Threatened Species Recovery Hub

National Environmental Science Programme

Progress Report 5:

Strategic Planning for the Far Eastern Curlew

December 2019

Charles Darwin University Australia · The University of Queensland Australia · Darwin Port (Part of the Landbridge Group) · Larrakia Nation · In partnership with Northern Territory Government

Progress Report 5: Strategic Planning for the Far Eastern Curlew

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Front cover: Far Eastern Curlew. Photo: Amanda Lilleyman

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Far Eastern Curlew. Photo: Dean Ingwersen

Project overview

The Far Eastern Curlew (FEC) is the largest migratory shorebird in the world. It is listed as Critically Endangered under the Environment Protection Biodiversity Conservation Act 1999 in Australia with numbers rapidly declining. Recent research has highlighted the importance of high quality non-breeding habitat to migratory shorebirds, but it is difficult to provide strategic guidance to developers and decision-makers because too little is known regarding the ecological requirements of the bird. Currently little is known about their exact feeding and roosting habitat needs. While coastal development can negatively impact populations, they are known to use some artificial habitat for roosting. This project will provide the knowledge needed to develop strategic guidelines for Far Eastern Curlew conservation.

This report draws on information presented in previous progress reports for this project NESP 5.1.1. This project also provides recommendations on migratory shorebirds that occur in Darwin Harbour.

Update on tracking of Far Eastern Curlew

Bird capture and satellite tracking

We captured 22 Curlew at four regions (Darwin, Northern Territory, Broome, Western Australia, Moreton bay, Queensland, Western Port, Victoria) across Australia during 2017, 2018, 2019 (Table 1) using cannon nets (day-time catches) or mist nets (night-time catches) depending on the site and conditions for catching. All birds were captured at high tide roosts or when birds were arriving at the site during high tide. All birds were measured and individually marked with a metal band and leg flags with a unique combination code used to identify the bird in the field. Birds were aged on the basis of plumage and wing-moult characteristics (Higgins and Davies 1996) and weighed to the nearest 1 g. The following linear measurements were taken: wing length (maximum chord, to the nearest mm); head-bill, and bill (exposed culmen) to the nearest 0.1 mm. Bill length was used to sex the bird (following summaries listed in Higgins and Davies (1996)). Primary moult was recorded in all birds, with the wear and stage of growth of each primary classified.

All birds were fitted with a solar-powered GPS tag (Table 1). We used a combination of Argos tags and 15 or 20 g GSM GPS tags (Ornitela, Lithuania) (tag weights were within the 5% rule) and attached tags to the lower back of the bird using a leg-loop harness made up of Teflon ribbon (4.7 mm wide, Bally Ribbon Mills, USA) and held together with aluminium fishing crimps. Birds were kept in a holding cage for at least 30 minutes after attaching the tag to ensure that they were not affected by it and they were then released at the site of capture. Operational duration for all tags is shown in Table 1.

The GPS tags have been operating from Broome for an average of 208 days, from Darwin for 491 days, from Moreton Bay for 332.4 days, and from Western Port for 264.7 days.

Table 1. Summary of catching and satellite tracking information of Far Eastern Curlew in Australia.

Unique ID	Engraved leg flag	Age	Sex	State	Region	Device type	Operational duration (days)
17006	16	3+	F	WA	Broome	Ornitrack	210
17008	W2	3+	M	WA	Broome	Ornitrack	191
180111	17	3+	F	WA	Broome	Ornitrack	282*
180112	43	3+	M	WA	Broome	Ornitrack	75
180113	18	3+	F	WA	Broome	Ornitrack	281*
180114	26	3+	F	WA	Broome	Ornitrack	281*
182226	13	3+	F	WA	Broome	Ornitrack	63
180115	19	3+	F	WA	Broome	Ornitrack	281*
17004	00	2+	M	NT	Darwin	Ornitrack	739*
17007	01	2+	M	NT	Darwin	Ornitrack	515
182228	03	2+	M	NT	Darwin	Ornitrack	219
40962	AFA	2+	M	QLD	Moreton Bay	Argos**	n/a
40963	AAD	2+	F	QLD	Moreton Bay	Argos**	624*
171323	AAH	2+	F	QLD	Moreton Bay	Ornitrack**	389
40964	AAJ	2-	F	QLD	Moreton Bay	Argos**	527*
40965	AAK	2+	NA	QLD	Moreton Bay	Argos**	525*
40961	AAL	NA	NA	QLD	Moreton Bay	Argos**	94
171332	AAN	NA	NA	QLD	Moreton Bay	Ornitrack**	68
171324	AAP	NA	NA	QLD	Moreton Bay	Ornitrack**	100
182225	50	2+	M	VIC	Western Port	Ornitrack	152
182227	51	2+	M	VIC	Western Port	Ornitrack	321*
182229	49	2+	F	VIC	Western Port	Ornitrack	321*

** GPS tags still operating, thus operational durations are estimates only. ** GPS tags are operated by colleagues from the University of Queensland*

Far Eastern Curlew from Broome, Darwin and Western Port migrated in March and April, Curlew from Moreton Bay migrated in March. All tagged Curlew migrated through the Yellow Sea region in eastern Asia (Figure 1).

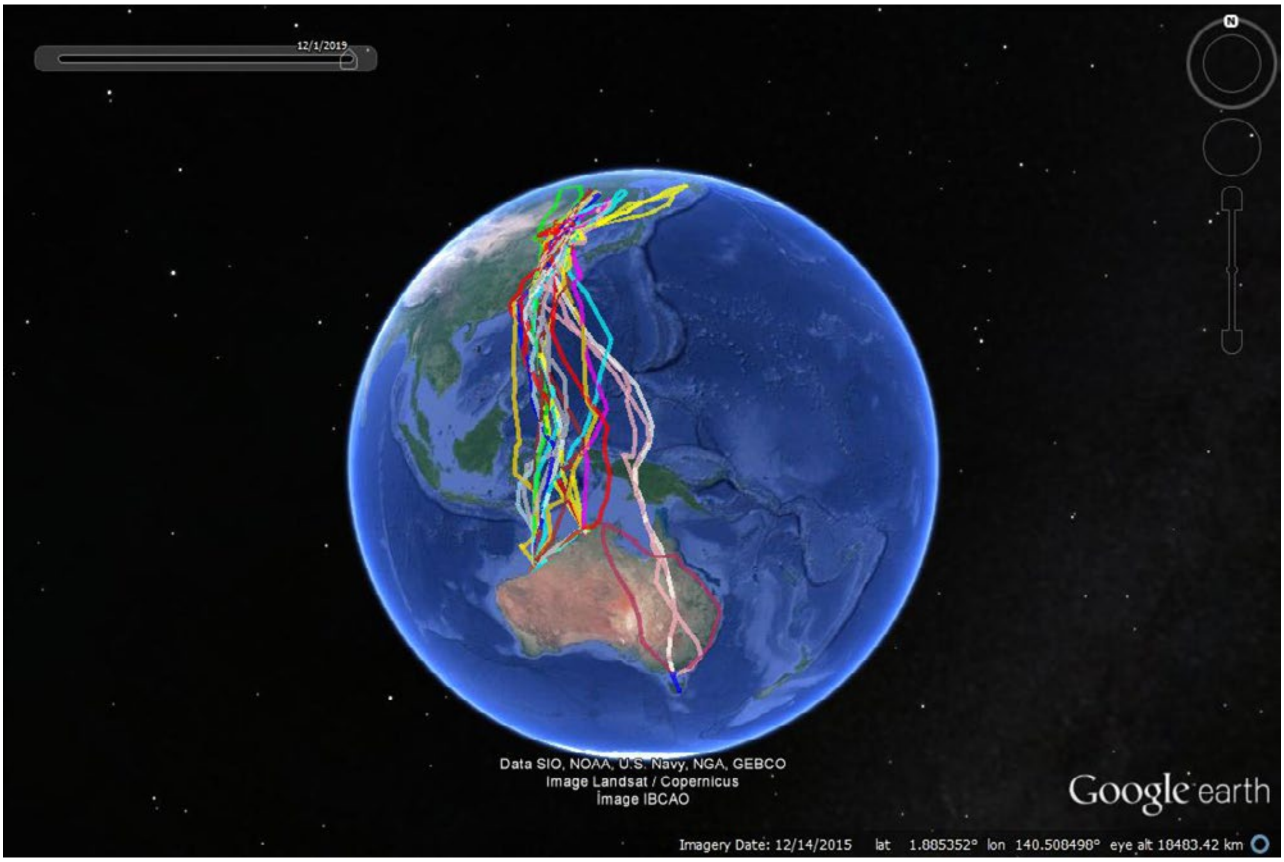

Figure 1. Map of all GPS-tagged Far Eastern Curlew and their migration tracks in the East Asian-Australasian Flyway.

Modelling of relationships between shorebird feeding and roosting sites

Multiple species of shorebird can coexist within the non-breeding intertidal zone by partitioning resources (food and space) amongst them. There is great variation among shorebirds in bill shape, type and length and is widely claimed as one of the primary means by which shorebird species partition food resources (Nebel 2005). Twenty-six species of migratory shorebird have been regularly recorded across the Darwin Harbour region, and a further species, the Ruff (*Calidris pugnax*) has recently been recorded in the region (Table 2). Of the regularly recorded shorebird species, seven are listed threatened species under the Environment Protection Biodiversity Conservation Act 1999. All species are listed under international conventions and bilateral agreements (for more information, see: https://www.environment.gov.au/biodiversity/migratory-species/migratory-birds). These species move throughout the network of sites in the Darwin Harbour region, with many using East Arm Wharf as a roost site.

Table 2. List of migratory shorebirds present in Darwin Harbour and their conservation status under the Environment Protection Biodiversity Conservation Act 1999 and the IUCN Red List of Threatened Species. CR = critically endangered, EN = endangered, LC = least concern, NT = near threatened, V/VU = vulnerable.

Pacific Golden Plover	Pluvialis fulva	EPBC Act	LC
Grey Plover	Pluvialis squatarola		LC
Little Ringed Plover	Charadrius dubius		LC
Lesser Sand Plover	Charadrius mongolus	EN	LC
Greater Sand Plover	Charadrius leschenaulltii	VU	LC
Oriental Plover	Charadrius veredus		LC
Black-tailed Godwit	Limosa limosa		NT
Bar-tailed Godwit	Limosa lapponica	VU	LC
Little Curlew	Numenius minutus		LC
Whimbrel	Numenius phaeopus		LC
Far Eastern Curlew	Numenius madagascariensis	CR	V
Terek Sandpiper	Xenus cinereus		LC
Common Sandpiper	Actitus hypoleucos		LC
Grey-tailed Tattler	Tringa brevipes		NT
Common Greenshank	Tringa nebularia		LC
Marsh Sandpiper	Tringa stagnatilis		LC
Wood Sandpiper	Tringa glareola		LC
Ruddy Turnstone	Arenaria interpres		LC
Asian Dowitcher	Limnodromus semipalmatus		NT
Great Knot	Calidris tenuirostris	CR	V
Red Knot	Calidris canutus	EN	LC
Sanderling	Calidris alba		LC
Red-necked Stint	Calidris ruficollis		LC
Long-toed Stint	Calidris subminuta		LC
Sharp-tailed Sandpiper	Calidris acuminata		LC
Curlew Sandpiper	Calidris ferruginea	CR	LC

Site connectivity

On non-breeding grounds, most coastal migratory shorebirds feed on intertidal sand- and mud-flats and rest at open and exposed roosts where predators can be easily detected (Rogers 2003, Rogers et al. 2006a). Roosts are usually close to feeding grounds to allow short commutes that occur at least twice a day, and in tropical locations both roosting and feeding sites need to be where birds can thermoregulate to avoid heat stress (Rogers et al. 2006b). Shorebirds also require a range of feeding and roosting sites in a region because some species track the availability of ephemeral foods at the feeding sites (Kraan et al. 2009) and still need nearby roosts to conserve energy and avoid disturbances (Rehfisch et al. 1996). Maintaining and conserving a network of both feeding and roosting sites is critical, as different shorebird species have different degrees of habitat fidelity in a region (Warnock and Takekawa 1996, Leyrer et al. 2006, Buchanan et al. 2012, Piersma et al. 2016). To identify and manage appropriate shorebird habitat, it is essential that the availability of feeding grounds is paired with suitable nearby roosting grounds (Rogers et al. 2006b). A network of safe and high-quality roosting habitat is crucial to ensuring the ongoing survival of shorebird species in the EAAF (Aharon-Rotman et al. 2016).

Recent analyses of the movements of other migratory shorebirds in the Darwin Harbour region have shown that individuals return to the non-breeding grounds in Darwin year after year and when birds are in the Darwin Harbour region they move between a range of sites within a network. Great Knots (Calidris tenuirostris) that were tagged with individually-identifiable leg-flags at East Arm Wharf were recorded at monitoring sites away from the wharf, indicating that some birds will travel up to 20 km away (Figure 2). All sites within the network are connected to each other and some sites are more important at certain times of the year, depending on resource availability and the needs of the birds. The results from our study suggest there is a hierarchy of importance in the network of sites.

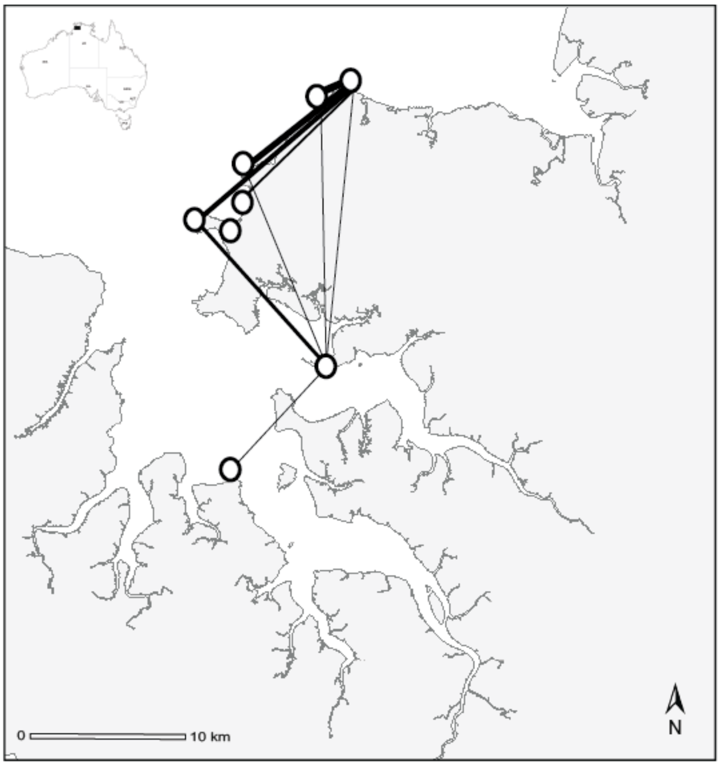

Figure 2. Network plot of resightings of Great Knots in the Darwin Harbour study region for the years 2014 – 2018. Line thickness represents the number of resightings between banding sites at Lee Point and East Arm Wharf.

Habitat use at an artificial roost site

Migratory shorebirds that used East Arm Wharf as a roost site used the site at high tide when intertidal foraging grounds were covered by the tide. Shorebirds roosted within dredge ponds (Figure 3). Shorebirds roosted in all ponds, but this changed over time as species responded to environmental changes within dredge ponds. We recorded a total of 19 species of migratory shorebird across four ponds at East Arm Wharf over the survey years 2013 – 2018. Species richness was highest in Pond K and Pond B had the lowest species richness. Pond D species richness decreased over the survey period. The species most regularly recorded during the survey years at the site were Common Greenshank, Far Eastern Curlew, Greater Sand Plover, Red-necked Stint, and Whimbrel (Table 3).

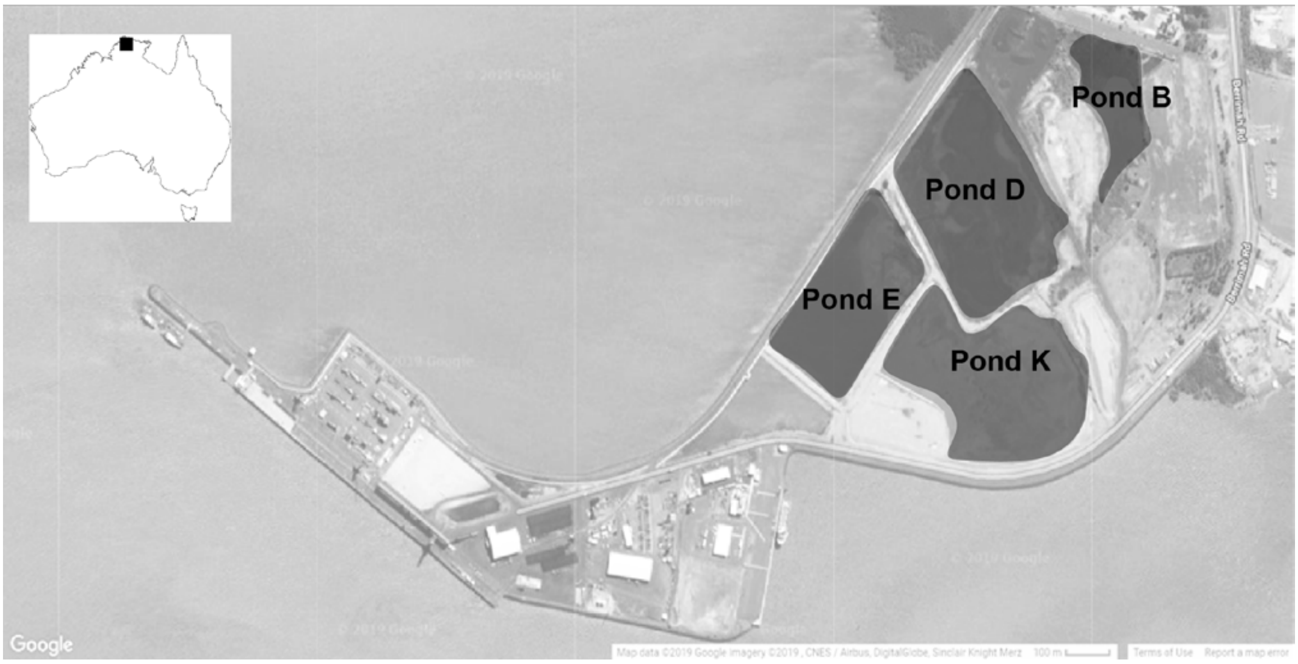

Figure 3. Map of the East Arm Wharf study site and ponds.

Table 3. Frequency (%) of shorebird species in surveys across all ponds at the East Arm Wharf study site over the period 2013 – 2018.

Species	2013	2014	2015	2016	2017	2018
Bar-tailed Godwit	58.3	66.7	75.0	33.3	83.3	50.0
Black-tailed Godwit	25.0	16.7	8.3	25.0	0.0	8.3
Common Greenshank	83.3	100.0	100.0	33.3	100.0	83.3
Common Sandpiper	66.7	83.3	75.0	33.3	8.3	25.0
Curlew Sandpiper	0.0	8.3	0.0	0.0	16.7	16.7
Eastern Curlew	83.3	100.0	100.0	33.3	100.0	75.0
Great Knot	83.3	91.7	75.0	33.3	83.3	50.0
Greater Sand Plover	83.3	100.0	83.3	33.3	100.0	75.0
Grey Plover	75.0	75.0	58.3	25.0	66.7	16.7
Grey-tailed Tattler	41.7	66.7	66.7	8.3	58.3	41.7
Lesser Sand Plover	83.3	83.3	58.3	16.7	41.7	8.3
Marsh Sandpiper	58.3	66.7	83.3	33.3	50.0	66.7
Pacific Golden Plover	58.3	66.7	41.7	16.7	8.3	0.0
Red Knot	25.0	0.0	16.7	0.0	8.3	0.0
Red-necked Stint	83.3	100.0	91.7	25.0	91.7	75.0
Ruddy Turnstone	0.0	0.0	0.0	0.0	8.3	0.0
Sharp-tailed Sandpiper	58.3	75.0	75.0	33.3	50.0	50.0
Terek Sandpiper	66.7	50.0	66.7	16.7	66.7	50.0
Whimbrel	75.0	91.7	100.0	25.0	91.7	75.0

Characterising conditions at an artificial roost site

Vegetation cover has increased in all ponds over time (Figure 4), while water cover and the amount of mud and rock cover fluctuated over time but is generally controlled by stormwater input into the system (Figures 6 and 8). Vegetation cover was highest in Pond B from March through to May, and highest in Pond D during July, highest in Pond E from May through to July, and highest in Pond K during February and April (Figure 5). Water cover was lowest from May through to July in Ponds D, E and K, and lowest from August through to October in Pond B (Figure 7). Conversely, there was more higher mud cover in Pond B during these drier months. Pond D had highest mud cover from July through to October, while Pond E from May through to August. Pond K had highest mud cover during July (Figure 9).

Pond B (3.1 ha) fills with rainwater from the wet season and stormwater from nearby drains. This is a freshwater pond. Pond B had wetland vegetation around the perimeter in 2014-2015 and then the vegetation expanded from 2016-2018 and much of the pond is now dominated by Typha sp.

Pond D (10.7 ha) is a freshwater pond and fills from rain during the wet season. Shorebirds stop using it when it dries up. Pond D only had vegetation along the perimeter in 2013, and in 2014-2015 vegetation expanded to reach the border of the water. From 2016 vegetation expanded to the middle of the pond and more recently a wetland sedge has dominated the middle of the pond.

Pond E (7.6 ha) is a saltwater pond and is a permanent waterbody at EAW. The pond is sectioned by a bund wall and the western-most side of Pond E is smaller than the northern-most side. Pond E had close to 100% water cover in 2013 and as Pond K filled with dredge material, a mud bank built up in Pond E. Mud has accreted in this pond over time and as a result there has been ecological succession with vegetation covering much of the mud.

Pond K (10.5 ha) is a freshwater pond. In 2013 Pond K only had vegetation bordering one side of the pond bund wall and has since had periodic the flow of dredge spoil material and water from the harbour as well as annual flushing from rain events. This has caused ecological succession of saltmarsh and some grasses across some of the pond interior.

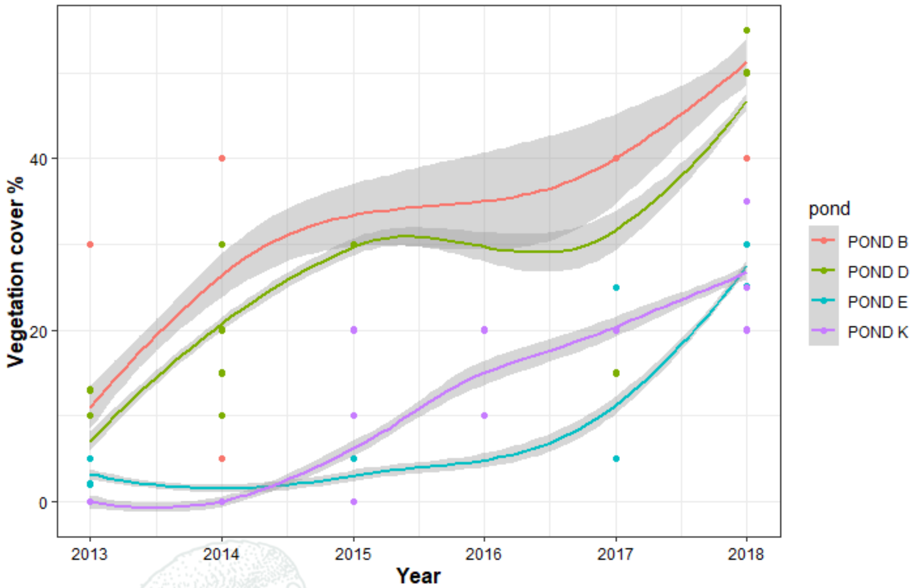

Figure 4. Vegetation cover (%) within each dredge pond at East Arm Wharf from 2013 – 2018. Data points are percentage estimates over time and lines show the general trend and the grey band show the 95% confidence intervals.

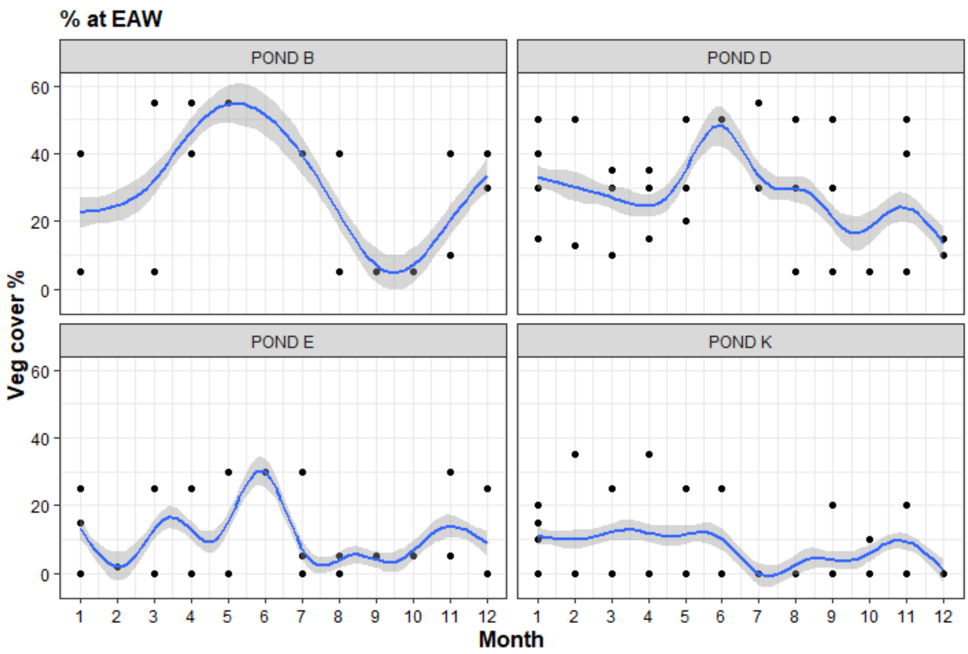

Figure 5. Vegetation cover (%) within each dredge pond at East Arm Wharf for all months of the years from 2013 – 2018. Data points are percentage estimates over time and lines show the general trend and the grey band show the 95% confidence intervals.

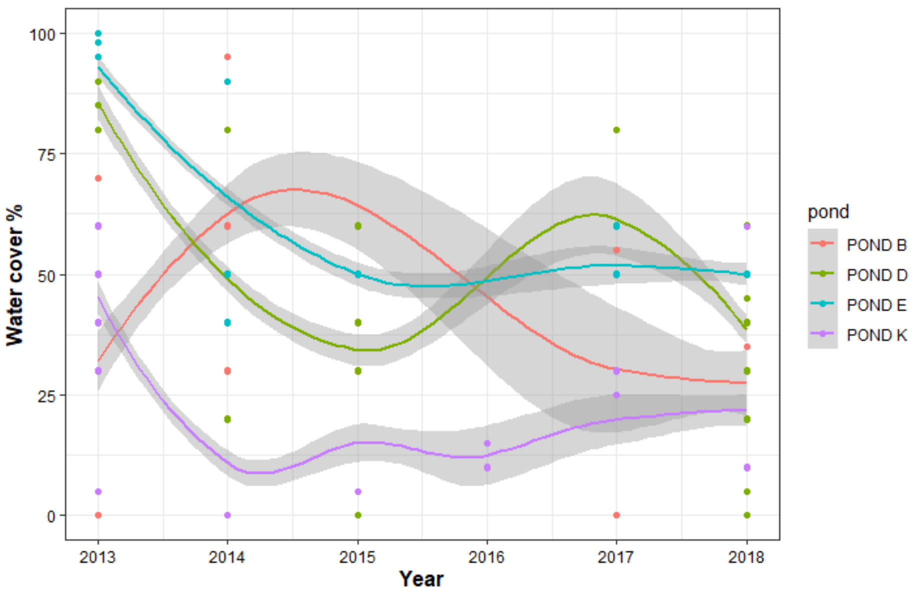

Figure 6. Water cover (%) within each dredge pond at East Arm Wharf from 2013 – 2018. Data points are percentage estimates over time and lines show the general trend and the grey band show the 95% confidence intervals.

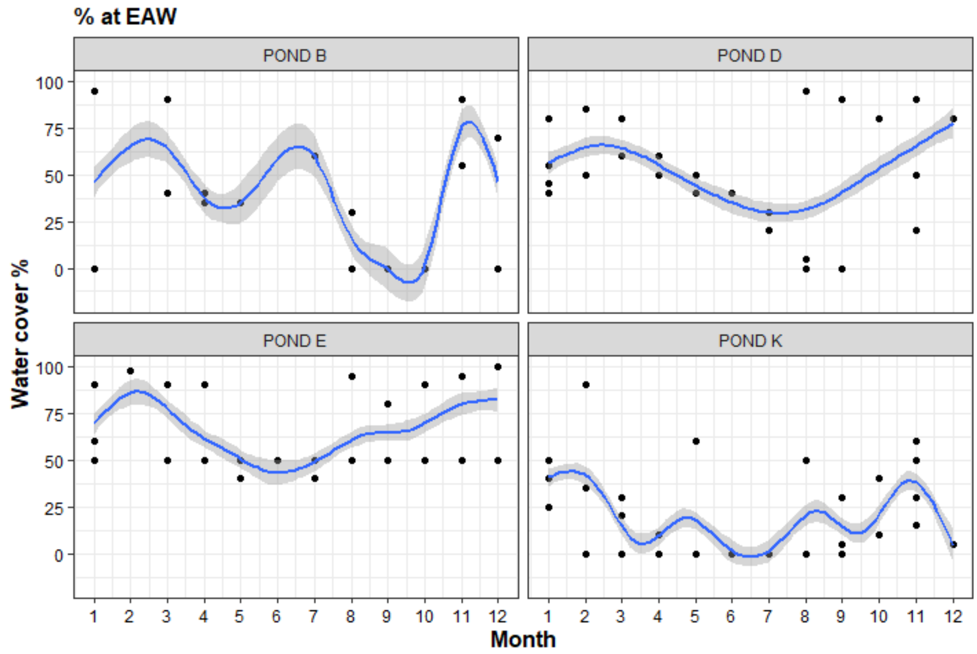

Figure 7. Water cover (%) within each dredge pond at East Arm Wharf for all months of the years from 2013 – 2018. Data points are percentage estimates over time and lines show the general trend and the grey band show the 95% confidence intervals.

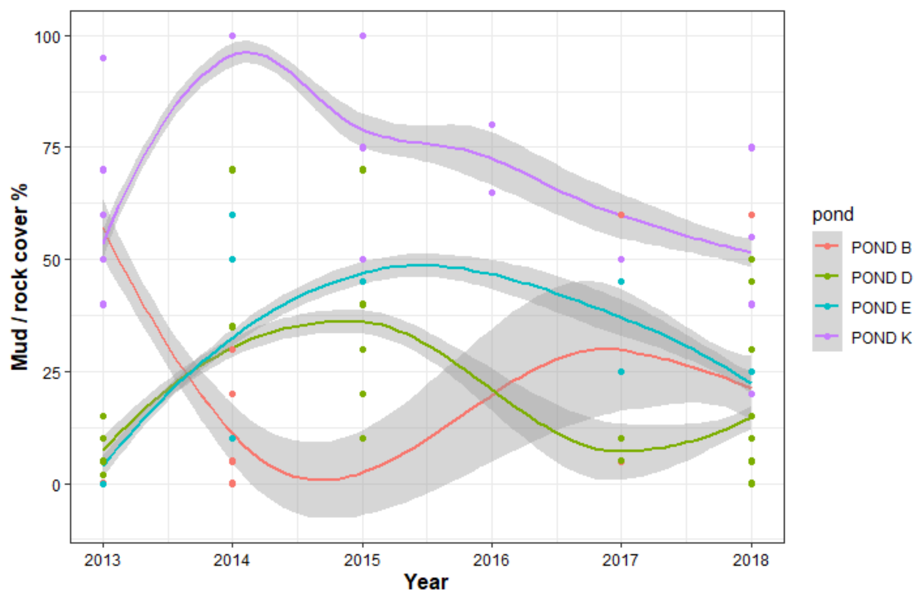

Figure 8. Mud and rock cover (%) within each dredge pond at East Arm Wharf from 2013 – 2018. Data points are percentage estimates over time and lines show the general trend and the grey band show the 95% confidence intervals.

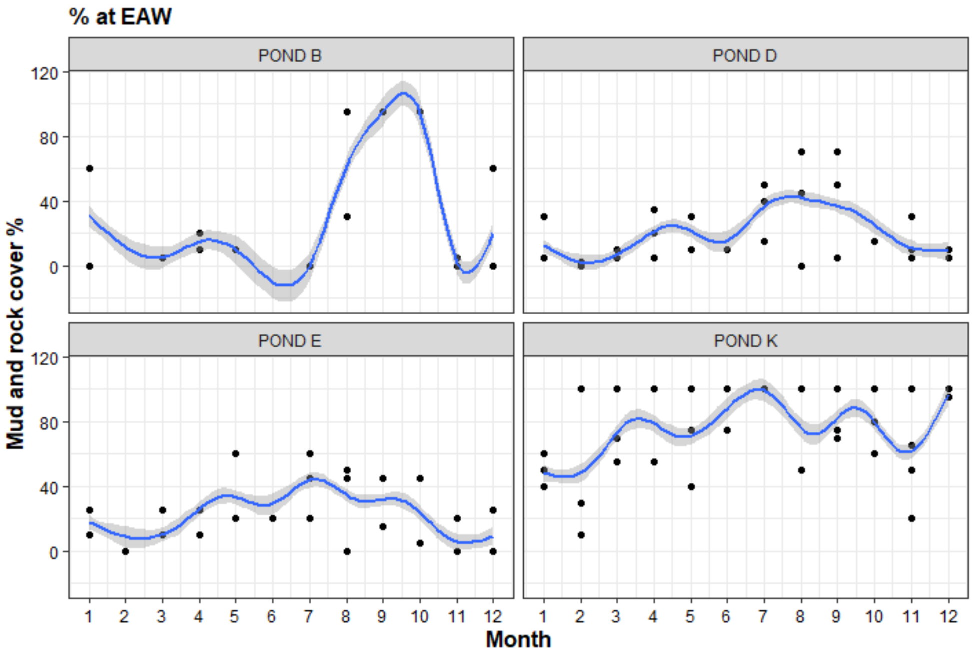

Figure 9. Mud and rock cover (%) within each dredge pond at East Arm Wharf for all months of the years from 2013 – 2018. Data points are percentage estimates over time and lines show the general trend and the grey band show the 95% confidence intervals.

Draft planning guidelines

Draft planning guidelines for the management of migratory shorebirds in Darwin Harbour will follow an adaptive management framework and include recommendations on how to manage habitat in the instance that compensatory offsetting is required as part of coastal development (Figure 10).

Future planning for migratory shorebirds in Darwin Harbour should include adequate survey effort at optimal times of the year for all species and across appropriate habitat types (Table 4).

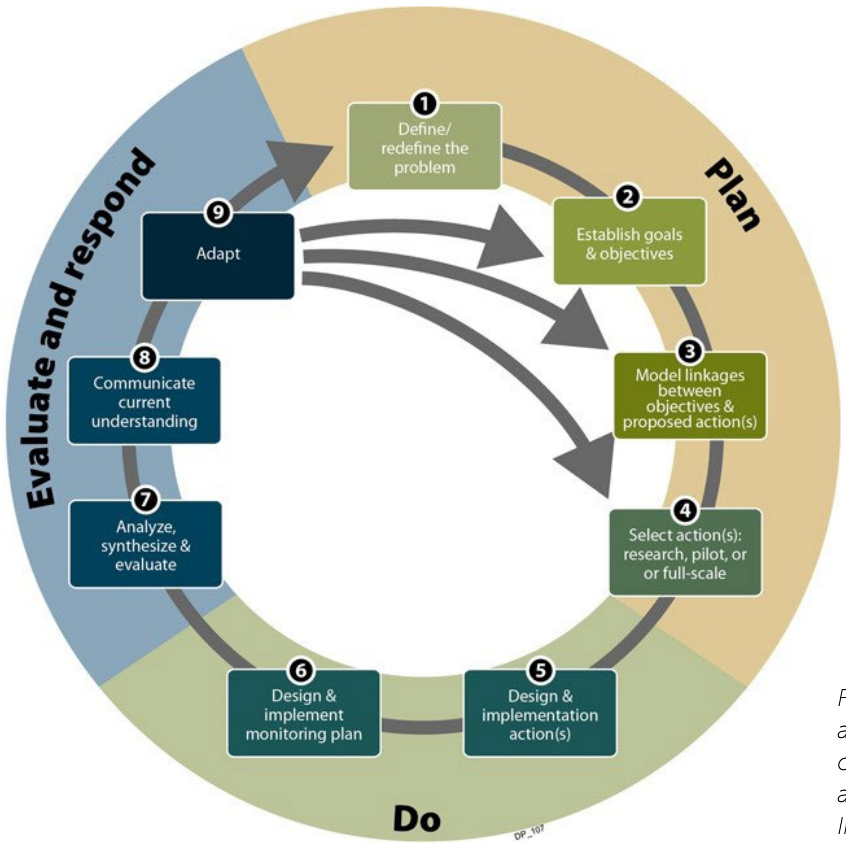

Figure 10. Flow chart showing the adaptive management framework that can be employed to manage shorebirds and habitats in Darwin Harbour. Image credit: Nagarkar et al. (2016).

Table 4. Migratory shorebirds and the month with the highest counts at the Darwin Harbour East Arm Wharf high tide roost site. Data are from surveys conducted from 2013 – 2018. NA = not enough data available as the species is uncommon at the site.

Shorebird common name	Optimal survey months	Optimal survey habitat and conditions
Pacific Golden Plover	January	Mudflats adjacent to EAW site during low tide
Grey Plover	October	Highest spring tides at EAW ponds
Little Ringed Plover	NA	Leanyer Sewage Ponds or EAW during northward migration month of March
Lesser Sand Plover	September	Highest spring tides at EAW ponds
Greater Sand Plover	November	Highest spring tides at EAW ponds
Oriental Plover	NA	Nightcliff Rocks or Darwin Airport grassland
Black-tailed Godwit	January	Dependent on inland wetland conditions
Bar-tailed Godwit	October	Highest spring tides at EAW ponds
Little Curlew	NA	Inland grassland specialist
Whimbrel	November	Highest spring tides at EAW ponds
Far Eastern Curlew	February	Highest spring tides at EAW ponds
Terek Sandpiper	September	Highest spring tides at EAW ponds
Common Sandpiper	October	Highest spring tides at EAW ponds
Grey-tailed Tattler	September	Highest spring tides at EAW ponds
Common Greenshank	October	Highest spring tides at EAW ponds
Marsh Sandpiper	February	Dependent on inland wetland conditions
Wood Sandpiper	NA	Dependent on inland wetland conditions
Ruddy Turnstone	NA	Prefers beach habitat, occasionally recorded in Darwin Harbour
Asian Dowitcher	NA	Uncommon visitor during southward migration months
Great Knot	February	Dependent on local conditions in the site network
Red Knot	NA	Prefers beach habitat, occasionally recorded in Darwin Harbour
Sanderling	NA	Prefers beach habitat, occasionally recorded in Darwin Harbour
Red-necked Stint	November	Highest spring tides at EAW ponds
Long-toed Stint	NA	Uncommon visit to Leanyer Sewage Ponds
Sharp-tailed Sandpiper	October	Highest spring tides at EAW ponds
Curlew Sandpiper	NA	Low abundance at EAW but occasionally recorded at EAW

Future work and recommendations

Currently we know that Far Eastern Curlew are site faithful and are predictable in their daily movements between high tide roost sites and low tide foraging grounds. This may be because individuals are competing for resources and maintain foraging territories. There is now of evidence showing that migratory shorebirds have strong site fidelity between years and within years, and this places importance on maintaining roosting and feeding sites where shorebirds are currently known from. Further to this, species require a range of sites within a network to allow for changes within the local environment and to account for fluctuations in resource availability and individuals competing for resources.

There is the opportunity to maintain and preserve the current habitat that shorebirds use in Darwin Harbour so as to protect the population of shorebirds in the region. Future coastal developments in Darwin Harbour will have to consider habitat offsetting and will require an understanding of site connectivity and habitat use by all species found in the region as responses to the environment and conditions is species' specific.

Acknowledgements

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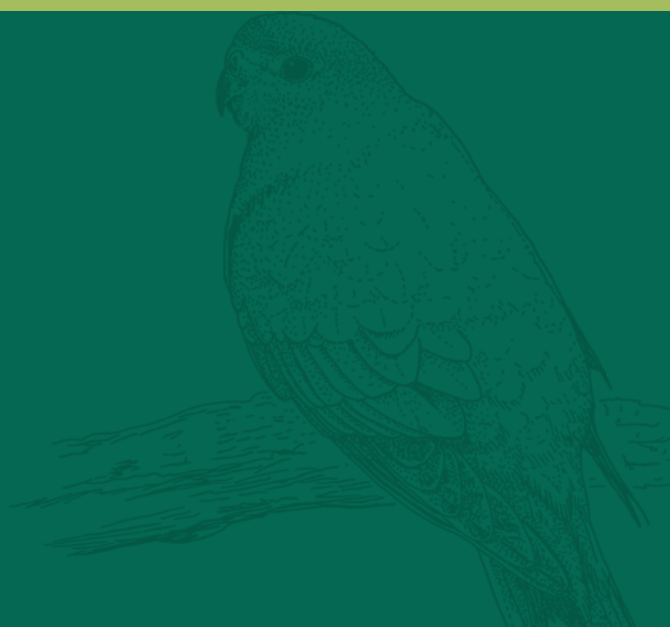
Further information:

http://www.nespthreatenedspecies.edu.au/



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