1910.

Weston, M.A., McLeod, E.M., Blumstein, D.T., & Guay, P.-J. (2012). A review of flight-initiation distances and their application to managing disturbance to Australian birds. *Emu* 112: 269-286.

Zharikov Y & Skilleter G (2003) Depletion of benthic invertebrates by Bar-tailed Godwits Limosa lapponica in a subtropical estuary. Marine Ecology Progress Series, 254, 151–162.

Zharikov Y & Skilleter G (2004) Potential interactions between humans and non-breeding shorebirds on a subtropical intertidal flat. Austral Ecology, 29, 647–660.

Zöckler, C., R. Lanctot, S. Brown and E. Syroechkovskiy. 2013. Waders (shorebirds). Pages 92–102 in Arctic Report Card 2012 (M. O. Jeffries, J. A. Richter-Menge and J. E. Overland, Eds.). National Oceanic and Atmospheric Administration, Silver Spring, Maryland, USA. www.arctic.noaa.gov/Report-Card/Report-Card-Archive.