

Global Flyway Network

The shorebird
ecological demographics &
conservation initiative



RED KNOT NORTHWARD MIGRATION THROUGH BOHAI BAY, CHINA, FIELD TRIP REPORT APRIL - JUNE 2013

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Summary

The fieldwork season commenced on 9 April and finished on 6 June 2013.

We recorded 4,615 marked shorebirds from throughout the East Asian-Australasian Flyway (EAAF). Included in the total flag sightings were 873 that we could identify to an individual bird, within those were 613 sightings of colourbanded birds from NWA, the main focus of this study, and this gave us 285 individually recognizable individuals. This was of course dominated by Red Knot with 269 individuals, Great Knot 13 and Bar-tailed Godwit 3. This reflects the vital importance of the area for the Red Knot *piersmai* subspecies. Most researchers would be thrilled with this result if they saw this number of 'their' birds at the marking location. GFN are recording these birds some 6400km away from where the birds were marked!

The importance of the vast area of commercial salt ponds adjacent to the inter-tidal area was again evident for both feeding and roosting opportunities for migrant birds. We had stunning counts on 16 May 2013 of 95,000 birds in a single pond. There were 61,891 Curlew Sandpipers which is 34% of the EAAF estimated population. In an adjacent pond on 29 May 2013, 34,200 Red Knot were counted equal to 33% of the entire EAAF population more than 50% of the worlds' population of the subspecies *piersmai*. As in 2012, we estimate that at least 40,000 White-winged Black Terns are in the area at any one time. The population estimate for this species in the EAAF is vague but 40,000 would equate to anything from 4 to 40% of the EAAF population, perhaps more if turnover of migrants is taken into account! The salt works area hosts all the migrant birds at high tide when the mudflats are inundated by the sea making the area a critical component of the Luannan Coast Shorebird Site. The salt ponds should be included in any conservation initiatives.

A table of species recorded in internationally important numbers has been compiled from GFN studies over the previous 7 northward migration seasons. It is an effective way to represent the immense importance of the Luannan Coast Shorebird Site.

The continuing pressures on the inter-tidal area are obvious with the continuing development of industrial and housing areas adjacent to and on the inter-tidal area. The direct destruction of the inter-tidal area had slowed this season but huge building projects are taking place in former salt pond habitat.

Collaborative conservation efforts by various NGO's, spearheaded by WWF-China Beijing office continued with a meeting of shorebird and wetland scientists from China and the EAAF. It was very well attended and received media coverage.

An important aspect of any conservation action is media coverage and we were lucky to have science journalist Jane Qiu with us during part of our field work and she presents a summary for this report.

Future studies at the site will continue. GFN will continue to document the fates of four shorebird species at their non-breeding sites in NWA and throughout the flyway with an emphasis on Bohai Bay. From this work we will be able to assess the effects of human induced habitat change through survival analysis and statistical work. GFN will continue conservation efforts at Bohai Bay in conjunction with WWF-China and other organisations. A Masters student, Miss Ying Chi Chan, will analyse GFN data under the supervision of Theunis Piersma and Tamar Lok, a postdoctoral researcher, has been employed by GFN and commenced sophisticated analyses on the GFN data with the aim to publish papers in high-end biological journals.

Introduction

The ecology of the enigmatic long-distance migratory shorebird Red Knot *Calidris canutus*, despite a lot of study, is still not fully understood in the East Asian-Australasian Flyway (EAAF). It is represented in this flyway by three subspecies *piersmai*, *rogersi* and *roselaari* (the latter is not part of this study as it only breeds on Wrangel Island and migrates to the Americas) *piersmai* and *rogersi* breed in different locations in the Siberian Arctic and share non-breeding locations in Australasia (Rogers *et al.* 2010). One of the mysteries of the species was where they stop-over during their northward migration. Surveys of the Yellow Sea by Mark Barter and Chinese colleagues failed to find significant numbers of the species despite extensive searching. They did record 14,277 in the NW Bohai Bay region during spring migration 2002 (Barter *et al.* 2003). During a brief 6-day visit in late April 2007 Chris Hassell (CH) from Global Flyway Network (GFN) counted a single flock of 10,650 Red Knot in the same region. In September 2007 Yang Hong-Yan (YHY, Beijing Normal University) commenced a PhD project on the food, foraging and stopover ecology of Red Knots in the area. She has been conducting regular counts since 2003 during the spring period of northward migration and her work shows that numbers of birds in the study area have increased over the years, presumably due to habitat destruction elsewhere and consequently birds moving in to the study site (Yang *et al.* 2011). It is clear from our current knowledge this site is the single most important site for Red Knot on northward migration in the EAAF. The Southward migration route of Red Knot is still a relative mystery to us. The attachment of geolocators to Red Knot in Roebuck Bay NWA, New Zealand and Chukotka, NE Siberia will hopefully help us unravel this piece of the Red Knot jigsaw.

In concert with the work by YHY, studies by GFN have continued during the northward migration seasons of 2009 to this year, 2013. These field studies have concentrated on searching for individually marked birds and have been remarkably successful. In view of the many human-related threats, to what would seem to be the single most important staging area for two subspecies of Red Knot, encompassing all Red Knots wintering in Australia and New Zealand, it seemed of utmost importance to continue the survey work. This need was recognized by WWF-Netherlands and WWF-China who have continued to fund the field work in 2013 through their association with GFN (CH remains supported by Vogelbescherming-Netherlands). Beijing Normal University also funded aspects of the project. Here we report on what we have achieved in April - June 2013.

All the migratory birds mentioned in this report are covered by the China-Australia Migratory Bird Agreement (CAMBA) and it should be a source of embarrassment to both governments that this destruction of critical habitat to migratory birds is happening unregulated and unabated.

The Study Site

The centre of the study site is situated at 39° 03' 35"N 118° 12' 33"E.

It is near Nan Pu Development City, situated on the edge of Bohai Bay, 190 km South east of Beijing, China. See figure 1 below.

The image shows the 4 study sites and the Caofeidian New Area Industrial Park. This enormous area will have destroyed 142km² of inter-tidal mudflat at its completion in 2020 (Yang *et al.* 2011). It has already covered >75% of its planned area. The mudflats of the 4 study sites used to give a 25km long and 1-3km wide (on the lowest tides) foraging area for shorebirds. This is no longer the case as most of the Zuidong

mudflats have been claimed for industry. The mudflats are separated by a man-made seawall from the Nanpu Salt Ponds. These are reputedly ‘the largest salt works in Asia’. This area, that is adjacent to the mudflats, is also critical habitat for birds to forage and roost but is also being lost to industrial development.



Fig. 1: Interpreted satellite image of Bohai Bay, China

Marking of Shorebirds

Shorebirds captured throughout the EAAF are marked with plain coloured flags, engraved leg flags (ELF), or combinations of 4 colour-bands and 1 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 coloured flag and/or position of the flag on the birds' leg. The focus of our study is the individually colour-banded birds from Roebuck Bay, Broome and 80 Mile Beach, NW Australia, but we record every single marked bird we see during our field work thereby documenting the importance of this area to various species from throughout the flyway.



Colour-banded Red Knot from NWA at Bohai Bay 2013 © A Boyle

Human Use of the Mudflats

The birds share the mudflats and food resources with the human population. The professional shell-fishers are able to harvest huge amounts of bivalves from the highly productive mudflats that comprise our study site. This method for harvest ranges from searching by hand with small rakes to pumping equipment powered by generators mounted on large floating tyre tubes. The economic benefit to local people is very real, the income is in the region of 10 million RMB per annum (A\$1.4 million) (Yang, pers.comm.) and as the mudflats are gradually destroyed their livelihood is threatened. The tidal-flats are worked for about 6 months each year (Yang, pers.comm.).



Shell-fishers with the day's catch, © M Slaymaker

Field work in 2013

The fieldwork program for 2013 started on 9 April and finished on 6 June, this is 59 continuous days of field work with between two and five observers in the field daily. Upon arrival at the study site 400 Red Knot were present. This had increased to 2,500 by April 10. Great Knot were also already present, numbering in the 1000's, and other species present but in smaller numbers included Bar-tailed Godwit, Curlew Sandpiper and Sanderling. Grey Plover, Eurasian Curlew and Dunlin were all numerous and made up the bulk of the birds seen. Some individuals of these three species spend the non-breeding season in Bohai and have not migrated from further South. This pattern of occurrence is very similar to previous years although Red Knot seems to show a slight tendency for earlier arrival over the last two years.

Table 1 documents the evolution of our studies at Bohai Bay as our understanding of the importance of the site became clear to us. We started with a preliminary visit in 2007 leading to the complete and continuous coverage of northward migration from 2010 – 2013. During northward migration season 2008 CH and Adrian Boyle (AB) were conducting shorebird studies in South Korea.

Table 1.

	Days of Observation	Total Flag Sightings	Total Individually recognizable Birds	Total Color-banded Red Knot from NWA
2007	7	49	3	
2008	0	0	0	0
2009	19	859	143	76
2010	57	3,143	394	106
2011	52	3,336	493	170
2012	53	4,503	691	279
2013	59	4,616	859	269

It is interesting that in 2013, while the total number of sightings of colourbanded Red Knot from NWA was down (only 613 compared to 904 in 2012), the numbers of identified individuals was very similar 269 (2013) to 279 (2012). This season the Red Knots were using the inter-tidal mudflats less than in previous years so walking out on to the mud to view flocks of thousands was rarely achievable. The difficulties of working on the mud were compounded by two other factors. Firstly, the surface of the mud was a little different to previous years with many shallow indents and water filled puddles. This was possibly caused by an unusually cold winter and made the viewing of the shorebirds legs surprisingly difficult. Secondly and most frustratingly, at times the birds were favouring an area several kilometers further north than in previous years which, despite our best efforts, proved difficult to survey. Our access to the mud was prevented by wet areas and deep channels and the birds rarely came close enough to the wall for satisfactory scanning. Especially towards the end of the field work the Red Knots were frequently in the adjacent salt works. This vast area is difficult to survey and we spent many days searching for birds with varied success. However on some days when birds were using ponds that were accessible to us we collected some fantastic data. On one afternoon, with perfect light (and even a lack of smog!), we spent several hours observing 34,200 Red Knot in a single pond and we recorded 82 individually marked Red Knot from NWA plus a host of other marked birds from throughout the EAAF. The obvious questions that arise from the Red Knots use of the area this year is 'why? Were the ponds particularly suitable this season and if so, what was different? Perhaps changes in management practices have opened opportunities for more cost effective feeding in the ponds than can be found on the mudflats? Was there less food in the mudflats? Was there increased disturbance on the mudflats?

At this stage, we offer more questions than answers!

In regards to the densities, and therefore availability, of the knots predominant food, the small mollusc (*Potamocorbula laevis*), YHY has yet to fully analyse her data from 2013

But she says "according to the situation in the field I think the density of pots in this year might be higher than last year". So it seems the apparent increase in use of the salt pond habitat was not caused by a decrease of 'pots' in the mudflats. Please note this is preliminary information. There is undoubtedly a good food source in the salt ponds consisting of Brine Shrimp (*Artemia* species) and an abundant Red Worm (species unknown) and probably more yet to be found. The availability of this food source to the birds is the interesting factor. The raising and lowering of the water levels and strong winds all appear to make the ponds very attractive to birds (shallow water, exposed ponds floors) or not at all suitable (deep water). A student at Beijing Normal University, Wei-Pan Lei, will start a PhD project on migrant bird use of the Salt Ponds in September 2013. This will be a very welcome addition to our knowledge of the Luannan Shorebird Site.

The scanning of foraging birds on the inter-tidal mudflats and exploration and scanning in the salt ponds occupied the majority of our time. We recorded the usual excellent haul of sightings (see Table 3). All shorebirds that forage on the mudflats leave the mud at high tide as the sea reaches the seawall and fly to roost in salt ponds. Some roost in close proximity to the mudflats (especially early in the season) but as with last year, by early May most birds flew many kilometres from the mudflats to roost sites. This change in roost preference seems to happen every year. The reasons are not obvious to us. The area of salt ponds and therefore roosting opportunities is vast, stretching 10km inland and across the entire 20km, from South east to north west, of our study sites (see Fig 1, study site image). The roosts we could access are relatively undisturbed (compared to our other study site at Roebuck Bay), and although migrating raptors and salt pond workers do cause some disturbance, it is not significant. The myriad roosting opportunities are a positive for the birds but the foraging opportunities for Red Knots do not appear to be constant in the ponds. Thus the retention of the remaining inter-tidal mudflats at Zuidong, Nanpu and Beipu remains of greatest conservation importance enabling the huge numbers of migrant birds using the area to fatten up, continue their migrations to their breeding grounds and to be able to breed successfully.

Table 2 below shows the totals of all marked migratory shorebirds recorded during the field work and the location they were originally marked. The birds with plain flags just indicate the original banding location and can not be identified to a specific individual. The colour-banded birds, the engraved leg flagged birds (ELF) and some birds with unique positioning of flags on their legs can be attributed to individual birds when close views are obtained. The closely monitored colour-banded birds from NWA show some very interesting 'life histories' (see appendix 1). As the team were seeing individually marked birds that were 'new' to the area late into the field work period, it is not unreasonable to assume that plain-flagged birds were also still arriving or had escaped our attention previously while others will have moved through the site. So while some will undoubtedly be multiple sightings the numbers in the table appear to be a good reflection of the numbers of flagged birds present during the study period.

These records (2010-2013) represent 26 different marking areas in the EAAF highlighting the importance of these mudflats, not only to birds from NWA, but from throughout the entire EAAF. The total number of sightings for 2013 (4,616) is almost identical to that of 2012 (4,503). The GFN team was comprised of the same skilled and experienced observers over a similar time frame for both years. We were pleasantly surprised at this result for 2013, as finding the birds to scan was more difficult this year due to the problems highlighted earlier, particularly towards the end of May when we had to walk many kilometres around the ponds to locate flocks of birds. But these problems were partly compensated by an increased number of hours in the field during 2013 combined

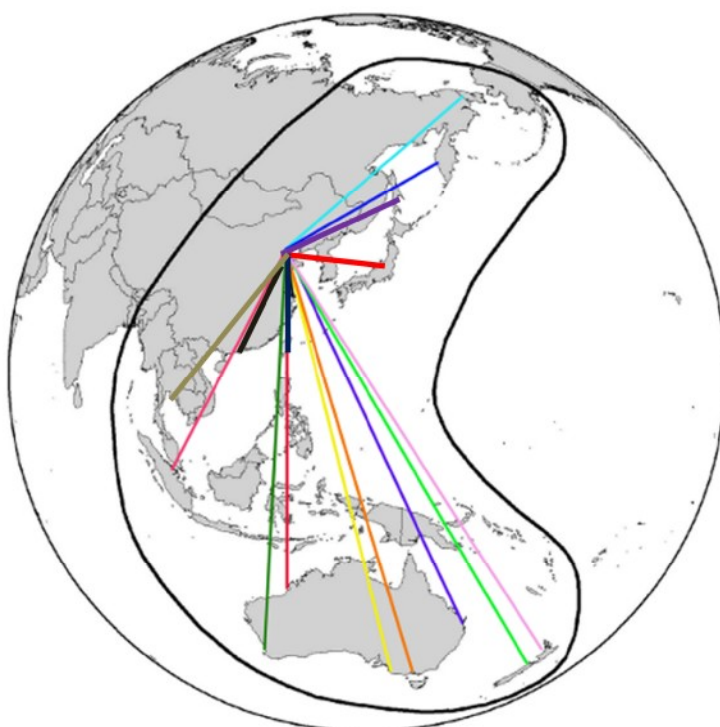


Figure 2. Between 2009 and 2013 we have recorded Red Knot from 17 different banding locations throughout the EAAF. The map below is a representation of some of these sites.

with a better general understanding of the site after 5 years of experience. This is a great help knowing how to 'work' the area.

Records of individually colour-banded birds from NWA (285 total, 269 Red Knot, 13 Great Knot, 3 Bar-tailed Godwit) was very similar to 2012 (300 total, 287 Red Knot, 17 Great Knot, 4 Bar-tailed Godwit). This is an excellent set of data. Most ornithological researchers would be thrilled if they were to record this many individually marked birds at the initial marking site. The GFN project is getting 1,000's of resightings in Roebuck Bay and 80 Mile Beach in addition to this set of data compiled from resighting work 6,400km distant from the marking location.

Table 2. Totals of marked birds recorded during field work 2010 to 2013.

Marked at	2010	2011	2012	2013	Total 2010-2013	Individuals 2013
Bohai Bay	122	96	122	99	439	
South Bohai / Individuals	0	0	7	26	33	18
Chongming Dontang / ELF	48	114	104	103	369	25
Chongming Dontang / Plain	273	333	461	449	1,516	
Chukotka	1	32	43	50	126	10
Hong Kong	5	23	19	44	91	21
India	1	0	0	0	1	
Japan	1	7	10	5	23	
Java	1	0	0	0	1	
Kamchatka	1	3	4	1	9	
King Island	3	2	4	0	9	
New South Wales	0	2	0	1	3	
Northern Territory	3	0	0	1	4	
NWA / Colour Band	317	412	904	613	2,246	285
NWA / ELF	305	312	592	642	1,851	232
NWA / Plain	605	503	574	411	2,093	
NWA Tracking 2000	2	0	0	0	2	
NZ / Colour Band	171	228	171	177	747	47
NZ / ELF	243	374	340	511	1,468	186
NZ / Plain	186	175	198	205	764	
Phillipines	0	0	0	1	1	
Queensland	7	7	8	27	49	6
Sakhalin	0	4	5	48	57	
Saunder's Gull	1	9	0	1	11	
Singapore	1	0	0	1	2	
South Australia	12	35	62	73	182	7
Sumatra	12	4	5	8	29	
SW Western Australia	6	0	0	1	7	
Taiwan	4	0	2	3	9	
Thailand	66	47	70	129	312	
Victoria	746	644	776	910	3,076	
Victoria ELF	0	0	22	75	97	22
Yalujiang	0	0	0	1	1	
Totals	3,143	3,366	4,503	4,616	15,628	859

Internationally Important Counts

During the 7 years GFN have been working at the Luannan Shorebird Site we have been doing formal and informal counts. The importance of the site is not in any doubt. The table below shows clearly the immense importance of these mudflats and salt ponds to shorebirds from the EAAF. All counts are minimum counts as the vast area can never be completely covered.

Table 3.

Species	Scientific Name	Date recorded	Count = c Estimate = e	% of EAAF Population present	EAAF Population (Bamford 2008) except *, **, ***	1% Ccritery
Black-winged Stilt	Himantopus himantopus	30/04/2008	653 c	2,6	25,000-100,000	250
Pied Avocet	Recurvirostra avosetta	30/04/2008	712 c	2,8	25,000-100,000	250
Grey Plover	Pluvialis squatarola	30/04/2008	3455 c	2,8	125,000	1,25
Asian Dowitcher	Limnodromus semipalmatus	13/05/2008	755 c	3,3	23,000	230
Black-tailed Godwit	Limosa limosa	30/04/2012	4,100 c	2,6	160,000	1,6
Eurasian Curlew	Numenius arquata	25/05/2007	425 c	1,1	40,000	400
Spotted Redshank	Tringa erythropus	16/05/2013	660 c	2,6	25,000-100,000	250
Marsh Sandpiper	Tringa stagnatilis	26/04/2012	>10,000 e	10	100,000-1,000,000	1
Nordmann's Greenshank	Tringa nebularia	09/05/2012	10 c	1	1,000	10
Great Knot	Calidris tenuirostris	14/04/2010	7000 c	1,8	380,000	3,8
Red Knot	Calidris canutus	13/05/2011	66,500 c	63,3	104,986*	1,05
Sanderling	Calidris alba	29/05/2012	2,430 c	11	22,000	220
Red-necked Stint	Calidris ruficollis	16/05/2013	20,587 e	6,3	325,000	3,25
Sharp-tailed Sandpiper	Calidris acuminata	29/04/2009	5,242 c	3,3	160,000	1,6
Curlew Sandpiper	Calidris feruginea	11/05/2010	80,000 e	44,4	180,000	1,8
Dunlin	Calidris alpina	29/04/2009	9950 c	1	950,000	9,5
Spoon-billed Sandpiper	Eurynorhynchus pygmeus	28/05/2013	2 c	0,5	400**	4
Broad-billed Sandpiper	Limicola falcinellus	25/05/2009	6000 c	24	25,000	250
White-winged Black Tern	Chlidonias leucopterus	var. dates	40,000 e	40	100,000-1,000,000***	1

* Rogers et al 2010

**Zöckler, C., Syroechkovskiy, E. & Atkinson, P.W. 2010a

*** Delany & Scott 2006



Asian Dowitcher, © A Boyle

Use of the mudflats and resighting coverage

The use of the study site (see Fig. 1, Study Site image) has changed from our first visit in 2007. We now have 4 sites within the study area. This year we worked regularly at 'North Beipu' as the birds were using this site in good numbers and we hardly worked at Zuidong at all due to the industrial development there (see Bohai Bay Report 2012). Also this year, a very thick covering of green algae made the remaining mudflats at this site even more unsuitable for birds. Another potential threat to the mudflat foraging area is the establishment of small areas of Smooth Cordgrass *Spartina alterniflora*. Currently the patches are small but this is a highly invasive, non-native species and has caused huge problems in other important shorebird sites in the Yellow Sea most notably at Chongming Dongtan National Nature Reserve where a multi-million dollar project is underway to try and mitigate the problem.

The destruction of the mudflats at Beipu, the most northerly of our study sites, started in March 2011. For the whole 7 weeks we were in the field during 2011 the Beipu seawall was very busy with trucks, large machinery cars and construction workers. This situation had changed dramatically in 2012 and remained the same in 2013. There had been a dispute between the development companies and the pumping companies and the mud and the seawall was completely clear of any signs of the work being done in 2011. However the salt pans immediately inland from the mudflats at the north end that had

had mud pumped in to them were devoid of birds. The Beipu mudflats held almost no birds for most of their area during both 2012 and 2013. The birds were only using the southern Beipu mudflats adjacent to Nanpu, not surprisingly this is the area that had not been pumped and had the least fishing nets on it. The lack of foraging birds may be due to a big increase in fishing in the area. This meant many more nets and many more fishermen spread out over the mudflats. It seems that once the mudflats start to be destroyed that the fishermen and shellfishers increase their activity in that area in anticipation of it being lost to them for good. This has repercussions for the birds that have to share the mudflat area with more nets and people and the inevitable disturbance that comes with this. The relatively undisturbed mud at 'North Beipu' had thousands of birds feeding there with up to 7,000 Red Knot and 3,000 Broad-billed Sandpipers there on



Algae covering the Zuidong mudflats, © Y. C. Chan



A former salt pond roost and feeding area at Zuidong, © Y. C. Chan

May 17th 2013. We 'added' this site to our work area for 2013 as we had only visited it very briefly in previous years and then it held very few birds. We were able to scan the flocks of birds there for short periods of time, this season, on outgoing tides and incoming tides but we could not follow the birds out on the flats as the mud was very soft and dangerous. However this area is adjacent to a large waste pond facility for the Sanyou Corporation and we were asked by the police not to survey there!

The Nanpu mudflat is usually where most of the birds congregate and subsequently where the vast majority of our field work is done. Viewing can be done from the seawall during the smaller tides and out on the flats



Where fishing activity is at a reasonable level the birds and the fishermen share the mudflats. © Ying Chi Chan

during the spring tides. The Nanpu mudflats are still relatively undisturbed and undoubtedly the most important of the remaining mudflats in the area. They have had some pumping done in 2006 and artificial islands have been built close off-shore for oil drilling and oil tanker loading but the mudflats abutting the seawall are still excellent areas for shorebird foraging. This is the area that must be saved and given Nature Reserve status to enable the Red Knot and many other species of migrant shorebird of the EAAF to maintain sustainable population levels.

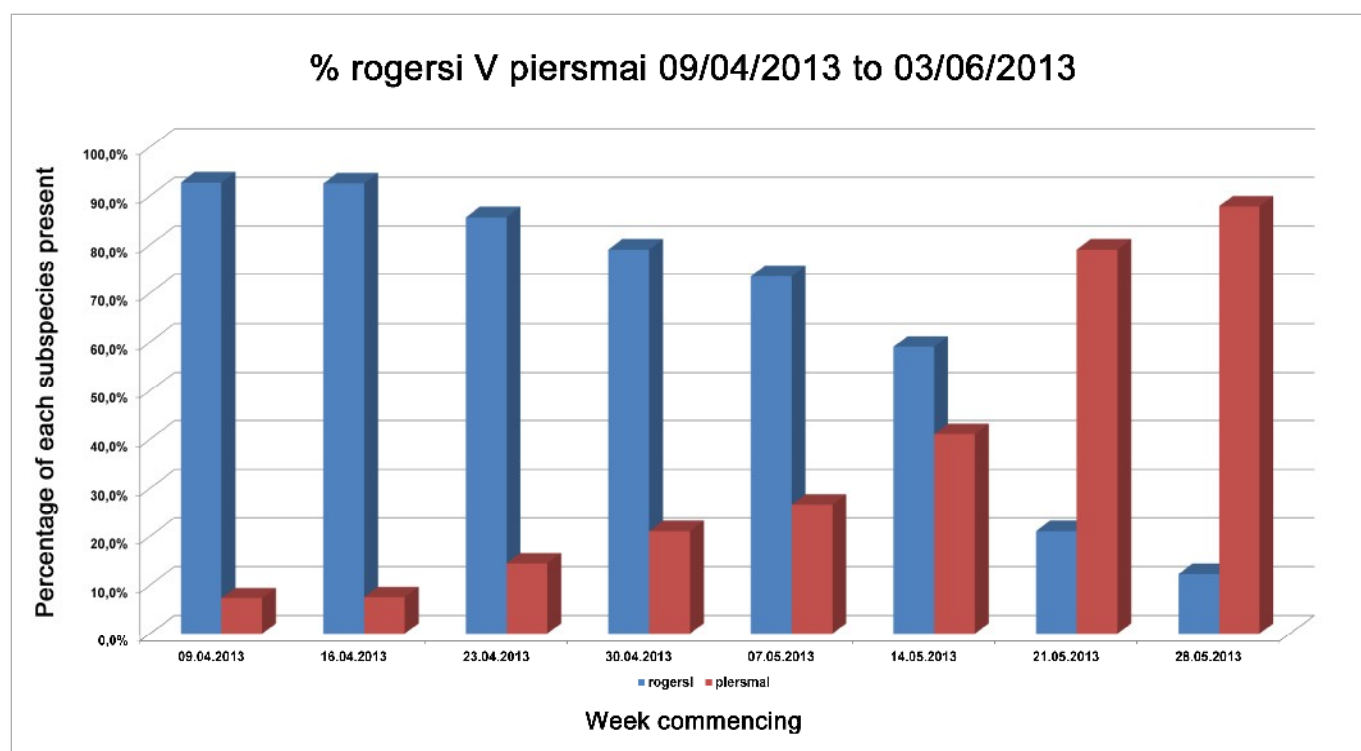


Red Knots stream back to the Nanpu mudflats as the tide recedes. © M. Slaymaker

Presence of *rogersi* and *piersmai* subspecies

The majority of the two subspecies of Red Knot using the EAAF can be distinguished, when in fresh, full or near-full breeding plumage on the basis of the colour and pattern of that breeding plumage. This is particularly noticeable when the two subspecies are side by side as is usually the case in our study site. We did random counts of flocks of Red Knots regularly throughout the study period totaling 72,491 this is considerably lower than in 2012 where we assessed 85,276 birds. This was due to not having the close, settled flocks of Red Knots on the mudflats to work with. We assigned each bird to a subspecies on the basis of plumage characteristics. The rogersi birds, predominately from SE Australia and New Zealand, arrived first and left for their eastern Siberian breeding grounds earlier than the piersmai birds, predominately from NW Australia, which breed in more northerly latitudes, on the New Siberian Islands. This is consistent with the patterns from previous seasons see Figure 3.

Figure 3. 72,491 Red Knot were scanned during the study period and assigned to the rogersi or piersmai sub-species on the basis of plumage characteristics. The results show that the rogersi birds arrive earlier than piersmai birds and leave for the breeding grounds earlier. The composition of the two sub-species is almost exactly mirrored at the beginning and end of the study period.



A 'typical' rogersi (left) and piersmai (right) © I. Southey and A Boyle

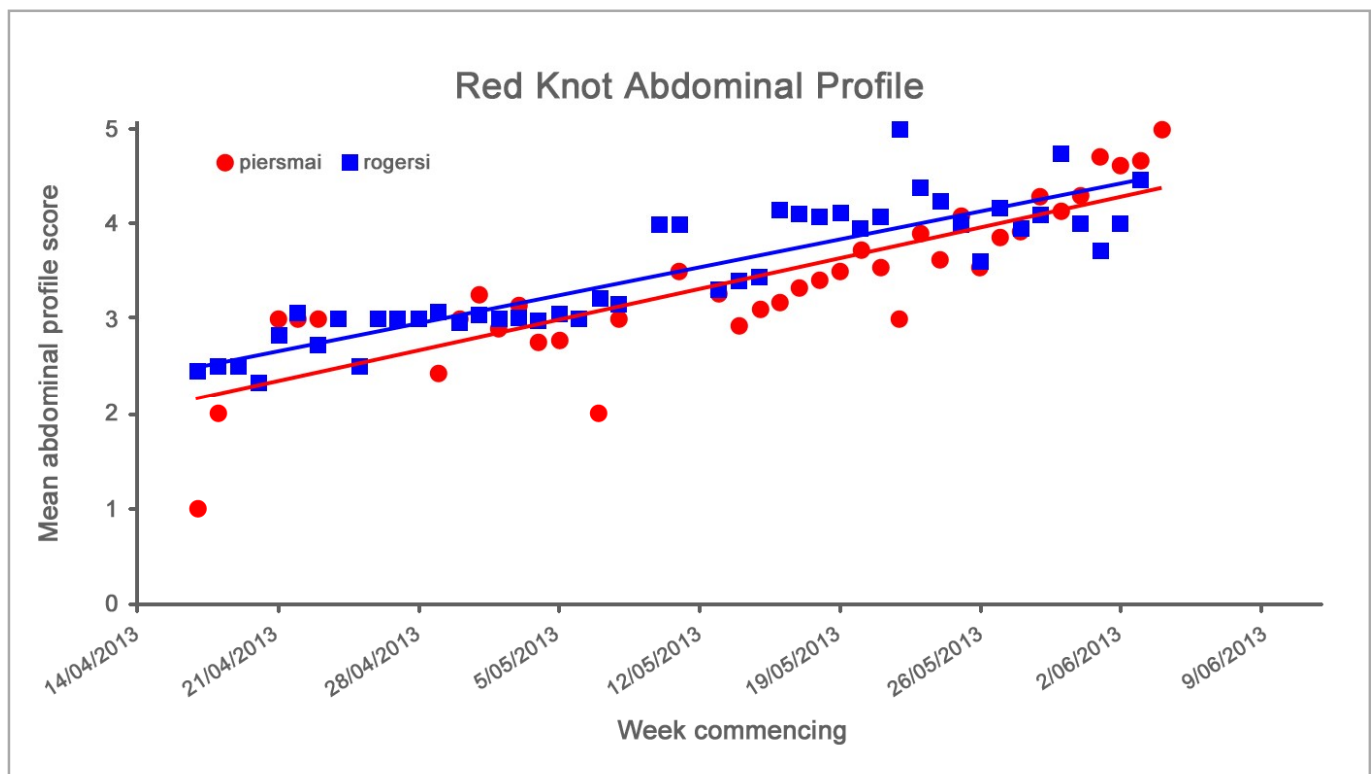
Abdominal Profiles

In the absence of mass data from captured birds it is possible to score the abdominal profile (AP) of birds in the field from telescope observations (Wiersma & Piersma 1995). We record abdominal profile on all birds when we get a suitable view. A side on view of the bird is needed for an accurate assessment. A factor the observer has to take in to account is if the bird is 'fluffed-up' due to cold weather. This can mislead the observer into thinking the bird is 'fatter' than it really is. This can certainly be a problem but the experienced observers of GFN are aware of this and so all observers are scoring under the same criteria. The scores range from 1-skinny to 5-obese. A bird scored as 1 looks unhealthy and a bird scored at 5 can hardly walk!

It would seem that piersmai are arriving at Bohai in slightly better condition than rogersi, whilst almost no birds are arriving at Bohai in very poor condition (AP 1). This might mean that they are stopping or staging between their Australian and New Zealand non-breeding sites. This is however one piece of the Red Knot migration question that we are still attempting to answer with various methods; we currently have 42 geolocators deployed with the hope that we will re-catch some of these birds in future capture events to try and gain further insight in to the migration strategy of Red Knot from NWA.

There is some suggestion from the data collected in our study site at Bohai over the years that birds are leaving Bohai with lower AP scores each year. The birds we see on the mud and in the ponds do not look like stressed birds. They spend a lot of time roosting, bathing, preening and don't appear to be 'struggling' to find food. More sophisticated analysis of our data will hopefully tease out what is happening. We do still have a real concern that a 'tipping point' can not be far away as the area of mudflat taken for industrial development continues and consequently the foraging area available to the birds is reduced. This is why we continue in conjunction with WWF-China and others to try and reserve the remaining inter-tidal mudflats and adjacent salt ponds.

Figure 4. The graph below shows the increase in AP, over time, for the two subspecies of Red Knot in 2013.



Habitat Destruction

The field work at the study sites is challenging, not so much from a practical point of view as there are good roads towards the sites and accessible tracks along the sea wall, but it is mentally challenging to work in an area that is having prime shorebird habitat destroyed as we watch the birds. The sense of a rapidly growing economy (progress or destruction?) is palpable.

This year the destruction of the inter-tidal flats themselves had slowed. However the development adjacent to the mudflats was still in full-swing with a six-lane highway having been completed to and along half of the Zuidong seawall, this can only herald plans for further destruction of the inter-tidal areas to the north west, further in to the critically important areas of the Luannan Coast Shorebird Site. Factories and apartment blocks have been and are being built on recently claimed land at Zuidong and some filled-in ponds at Beipu have preliminary work being done within them. The race to conserve the area is still on. It is assumed that the dispute with the mud-pumping companies will be resolved and once more precious, bio-diverse mud will start to be pumped from the inter-tidal area over the seawall into the salt ponds thereby damaging two habitats in one process. Enormous areas of inter-tidal mud flats have been converted to industrial land in this way. Between 1994 and 2009, approximately 453 km² of sea area in Bohai Bay was lost to development. This included 156 km² of intertidal mudflats being destroyed, a 36% loss of the total area of 428 km² mudflats (Yang et al 2010). This scenario is playing out all along the Yellow Sea coast of China not just in Bohai Bay. It is a real challenge for Governments and other organisations to find a balance between development and conservation reserves before shorebird populations reach critically low levels from which they will not be able to recover.



Chris and Adrian scanning Red Knots © Matt Slaymaker

One off massive pollution events like oil spills (e.g. ConocoPhillips June 2011) are a problem along with chronic pollution issues. The China Marine Environment Monitoring Centre states that the Bohai Sea is the most polluted sea in the world and absorbs nearly 5.7 billion tonnes of sewage and 2 million tonnes of solid waste each year. 43 of the 52 rivers that flow into it are heavily polluted (the China Marine Environment Monitoring Centre website). The latest

study by the IUCN states that 'at least 24 species of shorebirds from the EAAF are heading towards extinction, with many others facing exceptionally rapid losses of 5–9 % per year' MacKinnon et al (2012).

Wetlands International are working in conjunction with GFN in an attempt to get a Luannan Nature Reserve and Wetland Centre established. A report by Doug Watkins is in Appendix 2.

Salt Ponds

The salt ponds are a critical habitat and must be considered in all conservation initiatives associated with the Luannan Coast. They are mentioned in the text above in some detail but a complete report is presented in Appendix 3.

Nordmann's Greenshank *Tringa guttifer*

Nordmann's Greenshank is an endangered shorebird (IUCN 2001) with a continuing decline in its population. During our field work we saw up to a minimum of 8 on any one day. Nordmann's Greenshanks were recorded on 24 days between April 16 and May 14. We saw them feeding on the mudflats at Nanpu and feeding and roosting in the adjacent salt pans. Unlike previous years, during 2013 we did not record this species at Zuidong.



Nordmann's Greenshank *Tringa guttifer* (left) roosting in a salt pond © A Boyle

Spoon-billed Sandpiper *Eurynorhynchus pygmeus*

Two individuals of this critically endangered species were seen during our field work in late May both individuals were recorded in the salt pond habitat, see Appendix 4.

New Zealand Red Knots

During our work at the Luannan Shorebird Site we record excellent numbers of individually marked Red Knots from New Zealand. Presented in Appendix 5 is report from Adrian Riegen of the New Zealand Wader Studies Group.

Media

An important component of raising the profile of important shorebird habitat is through the media. We were lucky this year to be joined by Jane Qiu an independent journalist. Jane has prepared a report with links to many of the articles in both English and Chinese. The report is presented in Appendix 6.

The future of research

GFN, with continued funding from Vogelbescherming-Netherlands, will continue to document the fates of four shorebird species at their non-breeding sites in NWA applying individual colour-band combinations and conducting intensive re-sightings scans for the marked birds and building up a comprehensive database of sightings from the marking site and throughout the flyway. With the work in Bohai Bay and sightings from other shorebird colleagues throughout the flyway, particularly in New Zealand and China (Chongming Dongtan and Yalu Jiang National Nature Reserves), we will be able to assess the effects of human induced habitat change through survival analysis and statistical work. GFN will continue conservation efforts at Bohai Bay in conjunction with WWF-China and other organisations. A Masters student, Miss Ying Chi Chan, will analyse GFN data under the supervision of Theunis Piersma, and hopes to start a PhD project on the migration of Red Knots along the EAAF (contingent on securing the necessary financial support) and Tamar Lok has started postdoctoral work on sophisticated demographic analyses on the GFN data in early 2013 and is working towards publishing papers in high-end biological journals.

Passerine Migration

Although the migratory shorebirds were the focus of our work, we had a number of keen ornithologists present and 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 wooded habitat. Appendix 7 has a complete list of all the birds seen during the field work period and includes some rare and difficult to see species.



Orange-flanked Bush Robin © A Boyle

Acknowledgments

GFN acknowledges the Yawuru People via the offices of Nyamba Buru Yawuru Limited for permission to catch on the shores of Roebuck Bay, traditional lands of the Yawuru people. Financial support for this work comes from Birdlife-Netherlands, WWF-China, WWF-Netherlands, and Beijing Normal University. A huge thank you to Yang Hong-Yan and Mr. Zhao for their friendship and constant help during our fieldwork. We thank Tamar Lok for answering many and varied questions in relation to the database and updating the database. Thank you to all the shorebird enthusiasts throughout the EAAF who send in sightings of marked birds. Thank you to the NWA 2013 expedition team. Thank you to the fabulous group of volunteers from the Broome community who assist with the capture of the birds. Thank you to Andreas Kim for formatting and presentation of the report. Thank you to Liz Rosenberg for editing this report. Thank you to Ian Southey for use of his image. Thank you to Kim Onton for Figure 4.

More information on the GFN colour banding project can be found at:

<http://www.globalflywaynetwork.com.au>

Contact Chris on: turnstone@wn.com.au

Collaborative partners

- ❖ Vogelbescherming-Netherlands (main funding body)
- ❖ Australasian Wader Studies Group (AWSG)
- ❖ Beijing Normal University, China
- ❖ WWF-China
- ❖ WWF-Netherlands
- ❖ Broome Bird Observatory
- ❖ Broome Community Volunteers

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GFN team 2013, it's not all serious!



Ady hard at work!



Ying Chi Chan messing about!



Ady and Chris doing serious research



Professor Piersma and Mr Hassell hard at work. Matt just happy to be alive!

Appendix 1

Individual Life Histories

The individual colour marking of birds allows their life histories to be built up over time, providing regular searches are made for them. The site fidelity of shorebirds makes them suitable species for such work. Below is an example from the database of a Red Knot marked in Roebuck Bay and seen at Bohai 5 years in a row and returning to Roebuck Bay each non-breeding season. This data set has been modified for presentation.

Summary of sightings

Red Knot

Banding 1BYLL

14/09/2008 Richards Point, Roebuck Bay, Broome, Australia 05241744 (1BYLL) Aged 2

Resightings of 1BYLL

06/10/2008	Stilt Viewing, Roebuck Bay, Broome, Australia
18/05/2009	Nan Pu, Bohai Bay, China
23/05/2009	Nan Pu, Bohai Bay China
25/05/2009	Nan Pu, Bohai Bay China
04/10/2009	Wader Beach, Roebuck Bay, Broome Australia
31/12/2009	Wader Beach, Roebuck Bay, Broome Australia
21/05/2010	Zuidong Bohai, China
23/05/2010	Zuidong Bohai, China
24/05/2010	Zuidong Bohai, China
27/05/2010	Zuidong Bohai, China
19/04/2011	Wader Spit, Roebuck Bay, Broome Australia
09/05/2011	Nan Pu, Bohai Bay China
16/05/2011	Nan Pu, Bohai Bay China
20/05/2011	Nan Pu, Bohai Bay China
22/05/2011	Nan Pu, Bohai Bay China
26/05/2011	Nan Pu, Bohai Bay China
27/05/2011	Nan Pu, Bohai Bay China
29/05/2011	Nan Pu, Bohai Bay China
30/05/2011	Nan Pu, Bohai Bay China
31/10/2011	Roebuck Bay, Broome , Australia
24/04/2012	Tattler Rocks, Roebuck Bay, Broome, Australia
28/05/2012	Nan Pu, Bohai Bay China
30/05/2012	Nan Pu, Bohai Bay China
31/05/2012	Nan Pu, Bohai Bay China

Continued next page.

28/08/2012	Wader Beach, Roebuck Bay, Broome, Australia
28/09/2012	Richards Point, Roebuck Bay, Broome, Australia
21/12/2012	Stilt Viewing, Roebuck Bay, Broome, Australia
09/02/2013	Stilt Viewing, Roebuck Bay, Broome, Australia
24/04/2013	Quarry Beach (West), Roebuck Bay, Broome, Australia
19/05/2013	Nan Pu, Bohai Bay, China
27/05/2013	Prison Salt Ponds Bohai Bay China
29/05/2013	Prison Salt Ponds Bohai Bay, China

Below is a Red Knot that has moved away from Roebuck Bay to an 'unwatched' site but is seen every year at Bohai.

Summary of sightings

Red Knot

Banding 1YBLY

12/08/2007 Richards Point, Roebuck Bay, Broome, Australia 05241923 (1YBLY) Aged 3+ Sex M

Resightings of 1YBLY

18/12/2007	Wader Beach, Roebuck Bay, Broome, Australia
19/05/2009	Nan Pu, Bohai Bay, China
22/05/2011	Beipu Bohai Bay, China
25/05/2011	Nan Pu, Bohai Bay, China
9/05/2011	Nan Pu, Bohai Bay, China
30/05/2011	Nan Pu, Bohai Bay, China
29/04/2012	Nan Pu, Bohai Bay, China
26/05/2012	Nan Pu, Bohai Bay, China
17/05/2013	Beipu North Bohai Bay, China
21/05/2013	Beipu North Bohai Bay, China

Appendix 2

Securing the Luannan Coast

Doug Watkins

Wetlands International has been involved in efforts to maintain the wetlands of the Luannan coast and Tanghai area for over a decade. The first shorebird surveys of the area were led by Mark Barter for Wetlands International in 2002. With the commencement of the construction of Caofeidian Port in 2005, Wetlands International organised a multi-stakeholder workshop with the County and Provincial Government to promote awareness of the importance of the area for migratory waterbirds.

In recent years, with the excellent work of Ms Yang Hong Yan (Beijing Normal University) and the Global Flyway Network team, the outstanding international importance of the area has been more comprehensively documented. In response, Wetlands International has increased its efforts to secure the values of this area. The first challenge has, and will continue to be, to address the need for decision makers and the local community to value the international importance of the area.

In 2011, Wetlands International proposed the establishment of a Wetland Centre adjacent to existing tourism facilities in Tanghai Nature Reserve (5 km inland from the coast). This facility would be easily accessed from the main expressway that services Caofeidian Port. The Centre would focus on the international importance of the area in supporting waterbird migration across the East Asian – Australasian Flyway. The Centre is considered to be a core element in successfully securing the biodiversity of the area. It would service the need for building environmental awareness, environmental education and wetland management skills. A Wetlands Centre would also provide employment opportunities and increase tourism revenue for the local community.

Economic development, international trade and waterbird migration all intersect in the area of the Luannan coast. The coast is a critical staging area for several species that migrate to and from Australia. Much of the iron ore and coal that is now landing at Caofeidian Port is from Australia. In particular, Rio Tinto is one of the largest exporters of iron ore and coal from Australia to China. With this trade and biodiversity context, discussions were started with Rio Tinto to seek their involvement in being part of a Wetland Centre concept adjacent to Caofeidian Port. In late 2011, Rio Tinto agreed to support the “concept development” phase of the project.

During 2012, the first phase of the project was implemented, involving a range of consultations with County, City, Provincial and National Government agencies in China. The outcomes of this stage were:

- ❖ Support from all levels of Government for the Wetland Centre concept
- ❖ An undertaking to allocate a site of 350 ha for the development of a Wetland Centre
- ❖ Development of a detailed concept for the Wetland Centre
- ❖ Agreement on the importance of protecting the Luannan Coast and to commence a formal evaluation of the establishment of a coastal Nature Reserve.

In making the proposal for a protected area to local, city and provincial Government, Wetlands International recommend the coastal habitats be included in the core of the Nature Reserve and the adjacent saltfields be zoned as buffer. It is recognised that much of the proposed core zone is presently under the administration of Luannan County and the saltfields by Hebei Provincial Government. As such, the conservation proposal may need two stages to deal with the two levels of Government.

An evaluation of the potential establishment of a Nature Reserve is now being conducted by Hebei Forestry Department, Tangshan City Government and the two relevant local Governments (Luannan County and Caofeidian Administration).

Three major issues remain before the wetland centre project can move to the next stage. One is a successful outcome from the evaluation of the Nature Reserve proposal. The second is obtaining support from PetroChina which is extracting oil from under the area and refining it on-site. The third is to secure the funding to continue to develop the Wetland Centre. Continuing progress on the Wetland Centre project will increase support for the new Nature Reserve along the Luannan Coast.

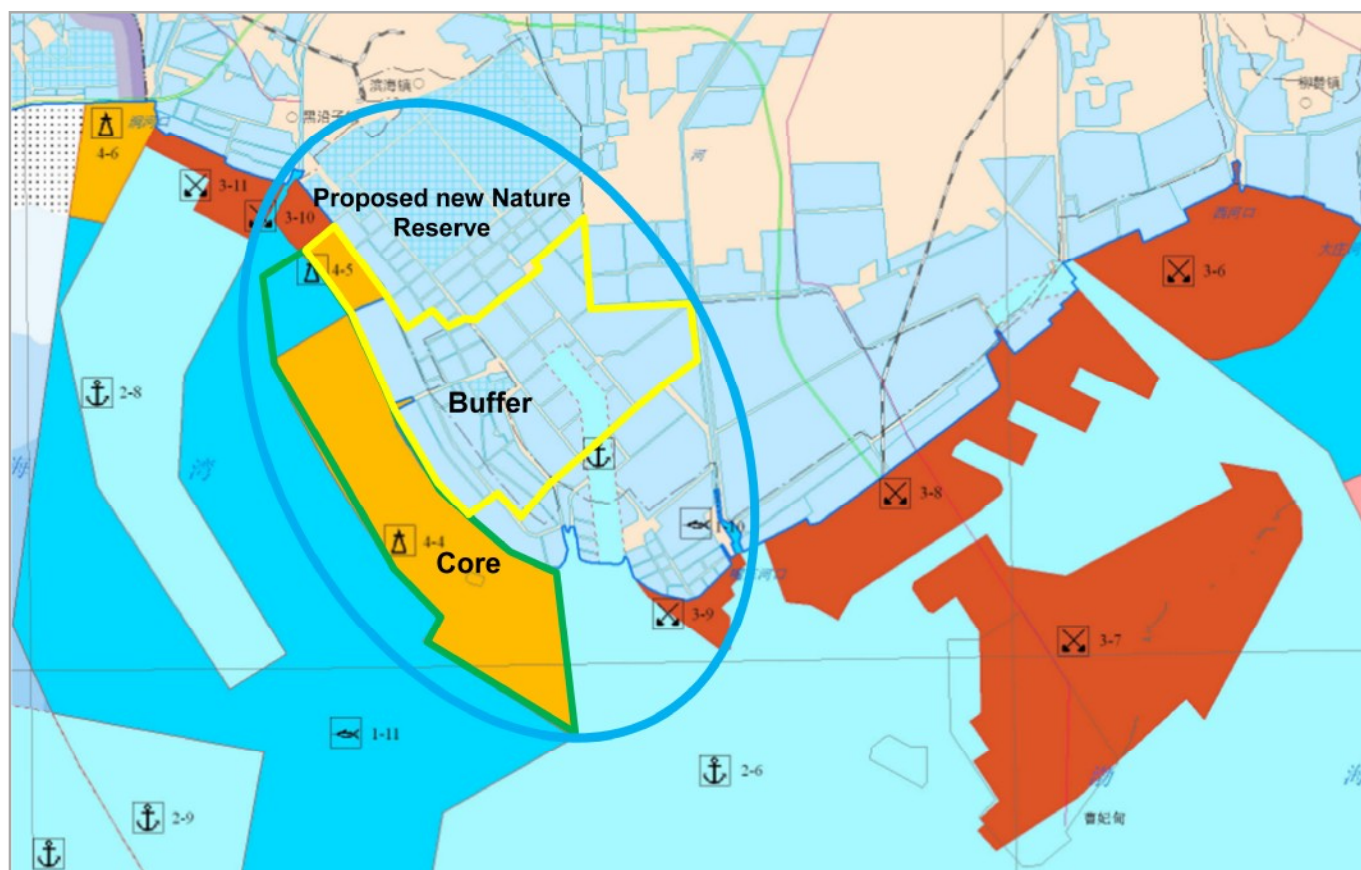
Proposed Luannan Coastal Nature Reserve

(Core area - Green; Buffer – Yellow)

The proposed core area and the adjacent coastal strip are primarily under the administration of Luannan Local Government; the remaining proposed buffer area is controlled by Hebei Government (outlined in yellow). The existing Tanghai Nature Reserve is outlined in dark green.



Proposed Coastal Nature Reserve superimposed on the Approved Marine Functional Zones (2012)



Appendix 3

The Importance of Salt Pond Habitat to Migratory Shorebirds at Nanpu Salt Works, Bohai Bay China

It must be noted that all numbers in this document are minimum numbers for the Luannan Shorebird Site as we can never cover all the area in one count. However on some days when birds were using ponds that were accessible to us we got some fantastic data.

The vast area of salt ponds that comprise the Nanpu Salt Works is an important habitat for migratory shorebirds. Counts of various species show it to be internationally important in relation to the Ramsar criteria for an internationally important shorebird site.

The size and complexity of the salt works with the thousands of bund walls and channels makes surveys extremely challenging. However some of the ponds that get used by shorebirds in big concentrations are close to the roads and therefore accessible for survey work. This seemed to be more frequently the case in 2013 than in previous years. We took the opportunity to undertake counts when we encountered large numbers of birds in salt ponds. One such occasion (16/05/2013) revealed a single pond with 95,833 birds using it for feeding during high tide at the inter-tidal area. Due to the vast numbers the count was conducted by one observer counting the entire area of the pond and all the small and medium-sized birds in it. Two other observers did 15 random counts of the small and medium-sized birds, to species level, feeding in the very shallow water at scattered localities throughout the pond (n=8,326). From this we worked out the percentage of each species in relation to the total of 90,500 (large species excluded). The numbers came out in-line with what we felt we experienced in the pond during the count but a few notes to take in to account are;

Little Stint and Ruff are much higher numbers than we have ever recorded in our study area before. We have only recorded single Ruff and up to 25 Little Stint during previous one-off counts. But we feel with the vast numbers birds in this pond these estimates are realistic.

The pond in which this count was conducted is between 10 and 15km from the mudflats of our study site. That is where the majority of shorebirds feed as the tide comes in, prior to them moving to roost or forage in various salt ponds. The pond in which this count was conducted is 3km² and held a total of 95,833 birds. The table below shows the breakdown of the species counts and estimates.

Table 1. Counts and estimates of shorebirds in one Salt Pond adjacent to the Luannan Coast 16/05/2013

Species	Scientific Name	Estimate	Count
Curlew Sandpiper	<i>Calidris feruginea</i>	61,891	
Red-necked Stint	<i>Calidris ruficollis</i>	20,587	
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>	4,196	
Marsh Sandpiper	<i>Tringa stagnatilis</i>	1,478	
Dunlin	<i>Calidris alpina</i>	1,196	
Red Knot	<i>Calidris canutus</i>	511	
Sanderling	<i>Calidris alba</i>	163	
Common Redshank	<i>Tringa totanus</i>	130	
Lesser Sand Plover	<i>Charadrius mongolus</i>	141	
Kentish Plover	<i>Charadrius alexandria</i>	98	
Little Stint	<i>Calidris minuta</i>	43	
Broad-billed Sandpiper	<i>Limicola falcinellus</i>	22	
Common Greenshank	<i>Tringa nebularia</i>	11	
Asian Dowitcher	<i>Limnodromus semipalmatus</i>	11	
Ruff	<i>philomachus pugnax</i>	11	
Terek Sandpiper	<i>Xenus cinereus</i>	11	
	Sub-Total	90,500	
Black-tailed Godwit	<i>Limosa limosa</i>		3,200
White-winged Black Tern	<i>Chlidonias leucopterus</i>		1,226
Spotted Redshank	<i>Tringa erythropus</i>		660
Pied Avocet	<i>Recurvirostra avosetta</i>		239
Black-winged Stilt	<i>Himantopus himantopus</i>		8
	Sub-Total		2,333
	Grandtotal	95,833	

It should be remembered that all these numbers are just for one pond, counted at one point in time. Therefore these are absolute minimum numbers using the Luannan Shorebird Site.

In addition to the count detailed above we also conducted a count of Red Knots on 29/05/2013 in an adjacent Salt Pond, outlined in red in the figure below. The Red Knots were both feeding and roosting. It was high tide so the mudflats would have been inundated by the sea. A single flock of feeding birds at the south of the pond comprised 4,300 individuals and the remaining area of the pond had 29,900 feeding and roosting knots giving a total of 34,200. The birds were very settled and counted 'carefully' through a telescope using a counter to keep track. It was an accurate count of the birds present and similar figures were reached independently by several experienced observers.

At this late date in May our data show that approximately 90% of the Red Knots in our study site belong to the *piersmai* subspecies. That would mean that 30,780 of the birds were of the *piersmai* subspecies. The *piersmai* subspecies has a maximum of 60,068 (Rogers *et al* 2010) birds in the population meaning 51% of the world population of the *piersmai* subspecies of Red Knot were present in a single salt pond at Bohai Bay on May 29th 2013, a remarkable statistic. We also recorded 82 individually marked Red Knot from NWA plus a host of other marked birds from throughout the EAAF.

The obvious questions that arise from the Red Knots use of the area this year is 'why?' Were the ponds particularly suitable this season due to the water level in the ponds from management practices making food resources easily available? Was there less food in the mudflats? Was there increased disturbance on the mudflats?

In regards to the densities and therefore availability of the knots predominant prey, the bivalve *Potamocorbula laevis*, YHY has not yet fully analysed her data but she says "according to the situation in the field I think the density of *Potamocorbula laevis* ('pots') in this year might be higher than last year". So it seems the apparent increase in use of the salt pond habitat was not caused by a decrease of 'pots' in the mudflats. Please note this is preliminary information. There is undoubtedly a good food source in the salt ponds consisting of Brine Shrimp (*Artemia* species) (Fig. 1) and an abundant Red Worm (species unknown) and probably more yet to be found. The availability of this food source to the birds is the interesting factor. The raising and lowering of the water levels and strong winds all appear to make the ponds very attractive to birds (shallow water, exposed ponds floors) or not at all (deep water).



Artemia species sample from the salt pond. © Y. C. Chan

Figure 2 below shows the majority of the Nanpu Salt Works and the adjacent inter-tidal mudflats of our study site (blue outline). The two ponds where the counts mentioned in this note are outlined and named by the date the count was undertaken.

The regime of moving water through the ponds for salt production means the water levels fluctuate regularly. A pond with 90,000 birds in it one day may have just a few thousand the next day, scattered along the edges, as the water level changes from a few centimetres to 20-30cm deep.

With birds generally highly mobile and spread over a wide area, counting accurate totals for the whole area is difficult. However this year we did feel that most birds were being attracted to the ponds we were observing regularly and that the counts were a fair representation of numbers of birds using the salt ponds but it must be noted they are minimum numbers and it is almost certain that other birds are using the vast complex of ponds.

Figure 2.

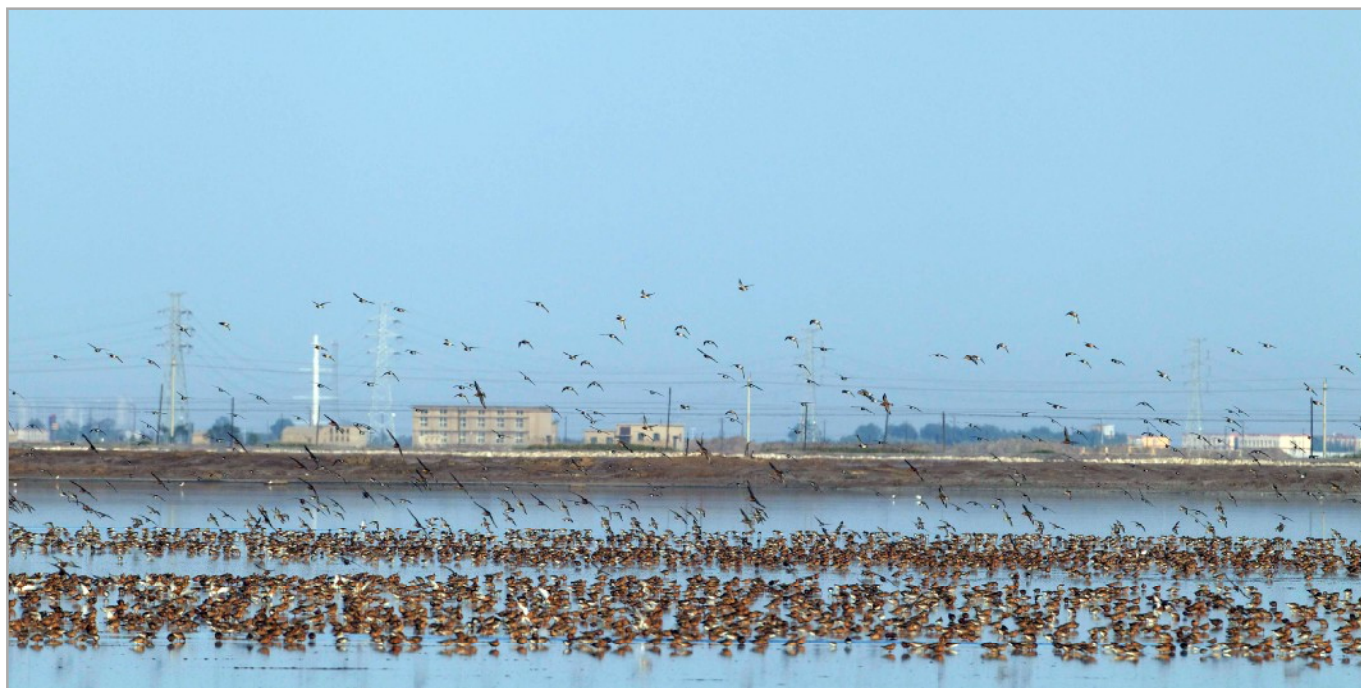


The relatively undisturbed mud-walls of the salt ponds are suitable nesting sites for some species we have recorded Black-winged Stilt, Pied Avocet, Kentish Plover, Common Redshank, Common Tern and Little Tern.

Note: Although generally referred to here as 'salt works' the area is used not just for salt production. Some ponds are used for shrimp production and increasingly, in the last year, sea cucumber production. These two commercial uses of the ponds are less favourable to the birds as they generally have deeper water and steeper sides than the salt producing ponds.

A student at Beijing Normal University, Wei-Pan Lei, will start a PhD project on migrant bird use of the Salt Ponds in September 2013. This will be a very welcome addition to our knowledge of the Luannan Shorebird Site.

Figure 3. A small portion of the flock of Red Knots counted on 29/05/2013 in a salt pond of the Nanpu Salt Works.



Appendix 4

Spoon-billed Sandpiper sightings in Northern Bohai Bay, 25 May to 29 May 2013

Observers; Adrian Boyle, Matt Slaymaker, Chris Hassell and Ying Chi Chan

On 25 May 2013, we were scanning flocks of shorebirds for individually marked Red Knots at 'Prison Salt Pond' Beipu, Bohai Bay, China 39° 08' 58"N 118° 15' 44"E during Global Flyway Network (GFN) field work when we saw a Spoon-billed Sandpiper.

The bird had 0% breeding plumage. The bird was checked carefully for flags, colourbands and metal bands, it was carrying none. This same bird was relocated in the same salt pond on 26 May and 29 May. Images of this bird were taken on 25th and 26th, one is reproduced below.

A Spoon-billed Sandpiper was also recorded at the same site on 28 May.

This was a different individual as it was in 100% breeding plumage. One distant image of this bird was obtained.

We were very pleased to record two different Spoon-billed Sandpipers however with the huge areas of suitable habitat and large numbers of birds present we could easily have missed them in this and previous years. The salt pond that we saw the bird in had tens of thousands of shorebirds foraging and roosting in it. On 16 May there were 90,500 birds using this pond and 20,600 of those were Red-necked Stint so it would be easy for us to overlook other Spoon-billed Sandpipers at this site.

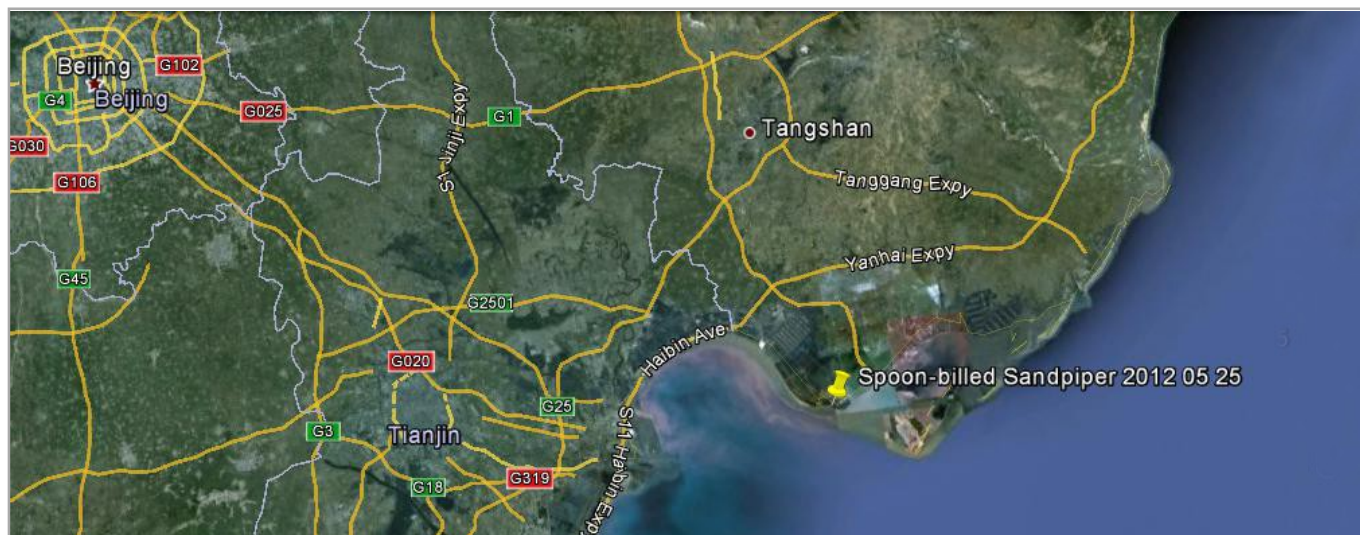


© Matt Slaymaker May 26th 2013

We have been conducting shorebird studies at this site for 5 years during April and May 2009 to 2013 and this is our second and third sightings of this species on the mudflats and within the salt works complex. The sighting in 2012 was on the very same date as this 2013 sighting but the 2012 bird was on the inter-tidal mudflats. This could very well be a coincidence as we have spent a lot more time working on the mudflats, as opposed to the salt ponds, in previous years.

See the report for 2012 <http://globalflywaynetwork.com.au/bohai-bay/> for more details.

Figure 2. The Google map shows the location of the sighting in relation to Beijing.



Appendix 5

New Zealand Red Knot in Bohai Bay, China

A brief review

The New Zealand Wader Study Group (NZWSG) started banding Red Knot in the mid 1980's in an effort to understand, among other things, the Red Knot's migration routes. Up to 1991 only a metal band was used, which relied on someone finding the bird and returning the band, to learn anything of its movements. In the first few years about one overseas recovery for every 350 birds banded, was received. There were few birdwatchers in Asia in the 1980's and even fewer looking for marked waders. Staging sites in China were generally out of bounds to foreigners and to a greater extent not even known.

In the early 1990's Mark Barter started searching the Chinese coast for wader staging sites and in 2000 with Yang Hong-Yan, who was studying Red Knot in Bohai Bay, found some 25,000 along the northern shores of Bohai Bay. At the time the estimated Red Knot population was at least 220,000, so this find amounted to around 10% of the population. Where were the rest? In 2005 the NZWSG started using white flags engraved with three black letters. It was hoped that with more birdwatchers in Asia and foreign wader people visiting East Asia, these flagged birds would be seen and thus help identify more staging sites.

The results show that few sites outside Bohai Bay appear to hold significant numbers of Red Knot, (see Table 1).

In 2009 the Global Flyway Network team, led by Chris Hassell started fieldwork that focused on the north-west Bohai Bay region, primarily looking for Red Knot during northward migration that they had colour-banded in NW Australia. The spin off was that they not only found many of their birds but large numbers of New Zealand colour-banded and engraved-flagged Red Knot as well.

Their impressive efforts over the past 5 years have generated a huge amount of data and clearly shown that the small area of the north west Bohai Bay is by far the most significant staging site for Red Knot on the East Asian-Australasian Flyway during northward migration. The flyway population of Red Knot was revised down in 2010 to around 110,000 (Rogers et al 2010), and it now appears that most of the flyway's Red Knots stage in Bohai Bay during northward migration.

Of the 376 individuals seen, 55 have only been seen in the Bohai Bay and a further 29 have been seen outside New Zealand, in at least two countries

Table 1. All overseas sightings of individual New Zealand engraved flagged Red Knot on north and south migration

Location	Sightings
Bohai Bay - China	376
Newcastle – NSW, Australia	14
Gulf of Carpentaria – Australia	4
SE Queensland - Australia	3
Chongming Dao – China	2
Japan	2
NSW (other than Newcastle)	1
NW Australia	1
Chukotka - Russia	1
South Korea	1
Yalu Jiang – China	1

Table 2. Number of different engraved flagged New Zealand Red Knot seen in Bohai Bay

Year	Sightings	Number of Birds
2007	1	1
2008	5	5
2009	21	21
2010	90	79
2011	191	136
2012	153	117
2013	343	184

Table 3. Total Red Knot all years seen in Bohai Bay and a breakdown of subspecies

Sightings	803
Individual birds	376
<i>rogersi</i>	289
<i>piersmai</i>	46
Recorded as <i>rogersi</i> & <i>piersmai</i> on different occasions	16
Subspecies not recorded	25

Putting the Bohai sightings into context

1,001 Red Knots have been fitted with white engraved flags. A total of 846 have been seen at least once, therefore the number seen in Bohai Bay represents about 44% of all birds seen a remarkable total as the marking and resighting sites are some 10,000km apart. There have been 3,864 engraved flag sightings recorded so the 803 from Bohai Bay represent 20% of all sightings.

This is an impressive contribution to the knowledge of New Zealand Red Knots during northward migration, and the NZWSG is extremely grateful to all those involved with the GFN project and their principal funders. We hope they are able to continue this work and that the focus they have put on the area will help to save it from complete destruction. Already 50% of the Red Knot population in New Zealand has been lost over the past 15 years. It will be a tragedy if this trend continues. The importance of Bohai Bay for Red Knot cannot be overstated and without these feeding and staging grounds the outlook for their future is very bleak.

Adrian Riegen
Convener, NZWSG
July 2013

Appendix 6

In the last 12 months, there have been several articles in newspapers and magazine in and outside China. Audubon, a conservation magazine published by the US National Audubon Society, ran an in-depth feature (<http://mag.audubon.org/articles/birds/stemming-tide-shorebird-losses>) on the importance of the Yellow Sea for migratory birds that use the East Asia Australasia Flyway (EAAF) and how an intense push for economic development, especially land reclamation, has resulted in a rapid decline in mudflats in the region in the past few decades. The article highlights the importance of long-term monitoring studies to delineate the timing and location of migration stopover, the number of birds at each site, and the population turnover rate -- such as those supported by the Global Flyway Network.

Nature, a London-based prestigious scientific journal, published a news report (<http://www.nature.com/news/china-s-cordgrass-plan-is-overkill-1.13437>) on an upcoming US\$163 million project to eradicate cordgrass (*Spartina alterniflora*) in the Shanghai Chongming Dongtan National Nature Reserve, a key stopover site on the EAAF. It raises the concerns of whether the planned 8-meter high, 26-kilometre long sea wall would be really necessary and how this would disrupt tidal regimes, prevent native intertidal vegetation to grow back and destroy mudflat habitats.

Similar reports were also published by Xinhua

(<http://finance.qq.com/30055/2013/07/21/7544@8806685.htm>),

China's state news agency, and Chinese-language newspapers such as China Science Daily

(<http://news.sciencenet.cn/sbhtmlnews/2013/6/273875.shtml>),

Beijing Times

(<http://news.dichan.sina.com.cn/2013/07/22/802418.html>)

and News Express

(<http://news.gz.soufun.com/2013-07-22/10574121.htm>).

In addition, Chinese National Geography, a media group of the Chinese Academy of Sciences, has completed a documentary about the ecological importance of the Yellow Sea and how members of the public could help by volunteering with research groups. CCTV, China's state television, is also making a documentary on the topic.

Appendix 7

The full list of the 207 species (plus 1 *Bradypterus* species) recorded April 9 to June 6 2013.

Common Shelduck	Common Sandpiper	Little Grebe
Ruddy Shelduck	Terek Sandpiper	Great-crested Grebe
Swan Goose	Ruddy Turnstone	Great Cormorant
Mallard	Great Knot	Oriental Stork
Spot-billed Duck	Red Knot	Great Egret
Northern Shoveler	Sanderling	Little Egret
Mandarin Duck	Sharp-tailed Sandpiper	Grey Heron
Gadwall	Broad-billed Sandpiper	Purple Heron
Garganey	Curlew Sandpiper	Chinese Pond Heron
Common Teal	Dunlin	Striated Heron
Common Pochard	Little Stint	Black-crowned Night Heron
Common Goldeneye	Red-necked Stint	Eurasian Bittern
Red-breasted Merganser	Spoon-billed Sandpiper	Yellow Bittern
Goosander	Temminck's Stint	Eurasian Spoonbill
Eurasian Wryneck	Long-toed Stint	Black-faced Spoonbill
Great-spotted Woodpecker	Eurasian Oystercatcher	Brown Shrike
Rufous-bellied Woodpecker	Black-winged Stilt	Black-billed Magpie
Common Kingfisher	Pied Avocet	Daurian Jackdaw
Hoopoe	Pacific Golden Plover	Black-naped Oriole
Large Hawk Cuckoo	Grey Plover	Ashy Minivet
Common Cuckoo	Little Ringed Plover	Black-winged Cuckoo-shrike
Common Swift	Kentish Plover	Black Drongo
Fork-tailed Swift	Greater Sand-plover	Blue Rock-thrush
White-throated Needletail	Lesser Sand-plover	White's Thrush
Little Owl	Red-necked Phalarope	Siberian Thrush
Grey Nightjar	Black-tailed Gull	Grey-backed Thrush
Feral Pigeon	Mew (Common) Gull	Eyebrowed Thrush
Oriental Turtle Dove	Vega Gull	Pale Thrush
Eurasian Collared Dove	Heuglin's Gull	Dusky Thrush
Spotted Dove	Glaucous Gull	Chinese Thrush
Japanese Quail	Mongolian Gull	Red-flanked Blue-tail
Common Pheasant	Pallas's Gull	Bluethroat
Moorhen	Black-headed Gull	Siberian Rubythroat
Coot	Saunders's Gull	Siberian Blue Robin
Oriental Pratincole	Relict Gull	Swinhoe's (rufous-tailed) Robin
Grey-headed Lapwing	Common Tern	Daurian Redstart
Common Snipe	Little Tern	Grey-headed Canary Flycatcher
Ruff	Caspian Tern	Red-throated (Taiga) Flycatcher
Black-tailed Godwit	Gull-billed Tern	Yellow-rumped Flycatcher
Bar-tailed Godwit	Whiskered Tern	Asian Brown Flycatcher
Far Eastern Curlew	White-winged Black Tern	Grey-streaked Flycatcher
Eurasian Curlew	Hen Harrier	Dark-sided Flycatcher
Whimbrel	Eastern Marsh Harrier	Common Stonechat
Little Curlew	Pied Harrier	Red-billed Starling
Grey-tailed Tattler	Japanese Sparrowhawk	White-cheeked Starling
Asian Dowitcher	Eurasian Sparrowhawk	Bohemian Waxwing
Marsh Sandpiper	Oriental Honey Buzzard	Crested Myna
Common Greenshank	Common Buzzard	Yellow-bellied Tit
Nordmann's Greenshank	Grey-faced Buzzard	Eastern Great Tit
Spotted Redshank	Common Kestrel	Coal Tit
Common Redshank	Amur Falcon	Chinese Penduline Tit
Wood Sandpiper	Eurasian Hobby	Sand Martin
Green Sandpiper	Peregrine Falcon	Barn Swallow

Red-rumped Swallow
 Light-vented Bulbul
 Zitting Cisticola
 Asian Stubtail
 Lanceolated Warbler
 Pallas's Grasshopper Warbler
 Bradypterus sp.
 Oriental Reed Warbler
 Thick-billed Reed Warbler
 Black-browed Reed Warbler
 Dusky Warbler
 Radde's Warbler
 Eastern Crowned Warbler
 Arctic Warbler
 Blyth's (Claudia's) leaf warbler
 Yellow-browed Warbler
 Pallas's Leaf Warbler

Chinese Leaf Warbler
 Two-barred Warbler
 Pale-legged Leaf Warbler
 Goldcrest
 Reed Parrotbill
 Vinous-throated Parrotbill
 Asian Short-toed Lark
 Chestnut-flanked White-eye
 Tree Sparrow
 Yellow Wagtail
 Forest Wagtail
 Grey Wagtail
 White Wagtail
 Richard's Pipit
 Blyth's Pipit
 Olive-backed Pipit
 Red-throated Pipit

Pechora Pipit
 Buff-bellied Pipit
 Chinese Grosbeak
 Hawfinch
 Siskin
 Brambling
 Common Rosefinch
 Yellow-throated Bunting
 Yellow-browed Bunting
 Black-faced Bunting
 Chestnut-eared Bunting
 Tristram's Bunting
 Little Bunting
 Chestnut Bunting
 Pallas's Bunting



Eastern Crowned Warbler (top) Yellow-browed Bunting (bottom), © A Doyle