global flyway network
Team Piersma

SHOREBIRD NORTHWARD MIGRATION THROUGH THE LUANNAN COAST, BOHAI BAY, CHINA, APRIL – JUNE 2025

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Red Knots and other shorebirds landing, Nanpu mudflats, 1 May 2025. © Katherine Leung

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Flying flock of Red Knots at Luannan Coast, 4 June 2025.

Summary

This is the eighteenth year for Global Flyway Network (GFN)'s fieldwork at the Luannan Coast, Bohai Bay, China. Chris Hassell, Katherine Leung and Yang Liu carried out the fieldwork for 5 weeks, from 30 April to 4 June 2025, 36 days in total.

The main findings from this year's fieldwork showed that in 2025, Red Knot *Calidris canutus* highest peak daily counts at Nanpu increased from the low numbers of 2021-2024. The biggest day count was 30,000 on 21 May at Nanpu. The number of Red Knot using the Luannan Coast varies a lot from year to year. The 2018 (48,630) and 2019 (47,537) counts were our highest since 2015, and the lowest was 3,660 in 2023 since the start of our studies in 2010. None of the non-breeding areas of the East Asian – Australasian Flyway (EAAF) have had dramatic changes in the numbers of Red Knots utilising them in the 2024/25 season that we are aware of, so, despite the dramatic changes in numbers over the past 10 years at the Luannan Coast, we do not think there is a flyway-wide crash in Red Knot numbers. We believe that the northward migration pattern of Red Knot has changed in recent years and this may not be unusual in migratory species in a rapidly changing flyway landscape. The fluctuating numbers of Red Knot at Nanpu appear to reflect local food abundance. The biggest day counts of Red Knot this year is equivalent to 27.3% of the EAAF's Red Knot population, highlighting the continued importance of the Luannan Coast to the EAAF's Red Knot.

This year, we recorded 1,389 marked shorebirds of 10 species from 21 marking locations throughout the EAAF, as well as from India on the Central Asian Flyway (CAF). One hundred and thirty-five birds were individually recognisable from the GFN colour-banding project in Northwest Australia (NWA), which is similar to 2024 but lower than most other years. This is to be expected as GFN's regular colour-banding stopped in October 2019 with only a small 'top up' of 89 birds in October 2023. The GFN colour band totals were dominated, as always, by Red Knot with 132 individuals identified, Great Knot *Calidris tenuirostris* with two and Bar-tailed Godwit *Limosa lapponica* with one. These records once again reflect the vital importance of the Luannan Coast for Red Knots from NWA and throughout the EAAF.

Red Knots and other shorebirds on Nanpu mudflats, 1 May 2025. © Katherine Leung

Red Knots and other shorebirds at Nanpu salt ponds, 27 May 2025. © Katherine Leung

This 2025 season's work was made possible with financial support from Wetlands International's Flyway Bottleneck Yellow Sea Project and administrative support from Beijing Normal University (BNU).

A list of species recorded in internationally important numbers has been compiled from GFN and BNU studies from 2010–2025. It is an effective way to give an indication of the immense importance of the Luannan Coast shorebird site. In the period 2015-2019, fourteen species of migratory shorebirds have been recorded in internationally significant numbers, including four species with an absolute minimum of 10% of their entire EAAF population passing through the Luannan Coast during northward migration. In addition to the migratory shorebirds and terns passing through the Luannan Coast, there are nine species we have recorded breeding within the study site from 2010 to 2025.

Both the mudflats and the adjacent ponds of the Luannan Coast are vital components of the area for shorebird conservation, and an important contributing factor to the local economy and jobs. Since October 2020, 5,791.6 ha of the Luannan Coast at Nanpu was protected as Hebei Luannan Nanpu Zuidong Provincial Wetland Park. However, we feel there has not been much positive progress in respect to the site in relation to its importance for shorebirds. Proper strategic conservation management with careful planning and engagement with scientists from China is vital to enhance the status of this critical site. It is hoped that better communication can be set up between decision makers and scientists so that subsequent conservation management of the Wetland Park will ultimately enable the Red Knots and many other waterbird species of the EAAF to maintain sustainable population levels, as well as serving the local communities with a sustainable economy and for raising the public's awareness of wetland conservation. GFN will endeavour to continue assisting with conservation efforts at the Luannan Coast in conjunction with BNU.

Introduction

Most of the Yellow Sea intertidal mudflats are critical feeding areas for migratory shorebirds on their journeys to and from their breeding and non-breeding grounds. The areas used by migratory shorebirds are referred to as 'stop-over sites' (sites used mainly for a 'pit-stop', a rest) or 'staging sites' (sites used for more than a few days for serious refuelling). Birds spend from a few days to about six weeks at any one or several sites on their way north. The Luannan Coast is one such critical area and is particularly important to Red Knot (Piersma *et al.* 2016, Rogers *et al.* 2010). Red Knot are represented in the EAAF by three subspecies: *piersmai, rogersi* and *roselaari* (the latter is not part of this study because it only breeds on Wrangel Island in the Russian Far East and migrates to the Americas). The subspecies *piersmai* and *rogersi* breed in different locations in the Siberian Arctic and share wintering locations in Australasia (Tomkovich 2001, Rogers *et al.* 2010), as well as South-east Asia.

Despite Red Knots having been one of the best researched shorebirds in the world for quite a long time (see, for example, summary in Piersma *et al*. 1997), we only started to understand the northward and southward migration strategies of the two subspecies that use the Luannan Coast, and changes to these strategies, as a consequence of habitat loss and change within the EAAF (Piersma *et al.* 2021). Surveys of the Yellow Sea by Mark Barter and Chinese colleagues did not find significant numbers of the species despite extensive searching in May 2000. During northward migration in 2002, they did record 14,277 in the north-west Bohai Bay region, now called the Luannan Coast (Barter *et al.* 2003). During a brief six-day visit in late April 2007, Chris Hassell from GFN counted a single flock of 10,650 Red Knot in the same region. In September 2007, Hongyan Yang, a Master postgraduate and then a PhD graduate at BNU commenced a project on the food, foraging and staging ecology of Red Knots in the area. She conducted regular counts during northward migration in 2003-2014 and her work showed that numbers of Red Knot at the Luannan Coast had increased over the years, presumably due to habitat destruction elsewhere and consequently birds moving into her study site (Yang *et al*. 2011).

Building on the research conducted in NWA, in conjunction with the work by researchers from BNU, Fudan University and the Center for East Asian-Australasian Flyway Studies at Beijing Forestry University (CEAAF), studies by GFN have continued during the northward migration seasons of 2009 to this year, 2025. These fieldwork studies

Red Knots feeding at Nanpu salt pond, 27 May 2025. © Katherine Leung

have concentrated on searching for individually marked Red Knots and have been remarkably successful. Several PhD students have graduated at the University of Groningen under the tutelage of Theunis Piersma, and a number of them have used data from the Luannan Coast studies. These academic studies are made possible under the Rudi Drent Chair in Global Flyway Ecology at the University of Groningen, with past support from WWF Netherlands, WWF-China, SEE Foundation of China and BirdLife-Netherlands, with the in-kind support of the Royal Netherlands Institute for Sea Research (NIOZ), and in close cooperation with BNU.

It is clear from our current knowledge that the Luannan Coast has been the single most important site known for Red Knot on northward migration in the EAAF, encompassing the vast majority of the populations wintering in Australia, New Zealand and South-east Asia. In recent years there have been changes to the peak single day counts of Red Knot at the Luannan Coast and possibly there are now other sites which support more Red Knots during the northward migration season. But this is not certain, and the Luannan Coast remains a site of significant international importance to the EAAF's Red Knot.

This 2025 season's work was made possible with financial support from Wetlands International's Flyway Bottleneck Yellow Sea Project and administrative support from BNU.

All the migratory birds mentioned in this report are covered by the China-Australia Migratory Bird Agreement (CAMBA). The data in this report confirm the importance of the Luannan Coast for migratory birds and the priority for both Australia and China to advance and build on their actions to protect this site and the wider Yellow Sea mudflats for the future of migratory birds.

Red Knots and other shorebirds on Nanpu mudflats, 20 May 2025. © Katherine Leung

Study site

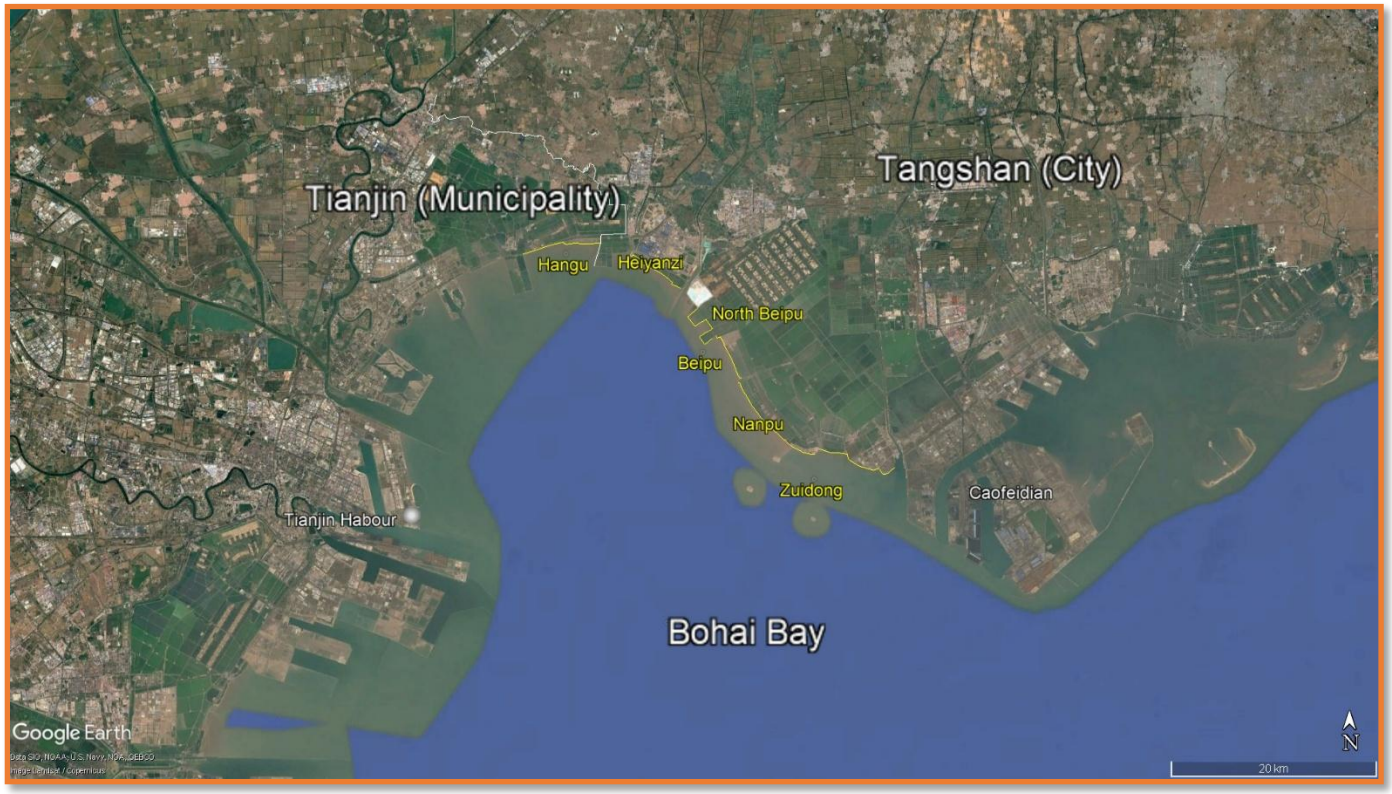


Figure 1. Interpreted satellite image of northern Bohai Bay, China with the coastal study sites marked in yellow.

The Luannan Coast referred to throughout this report encompasses our study sites shown in Figure 1 and the adjacent salt and aquaculture ponds.

The centre of our study site is situated at 39.0597N, 118.2092E. It is near Nanpu Development Zone of Tangshan City, situated 190 km south-east of Beijing, China. Figure 1 shows the six coastal study sub-sites. The mudflats of our six sub-sites cover 40 km in length and are 1-4 km wide (on the lowest tides). The total coastline of Bohai Bay is 1,294 km of which more than 95% is considered to be 'built environment'. This is mostly the huge port and industrial developments of Caofeidian, Tianjin and Huanghua (Sun *et al.* 2017).

The Nanpu mudflat is the largest of the sub-sites that we study at 8 km long and 4 km wide, at the lowest tide. It is probably the most important of the remaining mudflats in the area, where most of the Red Knots often congregate. This is presumably because, at present, this site has the most abundant and/or accessible prey. Due to the topography of the artificial seawall, it is also the last area of mudflat to be covered on an in-coming tide and the first to become exposed on an out-going tide. Consequently, this is where we obtain the best views of birds and is where most of our fieldwork is conducted.

The Nanpu mudflats are an important shorebird foraging ground as well as contributing to the local fishing communities. Shell-fishing operations are carried out by people from the nearby village of Beipu. Reasonable levels of fishing activity do not appear to concern the birds; we often watch flocks of birds feeding close to the people collecting shellfish. Thanks to the continuous effort and discussions between provincial and county governments, BNU and NGOs, the Nanpu mudflats and some of the adjacent ponds are protected within the Hebei Luannan Nanpu Zuidong Provincial Wetland Park since October 2020 (see later section).

Safe-guarding of Nanpu and the remaining mudflats at the Luannan Coast, and their benign ecological offerings to shorebirds, remains of great conservation importance to enable the

internationally significant number of migratory shorebirds and terns to continue using the area as a staging site. For details of the other sub-sites, please refer to previous reports (see Report 2021).

The Nanpu intertidal mudflats are separated by a man-made seawall from the Nanpu ponds complex. These were reputedly 'the largest salt works in Asia'. This ponds complex, adjacent to the mudflats, is also critical habitat for birds to forage and roost (Lei *et al.* 2018, Lei *et al.* 2021a), and for some species to nest (Lei *et al.* 2021b), but some of these areas have also been lost to industrial development. The area of ponds adjacent to the Luannan Coast is vast, stretching 10 km inland and across the entire 20 km, from south-east to north-west, of our four southerly study sites and therefore roosting opportunities are many and varied for migratory shorebirds and terns. There are also suitable ponds for feeding and roosting shorebirds and terns adjacent to the Hangu mudflats but almost zero roosting opportunities behind the seawall at Heiyanzi as this area is now highly industrialized.

Red Knots and other shorebirds about to land on the Nanpu mudflats, 3 May 2025. © Katherine Leung

Mudflats at the Hangu Wind Farm site, 9 May 2025. © Katherine Leung

Salt, fish, *Litopenaeus* shrimp, *Artemia* brine shrimp (adult and cysts) are the major products from the ponds adjacent to the Luannan Coast. Different water levels and salinities of the ponds are, more or less, suited to the different uses (Lei et al. 2025). For the purposes of this report, all and any pond, regardless of its use, is referred to as a 'pond'.

Our drive to the seawall has enabled us to see the same ponds over the entire 18 years of study, despite that journey now occurring along a stretch of newly built highway. Prior to 2018, the majority of shorebirds and terns have used the ponds for roosting as well as feeding. In 2013 when there were many and varied ponds available to birds, we had the amazing sight of 95,833 mixed shorebird species foraging in a single, shallow, large pond (2.6 km^2) on 16 May. On 29 May that year, we had a count of 34,200 Red Knot foraging in another shallow, large pond (3.4 km^2). Between 2016 and 2018, the water levels in most of these large ponds gradually became deeper due to increased management for aquaculture. Some ponds function as dual purpose, being part of both the aquaculture and the salt production system. The deep water in the ponds made them unsuitable for foraging shorebirds. The pond walls were still suitable for roosting but there were very few foraging opportunities particularly for the small and medium-sized shorebirds.

In recent years salt production has completely ceased in these large ponds and water levels maintain high throughout the season for aquaculture, even long-legged waders such as Black-tailed Godwits *Limosa limosa* and Pied Avocets *Recurvirostra avosetta* were rarely seen in these ponds. This year, only at the very end of the season in early June, did we found a couple of ponds with lowered water levels and about 2,000 shorebirds in each pond. Nevertheless, for now the foraging opportunities within the ponds we accessed have diminished almost completely.

A 10-ha area of small salt ponds behind the seawall adjacent to Nanpu mudflats were the main roosting sites in the past few years. This area continues to be relatively undisturbed although pond workers do cause some occasional disturbance. This is different from before 2018 when birds used to roost and do some foraging in these close ponds early in the season but then move further inland to the larger pond complex around mid-May.

Despite this change, it remains the case that both the ponds and the adjacent mudflats of the Luannan Coast are vital components of the area for shorebird conservation, even though the ponds are now predominately only suitable for their safe and relatively undisturbed roosting opportunities.

Red Knot roosting on bunds in Nanpu salt pond, 27 May 2025 © Katherine Leung

Marking of shorebirds

Shorebirds captured throughout the EAAF are mostly marked with plain coloured leg flags, engraved leg flags (ELF), or combinations of four colour-bands and one plain leg flag. Each bird also has a metal band placed on it supplied by the country's relevant banding scheme. Each capture location has its own colour leg flag combination and/or position of the flag on the birds' leg: Shorebird Colour Flagging Protocol for the East Asian-Australasian Flyway.

'Scanning' is systematically searching through feeding or roosting birds using telescopes to look specifically for flags and colour-bands on bird legs. Each marked bird is recorded, and the records are sent to each banding project at the end of our fieldwork season.

The focus of our study is the individually colour-banded birds marked at Roebuck Bay and Eighty Mile Beach, NWA, but we record every single marked bird we see during our fieldwork thereby documenting the importance of the Luannan Coast for various shorebird species from regions throughout the EAAF and CAF.

In addition to the data collected during our studies at the Luannan Coast, the GFN project is also getting tens of thousands of resightings at Roebuck Bay and Eighty Mile Beach. This huge dataset, with such a high number of records of individually marked birds, is very valuable for learning about survival and movements of these shorebirds (Piersma *et al.* 2016, Lok *et al*. 2019).

NWA colour-banded Red Knot 6RBRR was marked at Roebuck Bay, NWA on 23 July 2017 as an age 1 bird (born in 2016 boreal summer). Ever since its first norward migration in 2019 (in its 3rd year of life), this bird has been recorded at the Luannan Coast every spring and is now 8 years old. This image is from 20 May 2025. © Katherine Leung

Fieldwork in 2025

The fieldwork program for 2025 started on 30 April and finished on 4 June, equating to 36 consecutive days of fieldwork with two or three observers in the field daily. This year fieldwork was again almost solely focused on Red Knots at Nanpu with much reduced visits to other sites.

The birds' use of the study site (Fig. 1) has changed since our first visit in 2007 and continues to vary each year as local conditions fluctuate and affect the suitability of different areas for the birds, particularly Red Knot, as it is a highly specialised molluscivore (Piersma *et al*. 1998, Yang *et al*. 2013). Beipu, North Beipu and Heiyanzi continued to be inaccessible as the seawall was blocked by locked gates. We only made a few visits to Hangu this year as the highest single count of Red Knot there this year was only 100. We only did two mornings resighting work at Zuidong for Great Knot.

Table 1 documents the duration of our study periods at the Luannan Coast, Bohai Bay. We started with a preliminary visit in 2007, as our understanding of the importance of the site became clear to us, we started to cover the entire

northward migration season of Red Knots, leading to the complete and continuous coverage of northward migration from 2010-2019 and 2021. The fieldwork in 2020 and 2022 was hampered by COVID-19 restrictions. Since 2023, the fieldwork period was reduced due to funding availability.

Table 1. Days of observation, total sightings of marked birds and resightings of individually recognisable colour-banded Red Knot from NWA at the Luannan Coast study site 2007-2025.

YEAR	DAYS OF OBSERVATION	TOTAL SIGHTINGS OF ALL MARKED BIRDS	COLOUR-BANDED RED KNOT FROM NWA
2007	7	49	0
2008	-	-	-
2009	19	859	76
2010	57	3133	106
2011	52	3354	170
2012	53	4496	279
2013	59	4613	269
2014	57	5014	345
2015	57	4147	387
2016	56	3554	261
2017	55	2765	265
2018	57	4116	313
2019	57	3452	336
2020	34	1169	189
2021	59	2087	208
2022	40	486	106
2023	42	1211	124
2024	35	1288	131
2025	**36**	**1389**	**132**
TOTAL	**832**	**47182**	**3697**

Table 2 below shows the totals of all marked migratory shorebirds recorded during all our fieldwork seasons and the locations they were originally marked. The birds with plain flags just indicate the original marking location and cannot be identified to an individual bird. The colour-banded birds, the engraved leg-flagged birds and some birds with unique positioning of flags on their legs can be attributed to individual birds when close views are obtained. As the team were seeing individually marked birds that were 'new' to the area late into the fieldwork period, it is not unreasonable to assume that plain-flagged birds were also still arriving while others will have moved through the site. So, while some will undoubtedly be multiple sightings, the numbers in the table are a good reflection of the numbers of flagged birds present during the study period. These records from 36 marking locations within the EAAF highlight the importance of the Luannan Coast, not only to birds from NWA, but from the entire EAAF. In recent years, we have also started to record birds marked from two areas in India which is part of the CAF.

Team scanning on the Nanpu seawall, 22 May 2025. © GFN

Table 2. Totals of resightings of marked shorebirds, of all species, by banding area, recorded during fieldwork 2010-2025.

	MARKING LOCATION	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total 2010-25	KNOWN INDIVIDUALS 2025
1.	CHUKOTKA, RUSSIA	1	32	43	50	62	38	44	22	22	50	6	16	4	14	17	26	447	6
2.	KAMCHATKA, RUSSIA	1	3	4	1	0	6	7	20	37	65	11	25	23	17	23	26	269	6
3.	SAKHALIN, RUSSIA	0	4	5	48	52	44	43	33	36	21	3	1	1	4	2	0	297	0
4.	MONGOLIA	0	0	0	0	0	0	0	0	0	0	0	5	0	1	1	3	10	1
5.	HOKKAIDO, JAPAN	1	7	10	5	9	5	8	2	0	2	0	0	0	0	0	0	49	0
6.	NORTH-EAST COAST, JAPAN	0	0	0	0	0	4	1	0	0	0	0	0	0	0	0	0	5	0
7.	TOKYO BAY, JAPAN	0	0	0	0	0	0	0	0	1	7	0	1	0	1	0	0	10	0
8.	KYUSHU, JAPAN	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	0
9.	SOUTH KOREA	0	0	0	0	8	12	5	0	5	0	0	0	0	0	0	0	30	0
10.	LIAONING YALUJIANGKOU WETLAND NATIONAL NATURE RESERVE	0	0	0	1	3	3	0	0	0	0	0	5	0	1	0	0	13	0
11.	LIAONING LIAOHEKOU NATIONAL NATURE RESERVE (SAUNDERS'S GULL)	1	9	0	1	1	7	1	5	0	0	0	0	0	0	0	0	25	0
12.	HEBEI KANGBAO KANGBANOR NATIONAL WETLAND PARK (RELICT GULL)	0	0	0	0	0	0	0	0	0	2	0	0	1	0	0	0	3	0
13.	BOHAI BAY, LUANNAN & HANGU	122	96	129	125	108	55	162	78	126	77	16	43	2	75	101	96	1429	22
14.	BOHAI BAY, SOUTH										4	0	4	0	5	2	3		1
15.	JIANGSU, DONGTAI AND RUDONG	0	0	0	0	0	0	0	1	2	8	0	7	0	3	3	4	28	1
16.	SHANGHAI CHONGMING DONGTAN NATIONAL NATURE RESERVE	321	447	565	552	679	510	518	342	437	356	98	231	25	86	156	136	5459	32
17.	ZHEJIANG, HANGZHOU BAY	0	0	0	0	0	0	0	0	0	0	4	2	0	6	8	7	27	0
18.	GUANGDONG, LEIZHOU	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0
19.	HONG KONG	5	23	19	44	39	20	20	6	18	9	4	24	10	19	16	22	298	10
20.	TAIWAN	4	0	2	3	2	4	1	0	1	7	0	6	0	1	0	1	32	1
21.	KINMEN ISLAND	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	2	0
22.	SINGAPORE	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	3	0
23.	INNER GULF OF THAILAND	31	18	34	96	153	92	125	75	113	118	47	82	1	63	58	54	1106	4
24.	PENINSULA, THAILAND	35	29	36	33	60	56	33	27	49	33	12	32	3	11	8	8	465	0
25.	PHILIPPINES	0	0	0	1	1	0	0	0	0	0	0	0	0	0	6	6	14	2
26.	JAVA, INDONESIA	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
27.	SUMATRA, INDONESIA	12	4	5	8	7	6	2	2	0	2	0	0	0	0	0	0	48	0
28.	NORTH-WEST AUSTRALIA (COLOUR-BANDS)	317	412	904	613	922	1221	671	680	1122	1095	446	535	177	329	317	283	10044	135
	NORTH-WEST AUSTRALIA (FLAGS)	912	812	1166	1053	1222	1036	964	916	1315	963	332	791	191	405	371	521	12970	165
29.	NORTHERN TERRITORY, AUSTRALIA	3	0	0	1	0	4	57	24	55	53	6	11	0	9	6	4	233	1
30.	QUEENSLAND, AUSTRALIA	7	7	8	27	12	4	14	3	1	13	1	8	0	3	2	2	112	1
31.	NEW SOUTH WALES	0	2	0	1	0	1	0	0	0	0	0	0	0	0	0	0	4	0
32.	SOUTH-WEST WESTERN AUSTRALIA	6	0	0	1	4	3	0	0	0	0	0	0	0	0	0	0	14	0
33.	SOUTH AUSTRALIA	12	35	62	73	54	31	40	20	20	26	15	12	1	9	12	9	431	2
34.	VICTORIA, AUSTRALIA	746	644	798	985	858	507	487	290	433	309	97	139	25	76	86	86	6566	23
35.	KING ISLAND, AUSTRALIA	3	2	4	0	1	5	2	4	1	0	0	1	0	0	0	0	23	0
36.	NORTH & SOUTH ISLAND, NEW ZEALAND	590	768	702	890	756	469	335	203	309	226	71	95	22	61	83	72	5652	20
37.	NORTH INDIA	0	0	0	0	0	0	5	5	5	4	0	7	0	4	5	9	44	3
38.	SOUTH INDIA	1	0	0	0	0	4	7	5	8	2	0	2	0	8	5	11	53	2
	TOTALS	**3133**	**3354**	**4496**	**4613**	**5014**	**4147**	**3554**	**2765**	**4116**	**3452**	**1169**	**2087**	**486**	**1211**	**1288**	**1389**	**46274**	**438**
	NUMBER OF SPECIES	**14**	**14**	**13**	**18**	**17**	**18**	**17**	**15**	**14**	**15**	**11**	**16**	**6**	**11**	**12**	**10**		

During the 36 days of fieldwork, we made a total 1,389 sightings of marked birds of which 438 were 'known individuals', those able to be identified from unique engraved leg flags or colour-band combinations to an individual bird (Tables 1, 2 and 3). Total sightings of all marked birds for 2025 were slightly higher than 2023 and 2024 due to the presence of more Red Knots at the Luannan Coast this year (see later section). But we do not get the total numbers of marked birds that we used to get in the peak years of 2010 to 2019. This is possibly due to some of the main research projects in the EAAF having, for some years now, been marking much smaller numbers of birds. The total number of NWA Red Knot colour-band resightings for 2025 was 272, and the number of known individuals recorded was 132.

Table 3 shows records of individually colour-banded birds marked in NWA recorded on the Luannan Coast for the years 2010 to 2025. The 135 individuals recorded this year is significantly lower than the peak years of 2010 to 2019 but very similar to 2024. This reflects the fact that very little marking of Red Knots with colour bands has been done in NWA since 2019. The totals were dominated by Red Knot, as always with 132 individuals identified, then Great Knot with two and Bar-tailed Godwit with one. Numerous Red Knots have been seen over many consecutive years with some recorded in all years from 2010 to 2025. The Bar-tailed Godwit has been seen in all years since 2010 (see Nanpu 2025 Update 2), and the bird is a minimum of 20 years old. Despite this individual being very faithful to the Luannan Coast, this area is not a major staging site for Bar-tailed Godwits.

Table 3. Totals of individually colour-banded birds from the GFN project marked in NWA resighted on the Luannan Coast 2010-2025. No marked Black-tailed Godwit from NWA have been recorded within the study site.

NWA COLOUR-BANDED INDIVIDUALS	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
BAR-TAILED GODWIT	3	2	4	3	5	6	3	4	4	3	1	5	0	3	2	**1**
GREAT KNOT	6	20	17	12	11	30	31	22	44	48	3	23	1	1	1	**2**
RED KNOT	106	170	287	272	329	387	261	269	313	336	189	208	106	124	131	**132**
TOTAL	**115**	**192**	**308**	**287**	**345**	**423**	**295**	**295**	**361**	**387**	**193**	**236**	**107**	**128**	**134**	**135**

Chris checking the Nanpu ponds, 22 May 2025. © Katherine Leung

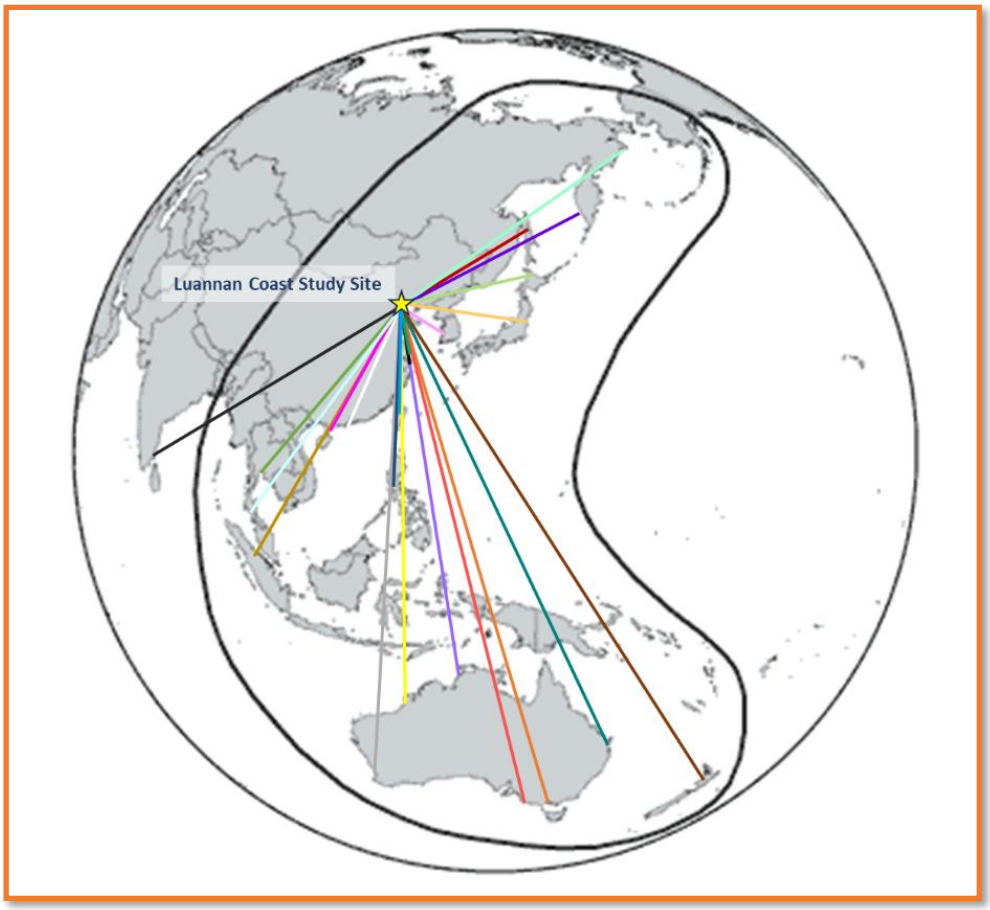


Figure 2. Between 2010 and 2025 we have recorded Red Knot from 26 different banding locations throughout the EAAF, and from India on the CAF. The map is a representation of some of these sites.

Shorebirds on Nanpu mudflats, 6 May 2025. © Katherine Leung

Internationally important counts

During the sixteen years GFN have been visiting the Luannan Coast from 2010 to 2025, we have been conducting regular counts in conjunction with BNU. The importance of this site is not in any doubt. Table 4 below shows clearly the immense importance of these mudflats and ponds to shorebirds from throughout the EAAF. All the counts should be considered absolute minimum totals for the area because there are areas of mudflats and ponds inaccessible to us and we cannot count all sites used by shorebirds simultaneously with our current resources and no turnover analysis is done: if that statistic was applied, the total number of birds assessed using the Luannan Coast during the northward migration season would be much greater (Lok *et al.* 2019). Note that there have been higher counts of some species in Table 4 prior to 2015 but with the renewed EAAF Waterbird Populations Portal (Wetlands International 2023), we have only used counts from the last ten years to more accurately reflect the current situation at the Luannan Coast. Most migratory shorebird populations in the EAAF are declining and it is no surprise that many species have also shown declines in peak numbers on the Luannan Coast.

Table 4. Internationally important counts at Luannan Coast 2015-2025.

Species	Scientific name	Date recorded	Count	% of EAAF population present	Waterbird Populations Portal*	Total for 1% Ramsar criteria^
Pied Avocet	*Recurvirostra avosetta*	26 04 2019	1,149	1.1	100,000	1,000
Grey Plover (VU)	*Pluvialis squatarola*	26 04 2019	3,220	4	80,000	800
Eurasian Curlew (NT)	*Numenius arquata*	26 04 2019	2,722	2.7	100,000	1,000
Black-tailed Godwit (NT)	*Limosa limosa*	13 04 2019	17,937	11.2	160,000	1,600
Great Knot (EN)	*Calidris tenuirostris*	08 05 2019	12,971	3.1	425,000	4,250
Red Knot (NT)	*Calidris canutus*	16 05 2018	48,630	43.8	110,000	1,100
Broad-billed Sandpiper (VU)	*Calidris falcinellus*	27 05 2015	2,460	8.2	30,000	300
Curlew Sandpiper (VU)	*Calidris ferruginea*	08 05 2016	16,568	18.4	30,000	300
Spoon-billed Sandpiper (CR)	*Calidris pygmaea*	02 06 2019	1	0.1	800	8
Red-necked Stint (NT)	*Calidris ruficollis*	08 05 2016	4,747	0.99	475,000	4,800
Sanderling	*Calidris alba*	29 05 2016	4,321	14.4	30,000	300
Dunlin (NT)	*Calidris alpina*	07 05 2017	40,000	1.6	2,460,900#	24,609
Asian Dowitcher (NT)	*Limnodromus semipalmatus*	08 05 2017	1,754	6.26	28,400	280
Spotted Redshank	*Tringa erythropus*	15 05 2016	592	2.6	25,000	250
Nordmann's Greenshank (EN)	*Tringa guttifer*	08 05 2016	7	0.7	1,200	10
Marsh Sandpiper	*Tringa stagnatilis*	27 04 2016	8,785	6.8	130,000	1,300

* - Wetlands International (2023). # - Uncertainty of distribution of all subspecies in EAAF.

^ - The 1% Ramsar criteria refers to Criterion 6 of the Ramsar Convention: A wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of waterbird.

Red Knot numbers

The focus of our studies on the Luannan Coast is Red Knot. This year the highest peak daily counts at Nanpu increased from the low numbers of 2021-2024, 2023 was the lowest of our sixteen-year study period (2010-2025). The biggest day count for 2025 was 30,000 on 21 May. There was an influx between 7 and 10 May from 10,000 to 25,000 respectively (we did not count on 8 and 9). After 5 days of very similar numbers there was a drop to 20,000, possibly a departure of *rogersi* towards the breeding grounds. Then numbers were similar for another 5 days until a boost to 27,000 on 20 May and the peak of 30,000 the following day, possibly an influx of *piersmai*. At some time on 28 May there was huge departure from Nanpu, and numbers went from 21,000 to 2,332. And then stayed around that number for the remainder of our field season until 4 June when 2,200 remained (see table in Nanpu 2025 Update 3). The flow of Red

Knots through Nanpu this year, while with higher peak numbers, was like other years.

It should be noted that these counts are from Nanpu only as some other sub-sites are inaccessible. We had a count of 100 Red Knot at Hangu on 9 May. Team size and logistics made visits to Hangu difficult. Other shorebird researchers are working there, and we did not hear of any large numbers there. From our knowledge of the study sites over the years, we know that Nanpu is usually where the largest numbers of Red Knots are seen. So, while we cannot completely rule it out, we are confident that there were not thousands of Red Knots at any of the other sub-sites this year.

Note: counting Nanpu is difficult, like most shorebird sites with large numbers. The counts were often estimates but they were done at the same stage of the tide from the same vantage point, after we considered that most Red Knot had moved from the pond roosts on to the mudflats. It was very nice to see the big numbers of Red Knot at Nanpu this year. Red Knot numbers using the Luannan Coast varies a lot from year to year. The 2018 (48,630) and 2019 (47,537) counts were our highest since 2015 (Table 5). None of the non-breeding areas of the EAAF have had dramatic changes in the numbers of Red Knots utilising them in the 2024/25 non-breeding season, to our knowledge. So, despite the dramatic changes in numbers over the past 11 years at the Luannan Coast, we do not think there is a flyway-wide crash in Red Knot numbers. For example, The Monitoring Yellow Sea Migrants in Australia (MYSMA) count programme that has been running for 21 years shows 'no significant change' in the northwest Australia Red Knot population. We believe that the migration pattern of Red Knot during northward migration changes by the year.

GFN, in a cooperative study with BNU, Princeton University and Australasian Wader Studies Group (AWSG) have attached trackers to 29 Red Knots at Roebuck Bay, NWA in late 2023 and hoped this will increase our understanding on the current migration patterns and can be compared to tracking work from previous years (Piersma *et al*. 2021, also see Tagging Report 2023). We also think the fluctuating numbers of Red Knot at Nanpu are also impacted by the local food abundance (see later section).

Table 5. Peak counts of Red Knots at Luannan Coast from 2015-2025.

2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
29,956	20,000	17,000	48,630	47,537	20,000	9,000	9,938 (BNU's data)	3,660	13,000	**30,000**

Red Knots arriving on Nanpu mudflats as it started to expose, 20 May 2025. © Katherine Leung

The presence of rogersi and piersmai Red Knot subspecies

A 'typical' *piersmai* (left) and 'typical *rogersi* (right). © Adrian Boyle

The subspecies *piersmai* and *rogersi* Red Knot both use the Luannan Coast as a staging site. We get fabulous data each year on the individually marked birds enabling sophisticated analyses and estimates of turnover rate and site use (Lok *et al*. 2019). The majority of the two subspecies of Red Knot using the EAAF can be distinguished, when in fresh, full or near-full breeding plumage by the colour and pattern of that breeding plumage (Tomkovich 2001, Hassell *et al.* 2011, Verhoeven *et al*. 2016). This is particularly noticeable when the two subspecies are side by side as is usually the case in our study site.

The *rogersi* birds, predominately from south-east Australia and New Zealand non-breeding grounds, generally arrive first and leave for their eastern Siberian breeding grounds earlier than the *piersmai* birds. The *piersmai* birds, predominately from NW Australia non-breeding grounds, breed in more northerly latitudes on the New Siberian Islands.

In relation to Red Knot marked in Roebuck Bay and Eighty Mile Beach, NWA, for both the total number of resightings and the individuals that those sightings represent, it needs to be considered that approximately 20% of Red Knots marked in NWA may be the *rogersi* subspecies. These *rogersi* birds may or may not move to New Zealand after marking in NWA and then use New Zealand as their permanent non-breeding area. From New Zealand they may migrate to the Luannan Coast under different schedules than *rogersi* that use NWA as their non-breeding location. Interestingly both *rogersi* and *piersmai* depart NWA at the same time (late April) despite the difference in breeding locations (Verhoeven *et al*. 2016). The breeding grounds of *rogersi* in Chukotka become snow free from about mid-May while the New Siberian breeding grounds of *piersmai* are not snow free until early-June.

In our experience it appeared that birds which arrive at the Luannan Coast early in the season, before 1 May, are predominantly *rogersi* and stay for up to a month. Birds that arrive late in the season, mid-May onwards, are predominantly *piersmai* that only stay for a short time, in some cases, a week or less. This was confirmed by a sophisticated statistical analysis showing the *piersmai* subspecies stay for 5-9 days at the Luannan Coast (Lok *et al.* 2019).

To evaluate the proportions of the two subspecies we conduct regular, random scans of flocks and assign a subspecies to each individual bird based on plumage characteristics. This year we assessed 29,545 Red Knot and assigned a subspeies to them. The number of flocks and birds scanned have been similar over the years, except during the outbreak of COVID-19, no scans were carried out in 2020 and 2022 (Table 6).

Figure 3 shows the 'flow' of the *rogersi* and *piersmai* subspecies through the Luannan Coast over the northward migration period. In the years 2010-2019, this graph was almost identical year on

year, with *rogersi* arrived and left earlier, *piersmai* later. Here we use 2019 to show a 'typical' year (Figure 3a). This year's 'flow' (Figure 3b) was similar to those 'typical' years in that the *piersmai* percentage increased steadily over the course of May but without hitting the very high ratio in favour of *piersmai*. This suggests that either *piersmai* are not using Luannan in the numbers they have in previous years or that *rogersi* are delaying their departure to the breeding grounds. It is difficult to be certain.

Both years 2023 and 2024 were very different from the 'typical' years. The percentage of *piersmai* birds gradually built up from 20% at the end of April until reaching 60% in mid-May, but then dropped back to 40-50% in the 2nd half of May (see Reports 2023, 2024).

Table 6. Number of Red Knot flocks and birds scanned for subspecies at Luannan Coast 2015-2025.

YEAR	Number of scans	Number of Red Knots assessed
2015	225	39,925
2016	221	38,364
2017	218	38,866
2018	231	39,164
2019	257	52,186
2020	0	0
2021	212	34,184
2022	0	0
2023	176	39,830
2024	140	31.423
2025	**150**	**29,545**

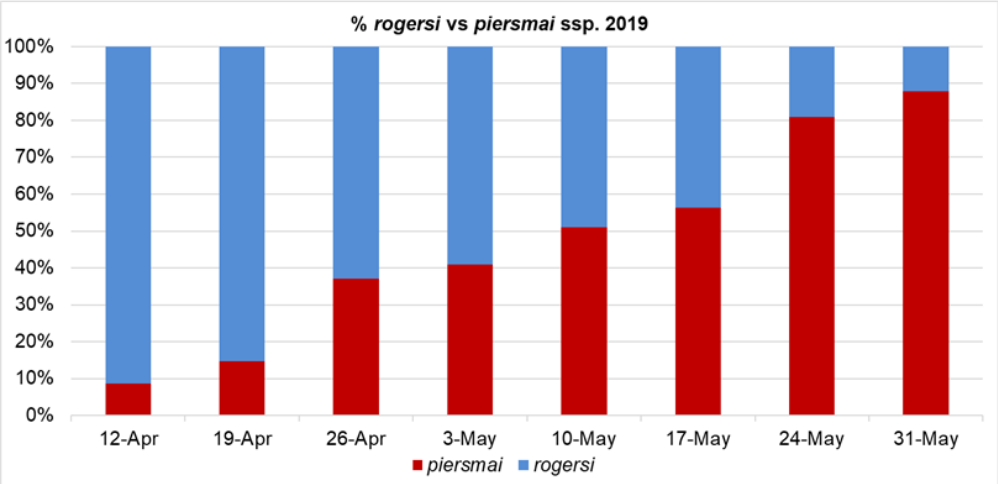


Figure 3a. Percentage *rogersi* vs *piersmai* subspecies over time 2019.

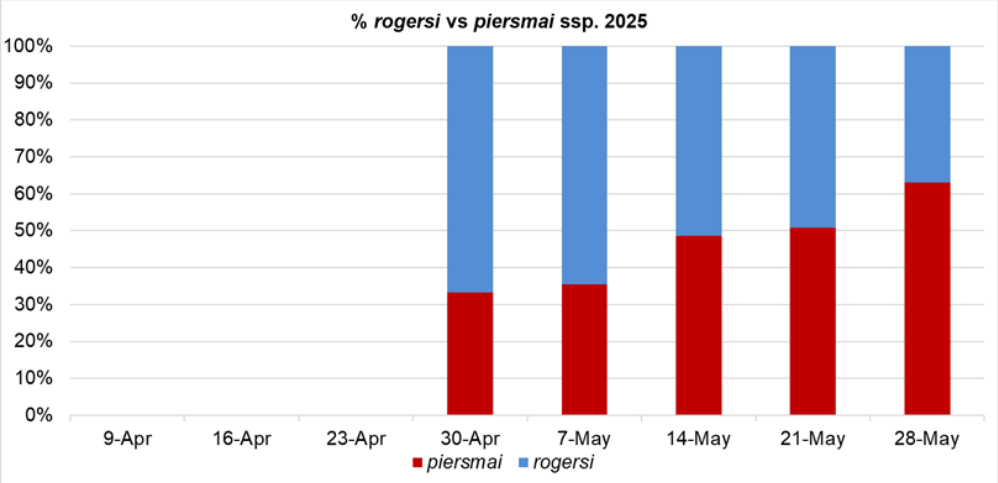


Figure 3b. Percentage *rogersi* vs *piersmai* subspecies over time 2025.

Red Knot abdominal profiles and *Potamocorbula laevis* density

As we are not catching Red Knots at the Luannan Coast, there is an absence of year-to-year body mass data (but see Hua *et al*. 2013 for data on the early years of study), however it is possible to score the abdominal profile (AP) of birds visually in the field from telescope observations (Wiersma & Piersma 1995). This is a low-effort alternative way to assess the fat stores and weight gain of birds. We record abdominal profile on all flagged and colour-banded Red Knot when we get a suitable view. A side-on view of the bird is needed for an accurate assessment. The scores range from AP 1- very thin to AP 5 - obese. A bird scored as 1 looks unhealthy and a bird scored at 5 is very fat.

Both subspecies and most individuals are arriving at our Luannan Coast study site in good body condition, whilst no birds are arriving in very poor condition (AP 1). This likely means that they are staging somewhere between their Australian, New Zealand and SE Asian non-breeding sites and the Luannan Coast. Colour-band and flag resightings show this and it is further supported from geolocator and satellite tracking data confirming birds stop at many sites south of the Luannan Coast including north-east Borneo, southern and eastern China coast (GFN, AWSG unpublished data, Piersma *et al*. 2021).

The results in 2010-2019 have been very similar with both subspecies' abdominal profile score increasing gradually throughout the season. Since 2020, there are some changes to the results such as early appearance of AP 5 birds in 2020 and 2021, whereas in 2023 both subspecies did only reach AP 4 rather than AP 5 at the end of the season. These changes coincide with changes in density of *Potamocorbula laevis* in the Nanpu mudflats.

Red Knot (*rogersi* ssp.) in AP 5, with engraved yellow leg flag VZ marked in NW Australia, 16 May 2025.
© Katherine Leung

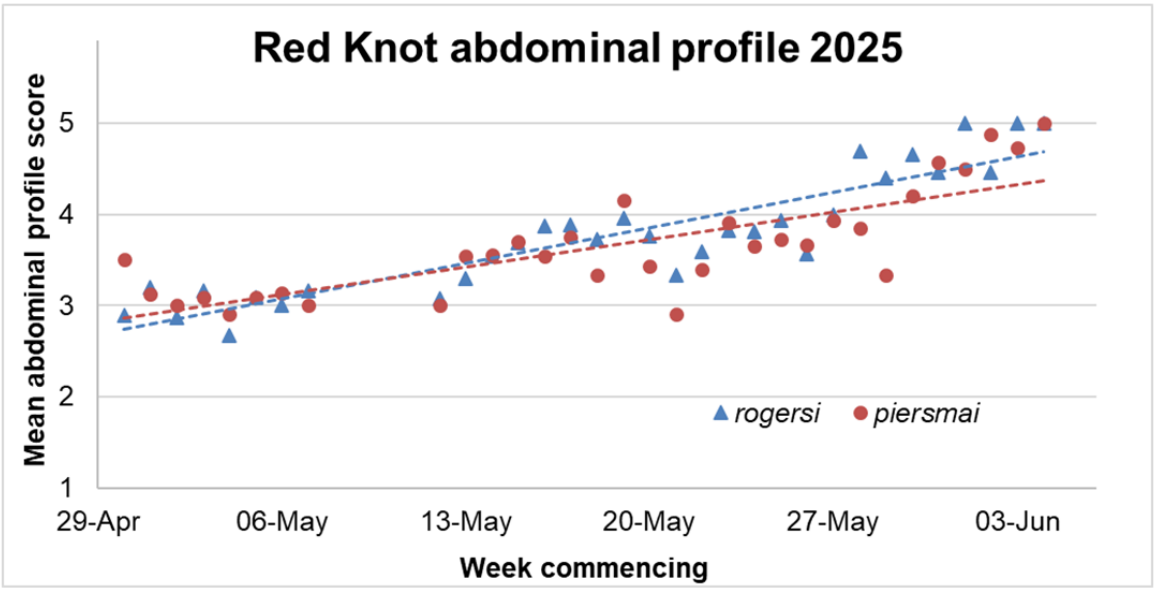


Figure 4. The graph shows the change in abdominal profile, over time, for the two subspecies of Red Knot in 2025 using 955 records.

P. laevis is the key food for Red Knot at the Luannan Coast (Yang *et al.* 2013). Understanding the availability of food for Red Knots would help to interpret variations in the changes in AP scores of Red Knot using the Luannan Coast from year to year. Our colleague Dr Hebo Peng conducted benthic sampling on mudflats along the China coast to monitor the variation of shorebirds' food (Peng *et al.* 2021, also "The 2024 shorebird survey in China: a myriad of threats"). His team visited the Luannan Coast twice to survey the macrobenthos in both early and late May. From 2010-2019, *P. laevis* showed stable levels at a high density, which provided abundant, high-quality food for Red Knots and other shorebirds. Results show that *P. laevis* densities declined at the Luannan Coast in 2020-2023, that directly correlated with the changes in AP scores results and, the low Red Knot numbers in those years.

P. laevis on a Chinse one yuan coin. © Zhang Wei

In 2024, and again in 2025, the density of *P. laevis* recovered from the low densities in the previous 4 years (Dr Hebo Peng *pers. comm.*). Abdominal profile score assessed on 955 Red Knot individuals shows that both subspecies gradually fattened up throughout the fieldwork season, both subspecies appeared to be able to feed effectively enough to gain suitable condition for the next leg of their migration to the breeding grounds at the end of the season.

The northward migration strategy is one piece of the Red Knot life-cycle question that we are still attempting to answer more fully (Piersma *et al.* 2021). We are not clear yet how the numbers, density and availability of food at a particular site is affecting Red Knot distribution along the Chinese coast, particularly the Yellow Sea coast, during northward migration. The intriguing question to us is, how do the Red Knots know and 'decide' if there is enough food for the numbers of birds present to allow them, as an individual, to gain enough weight for successful migration? And then logically they would need to decide to either stay at a particular site or to move on to ensure the necessary weight gain? Birds are not the 'auto-pilot' machines they have been considered to be. They must make decisions throughout the year and some of these are critical to get correct. Continuation of the benthic sampling fieldwork along the Chinese coast and our fieldwork at the Luannan Coast, together with analysis of migration tracking data should eventually give us more insights.

Breeding shorebirds and terns

Black-winged Stilt nest in Nanpu ponds, 22 May 2025.
© Katherine Leung

In addition to the migratory shorebirds and terns passing through the Luannan Coast, there are eleven species we have recorded breeding within the study site from 2010 to 2025: Black-winged Stilt *Himantopus himantopus*, Pied Avocet, Eurasian Oystercatcher *Haematopus ostralegus*, Little Ringed Plover *Thinornis dubius*, Grey-headed Lapwing *Vanellus cinereus*, Kentish Plover *Anarhynchus dealbatus*, Common Redshank *Tringa totanus*, Little Tern *Sternula albifrons*, Gull-billed Tern *Gelochelidon nilotica*, Whiskered Tern

Chlidonias niger and Common Tern *Sterna hirundo*.

Pied Avocet is the most common species we recorded and is the focus of continued study by Professor Zhengwang Zhang at College of Life Sciences at BNU (see Lei *et al*. 2018, Lei *et al*. 2021b). Pied Avocets nest on the bare banks of ponds, on open areas of dry mud in unused or recently reclaimed ponds and on small islands within the ponds. Many of these banks are impossible to access so an accurate estimation of the total nesting population is difficult but there are between 1,000 and 2,000 pairs in the Luannan pond complex (Weipan Lei *pers. comm.*). In recent years they have had less breeding habitat available and lower breeding success due to deep or unstable water levels in the ponds. Sudden rises in water level by severe weather or for the purpose of pond management often lead to direct loss of eggs or chicks. Feral animals also pose threats to the breeding shorebirds and terns. We have observed feral dogs chasing and eventually catching an adult Pied Avocet in the past. Feral cats were found by camera trap to consume eggs in nests (Yang Wu *pers. comm.*).

Black-winged Stilt, Kentish Plover, Common Tern and Little Tern breed in the same locations as Pied Avocet, all were recorded breeding in 2025 and presumably face similar threats to those of the Pied Avocet.

Common Tern nest and fledging in Nanpu ponds, 4 June 2025. © Katherine Leung

Wetland Park

The Hebei Luannan Nanpu Zuidong Provincial Wetland Park (the Wetland Park) established on 26 October 2020 covers an area of 5,791.6 ha, including nearly 3,000 ha of shallow sea habitat and 2,177 ha of intertidal mudflat along the whole 8 km shore of Nanpu, plus 690 ha of salt and aquaculture ponds behind the Nanpu seawall at the north-west corner near Beipu. The decision to protect the area as a wetland park allows both the biodiversity and, importantly, the income of the local communities to be safeguarded.

We fully support the establishment and first steps in the development of the Wetland Park. In June 2021, a workshop was held in Luannan with all the major stakeholders to share their view of the future management for the Wetland Park. Back then we saw lots of potential for the Wetland Park management to be a success and a model example of a win-win situation for both biodiversity conservation and sustainable income for the local communities.

However, despite our full support, we would like to highlight some areas where management actions would likely lead to better outcomes for the park's goals. These are based on our 18 years of study at Nanpu, and they are standard practice in many nature reserves and wetland parks around the world. We do not intend these suggestions as criticism, we hope they are seen as constructive suggestions. No new nature reserve or wetland park immediately meets all the outcomes expected or hoped for. It can take years for the habitat management actions to bring about the desired outcomes.

Where the park is situated and due to the fantastic ornithological significance of the area, four major priorities for biodiversity seem logical (1) to keep available intertidal habitats in good condition and (2) to enhance the pond habitats to make it even

more suitable for migratory shorebirds. This is also true for (3) breeding shorebirds during spring and summer and (4) of course the Wetland Park should be a haven for waterfowl and gulls in winter. These can all be carried out without compromising the current use of the mudflats and ponds by local communities.

The Wetland Park Exhibition Center, 24 May 2025. © Katherine Leung

Management Recommendations for the Wetland Park

Intertidal habitats: community use and its conservation

Mollusc aquaculture is carried out at both Zuidong and Nanpu mudflats by the local fishing communities of Nanpu and Beipu villages. Locals mentioned that summer harvesting (July to August) of *P. laevis* could be beneficial to their harvest in the following year. This theory has been argued by Yang *et al*. (2016) that the very intense fishing practices for *P. laevis* in the late-summer may even benefit shorebirds staging in the spring because it would allow an increase in the settlement of new recruits in the subsequent spring. Our colleague Dr Hebo Peng's work demonstrate that careful management of the mollusc aquaculture is needed to secure the food for the staging Red Knots (Peng *et al*. in press.). With the establishment of the Wetland Park, there is potential to explore regulated aquaculture and harvesting of *P. laevis* on the Nanpu mudflats, which might maximise the benefit to both shorebirds, especially Red Knot, and local communities.

At the Zuidong mudflats, the main mollusc harvested is *Mactra veneriformis*. Zuidong mudflats is the main foraging area of Great Knot on the Luannan Coast and is currently not protected within the Wetland Park. Consider the integrity of the intertidal habitats of the Luannan Coast, the Zuidong mudflats should be included as a protected area in future.

Mudflats of the Luannan Coast is vital for both shorebirds and the local economy, 4 May 2025. © Katherine Leung

Intertidal habitats: control of invasive Spartina

Smooth Cordgrass *Spartina alterniflora* is a highly invasive, non-native species and has caused huge problems in important shorebird sites in the Yellow Sea. In the past years, this invasive plant has established on the mudflats adjacent to the seawall at Zuidong and Nanpu. In 2018 and 2019, it was very pleasing to see that the issue was addressed at Nanpu in a project led by WWF-China with a spraying program to control the spread of the Spartina, following the success at Shanghai Chongming Dongtan National Nature Reserve. The spraying programme was very successful with only small green spouts of new growth observed during the 2020 field season. A similar spraying project was also initiated by the Paulson Institute at Zuidong mudflats in 2019.

During the winter 2020/21, an ecological restoration project was carried out by the Luannan County Government, which involves the removal of Spartina by cutting and digging the plants up to a depth of 40 cm over a total area of 18.3 ha at the Nanpu and Zuidong mudflats. We are uncertain whether such mechanical digging would cause any impact on the mudflat habitat, but a digger would bring greater and longer disturbance to birds when comparing to using drones to spray and treat the Spartina. Nevertheless, it is good to see the Luannan County Government's good intention in addressing the issue.

In early 2023, the Chinese Central Government has set a target to eliminate at least 90% of the invasive Spartina along China coast by 2025. Efforts over the past few years have been a great success in the control of Spartina with almost zero regrowth observed at both sites.

In this field season we observed small patches of Spartina regrowth on the Nanpu mudflats. Given the Spartina are in small patches, it would require minimal effort for a couple of workers with backpack sprayers to treat them with herbicide at a falling tide. We suggest that these should be treated as soon as possible before they further expand, which will increase the resources required for effective treatment.

According to this report, Prof. Zhang has contacted the local officials in Hebei Province, and they have agreed to take measures to remove the Spartina on the Wetland Park mudflats this year.

Regrowth of Spartina on the Nanpu mudflats, 3 June 2025. © Katherine Leung

Pond habitats: low islands and shallow water habitats for shorebirds

The ponds adjacent to the Luannan Coast are used for the production of salt (evaporation, storage and crystallization ponds), fish and shrimp for human consumption, brine shrimp (*Artemia*) that are fed to larger species of *Litopenaeus* shrimp to fatten them for harvest and sale for human consumption. Harvesting of brine shrimp are either carried out manually or with mechanical boats dragging a fine net in the water column. Brine shrimp cysts (dormant eggs) are also collected at the edge of the pond with hand net. They can be stored for long periods and hatched, on demand, to provide a convenient form of live feed for larval fish and are the most sought after of the Artemia products. The brine shrimp cysts in the shallow waters of the ponds are important food source for Red Knots and many other shorebirds. In recent years, most ponds in Nanpu had become deeper due to increased management for aquaculture and the availability of brine shrimp cysts for shorebirds, had diminished almost completely.

In October 2022, a hundreds-million yuan 'wetland restoration' project commenced at the Wetland Park to 'restore' some of the ponds near Beipu. During our 2023 fieldwork season we saw shorebirds feeding on the intertidal mudflats frequently disturbed by large trucks running along the seawall to transport earth into a few ponds for building high and steep-sided artificial islands. If large earthworks need to be conducted, they should be done outside of the times of major use of the area by the huge numbers of migratory shorebirds (spring and autumn).

The islands that were built do not benefit shorebirds or encourage them to use the pond habitats. In addition to the unsuitable steep sides, in 2024 we saw hundreds of tree seedlings were planted on these islands. We did record Black-winged Stilt, Pied Avocet, Eurasian Oystercatcher, Kentish Plover, Little Tern and Common Tern breeding in the 'restored' ponds, all these species breed in other ponds around Nanpu and birds breeding in the 'restored' ponds could be despite of, not because of, the changes. We observed that these birds only nested on the limited bare and flat

A salt pond with shallow water provides roosting and feeding habitat for shorebirds, 21 May 2025. © Katherine Leung

parts of the islands or bare bunds in these restored ponds indicating that the rest of the vegetated areas are not suitable for them. This year the numbers of birds breeding on those islands had decreased. The trees were slightly larger and the tangled vegetation on the islands was thicker, reducing the already limited bare patches of ground where birds nested in 2024. This is a very disappointing outcome.

The ponds previously had shallow water with low, sloping perimeter and internal bunds. These bunds do not require massive modification to provide roosting, feeding and breeding habitat for birds. It is with regret that we feel an opportunity has been missed to enhance the site, particularly in respect to its suitability for roosting shorebirds and breeding shorebirds and terns. However, as stated no managed area is perfect immediately.

We suggest that low islands with sparse vegetation surrounded by shallow water for the migration and breeding seasons would be preferable. Then the water level can be raised in the ponds in preparation for winter. This will be good for gulls and waterfowl and 'drown' the vegetation on the islands making it suitable once again the following spring for breeding and roosting birds with a corresponding lowering of the water level. This is standard management practice in wetlands managed for conservation around the world and would work at the Nanpu ponds (Lei *et al*. 2025).

'Restored' island in the Wetland Park with limited bare and flat parts for shorebirds, 20 May 2024. © Katherine Leung

A 'typical' island with roosting and feeding shorebirds in a pond at Luannan Coast, 3 June 2025. © Katherine Leung

Landscape and visitor facilities

Before the start of our field season in 2021, a line of *Tamarix* sp. tree seedlings was planted on the first 1.8 km section of the south-east end of the Nanpu seawall. During the 2024 fieldwork season as part of the 'wetland restoration' project, the Wetland Park continued to plant trees on both sides of the seawall for the remaining 5.3 km. It is obvious that the tree planting is to enhance the 'beauty' of the site. We have some sympathy for this approach to make the area attractive to human visitors, but it certainly will not improve the site for shorebird use. It is broadly accepted that shorebirds do not like tall trees close to them when they are feeding or roosting as it restricts their view of approaching danger, mainly birds of prey (Rogers *et al*. 2006). So, it remains to be seen if this tree planting will be detrimental to the bird's ability to forage close to the seawall, a very valuable portion of the mudflat to them as the importance of the upper tidal area is very likely a joint effect of longer exposure and higher food density (Mu *et al*. 2022). However, there is nuance in this. Currently the first section of trees that were planted are now at a height that shields trucks and people from the birds without being so tall that birds are nervous close to the trees therefore seemingly alleviating disturbance. If the trees grow tall then this may change.

Over the past years we have also seen some other management that could be detrimental to shorebird use of the area including a completely unnecessary viewing platform built. Great views of the birds can be obtained from the path along the seawall and the platform does not get people any closer to the birds. The only outcome from people climbing on to the platform will be disturbing the birds. When the birds first return from the salt pond roosts, they land close to the wall, start to feed, sometimes bathe, and sleep, people high on a platform will only disturb birds. We suggest changing the platform to a birdwatching hide in a more suitable place.

A series of educational signs and a visitor centre have been constructed over the past couple of years. We are very impressed with the centre. We found the exhibitions very informative and attractively presented. These facilities have great potential to educate local communities, school kids, and the public about the importance of the Luannan Coast and its biodiversity. However, somewhat confusingly the centre is not open to the public and this is a huge opportunity missed for education. We hope the Wetland Park Centre will open for public visitors as soon as possible.

Tamarix seedlings planted on the Nanpu seawall, 14 May 2025. © Katherine Leung

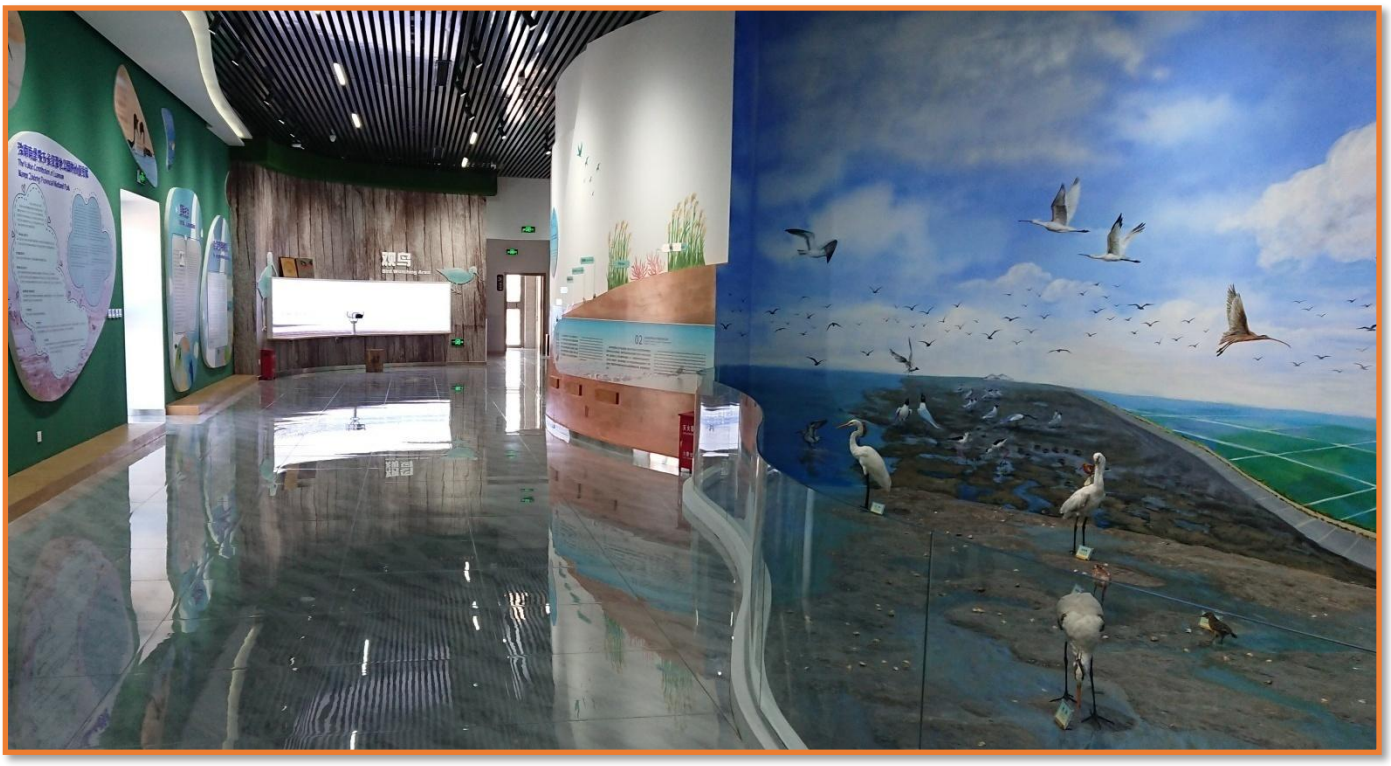
Potential threat

The Luannan Coast is very important for oil production and China National Petroleum Corporation (CNPC) operate there and have done so for many years. Generally, this industry does not cause too much of a conservation threat to the migratory bird populations. There is the loss of some habitat for drill rigs and infrastructure, but much of the exploration and infrastructure is offshore and away from the mudflats. However, due to the presence of oil production in the area, the World Heritage listing China – Migratory Bird Sanctuaries along the Coast of Yellow Sea-Bohai Gulf of China (Phase II) has not been supported to include Luannan Napu Zuidong Wetland Park by the IUCN.

Some serious risks are associated with large scale oil production. An oil spill would be serious for the Luannan Coast mudflats, the associated benthos and birds. If that oil spill were to coincide with the spring migration season, the effects on migratory populations could be catastrophic. If an accident were to occur outside of peak bird use of the area it would still be a very serious as the benthos would be affected and diminish the areas biodiversity, suitability for shorebirds and shellfish harvest for the local people.

Conclusion on management recommendations for the Wetland Park

It goes without saying that GFN is supportive of the protection of the Luannan Coast as a Wetland Park. However, there are clearly areas for improvement in the management strategies particularly to enhance the area for shorebirds. Proper strategic conservation management with careful planning and engagement with shorebird experts from BNU is vital to enhance the status of this critical site. It is hoped that better communication can be set up between decision makers and scientists so that subsequent conservation management of the Wetland Park will ultimately enable the Red Knot and many other waterbird species of the EAAF to maintain sustainable population levels, as well as serving the local communities for sustainable economy and raising conservation awareness with visitors from the local community and elsewhere.



Exhibition of the birds at Luannan Coast in the visitor centre, 20 May 2024. © Katherine Leung

Recommendations

- **Support, or help raise support, of Universities and Global Flyway Network to continue conducting field research including follow-up analyses and publication utilising the huge set of already recorded data and curated in the GFN database. This will help to document the futures of four shorebird species (Bar- and Black-tailed Godwit and Red and Great Knot) at their non-breeding sites in NWA and throughout the EAAF, with an emphasis on the Luannan Coast, Bohai Bay. We hope that our data set will be able to assess the effects of human-induced habitat change on survival rates of the populations and a variety of demographic parameters.**

- **The safe-guarding of the remaining mudflats at Zuidong, Nanpu, Beipu and Hangu, and their benign ecological offerings to shorebirds, remains of great conservation importance. Retaining these mudflats in good ecological condition will enable the huge numbers of migratory shorebirds and terns to continue using the area as a staging site.**

- **Following the establishment of the Hebei Luannan Nanpu Zuidong Provincial Wetland Park, explore the possibilities for the sustainable harvesting of shellfish on the mudflat, which could maximise the benefit to both local communities and shorebirds for foraging and breeding during spring and summer and the potential for over-wintering waterfowl and gulls.**

- **Establish strategic conservation management of the Wetland Park and consistent communication between decision makers and scientists.**

Scenery of sunset and shorebirds on the mudflats at the Wetland Park, 27 May 2025. © Katherine Leung

Key points from 2025

- **It is clear from our current knowledge that the Luannan Coast is an important staging site of international significance for two subspecies of Red Knot in the EAAF encompassing the vast majority of Red Knots wintering in Australia, New Zealand and South-east Asia. Between 2010 and 2025, we have recorded Red Knot from 26 different banding locations throughout the EAAF, plus India in the CAF.**
- **We recorded 1,389 marked shorebirds of 10 species from throughout the EAAF, as well as from India, within the CAF, highlighting the importance of the Luannan Coast for these two flyways.**
- **This year, 135 birds were individually recognisable from the GFN colour-banding project in northwest Australia (NWA), dominated by Red Knot with 132 individuals identified.**
- **In the period 2015-2019, fourteen species of migratory shorebirds have been recorded in internationally significant numbers, including four species with an absolute minimum of 10% of their entire EAAF population passing through the Luannan Coast during northward migration.**
- **In addition, there are eleven species of shorebirds and terns we have recorded breeding within the study site from 2010 to 2025.**
- **On the Luannan Coast in 2025, the highest peak daily count of Red Knot was 30,000 on 21 May at Nanpu. The number has increased from the low numbers of 2021-2024. The count this year is equivalent to 27.3% of the EAAF Red Knot population. Densities of the Red Knot's preferred bivalve prey *Potamocorbula laevis* also showed considerable recovery from the decline in the past few years.**
- **Both the mudflats and the adjacent ponds of the Luannan Coast are vital components of the area for shorebird conservation, and an important contributing factor to the local economy and jobs.**
- **Since 2016, the water levels in most ponds have gradually become deeper, Red Knots did very little feeding there. The loss of shallow ponds is depriving shorebirds of foraging opportunities.**

Chris scanning at Nanpu seawall, 4 May 2025. © Katherine Leung

Non-shorebird migration

Although the migratory shorebirds were the focus of our work, whenever there was an opportunity, we were looking for anything with wings. The passerine migration through the area is marked by high species diversity despite the paucity of any substantial wooded habitat.

Yellow-breasted Bunting on Nanpu seawall, 17 May 2025. © Katherine Leung

Fledging of Long-eared Owl at Caofei Lake, 10 May 2025. © Katherine Leung

Appendix 1 has a complete list of all the 184 birds seen during the fieldwork period.

Acknowledgements

Yang Liu is now an integral part of our team, much more than a local driver. His reliable scanning work, safe and secure driving, every conceivable logistical help and his great company means that now the project would struggle without him, we convey huge thanks to him.

Junfeng Liu was working with our colleague Dr Hebo Peng this season but is still our best local ambassador for the birds and mudflats of Luannan.

We thank Dr Weipan Lei for the administrative work to enable our presence at Nanpu. Prof. Zhengwang Zhang and Beijing Normal University for continued support and invitations to conduct research together.

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Collaborative partners

- Australasian Wader Studies Group (AWSG), Australia
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- Broome Bird Observatory, Broome, Australia
- Broome Community Volunteers, Broome, Australia
- CEAAF Center for East Asian-Australasian Flyway Studies, Beijing Forestry University, Beijing, China
- Conservation Ecology Group, Groningen Institute for Evolutionary Life Sciences, University of Groningen, Leeuwarden, The Netherlands
- Ministry of Education Key Laboratory for Biodiversity Sciences and Ecological Engineering, College of Life Sciences, Beijing Normal University, Beijing, China
- Ministry of Education Key Laboratory for Biodiversity Science and Ecological Engineering, National Observation and Research Station for Wetland Ecosystems of the Yangtze Estuary, Fudan University, Shanghai, China
- NIOZ Royal Netherlands Institute for Sea Research, Department of Coastal Systems, Texel, The Netherlands
- Princeton School of Public and International Affairs, Princeton University, New Jersey, USA
- Wetlands International's Flyway Bottleneck Yellow Sea Project
- WWF China, Shanghai/Beijing, China
- WWF Netherlands, Zeist, The Netherlands

More information of GFN, see https://www.globalflywaynetwork.org/.

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Red Knots flying over Nanpu ponds, 4 June 2025. © Katherine Leung

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Red Knots feeding on Nanpu mudflats, 4 May 2025. © Katherine Leung

Appendix 1. Bird list

The full list of the 184 species recorded 30 April to 4 June 2025.

Greylag Goose *Anser anser*
Common Shelduck *Tadorna tadorna*
Gadwall *Mareca strepera*
Eurasian Wigeon *Mareca penelope*
Eastern Spot-billed Duck *Anas zonorhyncha*
Mallard *Anas platyrhynchos*
Tufted Duck *Aythya fuligula*
Common Goldeneye *Bucephala clangula*
Red-breasted Merganser *Mergus serrator*
Common Pheasant *Phasianus colchicus*
Japanese Quail *Coturnix japonica*
Rock Dove *Columba livia*
Oriental Turtle Dove *Streptopelia orientalis*
Eurasian Collared Dove *Streptopelia decaocto*
Spotted Dove *Spilopelia chinensis*
Large Hawk-Cuckoo *Hierococcyx sparverioides*
Indian Cuckoo *Cuculus micropterus*
Common Cuckoo *Cuculus canorus*
Oriental Cuckoo *Cuculus optatus*
Common Swift *Apus apus*
Pacific Swift *Apus pacificus*
Common Moorhen *Gallinula chloropus*
Eurasian Coot *Fulica atra*
Black-winged Stilt *Himantopus himantopus*
Pied Avocet *Recurvirostra avosetta*
Eurasian Oystercatcher *Haematopus ostralegus*
Grey Plover *Pluvialis squatarola*
Pacific Golden Plover *Pluvialis fulva*
Little Ringed Plover *Thinornis dubius*
Grey-headed Lapwing *Vanellus cinereus*
Siberian Sand Plover *Anarhynchus mongolus*
Greater Sand Plover *Anarhynchus leschenaultii*
Kentish Plover *Anarhynchus alexandrinus*
Eurasian Whimbrel *Numenius phaeopus*
Far Eastern Curlew *Numenius madagascariensis*
Eurasian Curlew *Numenius arquata*
Bar-tailed Godwit *Limosa lapponica*
Black-tailed Godwit *Limosa limosa*
Asian Dowitcher *Limnodromus semipalmatus*
Swinhoe's/Pin-tailed Snipe *Gallinago megala/stenura*
Common Snipe *Gallinago gallinago*
Red-necked Phalarope *Phalaropus lobatus*
Terek Sandpiper *Xenus cinereus*
Common Sandpiper *Actitis hypoleucos*
Green Sandpiper *Tringa ochropus*
Grey-tailed Tattler *Tringa brevipes*
Marsh Sandpiper *Tringa stagnatilis*
Wood Sandpiper *Tringa glareola*
Common Redshank *Tringa totanus*
Nordmann's Greenshank *Tringa guttifer*
Spotted Redshank *Tringa erythropus*
Common Greenshank *Tringa nebularia*
Ruddy Turnstone *Arenaria interpres*
Great Knot *Calidris tenuirostris*
Red Knot *Calidris canutus*
Ruff *Calidris pugnax*
Broad-billed Sandpiper *Calidris falcinellus*
Sharp-tailed Sandpiper *Calidris acuminata*
Curlew Sandpiper *Calidris ferruginea*
Long-toed Stint *Calidris subminuta*
Red-necked Stint *Calidris ruficollis*
Sanderling *Calidris alba*
Dunlin *Calidris alpina*
Little Stint *Calidris minuta*
Oriental Pratincole *Glareola maldivarum*
Saunders's Gull *Saundersilarus saundersi*
Black-headed Gull *Chroicocephalus ridibundus*
Relict Gull *Ichthyaetus relictus*
Black-tailed Gull *Larus crassirostris*
Mongolian Gull *Larus mongolicus*
Lesser Black-backed Gull *Larus fuscus*
Little Tern *Sternula albifrons*
Gull-billed Tern *Gelochelidon nilotica*
Caspian Tern *Hydroprogne caspia*
Whiskered Tern *Chlidonias hybrida*
White-winged Tern *Chlidonias leucopterus*
Common Tern *Sterna hirundo*
Little Grebe *Tachybaptus ruficollis*
Great Crested Grebe *Podiceps cristatus*
Oriental Stork *Ciconia boyciana*
Great Cormorant *Phalacrocorax carbo*
Eurasian Spoonbill *Platalea leucorodia*
Black-faced Spoonbill *Platalea minor*
Black-crowned Night Heron *Nycticorax nycticorax*
Chinese Egret *Egretta eulophotes*
Little Egret *Egretta garzetta*
Striated Heron *Butorides striata*
Chinese Pond Heron *Ardeola bacchus*


Left: Sanderling at Nanpu salt pond, 24 May 2025. Right: Little Grebe family at Nanpu Salt Culture Park, 27 May 2025.

Eastern Cattle Egret *Ardea coromanda*
Great Egret *Ardea alba*
Grey Heron *Ardea cinerea*
Purple Heron *Ardea purpurea*
Osprey *Pandion haliaetus*
Chinese Sparrowhawk *Tachyspiza soloensis*
Eastern Marsh Harrier *Circus spilonotus*
Pied Harrier *Circus melanoleucos*
Grey-faced Buzzard *Butastur indicus*
Eastern Buzzard *Buteo japonicus*
Little Owl *Athene noctua*
Long-eared Owl *Asio otus*
Eurasian Hoopoe *Upupa epops*
Common Kingfisher *Alcedo atthis*
Eurasian Wryneck *Jynx torquilla*
Rufous-bellied Woodpecker *Dendrocopos hyperythrus*
Great Spotted Woodpecker *Dendrocopos major*
Common Kestrel *Falco tinnunculus*
Amur Falcon *Falco amurensis*
Eurasian Hobby *Falco subbuteo*
Peregrine Falcon *Falco peregrinus*
Black-winged Cuckooshrike *Lalage melaschistos*
Black-naped Oriole *Oriolus chinensis*
Black Drongo *Dicrurus macrocercus*
Hair-crested Drongo *Dicrurus hottentottus*
Brown Shrike *Lanius cristatus*
Long-tailed Shrike *Lanius schach*
Azure-winged Magpie *Cyanopica cyanus*
Oriental Magpie *Pica serica*
Daurian Jackdaw *Coloeus dauuricus*
Coal Tit *Periparus ater*
Yellow-bellied Tit *Periparus venustulus*
Chinese Penduline Tit *Remiz consobrinus*
Eurasian Skylark *Alauda arvensis*
Asian Short-toed Lark *Alaudala cheleensis*
Zitting Cisticola *Cisticola juncidis*
Thick-billed Warbler *Arundinax aedon*
Black-browed Reed Warbler *Acrocephalus bistrigiceps*
Oriental Reed Warbler *Acrocephalus orientalis*
Lanceolated Warbler *Locustella lanceolata*
Sand Martin *Riparia riparia*
Barn Swallow *Hirundo rustica*
Eastern Red-rumped Swallow *Cecropis daurica*
Light-vented Bulbul *Pycnonotus sinensis*
Yellow-browed Warbler *Phylloscopus inornatus*
Hume's Leaf Warbler *Phylloscopus humei*
Pallas's Leaf Warbler *Phylloscopus proregulus*
Radde's Warbler *Phylloscopus schwarzi*
Dusky Warbler *Phylloscopus fuscatus*
Eastern Crowned Warbler *Phylloscopus coronatus*
Pale-legged Leaf Warbler *Phylloscopus tenellipes*
Arctic Warbler *Phylloscopus borealis*
Claudia's Leaf Warbler *Phylloscopus claudiae*
Reed Parrotbill *Paradoxornis heudei*
Vinous-throated Parrotbill *Suthora webbiana*
Chestnut-flanked White-eye *Zosterops erythropleurus*
Swinhoe's White-eye *Zosterops simplex*
Daurian Starling *Agropsar sturninus*
Red-billed Starling *Spodiopsar sericeus*
White-cheeked Starling *Spodiopsar cineraceus*
Crested Myna *Acridotheres cristatellus*
White's Thrush *Zoothera aurea*
Chinese Blackbird *Turdus mandarinus*
Eyebrowed Thrush *Turdus obscurus*
Dusky Thrush *Turdus eunomus*
Grey-streaked Flycatcher *Muscicapa griseisticta*
Dark-sided Flycatcher *Muscicapa sibirica*
Asian Brown Flycatcher *Muscicapa dauurica*
Blue-and-white Flycatcher *Cyanoptila cyanomelana*
Siberian Blue Robin *Larvivora cyane*
Bluethroat *Luscinia svecica*
Siberian Rubythroat *Calliope calliope*
Yellow-rumped Flycatcher *Ficedula zanthopygia*
Green-backed Flycatcher *Ficedula elisae*
Taiga Flycatcher *Ficedula albicilla*
Daurian Redstart *Phoenicurus auroreus*
White-throated Rock Thrush *Monticola gularis*
Blue Rock Thrush *Monticola solitarius*
Amur Stonechat *Saxicola stejnegeri*
Eurasian Tree Sparrow *Passer montanus*
Grey Wagtail *Motacilla cinerea*
Eastern Yellow Wagtail *Motacilla tschutschensis*
White Wagtail *Motacilla alba*
Richard's Pipit *Anthus richardi*
Olive-backed Pipit *Anthus hodgsoni*
Brambling *Fringilla montifringilla*
Chinese Grosbeak *Eophona migratoria*
Common Rosefinch *Carpodacus erythrinus*
Chestnut-eared Bunting *Emberiza fucata*
Yellow-throated Bunting *Emberiza elegans*
Yellow-breasted Bunting *Emberiza aureola*
Little Bunting *Emberiza pusilla*
Black-faced Bunting *Emberiza spodocephala*
Chestnut Bunting *Emberiza rutila*
Yellow-browed Bunting *Emberiza chrysophrys*
Tristram's Bunting *Emberiza tristrami*

Left: Chinese Sparrowhawk on Nanpu seawall, 20 May 2025. Right: Little Bunting on Nanpu seawall, 7 May 2025.

global flyway network

Team Piersma

SHOREBIRD NORTHWARD MIGRATION THROUGH THE LUANNAN COAST, BOHAI BAY, CHINA, APRIL – JUNE 2025