An analysis of migratory and resident shorebird diversity and abundance in the Noosa River estuary 2005 – 2019

August 2020

Prepared by the Noosa Integrated Catchment Association Inc. Shorebird Survey Group with the support of Noosa Shire Council under the Community Environment Grants Program 2019.

Noosa Integrated Catchment Assn. Inc.

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This report was prepared by the Noosa Integrated Catchment Association, Inc. with the invaluable advice and support of Jill Dening. Thanks are due to the many past and present members of the Noosa River Shorebird Survey group led by Jill Dening, Barbara Dickson and Allen Briggs who have contributed their time and energy over the past 14 years to these surveys and continue to do so. Thanks are also due to O Boat Hire, Noosaville for the generous use of their vessels throughout the survey period. All photographic and editorial contributions have been credited where possible.

Cover photo of a *critically endangered* Far Eastern Curlew (*Numenius madagascariensis*) at rest in the Noosa River estuary. The total population of the species traversing the EAAF is estimated at around 35,000 individuals. A previously abundant migrant, it was last observed in the Noosa River in October, 2017. Credit Bob Inglis.

Introduction

The purpose of this report is to summarise the results to date of the first known longitudinal survey of shorebirds in the Noosa River estuary. The survey has been conducted by the Noosa Integrated Catchment Association, Inc. Shorebird Survey Group ("SSG") over a 14 year period commencing in October 2005 through October 2019 with funding and technical support provided by the Noosa Shire Council under the Community Environment Grants Program 2019.

The report provides a basis to better understand the long-term trends in shorebird biodiversity and abundance in the Noosa River estuary and for comparison against trends observed elsewhere in Australia and across the East Asian - Australasian Flyway ("EAAF"). All survey data compiled by the SSG has been contributed contemporaneously to the Queensland Wader Study Group database as part of the national Shorebirds 2020 program[1] and these surveys continue monthly.

> *Shorebirds or "waders" are those birds commonly found on coastal shores, including beaches, rocky shores, mudflats, tidal wetlands and lagoons. These include the many plovers and sandpipers in the families Charadriidae and Scolopacidae, as well as the stone-curlews, snipes, pratincoles, oystercatchers, stilts, avocets and the Plains-wanderer.*[2]

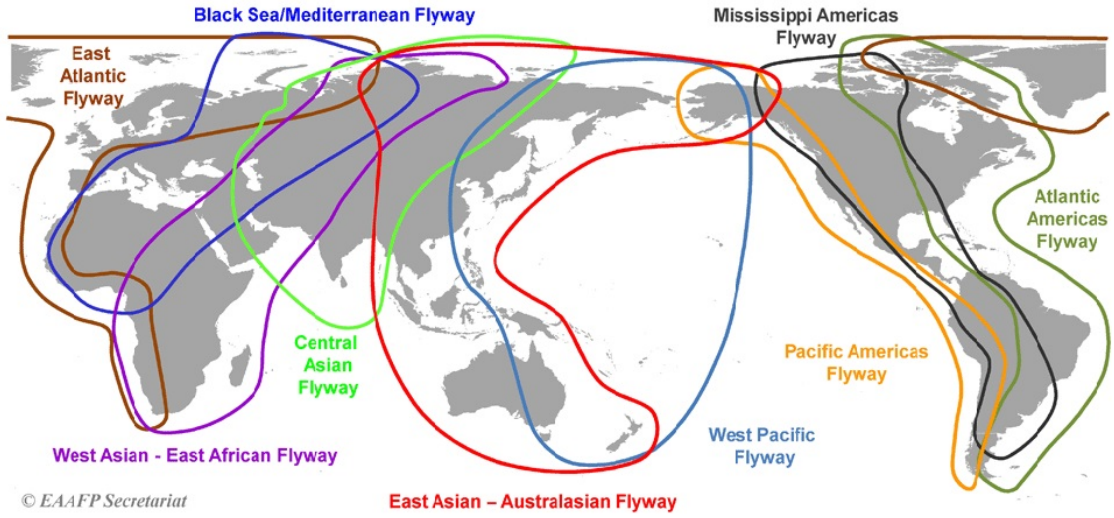
The information in this report is intended to assist the Noosa Shire Council and other relevant stakeholders in developing appropriate policy settings to assist in the conservation of these species and their habitat within the Noosa River estuary. The report is also intended to inform and engage the local community regarding the presence of resident and migratory shorebirds, some critically endangered, in the Noosa River estuary and to highlight the community's role in their conservation. To illustrate the rich but threatened biodiversity of the estuary and its high conservation value, survey results for the many other species of water birds observed has also been included. A primer on shorebird taxonomy is provided in Appendix 1 to assist in interpreting this report.

In addition to this report, NICA has prepared a 6-part brochure entitled "*Migratory and Resident Shorebirds and Terns*" for distribution in the community detailing key species observed, population trends and information on how to assist in conserving shorebirds in the Noosa River estuary. Distribution of the brochure will be followed by an information workshop hosted by NICA.

1. Background

The Noosa River estuary lies toward the southern end of the EAAF, one of nine major flyways for migratory birds around the globe. Originating within the arctic habitat of Siberia and Alaska, the EAAF traces its way through East and South East Asia to Australia and New Zealand at its southern extremity and is home to over 8 million migratory shorebirds plus numerous more resident species.

Diagram 1: Global migration flyways[3]



[1] National Shorebird Monitoring program established in 2007 and coordinated by Birdlife Australia (www.birdlife.org.au)
[2] Birds in backyards
[3] EAAF Flyways Partnership (www.eaafflyway.net)

Australia has long played a crucial role in protecting these shorebird species and habitat as a founding signatory of the RAMSAR Convention in 1971[4] and numerous bilateral conservation agreements aligned to the EAAF since. Australia is home to 66 Wetlands of International Importance covering over 8.3 million hectares with many of these listed using water bird criteria[5]. Five of these RAMSAR sites are in Queensland including the Great Sandy Straits (93,160ha, listed 2006) and Moreton Bay (113,314ha, listed 1996) located immediately to the north and south of the Noosa River estuary

Whilst the Noosa River system, and separately Lake Weyba, are recognised as DIWA Nationally Important Wetlands[6], neither has met the thresholds established *internationally* by the RAMSAR Convention to warrant protected status as important habitat for threatened shorebird species specifically.

The Noosa River estuary is one of around 150 sites located throughout Australia that comprise the *National Shorebird Monitoring Program.* The program is coordinated by Bird Life Australia (www.birdlife.org.au) in association with the Australasian Wader Studies Group and includes adjacent monitoring sites at the Maroochy River, Caloundra, Toorbul and Bribie Island. The aim of this program, initiated in 2007, is to understand and detect national population trends and discover what is driving population changes in Australia and elsewhere. Surveys and data collection are conducted entirely by volunteers.

Results from the program are used to inform the *Wildlife Conservation Plan for Migratory Shorebirds* coordinated by the Federal Government (www.environment.gov.au/biodiversity/publications) and aligned to similar initiatives elsewhere along the EAAF. This plan sets out national activities to support migratory shorebird conservation initiatives and provides a strategic framework to ensure these activities plus future research and management actions are integrated and remain focused on the long-term survival of migratory shorebird populations and their habitats. The Plan will be reviewed every 5 years from 2020.

2. Survey outcomes

A total of 151 surveys from October 2005 through October 2019 were conducted by the SSG in the Noosa River survey area and form the baseline for this report. Prior to this period, no known systematic survey of shorebirds in the Noosa River had taken place. Surveys continue to this day.

Records were maintained for all species of birds observed within the survey area including shorebirds (waders), water birds, wading birds, gulls, terns and raptors, but excluding terrestrial species (so called “bush birds”). Results of the surveys detailed herein highlight the unique but threatened biodiversity and declining abundance of the species frequenting the estuary despite its modest size and location adjacent to nearby RAMSAR sites.

A summary of the survey results include:

- A total of 59 distinct bird species, including 27 shorebird species, were observed in the estuary;
- Of the 27 shorebird species observed, 18 are considered migratory, whilst the remaining 9 are considered resident (or *endemic* to Australia). Together they represent around half of the known species of shorebirds that *regularly* visit or reside in Australia;
- The 18 migratory shorebird species observed in the survey represent half of the 37 species of migratory shorebirds identified as following the EAAF and regularly visiting Australia. They also include the *Double Banded Plover*, the only specie known to migrate along an east-west axis;
- The overall level of species diversity did not decline markedly over the survey period notwithstanding migratory patterns, with on average 18 species identified per survey. Nevertheless, sightings of a small number of threatened migratory species have become increasingly sporadic in recent years;
- Witness to the estuary’s critical conservation value, 8 shorebird species observed are listed as *threatened* under Australia’s EPBC legislation including 7 migrants[7]. Of those, 3 are *critically endangered (*the *Far Eastern Curlew, Curlew Sandpiper and Great Knot)*;

[4] The Convention on Wetlands of International Importance (RAMSAR, 1971)
[5] The Partnership for the Conservation of Migratory Waterbirds & Sustainable Use of their Habitats in the East Asian – Australasian Flyway (2006)
[6] Directory of Important Wetlands in Australia (1993)
[7] The Indo Pacific Little Tern, a migratory visitor to the Noosa River estuary was previously EPBC listed (endangered) but is now ineligible.

- Survey counts across all species in the early years of the survey regularly exceeded 7,000 individuals, though more recently, counts rarely exceeded 2,000 individuals, even during peak migration. This decline was largely attributable to declining migratory tern numbers;

- Amongst shorebird species, total numbers rarely exceeded 200 individuals or less than 10% of total birds observed in any given survey;

- Between early and latter survey periods, migratory shorebird numbers declined around 45%, whilst resident shorebird numbers increased 12%. Overall shorebird numbers declined 34%;

- Amongst shorebird species (where numbers were sufficient to permit analysis), the populations of 9 of 16 species declined. Only the *Red-Capped Plover* increased in abundance during the survey period. Numbers of the remaining 6 species were broadly stable;

- Concerningly, 8 of 11 species of migratory shorebird including the *Bar-Tailed Godwit*[8], *Far Eastern Curlew* and *Curlew Sandpiper,* saw numbers decline, in some cases precipitously;

- Inward and outbound migration patterns remained largely unchanged with arrivals peaking in October - November and departures peaking in March – April. However, the frequency of "over-wintering", where migratory species remain in the estuary year-round, declined; and

- Breeding behavior amongst shorebirds in the estuary was limited to pairs of three resident species, the *Beach Stone Curlew*, *Australian Pied Oystercatcher* and *Red Capped Plover*. Amongst those only the latter was observed to have successfully reared chicks with the estuary.

To the extent that the small data set here permitted, comparison of the results was made to empirical research on shorebird population trends across Australia and the EAAF. These trends indicate similarities between changes in shorebird numbers in the Noosa River estuary and those transiting the EAAF.

Finally, and as a general guide to the estuary's *significance*, a comparison has been made of the survey results for all shorebird species observed in the Noosa River estuary versus *international* and *national* RAMSAR conservation thresholds using revised population parameters.

A pair of Double-Banded Plovers (Charadrius bicinctus) at rest in the estuary.

Unique amongst migratory species, the Double-Banded Plover traverses along an east-west axis between its summer breeding grounds in New Zealand and winter foraging sites along the eastern seaboard of Australia.

The species is considered secure in Australia and has been observed in the estuary in all but one of the last 14 years.

Credit: Bob Inglis.

[8] Common name only for sub-specie Nunivak (or West Alaskan) Bar-Tailed Godwit (*Limosa lapponica baueri*)

3. Survey area

The area surveyed for this report included the tidal sand and mud banks, permanent islands, mangrove and saltmarsh foreshore areas and river mouth of the lower Noosa River as depicted in Diagram 2. A total of 7 observation sites were selected to observe bird species across all preferred habitat in the area. As much as possible, survey areas were located within line of sight of one another to avoid survey error.

The survey sites extend approximately 1,800 meters directly upstream from the eastern most point of the river mouth training wall to the western most point of the established islet adjacent to Munna Point. At its widest in the "Frying Pan" area of the river mouth, the survey area is approximately 1,000 metres wide, while at its narrowest, the survey area extends just 425 metres from the river mouth training wall to the established tree line on the north shore. The survey area encompasses an area of around 110 hectares.

Diagram 2: Lower Noosa River – Survey Area

The survey area consists primarily of tidal sand and mud substrate and permanent, partially vegetated sand islands rising to a height of around 1.5 metres above mean high tide. The tidal range in the estuary rarely exceeds 2 metres. The survey area itself is exposed to prevailing winds from the NE and SW though these were observed to have limited impact on shorebird numbers but for extreme climatic events.

Vegetation on the four permanent islands in the survey area consists of lightly vegetated foredunes with casuarina, wattle, acacia and banksia to heights of 6-8 meters in the swales and elevated areas behind. Species of mangroves fringe some islands.

Foreshore areas on both north and south banks include tidal mangrove, mud-flat and saltmarsh habitat punctuated by intermittent creeks. This habitat borders more established coastal heath and dry eucalypt forest on hind dune areas.

The nest of the Red-Capped Plover (Charadrius ruficapillus) disguised amid typical foredune vegetation cover in the Noosa River. Credit: Jill Dening

Due to the distance from the river mouth and relative absence of suitable habitat, the extensive upstream lakes, river system, creeks and tributaries of the Noosa River system were not incorporated into this survey though were monitored sporadically from time-to-time. Certain species, particularly water birds, though rarely shorebirds, were observed in these areas.

Similarly it is unlikely shorebirds, including otherwise resident species, likely remained restricted to the Noosa River estuary throughout the year, with the Great Sandy Strait (65 kilometres), Pumicestone Passage (50 kilometres) and Moreton Bay (70 kilometres) all providing similar sheltered habitat in near proximity and directly along known migration paths.

Like all estuarine systems, the channels, tidal banks and islands of the lower Noosa River remained in a constant state of flux driven by tides, rainfall and other events, prevailing weather conditions and human influence. An aerial comparison of the lower Noosa River in Diagram 3 taken in 2004 and 2019 depicts changes within the survey area and documented in other studies.

Diagram 3 – Lower Noosa River – 2004[9] and 2019

Localised natural movement of channels, tidal banks and permanent islands has occurred since 2005 though no changes were considered of such significance by the SSG as to materially impact either the overall size or suitability of the shorebird habitat.

Notably, significant erosion of the north bank of the river mouth over several years led, in late 2018, to a renewed north channel "breakthrough" where previously a sand spit had extended into the estuary. This enhanced the relative isolation of the area contributing to improved security for shorebirds. Ongoing rehabilitation of the area by volunteer groups led by NICA contributed to an improvement in the overall diversity and density of riparian vegetation on the prominent sand island and adjacent islets, though some foreshore areas, particularly around the lower North Shore, have deteriorated.

Minor human-scale development to have taken place since 2005 has been primarily intended to stabilise and replenish foreshore areas including the installation of geotextile sand container groynes and a submerged training wall in the Noosa Woods area in 2012, similar geotextile sand container groynes and replenishment works at Munna Point beach in 2015 and refurbishment of the river mouth carpark in 2018.

These works have understandably increased the available foreshore areas for visitors and pets, hence leading to more frequent disturbance of shorebirds nearby despite restrictions imposed by Noosa Shire Council in 2007[10]. Noosa Council is current considering the recommendations of the final Shoreline Erosion Management Plan ("SEMP") report[11], delivered in December 2019. Proposed works may impact upon estuarine areas including and adjacent to the Noosa Woods dog beach.

[9] 2004 aerial photo credit: Jim Upton (Sunshine Coast Daily, January 2019)
[10] The Noosa North Shore "Exclusion Zone" per Noosa Council Subordinate Local Law #4.
[11] Noosa Spit Shoreline Erosion Management Plan (15 December 2019)

4. Survey methodology

Weather permitting, surveys were conducted monthly commencing in October 2005 through October, 2019. A total of 151 surveys were undertaken (near 90% capture). A schedule of surveys conducted is provided in Appendix 2. Prior to 2005, no systematic survey of shorebirds in the Noosa River estuary was known to have taken place.

Surveys were generally undertaken 4 - 5 weeks apart to ensure migratory species were not missed due to those shorebirds having already arrived and departed from the survey area. The only exception were surveys conducted in December and January which were generally scheduled up to 6 weeks apart to avoid peak holiday disturbances in the survey area. Surveys were conducted regardless of the specific lunar cycle (and hence tidal range) at the time.

Most surveys consisted of two "windows" of observations, conducted on the same day[12]. The first commenced approximately 1.5 hours prior to the "day light" high tide at Noosa Heads and ended approximately 1.5 hours following that high tide. During high tides, shorebirds in the survey area were more easily observed as they congregated on the elevated sand banks and permanent islands. The second intra-day survey, for the purpose of more accurately assessing tern numbers in particular, occurred approximately 40 minutes prior to and following sunset. This survey was conducted from an elevated position on the river mouth training wall. During the period around sunset, terns feeding in Laguna Bay and further afield were observed to return to the estuary through the river mouth at relatively low elevation and when observed against the evening light permitted accurate surveying in flight.

By counting terns in this manner, a practice pioneered in this survey, a more accurate assessment of overall population numbers of birds, particularly migratory tern species, in the estuary was established.

Appendix 3 provides further detail on count variations observed for specific species of terns between day and evening survey windows.

Observations of individual birds and flocks were validated by multiple observers using high magnification binoculars, spotting scopes and digital cameras.

A mixed flock of terns returning at sunset to the Noosa River estuary as observed from the river mouth training wall. Credit: Jill Dening

Where possible, birds were counted individually, though in the case of larger flocks or flocks in flight, particularly terns, other counting techniques were used from time-to-time to derive more accurate data. These included grid studies, proportional counts and time lapse studies.

Notes on roosting, foraging and, where relevant, breeding behavior were taken as were records of tide, precipitation, wind speed and direction and other relevant climatic conditions.

Counts were conducted in accordance with relevant survey protocols[13].

Survey Group volunteer, Barbara Dickson, conducting a count from Site 2 opposite Noosa Woods. Where possible, observers use high magnification spotting scopes on fixed tripods to assist counts. Credit: Jill Dening.

[12] A total of 128 surveys (85%) including both day and evening counts, of the 151 surveys conducted.
[13] Including QWSG and EPBC survey guidelines.

6. Survey results

A. Species biodiversity

Over the 14 year survey period, 59 different bird species were observed in the survey area. Table 1 summarises the species distribution by sub-group applied in the survey. A full species distribution is provided in Appendix 7.

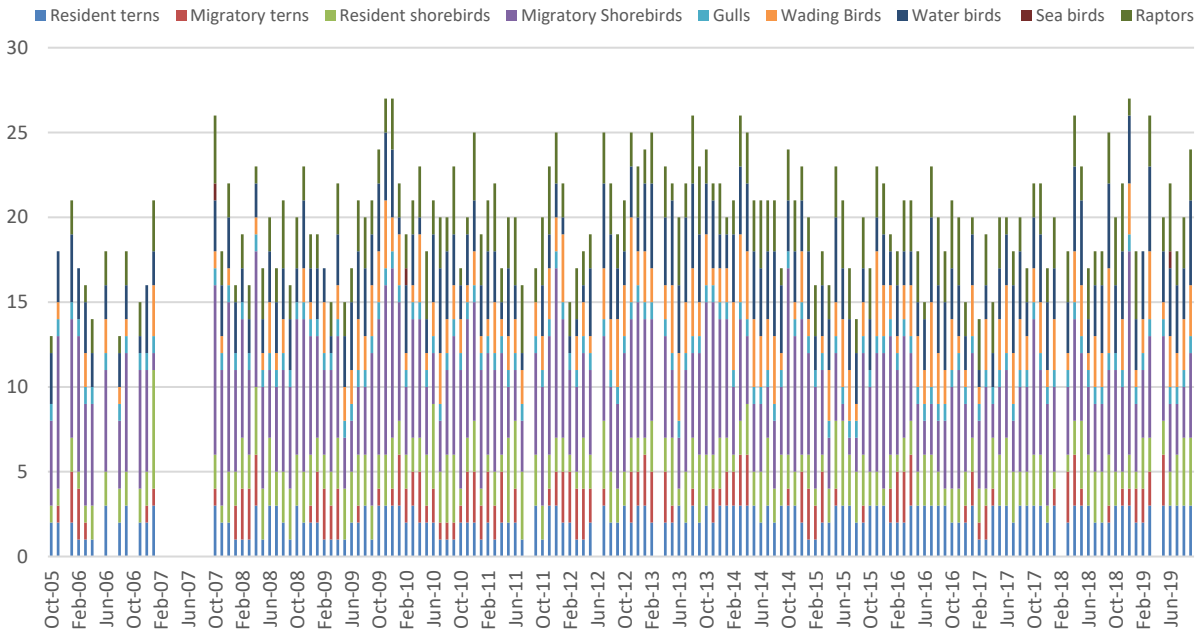
Table 1: Species distribution by sub-group

Species by sub-group	Species observed
Tern – Resident	4
Tern – Migratory	4
Shorebird – Resident	9
Shorebird – Migratory	18
Gull	1
Wading bird	6
Water bird	9
Sea bird	2
Raptor	6
Total species observed	**59**

Of the 59 species observed in the estuary, almost half (27) are considered shorebirds, including 18 of the 37 species of migratory shorebirds that follow the EAAF (North-South) and regularly visit Australia[14]. This list also includes the only specie to migrate along an East-West axis (*Double-Banded Plover*). The remaining 9 shorebirds are considered resident to Australia and generally do not migrate.

As evidenced in Diagram 4 and acknowledging distinct migratory patterns, the overall level of biodiversity over the 14-year survey period as noted by total species identified did not change markedly. On average around 18 distinct water bird species were recorded each survey.

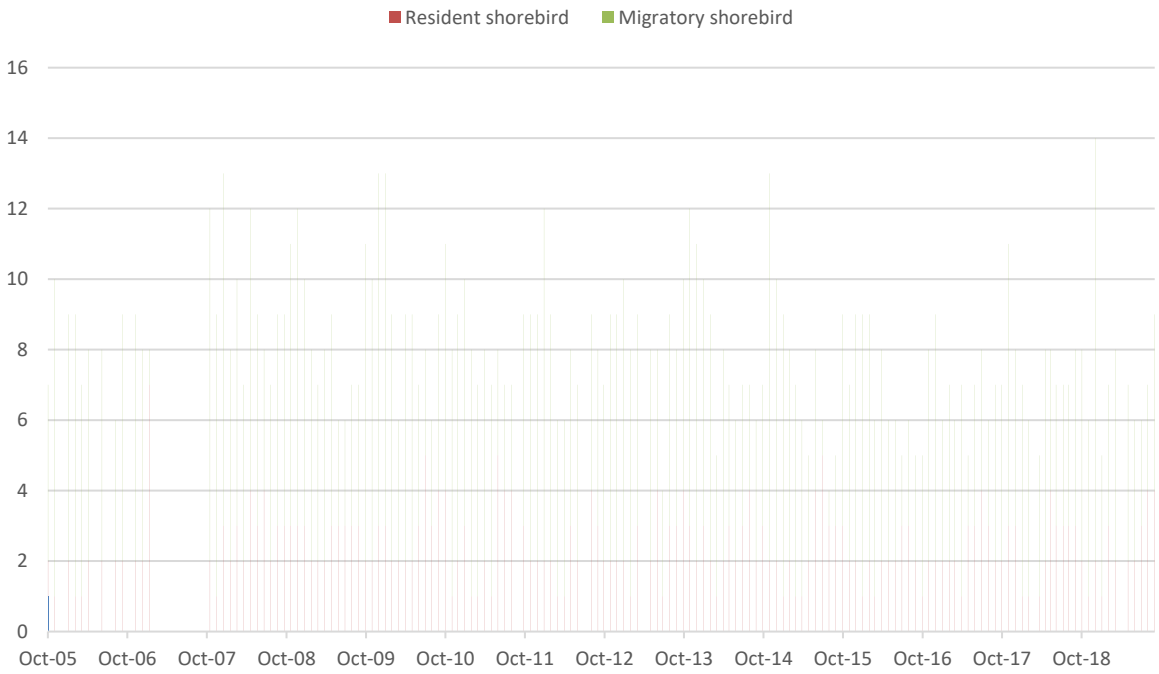
Diagram 4: Species biodiversity by sub-group time series– 2005 to present



Nevertheless, and as Diagram 5 illustrates, there has been a modest decline in the overall level of shorebird biodiversity and specifically migratory species over the survey period.

[14] Revision of East Asian-Australasian Flyway Population Estimates (Hansen et al, 2016)

Diagram 5: Shorebird species biodiversity time series– 2005 to present



Evidencing the Noosa River estuary's rich but threatened avian biodiversity, 8 of the 27 species of shorebirds observed are currently listed as *threatened* under Australia's Environment Protection and Biodiversity Assessment Act (1999). Of these, three species – the *Far Eastern Curlew*, *Great Knot* and *Curlew Sandpiper* - are all considered *critically endangered* or just one step removed from "extinct in the wild". A further 5 migratory shorebird species observed are listed nationally as either *endangered* or *vulnerable*.

Table 2 summarises the list of nationally *threatened* shorebird species known to frequent the Noosa River estuary. Amongst threatened species denoted in Table 2, only the *Hooded Dotterel* is resident, if a rare vagrant, to the area. The remaining 7 threatened species are migrants.

It should be noted that the *national* classification of conservation status of shorebird or other species (as defined in the EPBC Act) does not always align to the conservation status assigned *internationally* by the International Union for Conservation of Nature ("IUCN")[15]. Similarly, the list of species threatened at a State level may diverge from that at a national level.

For that purpose, a more comprehensive summary of all international, national and state conservation listings for all species observed throughout the survey is provided in Appendix 7.

Table 2: Threatened shorebird species by conservation status[16]

EPBC conservation status[17]	Total	Species observed in Noosa River
Critically Endangered	3	Far Eastern Curlew, Great Knot, Curlew Sandpiper
Endangered	2	Red Knot, Lesser Sand Plover
Vulnerable	3	Hooded Dotterel, Greater Sand Plover, Bar-Tailed Godwit
Conservation dependent	-	-
Total species listed	**8**	

[15] www.iucnredlist.org
[16] The Indo Pacific Little Tern (*Sternula albifrons sinensis*) was previously EPBC listed as *endangered* but is now considered ineligible.
[17] Per current EPBC listing (www.environment.gov.au)

A *critically endangered* Curlew Sandpiper (*Calidris ferruginea*) observed amongst seaweed.

The Curlew Sandpiper breeds in the lowland tundra of Siberia before its annual migration along the EAAF to Australia. The population is estimated at around 90,000 individuals.

It was last observed in the Noosa River in November, 2017.

Credit Bob Inglis.

One of the more abundant species of migratory shorebirds observed in the Noosa River estuary, the Pacific Golden Plover (*Pluvialis fulva*) seen here in its distinctive non-breeding plumage.

The EAAF population of the species, which breeds in Alaska, is estimated at 120,000 individuals. It is considered *secure* in Australia and has been observed in 136 of 151 surveys conducted.

Credit Bob Inglis.

The Lesser Sand Plover (*Charadrius mongolus*) pictured here in non-breeding plumage. The sub-species (one of five) migrates from its breeding grounds in far east arctic Siberia.

The sub-species is listed as *endangered* in Australia, and has been sighted in 8 of 15 Noosa River survey years, most recently in May, 2019.

Credit: Queensland Wader Studies Group (2010).

Table 3 details a summary of the observations recorded over the survey period for all species of bird observed including typical current counts and trends over time. Note *observation frequency* denotes the number of monthly surveys in which a specie was observed, whilst *seasonal frequency* denotes the number of years, or seasons, in which a specie was observed.

Table 3: Survey results - all species (October 2005-October 2019)

Common name	EPBC Status	Observation frequency[18]	Seasonal frequency[19]	Last observed	Recent peak[20]	Count trend
Resident Tern						
Caspian Tern	Secure	106	15	Sep-19	25	Stable
Greater Crested Tern	Secure	151	15	Sep-19	1,307	Declining
Australian Tern	Secure	95	15	Sep-19	27	Stable
Whiskered Tern	Secure	4	3	Oct-14	-	-
Migratory Tern						
Arctic Tern	Secure	1	1	Jun-10	-	-
Common Tern	Secure	82	15	May-19	1,818	Declining
Little Tern (Indo Pacific)	Secure	65	14	May-19	181	Declining
White-winged Tern	Secure	43	15	May-19	51	Declining
Resident Shorebirds						
Australian Pratincole	Secure	1	1	Sep-13	-	-
Banded Lapwing	Secure	1	1	Mar-09	-	-
Beach Stone-curlew	Secure	69	14	Sep-19	2	Stable
Pied Stilt	Secure	17	11	Sep-19	3	Stable
Hooded Dotterel	Vulnerable	3	1	Aug-10	-	-
Masked Lapwing	Secure	34	14	May-19	1	Stable
Australian Pied Oystercatcher	Secure	114	15	Sep-19	2	Declining
Red-capped Plover	Secure	151	14	Sep-19	45	Increasing
Red-necked Avocet[21]	Secure	1	1	May-18	1	-
Migratory Shorebirds						
Bar-tailed Godwit (Nunivak)	Vulnerable	139	15	Sep-19	43	Declining
Broad-Billed Sandpiper	Secure	1	1	Dec-18	1	-
Common Greenshank	Secure	61	14	Dec-18	1	Declining
Curlew Sandpiper	Critically End.	27	13	Nov-17	1	Declining
Double-Banded Plover	Secure	60	13	Aug-19	22	Declining
Far Eastern Curlew	Critically End.	71	13	Oct-17	1	Declining
Great Knot	Critically End.	11	7	Oct-17	2	-
Greater Sand Plover	Vulnerable	11	15	Sep-19	1	Stable
Grey-tailed Tattler	Secure	67	15	Sep-19	1	Declining
Lesser Sand Plover	Endangered	60	8	May-19	2	-
Pacific Golden Plover	Secure	136	15	Sep-19	52	Stable
Red Knot (Siberian)	Endangered	6	5	Dec-18	1	-
Red-necked Stint	Secure	93	15	Feb-19	10	Declining
Ruddy Turnstone	Secure	16	12	Dec-18	3	-
Sanderling	Secure	3	2	Dec-18	1	-
Sharp-Tailed Sandpiper	Secure	35	14	Mar-19	2	Declining
Terek Sandpiper	Secure	6	4	Dec-18	1	-
Whimbrel (Eurasian)	Secure	139	15	Sep-19	37	Stable
Gulls						
Silver Gull	Secure	151	15	Sep-19	96	Declining
Wading Birds						
Australian White Ibis	Secure	58	8	Sep-19	10	Stable
Black-necked Stork	Secure	4	2	Mar-11	-	-
Great Egret	Secure	32	8	Sep-19	2	Stable
Little Egret	Secure	68[22]	8	Sep-19	3	Stable
Striated Heron	Secure	33	11	Mar-19	1	Declining
White-Faced Heron	Secure	113	14	Sep-19	3	Declining
Water Birds						
Australasian Darter	Secure	14	7	Sep-19	1	Stable
Australian Pelican	Secure	134	15	Sep-19	46	Stable
Black Swan	Secure	1	1	Oct-06	-	-
Chestnut Teal	Secure	1	1	May-11	-	-
Great Cormorant	Secure	20	9	Sep-19	3	Stable
Little Black Cormorant	Secure	115	15	Sep-19	112	Declining
Little Pied Cormorant	Secure	21	9	Jun-19	2	Stable
Pacific Black Duck	Secure	61	13	Mar-19	8	Stable
Australian Pied Cormorant	Secure	142	15	Sep-19	29	Declining
Seabirds						
Australasian Gannet	Secure	1	1	Jun-19	-	-
Great Frigate bird	Secure	2	1	Feb-10	-	-

[18] Number of high tide surveys each species was observed (total = 151 surveys conducted).
[19] Number of (calendar) years each species observed (total = 15 years)
[20] Maximum number of that species observed in any daylight high tide or evening survey (terns) over last 24 months.
[21] At the commencement of the survey in 2005, the Red-Necked Avocet was incorporated into the survey database within the sub-group of wading birds per then accepted practice. The single sighting of the Red-Necked Avocet is hence included in the wading bird sub-group for this analysis.
[22] Data for the Little Egret, Great Egret and Australia White Ibis only available from 2012 due to change in survey collection methods

Table 4: Survey results by raptor species

Common name	EPBC Status	Observation frequency	Seasonal frequency	Last observed	Recent peak	Count trend
Black Kite	Secure	2	1	Aug-19	-	-
Brahminy Kite	Secure	101	14	Sep-19	2	Stable
Eastern Osprey	Secure	84	14	Sep-19	3	Stable
Nankeen Kestrel	Secure	1	1	Mar-09	-	-
White Bellied Sea Eagle	Secure	133	15	Sep-19	3	Stable
Whistling Kite	Secure	133	15	Aug-19	4	Stable

Despite the somewhat modest size of the survey area, the diversity of species observed including the presence of almost half of the migratory shorebirds common to the EAAF along with numerous threatened species illustrates the considerable conservation value of the Noosa River estuary.

A mixed group of migratory shorebirds, primarily Bar-Tailed Godwit (*Limosa lapponica baueri*), at rest in the Noosa River estuary.

One of two sub-species of Bar-Tailed Godwit to regularly visit Australia, the Nunivak or West Alaskan *baueri* sub-specie pictured here is listed nationally as *vulnerable*. The population of Bar-Tailed Godwit (both sub-species) traversing the EAAF is estimated at 325,000 individuals.

One of the larger and more abundant of the migratory shorebirds to visit the Noosa River estuary, the species was observed in 139 of the 151 surveys conducted.

Credit Jill Dening.

Three Great Knot (*Calidris tenuirostris*), foreground facing camera, in breeding plumage, captured at Toorbul Point in the Pumicestone Passage, amongst Nunivak Bar Tailed Godwit (*Limosa lapponica baueri*) and Pied Stilt (*Himantopus leucocephalus*) at rear.

One of three species of *critically endangered* shorebirds observed in the Noosa River, it migrates annually to Australia from its breeding grounds in far northern Siberia.

The EAAF flyway population of the Great Knot is estimated at 425,000 individuals but it has been observed only 11 times in 151 surveys in Noosa River, most recently in October, 2017.

Credit: Allen Briggs.

B. Species abundance

Overall, the survey data indicated a steady decline in the total abundance of all water birds observed in the estuary. Declines in total count numbers from peaks exceeding 10,000 individuals in the early years of the survey to infrequent counts exceeding 2,000 individuals in the latter years, were accounted for largely by the decline in tern numbers, particularly migratory terns (collectively up to 85% by number of any given count). Total shorebird numbers including during peak migration, rarely exceeding 200 individuals, hence robust declines in shorebird abundance had minimal impact on overall survey counts.

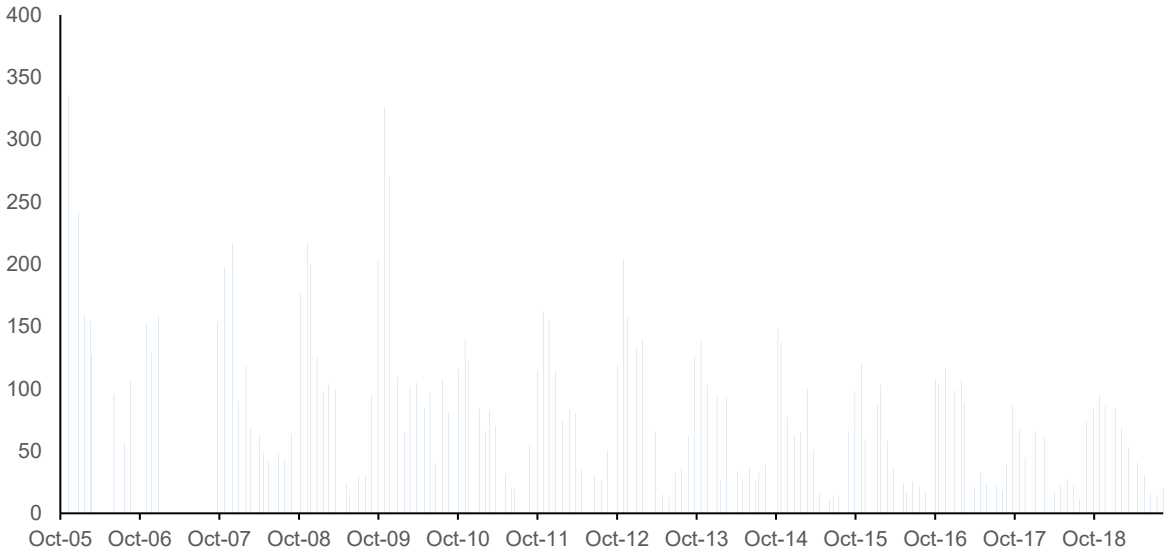
To the extent that the small data set permitted, Table 5 details population changes by sub-group counts across in the "early" and "latter" years of the surveys to date. The table indicates a 30% decline on average across all sub-group numbers, most notably amongst migratory shorebirds species.

Table 5: Change in population by sub-group – early and latter survey periods

Group	Average count 2007-2011	Average count 2015-2019	% Change
Migratory - Shorebirds	104	57	-45%
Resident – Shorebirds	24	27	+12%
Gulls	59	40	-32%
Wading Birds	6	5	-11%
Water Birds	66	53	-20%
All species (excluding terns)	**259**	**182**	**-30%**

Diagram 6 illustrates both the migratory patterns and long-term decline observed in numbers of migratory shorebirds frequenting the estuary. These include abrupt declines in numbers of several of the historically more abundant species such as the *Bar-Tailed Godwit*, *Sharp-Tailed Sandpiper* and *Double-Banded Plover*.

Diagram 6: Migratory shorebird (day) count time series – 2005 to present



Individuals from three shorebird species captured together in the Noosa River estuary (from left to right) - a *Red-Necked Stint (Calidris ruficollis)*, *Red-Capped Plover (Charadrius ruficapillus)* and *Sanderling* (*Calidris alba*) .

Though the Red-Necked Stint and Sanderling are EAAF migrants, all three are considered secure in Australia.

Credit: Dorothy Pashniak.

A Greater Sand Plover (*Charadrius leschenaultii*) captured in non-breeding plumage. The species breeds in Mongolia prior to its annual migration along the EAAF to Australia.

The species is considered *vulnerable* in Australia but has been sighted in 11 of the 15 years of the Noosa River survey, albeit in small numbers.

Credit: Queensland Wader Studies Group (2010).

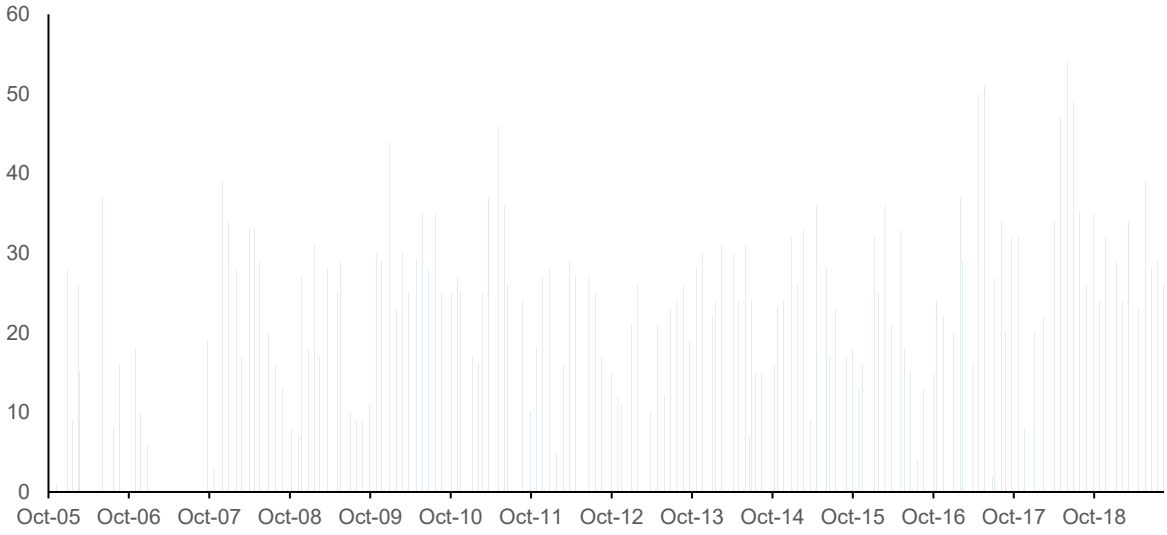
An Australian Pratincole (*Stiltia isabella*) captured here, has been observed only once in the Noosa River estuary in September, 2013.

The species is more common to northern and inland Australia and does not generally migrate. It is considered *secure* in Australia.

Credit Jill Dening.

Numbers of resident shorebird species have demonstrated greater resilience than migratory species, as indicated in Diagram 7, with resident shorebirds on average 12% more abundant in the latter years of the survey. This trend is largely attributable to the breeding success of the *Red Capped Plover*, by some margin the most abundant of resident shorebirds. Nevertheless, only one of five resident species[23] witnessed a decline in abundance.

Diagram 7: Resident shorebird (day) count time series – 2005 to present



[23] The Australian Pied Oystercatcher

A male Red-Capped Plover (*Charadrius ruficapillus*) foraging on sand flats in the Noosa River estuary. Groups of over 20 individuals were regularly sighted.

The Red-Capped Plover is both the only shorebird species to have increased in abundance and the only species to have bred successfully in the Noosa River.

Credit Bob Inglis.

Overall, to the extent analysis of the survey data permits, declines in numbers of migratory and some resident shorebirds in the Noosa River survey correlate with population declines witnessed elsewhere in Australia and along the EAAF[24].

Moreover, the research suggests that factors at a local or regional level were largely unable to account for variability in migratory shorebird populations between sites in Australia. This is further discussed in Appendix 5.

A Hooded Dotterel (*Thinornis cucullatus*) observed and photographed in the Noosa River in August, 2010. A resident species, it is considered *vulnerable* nationally.

The Hooded Dotterel has been observed only three times in 14 years, all in 2010, and likely the same individual.

Credit: Bob Inglis.

C. Migratory presence and breeding behavior

Survey data also permitted analysis of the in- and out-bound cycles of all migratory shorebirds (and terns) observed in the survey along with resident shorebirds known to transit regionally when conditions permitted. Table 6 depicts the relative presence of all species in the Noosa River where sufficient data existed to draw an inference.

[24] Continental-scale decreases in shorebird populations in Australia (Clemens et al, 2016).

Table 6: Migratory species patterns of the Noosa River estuary

Common name	Seasonal frequency	Last observed	Species presence in Noosa River											
Resident Tern			J	F	M	A	M	J	J	A	S	O	N	D
Caspian Tern	15	Sept-19												
Greater Crested Tern	15	Sept-19												
Australian Tern	14	Sept-19												
Migratory Tern														
Common Tern	15	May-19												
Little Tern (Indo Pacific)	14	May-19												
White-wing Tern	14	May-19												
Resident Shorebirds														
Beach-Stone Curlew	14	Sep-19												
Pied Stilt	11	Sep-19												
Masked Lapwing	14	May-19												
Pied Oystercatcher	15	Sep-19												
Red-capped Plover	15	Sep-19												
Migratory Shorebirds														
Bar-tailed Godwit	15	Sep-19												
Broad-billed Sandpiper	1	Dec-18												
Common Greenshank	14	Dec-18												
Curlew Sandpiper	13	Nov-17												
Double-Banded Plover	13	Aug-19												
Far Eastern Curlew	13	Oct-17												
Great Knot	7	Oct-17												
Greater Sand Plover	15	Sep-19												
Grey-tailed Tattler	15	Sep-19												
Lesser Sand Plover	8	May-19												
Pacific Golden Plover	15	Sep-19												
Red-necked Stint	15	Feb-19												
Red Knot	5	Dec-18												
Ruddy Turnstone	12	Dec-18												
Sanderling	1	Dec-18												
Sharp-Tailed Sandpiper	14	Mar-19												
Terek Sandpiper	4	Dec-18												
Whimbrel (Eurasian)	15	Sep-19												
Peak species presence														
Some species presence														

As Table 6 indicates, the majority of the 18 trans-hemisphere (EAAF) migrants arrived in early spring (September) and departed after the summer (April) for their Northern summer breeding cycle. Nevertheless, small numbers of these migrants including the *Whimbrel*, *Pacific Golden Plover* and previously the *Bar-Tailed Godwit* were observed to periodically "over winter" in the estuary. Numbers exhibiting this behavior have declined more recently.

Amongst tern species, the *Indo-Pacific Little Tern* and *White-winged Tern* were also observed to follow trans-hemisphere patterns whilst it was noted the abundant *Greater Crested Tern*, typically departed the estuary in November each year, returning in late January from its breeding habitat off northern NSW. The *Australian Tern* occasionally departed in the summer and bred inland when conditions permitted.

A Whimbrel (*Numenius variegatus)* captured "on the wing" over the Noosa River estuary. Another of the migratory species of curlew (*Numenius*) common to the Noosa River, its long de-curved bill is used to probe mud flats by day and night for invertebrates, crustaceans and worms.

The Whimbrel (Eurasian) is considered "secure" in Australia and amongst the most abundant and frequently sited migratory shorebirds in the Noosa River.

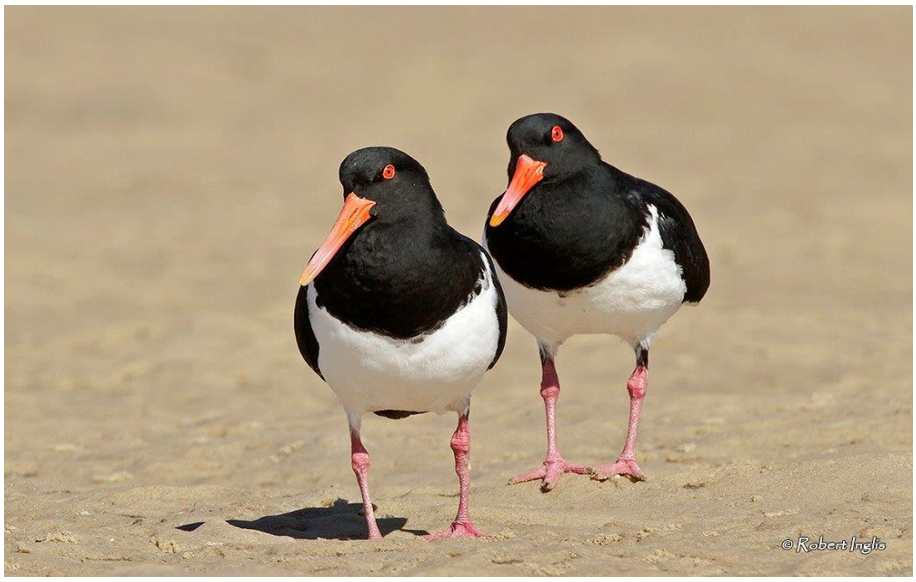
Credit Bob Inglis.

Evidence of breeding in the estuary was limited to three resident species - the *Beach Stone-curlew*, *Red-Capped Plover* and *Australian Pied Oystercatcher*. The nest of each species typically consisted of no more than a sand scrape above the high tide mark and disguised amid vegetation. Whilst courting behavior, nests and occasionally eggs were observed amongst pairs of all three species, only the *Red-Capped Plover*, was observed to successfully raise chicks to adulthood in the estuary[25]. The inability of the other species to do likewise was concerning.

A pair of Australian Pied Oystercatchers (*Haematopus longirostris*) (female at front, male at rear) as observed in the Noosa River. Individuals of the species have been known to live to 22 years.

Though considered secure, the entire Australian population may not exceed 10,000 individuals.

Credit: Bob Inglis.



The speckled eggs and "nest" of an Australian Pied Oystercatcher as photographed in the Noosa River estuary.

The resident pair of Australian Pied Oystercatchers in the estuary are not known to have hatched chicks - a concerning occurrence for such a slow breeding species.

Credit: Jill Dening.

[25] Records were not maintained on breeding success rates for the Red-Capped Plover or any other species.

A pair of Beach stone-curlew (*Esacus magnitostris*) at watch in the Noosa River estuary. A generally shy and nocturnal species the Beach Stone-curlew is considered *vulnerable* in Queensland.

This resident pair of the species in the Noosa River estuary are not known to have hatched a chick during the survey period.

Credit: Jill Dening.

7. Conservation

Results of the survey confirm a steady, albeit variable decline in numbers of migratory shorebirds visiting the Noosa River estuary, though resilience in numbers of *some* resident species of shorebirds. To the extent the data permits (see Appendix 5), the declines in migratory species reflects similar trends observed across the EAAF[26].

Whilst beyond the scope of this report, recent research suggests that environmental influences at a trans-hemisphere level (EAAF), as opposed to predominantly local factors, are primarily responsible for the decline in species numbers observed. The loss of intertidal staging habitat in the Yellow Sea "bottleneck" has been identified as disproportionately responsible for these declines[27], whilst the impact of climate change on atmospheric and localised sea surface temperatures, ocean acidity and fish stocks is likely also responsible. At a national level, declines in certain resident shorebird species, particularly species frequenting inland areas, suggest disruption to wetland systems in Australia may be influential.

Nonetheless, localised influences including loss of roosting and foraging habitat or food sources, changes in hydrology, predation and disturbance cannot be disregarded. Whilst the breadth of inter-tidal habitat of the lower Noosa River survey area remained largely unchanged (but for localised movement and sand replenishment works as described earlier), diminished riparian vegetation extent, sedimentation and declines in benthic biodiversity as identified in recent studies may have contributed to declining abundance witnessed in certain species.

Anecdotal evidence of predation including on the sandbanks and islands of the estuary was also observed and possibly attributable to introduced foxes, cats and dogs present around the estuary.

Disturbance of shorebirds, particularly migratory species, causing resting birds to repeatedly take flight, and expending significant energy doing so, is possibly a factor in declining abundance given the survey area's proximity to urban areas and the high volume of traffic on and around the Noosa River estuary. Human activity, particularly vehicular traffic on and around dunes, also risked destroying the fragile nests of resident shorebirds.

Indeed, disturbance of shorebirds was observed to occur with increasing frequency despite the Noosa North Shore restricted area imposed by Noosa Shire Council in 2007 to protect shorebird habitat within the estuary.

[26] Clemens et al (2016)
[27] The 2006-2008 Saemangeum shorebird monitoring program report (Moores et al, 2008); Threats to the Yellow Sea's Tidal Wetlands (Murray et al, 2014).

Four-wheel drive vehicle tracks emanating from Noosa North shore, continuing well past restricted access signage and into the Noosa River estuary.

Credit: Jill Dening.

Typical foredune vegetation cover in the Noosa River estuary opposite Noosa Woods.

Sparse vegetation nevertheless disguises the easily disturbed nest of a pair of *Red-Capped Plovers*, centre of photo.

Credit: Jill Dening

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Appendix 1: Shorebirds – a primer

The classification (and sub-grouping) of the numerous species of water birds observed in the Noosa River and adopted in this report represents a simplification of the complex taxonomy of avian species, itself an ongoing and fluid process. Species in this report have generally been referred to by their common or colloquial names in Australia though these may differ between regions. Where specific sub species have been observed and the precise taxonomy is known, they have been identified as such.

Amongst water birds, this report has focused specifically on the presence and abundance of shorebird species, also known as waders and members of the large (and incredibly diverse) *Charadriiformes* order which include gulls, terns, skuas, skimmers and auks. The use of the interchangeable terms "shorebirds" or "waders" can be misleading as several species infrequently wade (walk) or do not frequent shorelines. Nevertheless, most shorebirds generally do gather in intertidal areas or on the fringes of freshwater wetlands, they have long legs in relation to their body size, no webbing on their feet and they do not swim. The size and shape of their bills are adapted to forage for their typical diet of crustaceans and worms.

Together shorebirds make up around 5% of Australia's species of birds and whilst around 18 species are considered resident or endemic to Australia, another 37 generally migrate each year including along the EAAF discussed herein. A (very) high-level summary of the sub-groupings adopted for this report, their taxonomic orders, key species and distinguishing features or behaviours are provided in Table 7 below.

Table 7 – SSG survey species sub-groupings

Group	Taxonomic order(s)	Key species	Distinguishing features
Shorebirds	Charadriiformes	Plovers, Oystercatchers, Sandpipers, Curlews, Godwits, Knots, Tattlers, Sanderling, Stints, Stilts	Generally small to medium sized, long legs to body sized, adapted bills, no webbing between toes, do not swim.
Terns and Gulls	Charadriiformes	Terns, Gulls	Generally small to medium sized, long winged, short legs, web feet, can swim, feed on or under water's surface.
Water birds	Procellariiformes, Suliformes, Ciconiiformes	Pelicans, Egrets, Herons, Ibis, Storks, Cormorants	Generally small to large size, webbed and non-webbed feet, gather in colonies, obtain all (or most) food from water.
Wading birds	Anseriformes	Ducks, swans, geese	Generally medium to large, webbed feet, strong swimmers, broad and flattened bill, filter feeders, moult all flight feathers at once.
Sea birds	Procellariiformes	Petrels, Albatrosses, Frigate birds, Gannets.	Generally medium to large. Tubular nostrils, webbed feet missing hind toe, feed in saltwater.
Raptors	Falconiformes, Accipitriformes	Eagles, Kites, Osprey, Falcons	Generally medium to large size, hooked upper beak, clawed talons, keen eyesight, variable morphology based on diet.

Appendix 2: Survey schedule

A total of 151 (day) surveys were conducted over the period October 2005 through October 2019. In addition, 128 evening surveys of migratory terns were carried out over the period from October 2005 through April 2018, each coinciding with the date of day surveys. Table 8 sets out the survey schedule.

Table 8 – Schedule of surveys conducted by month

Calendar Year	Surveys conducted	Survey month											
		J	F	M	A	M	J	J	A	S	O	N	D
2005	2												
2006	9			2									
2007	4												
2008	12												
2009	12												
2010	12												
2011	11												
2012	11												
2013	11												
2014	12												
2015	12												
2016	12												
2017	12												
2018	11												
2019 YTD	8												
Total	**151**												

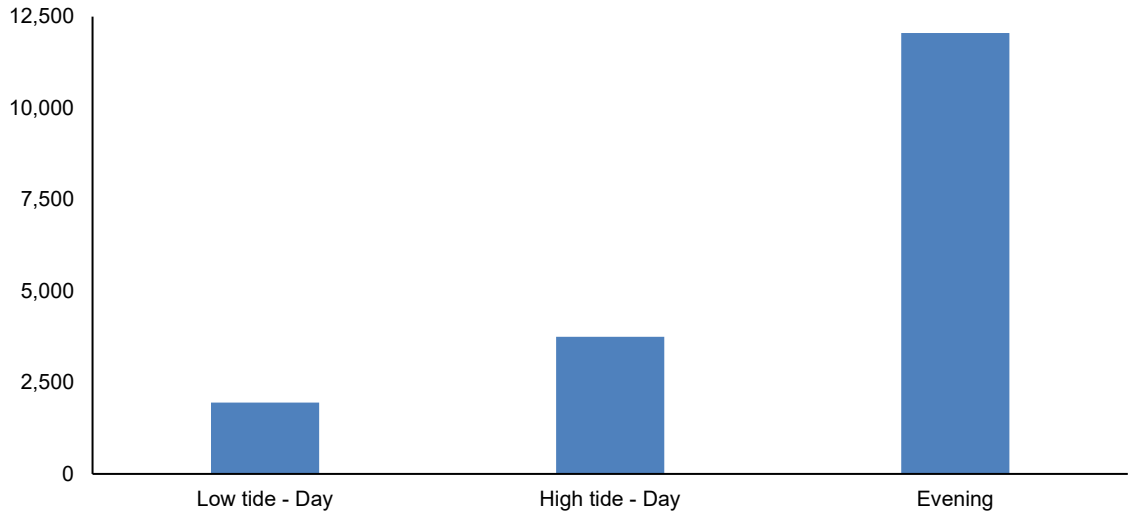
Appendix 3: Day and evening tern survey variations

Anecdotal observations upon commencement of surveys in 2005 indicated that large numbers of terns, particularly migratory species, spent considerable portions of each day feeding outside the Noosa River estuary. These terns were observed returning to the estuary late in the day and early evening to roost. This behavior suggested surveys conducted during daylight tidal cycles might under-estimate tern numbers roosting in the Noosa River estuary each evening.

To examine this thesis, a second early evening count either side of sunset was commenced in October 2005 to capture terns returning to the Noosa River estuary to roost. Observers noted terns returned almost exclusively through the narrow river mouth proper and when observed against the evening light permitted accurate surveying in flight. A total of 128 evening surveys from October 2005 through April 2018 have been conducted to further examine this thesis.

As Diagram 8 below illustrates, surveys conducted in the early evening (from a sample of 23 of 128 surveys) observed an average 12,000 individuals returning to the Noosa River estuary, as compared to 2,000-3,800 individuals on average recorded within the estuary during daylight hours.

Diagram 8 – Noosa River migratory tern counts by day and evening



Appendix 4: Non-shorebird population trends

In addition to the extensive data attained for shorebird species frequenting the estuary, the SSG also captured considerable insights into the long term abundance and biodiversity of a range of other bird species observed within the survey area including terns, gulls, water birds, wading birds and raptors. This section presents those findings.

On average tern numbers, together representing up to 85% of all individual birds by number recorded in any given survey, declined by 35% between the early and the latter years of the survey. Not unlike long term trends in shorebird abundance, declines amongst migratory tern species (-48%), was significantly more pronounced than amongst resident terns (-10%), indicating possible adverse influences at a trans-national level as compared to regional or localised factors.

Table 9: Average tern count declines – 2007 to present[28]

Group	Annual average 2007-2011	Annual average 2015-2019	% Change
Migratory Terns	5,189	2,703	-48%
Resident Terns	525	473	-10%
All Terns	5,714	3,176	-35%

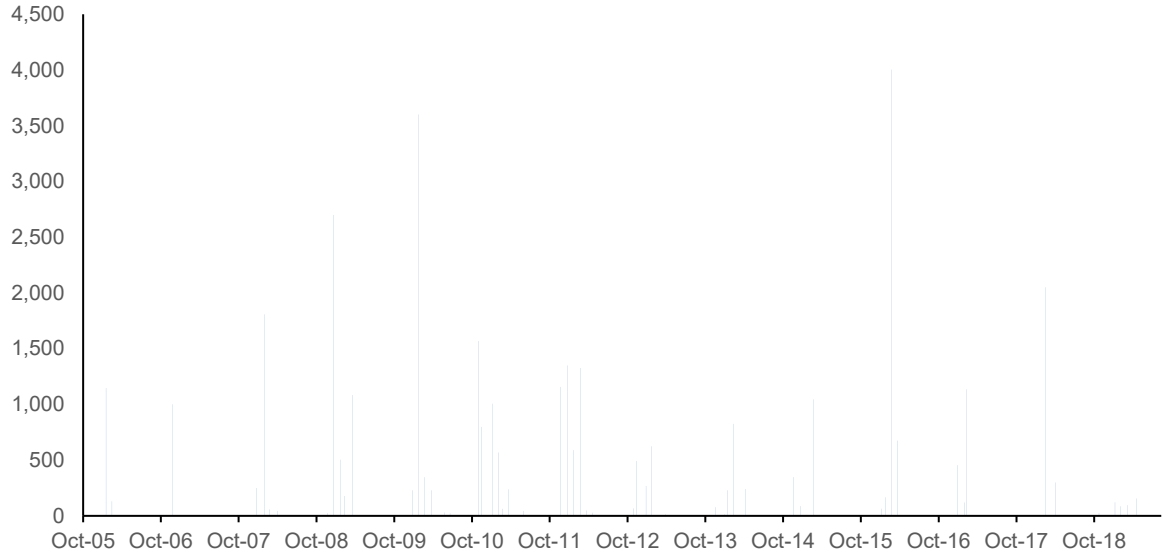
Diagram 9 and 10 provide times series for survey counts of both migratory and resident tern groups. Population declines amongst migratory terns were due almost entirely to declining abundance of principally the *Common Tern*, and to a lesser degree the *Indo-Pacific Little Tern*. The *Common Tern* is a non-breeding visitor to the eastern seaboard of Australia from its breeding grounds in Siberia and very occasionally North America. The *Little Tern* meanwhile is dispersed globally with distinct populations known to breed and migrate within Australia and from Eurasia.

Amongst resident terns, the abundant *Greater Crested Tern*, represented over 90% of all resident tern numbers. Seasonality witnessed in the resident tern trend series data highlights regional movements of the *Greater Crested Tern* during breeding season.

A pair of Greater Crested Terns with their distinctive lemon yellow bills, captured at rest in the estuary. The distinctive black cap extending over the eye of the individual at rear indicates breeding status. The Greater Crested Tern is a resident of Australia and was observed in every survey conducted. Credit: Jill Dening

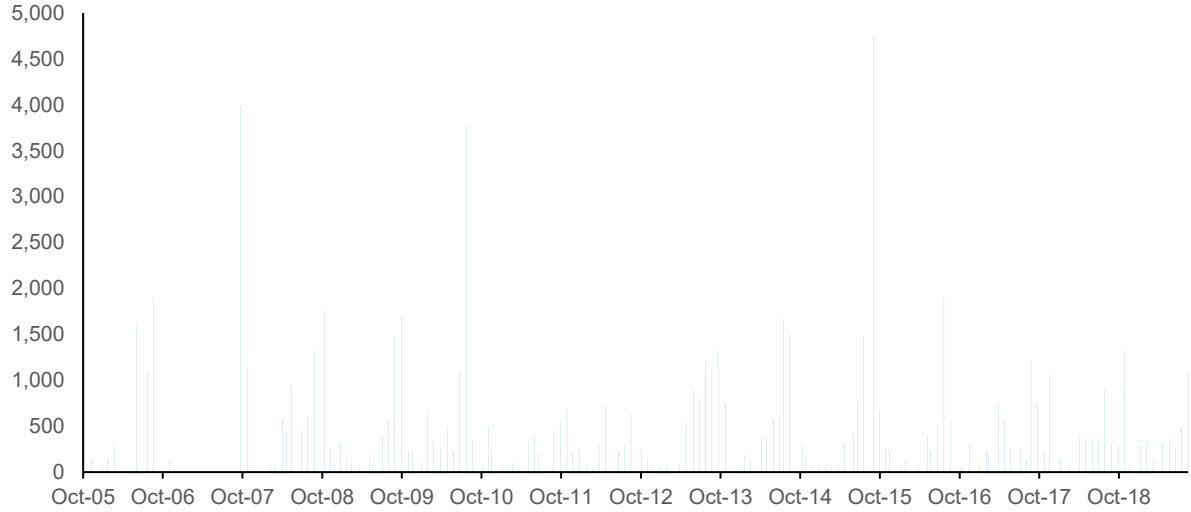
[28] Due to insufficient survey data between October 2005 and September 2007 (see Appendix 1), those time series have been removed.

Diagram 9: Migratory Tern (day) count times series – 2005 to present



Four species of terns captured together and illustrating relative size. From left to right - the Greater Crested Tern (*Thalasseus bergii*), the Common Tern (*Sterna hirundo*), the Australian Tern (*Gelochelidon macrotarsa*) and the Indo-Pacific Little Tern (*Sternula albifrons sinensis*). Both the *Common Tern* and *Little Tern* are considered migrants. Credit: Shorebird Survey Group.

Diagram 10: Resident Tern (day) count time series - 2005 to present



A flock of the resident Greater Crested Tern (*Thalasseus bergii*), some in breeding plumage in the mouth of the Noosa River. Discrepancies in day and evening tern counts based on their feeding behavior are further examined in Appendix 3. Credit Jill Dening

A decline in numbers of the only species of gull common to the estuary, the *Silver Gull*, is illustrated in Diagram 11. Though this trend mirrors that observed amongst tern species, it may not adequately capture its relative abundance as a ready scavenger in urban environments.

Diagram 11: Gull (day) count time series – 2005 to present

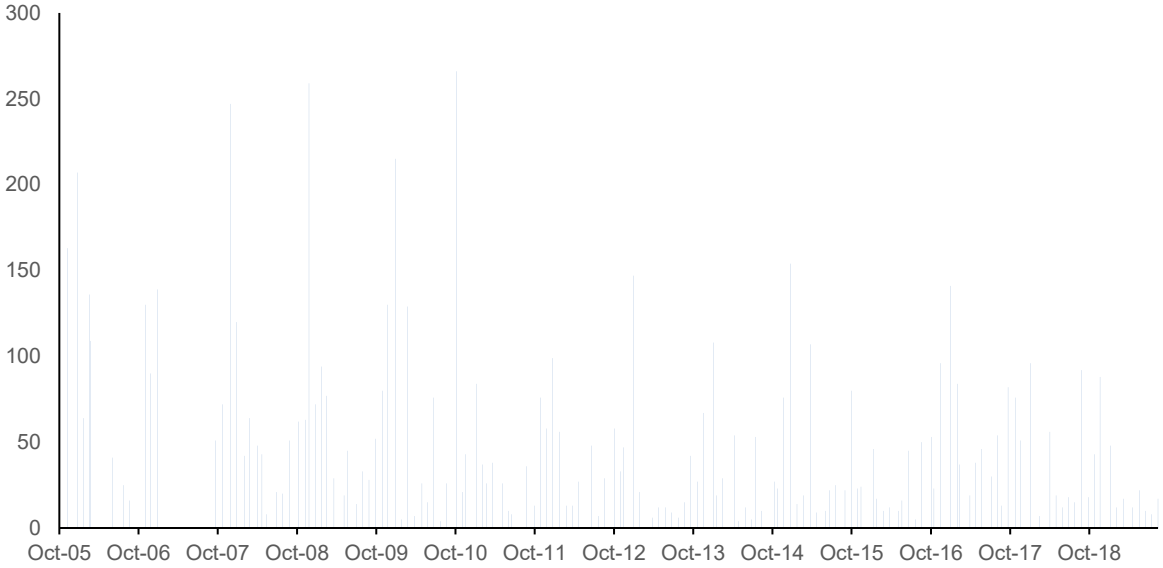
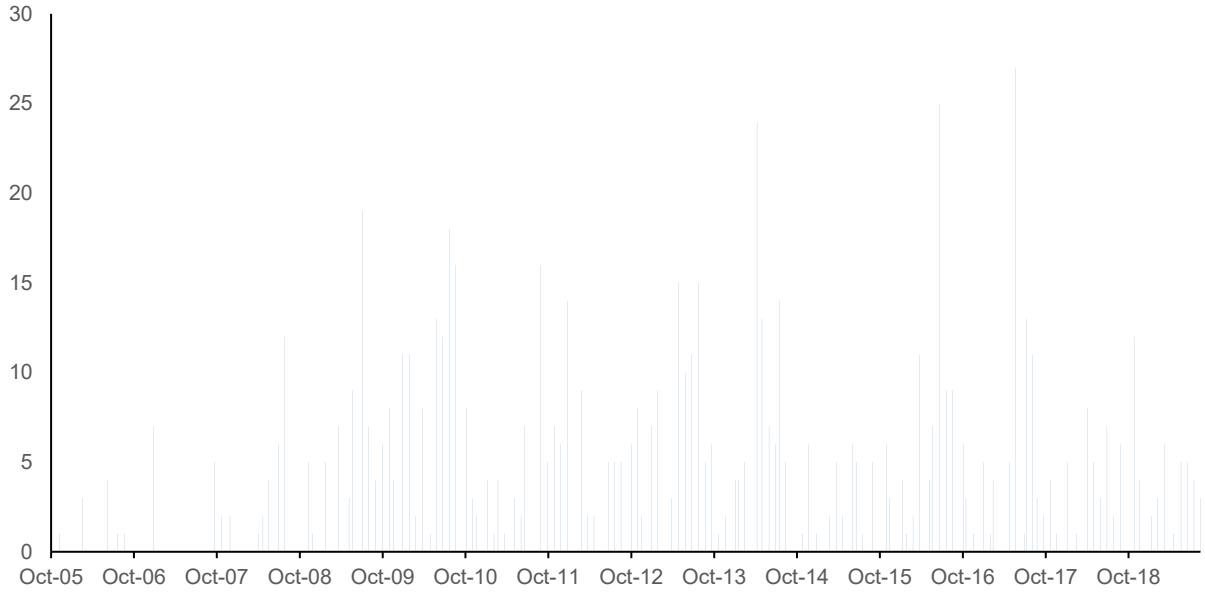


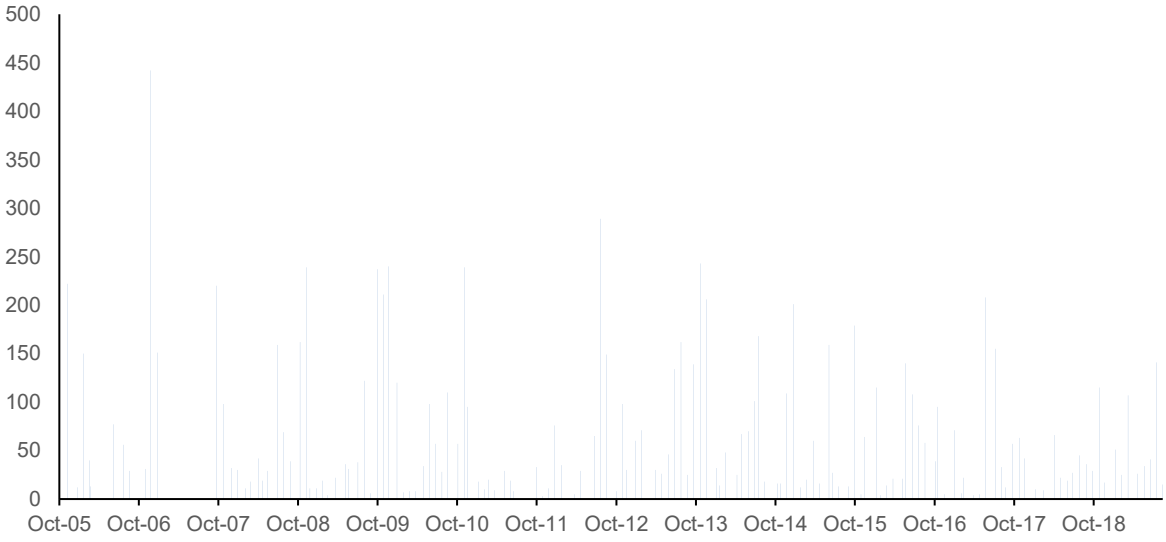
Diagram 12 illustrates the relative resilience in number of wading birds including several species of *Egret* and *Heron*, though the modest overall population (on average around 10 individuals sighted per survey) prevents genuine analysis. Moreover, the location of the survey sites in the Noosa River estuary adjacent to the river mouth may not adequately capture those wading species which might be expected to be more widely distributed amongst the inter-tidal mud flats of the lakes and creeks of the Noosa River system.

Diagram 12: Wading birds (day) count time series – 2005 to present



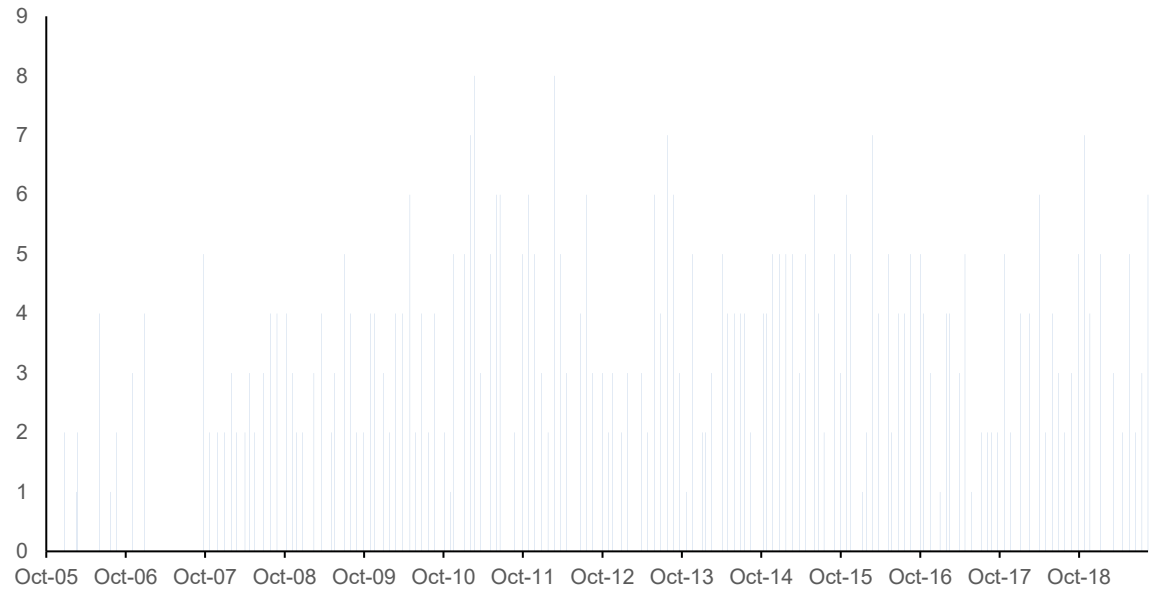
Declines of around 20% in the total numbers of water birds per Diagram 13 is largely attributed to declines witnessed amongst the more abundant *Little Black Cormorant* and *Pied Cormorant* species, though numbers of all other species of water bird remained generally stable over the period. It is possible the prolonged drought in parts of inland Australia could be contributing to this decline.

Diagram 13: Water bird (day) count time series – 2005 to present



As a broad indicator of overall ecosystem health, numbers of the four species of raptors present in the lower estuary generally remained stable as illustrated in Diagram 14.

Diagram 14: Raptor (day) count time series – 2005 to present



Appendix 5: Shorebird population research and survey trends

Given the small sample size and inconsistent sample periods, statistical comparison of the Noosa River survey results against national or trans-national (EAAF) shorebird population trends was considered problematic. Nevertheless, Table 10 provides a "high level" comparative summary of population trends derived by *Clemens et al (2016)* at a *national* level for 19 species of migratory shorebirds and 7 species of resident shorebird common to Australia and examined over the period 1973 – 2014[29]. These results are compared to those attained by the SSG in the Noosa River estuary over the period 2005 - 2019.

Whilst considerable disparity exists on a species-level basis, overall the population declines witnessed amongst migratory species as compared to the relative resilience of resident shorebirds on a national level broadly concur with those observed in the Noosa River estuary.

These trends extend to comparison on a regional basis, along a North-South axis at latitude 27.8 degrees (the Noosa River estuary is located at approximately 26.4 degrees South or comparable to the "Northern" data set), though again due care should be considered given the disparity in survey periods and the size of the data set.

Table 10 – National shorebird population trends and Noosa survey results

Common name	Population – National	Slope – National[30]	Slope – Northern	Recent Noosa peak	Noosa Count trend
Migratory Shorebirds					
Curlew Sandpiper	118,500	-9.53%	-0.98%	1	Declining
Lesser Sand Plover	25,360	-7.16%	-10.63%	2	-
Sharp-Tailed Sandpiper	140,550	-5.73%	8.34%	2	Declining
Terek Sandpiper	22,760	-5.40%	-4.90%	1	-
Black-tailed Godwit	69,850	-5.38%	-12.71%	-	-
Red-necked Stint	270,800	-3.35%	-3.06%	10	Declining
Bar-Tailed Godwit	185,760	-3.22%	-3.83%	43	Declining
Ruddy Turnstone	19,500	-3.17%	-1.09%	3	-
Far Eastern Curlew	28,000	-2.97%	-2.91%	1	Declining
Pacific Golden Plover	7,350	-2.02%	-0.17%	52	Stable
Grey Plover	11,650	-2.02%	0.22%	1	-
Common Greenshank	18,900	-1.98%	0.36%	1	Declining
Red Knot	134,850	-1.65%	1.08%	1	-
Marsh Sandpiper	12,750	-0.90%	-0.03%	-	-
Sanderling	10,010	0.08%	7.48%	1	-
Greater Sand Plover	74,330	0.54%	0.34%	1	Stable
Whimbrel	30,170	0.65%	-1.12%	37	Stable
Great Knot	364,100	1.43%	0.01%	2	-
Grey-Tailed Tattler	44,810	1.93%	2.65%	1	Declining
Resident Shorebirds					
Red-Necked Avocet	-	-2.87%	29.63%	1	-
Pied (Black-Winged) Stilt	-	-1.81%	7.64%	3	-
Black-Fronted Dotterel	-	-2.48%	-0.07%	-	-
Red-Kneed Dotterel	-	-2.10%	-2.09%	-	-
Red-Capped Plover	-	-0.67%	0.27%	45	Increasing
Sooty Oystercatcher	-	0.89%	-1.30%	-	-
Pied Oystercatcher	-	1.43%	0.31%	2	Stable

[29] "Continental-scale decreases in shorebird populations in Australia" (*Clemens et al, 2016*).
[30] Slope = estimate of log-transformed counter per year (approximates % change in population per year).

Appendix 6: Survey results and RAMSAR conservation thresholds

Application of Australia's Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) in protecting important habitat for shorebird species is contingent upon criteria set out in the RAMSAR Convention (1971) and Wildlife Conservation Plan for Migratory Shorebirds (2015). Under these frameworks, shorebird habitat is considered *internationally important* if it regularly supports 1% of the population of any single water bird species (or sub-species) or total abundance of 20,000 water birds. Failing that, shorebird habitat is considered *nationally important*, if regularly supports 0.1% of an EAAF population OR at least 2,000 listed migratory shorebirds OR at least 15 listed migratory species.

Table 11 below provides a sample comparison of the recently revised population thresholds[31] for the 37 listed EAAF species and outcomes from the current Noosa River survey. Species count numbers for the Noosa River reflect the *maximum* number of shorebirds for any given species observed in *any* survey over the preceding 24 months. It is noted this analysis DOES NOT directly align to the RAMSAR threshold of "*regularly supports*".

Table 11 – Noosa River shorebird numbers and RAMSAR conservation thresholds

Common name	Revised EAAF Population Estimate	1% Flyway Population	0.1% Flyway Population	Recent Noosa peak survey numbers
Asian Dowitcher	14,000	140	14	Not present
Bar-tailed Godwit	325,000	3,250	325	43
Black-tailed Godwit	160,000	1,600	160	Not present
Broad-Billed Sandpiper	30,000	300	30	1
Common Greenshank	110,000	1,100	110	1
Common Redshank	75,000-150,000	750	75	Not present
Common Sandpiper	190,000	1,900	190	Not present
Curlew Sandpiper	90,000	900	90	1
Double-Banded Plover	19,000	190	19	22
Far Eastern Curlew	35,000	350	35	1
Great Knot	425,000	4,250	425	2
Greater Sand Plover	200,000-300,000	2,000	200	1
Grey Plover	80,000	800	80	Not present
Grey-Tailed Tattler	70,000	700	70	1
Latham's Snipe	30,000	300	30	Not present
Lesser Sand Plover	180,000-275,000	1,800	180	2
Little Curlew	110,000	1,100	110	Not present
Little Ringed Plover	150,000	1,500	150	Not present
Long-toed Stint	230,000	2,300	230	Not present
Marsh Sandpiper	130,000	1,300	130	Not present
Oriental Plover	230,000	2,300	230	Not present
Oriental Pratincole	2,880,000	28,800	2,880	Not present
Pacific Golden Plover	120,000	1,200	120	52
Pectoral Sandpiper	1,220,000-1,930,000	12,200	1,220	Not present
Pin-tailed Snipe	170,000	1,700	170	Not present
Red Knot	110,000	1,100	110	1
Red-necked Phalarope	250,000	2,500	250	Not present
Red-necked Stint	475,000	4,750	475	Not present
Ruddy Turnstone	30,000	3,00	30	3
Ruff	25,000-100,000	250	25	Not present
Sanderling	30,000	3,00	30	1
Sharp-Tailed Sandpiper	85,000	850	85	Not present
Swinhoe's Snipe	40,000	400	40	Not present
Terek Sandpiper	50,000	500	50	1
Wandering Tattler	10,000-25,000	100	10	Not present
Whimbrel	65,000	650	65	37
Wood Sandpiper	130,000	1,300	130	Not present
Total species supported	Threshold > 15			
Total species abundance	Threshold > 2,000			

[31] Revision of the East Asian-Australasian Flyways Population Estimates for 37 listed Migratory Shorebird Species (*Hansen et al, Sept 2016*).

Appendix 7: Species and status listed

For the purposes of this report, species have been referred to using their common or colloquial name and taxonomy as prescribed by the *IOC World Bird List* (version 10.1, February 2020) - an open access resource of the international community of ornithologists (www.worldbirdnames.org). It is noted, classifications adopted by the IOC may differ slightly from other primary lists (e.g. Clements, Howard & Moore, Bird Life) due to differences in primary goals and / or taxonomic philosophy. Table 12 below details the *current* conservation status of all species observed in the Noosa River over the survey period on an international (IUCN[32]), national (EPBC[33]) and state (NCA[34]) basis.

Table 12 – Noosa River shorebird and raptor species by current conservation status

Common name (sub specie)	Taxon scientific name	IUCN Status	EPBC Status	NCA Status
		International	Federal	Queensland
Resident Tern				
Caspian Tern	*Hydroprogne caspia*	Least concern	Secure	Least concern
Greater Crested Tern	*Thalasseus bergii*	Least concern	Secure	Least concern
Australian Tern	*Gelochelidon macrotarsa*	Least concern	Secure	Least concern
Whiskered Tern	*Chlidonias hybrida*	Least concern	Secure	Least concern
Migratory Tern				
Arctic Tern	*Sterna paradisaea*	Least concern	Secure	Least concern
Common Tern	*Sterna hirundo*	Least concern	Secure	Least concern
Little Tern (Indo-Pacific)	*Sternula albifrons sinensis*	Least concern	Secure	Least concern
White-winged Tern	*Chlidonias leucopterus*	Least concern	Secure	Least concern
Resident Shorebirds				
Australian Pratincole	*Stiltia isabella*	Least concern	Secure	Least concern
Banded Lapwing	*Vanellus tricolor*	Least concern	Secure	Least concern
Beach-Stone Curlew	*Esacus magnirostris*	Near threatened	Secure	Vulnerable
Pied Stilt	*Himantopus leucocephalus*	Least concern	Secure	Least concern
Hooded Dotterel	*Thinornis cucullatus*	Vulnerable	Vulnerable	Least concern
Masked Lapwing	*Vanellus miles*	Least concern	Secure	Least concern
Australian Pied Oystercatcher	*Haematopus longirostris*	Least concern	Secure	Least concern
Red-capped Plover	*Charadrius ruficapillus*	Least concern	Secure	Least concern
Red-necked Avocet[35]	*Recurvirostra novahollandiae*	Least concern	Secure	Least concern
Migratory Shorebirds				
Bar-tailed Godwit (Nunivak)	*Limosa lapponica baueri*	Near threatened	Vulnerable	Vulnerable
Broad-Billed Sandpiper	*Calidris falcinellus*	Least concern	Secure	Least concern
Common Greenshank	*Tringa nebularia*	Least concern	Secure	Least concern
Curlew Sandpiper	*Calidris ferruginea*	Near threatened	Critically Endangered	Endangered
Double-Banded Plover	*Charadrius bicinctus*	Least concern	Secure	Least concern
Far Eastern Curlew	*Numenius madagascariensis*	Endangered	Critically Endangered	Endangered
Great Knot	*Calidris tenuirostris*	Endangered	Critically Endangered	Endangered
Greater Sand Plover	*Charadrius leschenaultii*	Least concern	Vulnerable	Vulnerable
Grey-tailed Tattler	*Tringa brevipes*	Near threatened	Secure	Least concern
Lesser Sand Plover	*Charadrius mongolus*	Least concern	Endangered	Endangered
Pacific Golden Plover	*Pluvialis fulva*	Least concern	Secure	Least concern
Red Knot (North East Siberian)	*Calidris canutus rogersi*	Near threatened	Endangered	Endangered
Red-necked Stint	*Calidris ruficollis*	Near threatened	Secure	Least concern
Ruddy Turnstone	*Arenaria interpres*	Least concern	Secure	Least concern
Sanderling	*Calidris alba*	Least concern	Secure	Least concern
Sharp-Tailed Sandpiper	*Calidris acuminata*	Least concern	Secure	Least concern
Terek Sandpiper	*Xenus cinereus*	Least concern	Secure	Least concern
Whimbrel	*Numenius variegatus*	Least concern	Secure	Least concern
Gulls				
Silver Gull	*Chroicocephalus novaehollandiae*	Least concern	Secure	Least concern
Wading Birds				
Australian White Ibis	*Threskiornis molucca*	Least concern	Secure	Least concern
Black-necked Stork	*Ephippiorhynchus asiaticus*	Near threatened	Secure	Least concern
Great Egret	*Ardea alba*	Least concern	Secure	Least concern
Little Egret	*Egretta garzetta*	Least concern	Secure	Least concern
Striated Heron	*Butorides striata*	Least concern	Secure	Least concern
White-Faced Heron	*Egretta novaehollandiae*	Least concern	Secure	Least concern
Water Birds				
Australasian Darter	*Anhinga novahollandiae*	Least concern	Secure	Least concern
Australian Pelican	*Penecanus conspicillatus*	Least concern	Secure	Least concern
Black Swan	*Cygnus atratus*	Least concern	Secure	Least concern
Chestnut Teal	*Anas castanea*	Least concern	Secure	Least concern
Great Cormorant	*Phalacrocorax carbo*	Least concern	Secure	Least concern
Little Black Cormorant	*Phalacrocorax sulcirostris*	Least concern	Secure	Least concern
Little Pied Cormorant	*Microcarbo melanoleucos*	Least concern	Secure	Least concern
Australian Pied Cormorant	*Phalacrocorax varius*	Least concern	Secure	Least concern
Pacific Black Duck	*Anas superciliosa*	Least concern	Secure	Least concern
Seabirds				
Australasian Gannet	*Morus serrator*	Least concern	Secure	Least concern
Great Frigate bird	*Fregata minor*	Least concern	Secure	Least concern

[32] International Union for Conservation of Nature's "Red List" (www.iucnredlist.org)
[33] Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) (www.environment.gov.au)
[34] Nature Conservation Act (Qld)(1992) and Nature Conservation (Wildlife) Regulation 2006 (Schedules 1-5)(www.legislation.qld.gov.au)
[35] At the commencement of the survey in 2005, the Red-Necked Avocet was incorporated into the survey database within the sub-group of wading birds per then accepted practice. The single sighting of the Red-Necked Avocet is hence included in the wading bird sub-group for this analysis.

Table 12 – Noosa River shorebird and raptor species by current conservation status (cont'd)

Common name (sub specie)	Taxon scientific name	IUCN Status	EPBC Status	NCA Status
		International	Federal	Queensland
Raptor				
Black Kite	*Milvus migrans*	Least concern	Secure	Least concern
Brahminy Kite	*Haliastur indus*	Least concern	Secure	Least concern
Eastern Osprey	*Pandion cristatus*	Least concern	Secure	Least concern
Nankeen Kestrel	*Falco cenchroides*	Least concern	Secure	Least concern
White Bellied Sea Eagle	*Haliaeetus leucogaster*	Least concern	Secure	Least concern
Whistling Kite	*Haliastur sphenurus*	Least concern	Secure	Least concern

Photo of a Bar-Tailed Godwit (*Limosa lapponica baueri*) foraging in the Noosa River estuary. Credit Bob Inglis.

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