

University of Groningen

Red Knot northward migration through Bohai Bay, China

Hassell, Chris J.; Boyle, Adrian N.; Slaymaker, Matt; Chan, Yin Chi; Piersma, Theunis

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version

Publisher's PDF, also known as Version of record

Publication date:

2014

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):

Hassell, C. J., Boyle, A. N., Slaymaker, M., Chan, Y. C., & Piersma, T. (2014). *Red Knot northward migration through Bohai Bay, China: Field Trip Report April-June 2014*. Global Flyway Network. <http://globalflywaynetwork.com.au/bohai-bay/reports-and-papers/>

Copyright

Other than for strictly personal use, it is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license (like Creative Commons).

The publication may also be distributed here under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license. More information can be found on the University of Groningen website: <https://www.rug.nl/library/open-access/self-archiving-pure/taverne-amendment>.

Take-down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Downloaded from the University of Groningen/UMCG research database (Pure): <http://www.rug.nl/research/portal>. For technical reasons the number of authors shown on this cover page is limited to 10 maximum.

Global Flyway Network

The shorebird
ecological demographics &
conservation initiative



RED KNOT NORTHWARD MIGRATION THROUGH BOHAI BAY, CHINA, FIELD TRIP REPORT APRIL - JUNE 2014

Chris Hassell
Adrian Boyle
Matt Slaymaker
Ying Chi Chan
and
Theunis Piersma



Contents

2	Contents
3	Summary
4	Introduction
5	The Study Site
6	Marking of Shorebirds
7	Human Use of the Mudflats Fieldwork in 2014
12	Internationally Important Counts
13	Use of the Mudflats and Resighting Coverage
15	Presence of <i>rogersi</i> and <i>piersmai</i> subspecies
16	Abdominal Profiles
17	Habitat Destruction
18	Nordmann's Greenshank <i>Tringa guttifer</i> Spoon-billed Sandpiper <i>Eurynorhynchus pygmeus</i> New Zealand Red Knots Breeding Birds
19	The Future of Research Passerine Migration Acknowledgments
20	Collaborative partners References
21	Appendix 1 Individual Life Histories
23	Appendix 2 New Zealand Red Knot in Bohai Bay, China
26	Appendix 3 Breeding Species
27	Appendix 4 Bird List

Summary

This year's fieldwork season commenced on 10 April and finished on 5 June 2014.

We recorded 5,018 marked shorebirds from throughout the East Asian-Australasian Flyway (EAAF). Amongst these there were 920 that we could identify to an individual bird, including 345 that were individually recognisable as birds from the GFN colour-banding project in NWA. This was of course dominated by Red Knot *Calidris canutus* with 329 individuals identified, then Great Knot *Calidris tenuirostris* 11 and Bar-tailed Godwit *Limosa lapponica*, 5. As in previous years, this reflects the vital importance of the area for Red Knot. 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 originally captured!

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 counts on 4th May 2014 of 10,890 Black-tailed Godwits *Limosa limosa* being 6.8% of the flyway population and 24,000 Curlew Sandpipers *Calidris ferruginea* representing 13.3% of the EAAF estimated population. These counts were just in a single pond. During April the ponds regularly supported over 10,000 Marsh Sandpiper *Tringa stagnatilis*. The population estimate is not very accurate for this species in the EAAF, but this total could equate to 10% of the flyway population.

As in 2012 and 2013, we estimate that a minimum of 40,000 White-winged Black Terns are using the area at any one time. The population estimate for this species in the flyway is vague, but 40,000 would constitute anything from 4 to 40% of the EAAF population. All of these figures could be much higher if turnover of migrants was taken into consideration. It should be noted that it is impossible to cover all the salt ponds at any one time and these counts are minimum numbers using the area. The salt works area, including ponds used for shrimp production, 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 and shrimp 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 8 northward migration seasons. It is an effective way to give an indication of the immense importance of the Luannan Coast Shorebird Site.

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

We will endeavour to seek funding to enable the study of this important site to be continued. At the very least 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 the Luannan Coast, 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, the Paulson Institute and Wetlands International-China. Tamar Lok, a postdoctoral researcher employed by the University of Groningen and a PhD student, Miss Ying-Chi Chan, will analyse GFN data under the supervision of Theunis Piersma, all work in close cooperation with Beijing Normal University.



Black-tailed Godwit flock © Matt Slaymaker

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 because 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 into 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 conjunction with the work by YHY, studies by GFN have continued during the northward migration seasons of 2009 to this year, 2014. 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 this area that is the single most important staging area for two subspecies of Red Knot in the EAAF, encompassing all Red Knots wintering in Australia and New Zealand, it seemed of utmost importance to continue the survey work. This need was recognised by WWF-Netherlands and WWF-China who have continued to fund the fieldwork in 2014 through their association with GFN (CH remains supported by Vogelbescherming-Netherlands). Beijing Normal University and the Australian Wader Studies Group have also funded aspects of the project. Here we report on what we have achieved in April - June 2014.

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.



Chris introducing a local construction worker to the wonders of shorebirds © Matt Slaymaker

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 fieldwork 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 the local communities is in the region of 10 million RMB per annum (A\$1.7 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 days catch © Adrian Boyle

Fieldwork in 2014

The fieldwork program for 2014 started on 10 April and finished on 5 June, this is 57 continuous days of fieldwork with two to five observers in the field daily. Upon arrival at the study site 1,500 Red Knot were present. Very close to 100% of these were of the *rogersi* subspecies, as we have come to expect from previous observations (see Figure 3). Great Knot were also present, numbering about 4,000, and other species recorded in smaller numbers included Bar-tailed Godwit, Curlew Sandpiper and Sanderling *Calidris alba*. Grey Plover *Pluvialis squatarola*, Eurasian Curlew *Numenius arquata* and Dunlin *Calidris alpina* were all numerous and made up the bulk of the birds recorded. Many individuals of these later three species spend the non-breeding season in Bohai and were presumed not to have migrated from further south. This pattern of species abundance is very similar to previous years.

Table 1. Fieldwork Summary 2007-2014

	Days of Observation	Total Flag Sightings	Total Individually recognisable Birds	Total colour-banded Red Knot from NWA
2007	7	49	3	0
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
2014	57	5,018	920	345

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 – 2014. During northward migration season 2008 CH and Adrian Boyle (AB) were conducting shorebird studies in South Korea.

Total sightings of all marked birds, individually marked birds and colour-banded Red Knot from NWA were all higher than in 2013. There are probably 5 reasons for this.

Good viewing conditions (particularly early in the season), newly marked birds in the population from NWA, predictable behaviour from the flocks of Red Knots, our increasing knowledge of the area and the fact that more ELF's are being applied to birds throughout the EAAF.

We experienced good viewing conditions for much of the season. It was less smoggy, cloudy and windy than has been the case in previous years. Also, we now have a much better understanding of how the shorebirds use the area from our continued work over the years. During late May Red Knots were using the inter-tidal mudflats at Nanpu more than in 2013, so walking out on to the mud to view flocks of thousands was a regular part of our fieldwork days. Viewing birds on the mudflats still presents challenges with birds often feeding in shallow water making recording colour-bands on the tarsi difficult. If the birds fly away from the observer to a new feeding patch it can mean a walk of one or two kilometres to get close enough to start scanning birds again. In North West Australia, after northward migration 2013 and prior to northward migration 2014 we marked 156 Red Knot with colour-bands. Most of these marked birds would now be adults and therefore moving north during April and May 2014.

In previous years and especially so in 2013, towards the end of the fieldwork season in late May and early June the Red Knots were frequently feeding in the adjacent salt works. This situation can occasionally lead to ideal circumstances for recording flags and colour-bands. The management of the salt ponds results in the water levels in the ponds changing as water flows into and out of them. When they get low enough to expose the muddy substrate at the base of the pond they can be perfect habitat for many shorebird species. Both the salt works and the adjacent inter-tidal mudflats of the Luannan Coast are vital components of the area for shorebird conservation.

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 previous years, by early May most birds flew many kilometres from the mudflats to their salt pond 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.



Adrian waiting for the fog to lift in the early morning © Matt Slaymaker

Table 2 below shows the totals of all marked migratory shorebirds recorded during the fieldwork and the location they were originally marked. The birds with plain flags just indicate the original banding location and cannot 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 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 appear to be a good reflection of the numbers of flagged birds present during the study period.

Table 2. Totals of marked birds recorded during fieldwork 2010 to 2014.

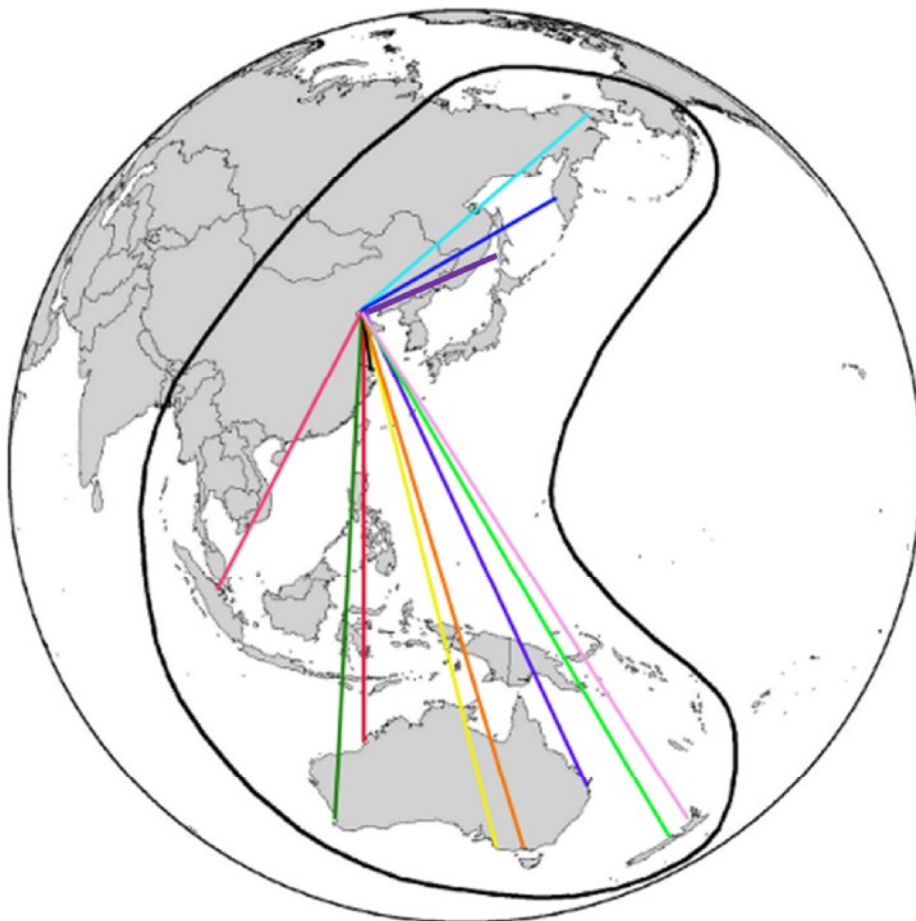
Marked at	2010	2011	2012	2013	2014	Total 2010-2014	Individuals 2014
Bohai Bay, China	122	96	129	125	108	580	2
Chongming Dontang, China ELF	48	114	104	103	190	559	56
Chongming Dontang, China Plain	273	333	461	449	489	2005	0
Chukotka, Russia	1	32	43	50	62	188	13
Hong Kong	5	23	19	44	39	130	12
India	1	0	0	0	0	1	0
Japan	1	7	10	5	9	32	0
Java, Indonesia	1	0	0	0	0	1	0
Kamchatka, Russia	1	3	4	1	0	9	0
King Island, Australia	3	2	4	0	1	10	0
New South Wales, Australia	0	2	0	1	0	3	0
Northern Territory, Australia	3	0	0	1	0	4	0
NWA Colour Band, Australia	317	412	904	613	922	3168	345
NWA ELF, Australia	305	312	592	642	891	2742	245
NWA Plain, Australia	605	503	574	411	331	2424	0
NWA Tracking 2000, Australia	2	0	0	0	0	2	0
New Zealand Colour-band	171	228	171	177	144	891	63
New Zealand ELF	243	374	340	511	442	1910	129
New Zealand Plain	186	175	198	205	174	938	0
Phillipines	0	0	0	1	1	2	0
Queensland, Australia	7	7	8	27	12	61	2
Sakhalin, Russia	0	4	5	48	52	109	0
Saunder's Gull, China	1	9	0	1	1	12	1
Singapore	1	0	0	1	1	3	0
South Australia, Australia	12	35	62	73	54	236	13
South Korea	0	0	0	0	8	8	0
Sumatra, Indonesia	12	4	5	8	7	36	0
SW Western Australia	6	0	0	1	4	11	0
Taiwan	4	0	2	3	2	11	2
Thailand	66	47	70	129	213	525	0
Victoria, Australia	746	644	776	910	755	3831	0
Victoria, Australia ELF	0	0	22	75	103	200	46
Yalujiang, China	0	0	0	1	3	4	0
Totals	3143	3366	4503	4616	5018	20646	929
Number of Species	14	14	13	18	17		

These records (2010-2014) represent 26 different marking areas in 13 countries and territories within 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 2014 (5,018) is 8.5% higher than that of 2013 (4,616). The GFN team was comprised of the same skilled and experienced observers over a similar time frame for both years. The records of individually colour-banded birds from NWA of 345 (329 Red Knot, 11 Great Knot, 5 Bar-tailed Godwit) was 18% higher than 2013's total of 285 (269 Red Knot, 13 Great Knot, 3 Bar-tailed Godwit). This rise is possibly due to the good marking effort mentioned earlier in the report. The GFN project is getting 1,000's of resightings in Roebuck Bay and 80 Mile Beach in NWA in addition to this set of data compiled from resighting work 6,400km distant from the marking location. 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 shorebird species.



Grey Plover marked in Hong Kong © Adrian Boyle

Figure 2. Between 2009 and 2014 we have recorded Red Knot from 17 different banding locations throughout the EAAF. The map below is a representation of some of these sites.



Internationally Important Counts

During the 8 years GFN have been visiting the Luannan Coast we have been doing regular formal and informal counts. The importance of the site is not in any doubt. Table 3 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 with our current resources. Only one count from 2014 was added to the table below. This was a count of 10,890 Black-tailed Godwits. We did however have significant counts of various species in the salt ponds including 23,773 Curlew Sandpipers, 8,637 Marsh Sandpipers and 2,616 Sharp-tailed Sandpipers *Calidris acuminata*, 515 Asian Dowitchers *Limnodromus semipalmatus* and 82 Ruff *Philomachus pugnax*.

Table 3. Internationally important counts of species at the Luannan shorbird site.

Species	Scientific Name	Date recorded	Count = c Estimate = e	% of EAAF Population present	EAAF Population (Bamford 2008) except *, **, ***	1% Criteria
Black-winged Stilt	<i>Himantopus himantopus</i>	30.04.2008	653 c	2,6	25,000-100,000	250
Pied Avocet	<i>Recurvirostra avosetta</i>	30.04.2008	712 c	2,8	25,000-100,000	250
Grey Plover	<i>Pluvialis squatarola</i>	30.04.2008	3455 c	2,8	125.000	1.250
Asian Dowitcher	<i>Limnodromus semipalmatus</i>	13.05.2008	755 c	3,3	23.000	230
Black-tailed Godwit	<i>Limosa limosa</i>	28.04.2014	10.890	6,8	160.000	1.600
Eurasian Curlew	<i>Numenius arquata</i>	25.05.2007	425 c	1,1	40.000	400
Spotted Redshank	<i>Tringa erythropus</i>	16.05.2013	660 c	2,6	25,000-100,000	250
Marsh Sandpiper	<i>Tringa Stagnatilis</i>	26.04.2012	>10,000 e	10	100,000-1,000,000	1.000
Nordmann's Greenshank	<i>Tringa nebularia</i>	09.05.2012	10 c	1	1.000	10
Great Knot	<i>Calidris tenuirostris</i>	14.04.2010	7000 c	1,8	380.000	3.800
Red Knot	<i>Calidris canutus</i>	13.05.2011	66,500 c	63,3	104,986*	1.050
Sanderling	<i>Calidris alba</i>	29.05.2012	2,430 c	11	22.000	220
Red-necked Stint	<i>Calidris ruficollis</i>	16.05.2013	20,587 e	6,3	325.000	3.250
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>	29.04.2009	5,242 c	3,3	160.000	1.600
Curlew Sandpiper	<i>Calidris feruginea</i>	11.05.2010	80,000 e	44,4	180.000	1.800
Dunlin	<i>Calidris alpina</i>	29.04.2009	9950 c	1	950.000	9.500
Spoon-billed Sandpiper	<i>Eurynorhynchus pygmeus</i>	28.05.2013	2 c	0,5	400**	4
Broad-billed Sandpiper	<i>Limicola falcinellus</i>	25.05.2009	6000 c	24	25.000	250
White-winged Black Tern	<i>Chlidonias leucopterus</i>	var. dates	40,000 e	40	100,000-1,000,000***	1.000

* Rogers et al 2010

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

*** Delany & Scott 2006



Pied Avocet © Matt Slaymaker

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 and changes each year as local conditions change and affects the suitability of different areas for the birds (particularly Red Knot our focus species and a 'specialised feeder'). We now have four major mudflat sites within the study area and also the salt ponds. This year we once again worked regularly at Zuidong, particularly early in the season when large numbers of Great Knot were using the mudflats there. The mudflats there had 'improved'. The thick green algal covering of 2013 had gone and when we were scanning there we saw Great Knots and Red Knots taking shellfish. However this site is now adjacent to a six-lane highway and construction sites. This makes it easily accessible to people and during late May and early June up to 1,300 people are on the mudflats on weekends and Public Holidays collecting shellfish. It's not surprising that no birds are there then!

The North Beipu site that we worked at quite a lot in 2013 was visited a little less in 2014. A small-scale reclamation project was taking place and the mudflats were subsequently impossible to access. We did still scan in the adjacent shrimp ponds. 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 mitigate the problem. After liaison with the local villagers and with advice and encouragement from David Melville, a visiting shorebird expert from New Zealand, we have sprayed some of the patches at the Nanpu site. We used an herbicide widely used for *Spartina* control in New Zealand and other parts of the world. We have just conducted a small-scale trial to assess if it is practical to control *Spartina* with this method in this area. It was extremely hard work, physically, for Adrian to move around in the very soft mud with 20kg of spray and sprayer on his back. The upside was it provided the rest of the team with lots of entertainment!



Adrian spraying *Spartina* © Ying Chi Chan

The destruction of the mudflats at Beipu, the most northerly of our study sites, that started in March 2011 had changed dramatically in 2012 and has remained the same in 2013 and 2014. 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 mud pumped into them in 2011 are dry mud and still devoid of birds. The Beipu mudflats held almost no birds for most of their area during both 2012 and 2013. This season some birds were using the area, but in small numbers. We did scan on occasions there, but it seems that it is still not suitable or certainly not favoured by the birds.

The Nanpu mudflat is usually where most of the birds congregate and subsequently where the vast majority of our fieldwork is done. This was no different during the 2014 season. One major change to the Nanpu mudflats was that there was zero fishing nets or ‘mud-pumps’ collecting shellfish. It appears there was some dispute between two local villages over access to the fishing rights and while this was resolved between the parties and the authorities no fishing activities took place. The dispute was resolved in late May, but by then as the season was well advanced neither village started fishing operations. This led to quiet mudflats for us to work on. It is unclear if it had any effect on the birds. Reasonable levels of fishing activity appear not to concern the birds. Viewing can be done from the seawall during the smaller tides and out on the flats during the spring tides. The Nanpu mudflats are still relatively undisturbed and undoubtedly the most important of the remaining mudflats in the area. There has been some pumping for small-scale reclamation done in 2006 and artificial islands have been built close off-shore for oil extraction, but the mudflats abutting the seawall are still excellent shorebird foraging grounds. This is the area that must be saved and given Nature Reserve status to enable the Red Knot and many other migratory shorebird species of the EAAF to maintain sustainable population levels.

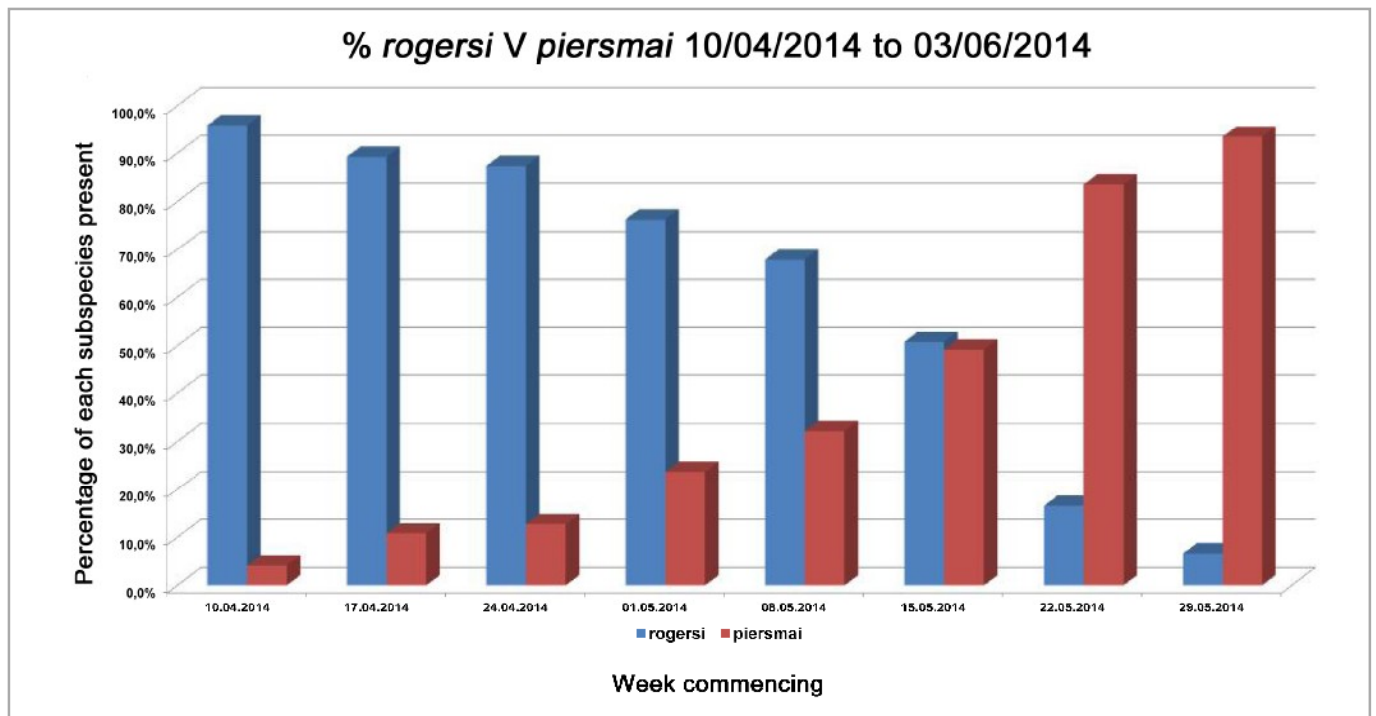


Shorebirds foraging in front of Caofeidian © Matt Slaymaker

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 totalling 39,864 individuals. This number is considerably lower than in 2012 and 2013, but various factors and the increased numbers of colour-bands led to this taking a lower priority this year. This sample size is still sufficient to assess the timing of migration of the two subspecies through the site. We assigned each bird to a subspecies based on 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 observed in previous seasons (figure 3).

Figure 3. 39,864 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' *piersmai* (left) and *rogersi* (right) © Adrian Boyle

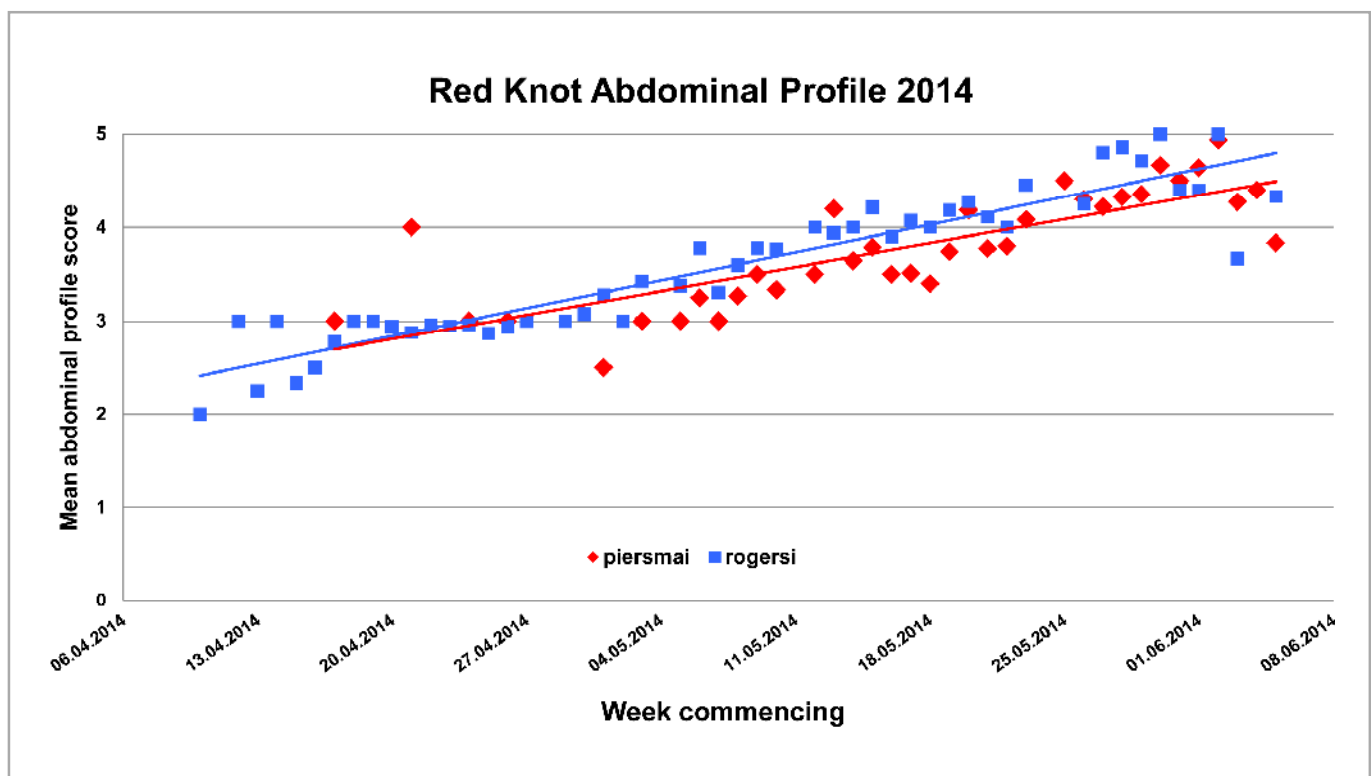
Abdominal Profiles

In the absence of body 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 into 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 both subspecies and most individuals are arriving at our Luannan Coast study site in good condition whilst almost no birds are arriving in very poor condition (AP 1). This might mean that they are stopping or staging between their Australian and New Zealand non-breeding sites. We do know that some birds stop in Hong Kong and southern China from resighting records. This is however one piece of the Red Knot migration question that we are still attempting to answer with various methods; GFN and the Australian Wader Studies Group (AWSG) currently have 42 geolocators deployed with the hope that we will recover some of these birds in future capture events to try and gain further insight into 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' cannot 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, The Paulson Institute and Wetlands International-China to try and conserve 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 2014. The dip in the last week of sightings is probably because most of the 'fat' birds have left leaving a lighter cohort behind.



Habitat Destruction

The fieldwork 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 was the second 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 into 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 mudflats have been converted to industrial land in this way. Between 1994 and 2009, approximately 453km² of sea area in Bohai Bay was lost to development. This included 156km² of intertidal mudflats being destroyed, a 36% loss of the total area of 428km² 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.

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).

WWF-China, The Paulson Institute and Wetlands International-China continue to work towards establishing a Luannan Coast Nature Reserve and Wetland Centre.



Seawall construction at Beipu April 2014 © Matt Slaymaker

Nordmann's Greenshank *Tringa guttifer*

Nordmann's Greenshank is an endangered shorebird (IUCN 2001) with a continuing decline in its population. During our fieldwork we saw up to a minimum of 7 on any one day. Nordmann's Greenshanks were recorded on 29 days between April 14 and May 15. We saw them feeding on the mudflats at Nanpu and feeding and roosting in the adjacent salt pans.



Nordmann's Greenshank *Tringa guttifer* © Adrian Boyle

Spoon-billed Sandpiper *Eurynorhynchus pygmeus*

In 2012 we recorded one Spoon-billed Sandpiper and two individuals of this critically endangered species were seen during our fieldwork in late May 2013. We did not record any this season although it is worth noting that viewing conditions in the salt ponds were less favourable than previous years and we could easily have missed birds.

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 2 is a report from Adrian Riegen of the New Zealand Wader Studies Group.

Breeding Birds

The Luannan Coast also hosts some breeding migratory shorebirds and terns. A short note on these is provided in Appendix 3.



Black-winged Stilts during courtship © Adrian Boyle

Future research

GFN, with ongoing funding from Vogelbescherming-Netherlands, will continue to document the fates of four shorebird species at their non-breeding sites in NWA by applying individual colour-band combinations and conducting intensive resighting scans for the marked birds. A comprehensive database of sightings from the marking sites in NWA and throughout the flyway is being developed. With the work in Bohai Bay and sightings from other shorebird colleagues throughout the flyway, particularly in New Zealand and China, we will be able to assess the effects of human-induced habitat change on survival rates of the populations. GFN will continue conservation efforts at Bohai Bay in conjunction with WWF-China, The Paulson Institute and Wetlands International-China. 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. All this work is made possible under the Chair in Global Flyway at the University of Groningen, with support from WWF-Netherlands and Vogelbescherming/Birdlife Netherlands, with in-kind support of the NIOZ Royal Netherlands Institute for Sea Research and in close cooperation with Beijing Normal University.

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 4 has a complete list of all the birds seen during the fieldwork period and includes some rare and difficult to see species.

Acknowledgments

Financial support for this season's work came from Birdlife-Netherlands, WWF-China, WWF-Netherlands, the Australasian Wader Studies Group and Beijing Normal University. A huge thank you to Yang Hong-Yan, Lei Weipan 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 for 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 2014 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 Clare Morton for editing this report. Thank you to Kim Onton for figures 3 and 4. GFN acknowledges the Yawuru People via the offices of Nyamba Buru Yawuru Limited for permission to catch birds to be marked for this project on the shores of Roebuck Bay, traditional lands of the Yawuru people. GFN acknowledges the Karajarri and Nyangumarta people for permission to catch birds to be marked for this project on the shores of 80 Mile Beach, traditional lands of the Karajarri and Nyangumarta people.

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

References

- ❖ Rogers, D. I., H-Y Yang, C. J. Hassell, A. N. Boyle., K. G. Rogers, Bing Chen, Z-W Zhang and T. Piersma. 2010. Red Knots (*Calidris canutus piersmai* and *C. c. rogersi*) depend on a small threatened staging area in Bohai Bay, China. *Emu* 110: 307-315.
- ❖ Wetlands International. 2006. *Waterbird Population Estimates* – Fourth Edition. Wetlands International, Wageningen, The Netherlands
- ❖ Yang H-Y., Bing Chen, M. Barter, T. Piersma, Zhou. Chun-Fa, Li. Feng-Shan and Zhang. Zheng-Wang. 2011. Impacts of tidal land reclamation in Bohai Bay, China: ongoing losses of critical Yellow Sea waterbird staging and wintering sites. *Bird Conservation International* (2011) 21:241–259.
- ❖ Yang, H.-Y., Chen, B., Ma, Z., Hua, N., van Gils, J.A., Zhang, Z.-W. & Piersma, T. (2013). Economic design in a long-distance migrating molluscivore: how fast-fuelling Red Knots in Bohai Bay, China, get away with small gizzards. *Journal of Experimental Biology* 216, 3627-3636.
- ❖ Zöckler, C., Syroechkovskiy, E. & Atkinson, P.W. 2010a. Rapid and continued population decline in the Spoon-billed Sandpiper *Calidris pygmeus* indicates imminent extinction unless conservation action is taken. *Bird Conservation International* 20: 9–111.



Ying Chi Chan scanning on the Nanpu mudflats © Adrian Boyle

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		24/04/2012	Tattler Rocks, Roebuck Bay, Broome, Australia
Banding 1BYLL		28/05/2012	Nan Pu, Bohai Bay China
14/09/2008	Richards Point, Roebuck Bay, Broome, Australia 05241744 (1BYLL) Aged 2	30/05/2012	Nan Pu, Bohai Bay China
		31/05/2012	Nan Pu, Bohai Bay China
Resightings of 1BYLL			
06/10/2008	Stilt Viewing, Roebuck Bay, Broome, Australia	28/08/2012	Wader Beach, Roebuck Bay, Broome, Australia
18/05/2009	Nan Pu, Bohai Bay, China	28/09/2012	Richards Point, Roebuck Bay, Broome, Australia
23/05/2009	Nan Pu, Bohai Bay China	21/12/2012	Stilt Viewing, Roebuck Bay, Broome, Australia
25/05/2009	Nan Pu, Bohai Bay China	09/02/2013	Stilt Viewing, Roebuck Bay, Broome, Australia
04/10/2009	Wader Beach, Roebuck Bay, Broome Australia	24/04/2013	Quarry Beach (West), Roebuck Bay, Broome, Australia
31/12/2009	Wader Beach, Roebuck Bay, Broome Australia	19/05/2013	Nan Pu, Bohai Bay, China
21/05/2010	Zuidong Bohai, China	27/05/2013	Prison Salt Ponds Bohai Bay China
23/05/2010	Zuidong Bohai, China	29/05/2013	Prison Salt Ponds Bohai Bay, China
24/05/2010	Zuidong Bohai, China	15/12/2013	Wader Spit, Roebuck Bay, Broome, Australia
27/05/2010	Zuidong Bohai, China	22/04/2014	Wader Beach, Roebuck Bay, Broome, Australia
19/04/2011	Wader Spit, Roebuck Bay, Broome Australia	19/05/2014	Nan Pu, Bohai Bay, China
09/05/2011	Nan Pu, Bohai Bay China	23/05/2014	Nan Pu, Bohai Bay, China
16/05/2011	Nan Pu, Bohai Bay China	26/05/2014	Nan Pu, Bohai Bay, China
20/05/2011	Nan Pu, Bohai Bay China	28/05/2014	Nan Pu, Bohai Bay, China
22/05/2011	Nan Pu, Bohai Bay China	09/05/2014	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		

Below is an example of a Red Knot that has moved away from Roebuck Bay to New Zealand, but has been seen for 5 years at Bohai 2010-2014. This bird is always recorded as the *rogersi* subspecies on plumage characteristics when seen in breeding plumage in Bohai Bay. The fact it spends the non-breeding season in New Zealand, arrives early in Bohai (11/04/2014) and presumably stays for over a month (21/05/2012) are also characters that most *rogersi* exhibit. It can be reasonably speculated that the sighting in Taiwan on 9/04/2012 was after a direct flight of 10,000km from New Zealand. Geolocator studies have shown this flight to be possible for Red Knot. This life history has been edited for presentation.

Summary of sightings

Red Knot		13/05/2011	Nan Pu, Bohai Bay, China
Banding/Recapture 2YYLB		17/12/2011	Kaipara Harbour, Auckland, New Zealand
16/08/2008	Richards Point, Roebuck Bay, Broome, Australia 05250589 2YYLB Aged 2 Sex: M	09/04/2012	Wang Gong, Chang-Hua County, Taiwan
Resightings of 2YYLB		21/05/2012	Nan Pu, Bohai Bay, China
23/08/2008	Wader Beach, Roebuck Bay, Broome, Australia	20/04/2013	Nan Pu, Bohai Bay, China
16/11/2008	Clark's Bay, Manukau Harbour, South Auckland, New Zealand	30/04/2013	Nan Pu, Bohai Bay, China
03/09/2009	Miranda Firth of Thames, South Auckland, New Zealand	04/05/2013	Nan Pu, Bohai Bay, China
28/12/2009	Clifton Beach, Whitford, Auckland, North Island, New Zealand	05/05/2013	Nan Pu, Bohai Bay, China
01/04/2010	Kaipara Harbour, Auckland, New Zealand	14/05/2013	Nan Pu, Bohai Bay, China
20/05/2010	Nan Pu, Bohai Bay, China	16/05/2013	North Beipu Bohai Bay, China
17/04/2011	Zuidong, Bohai Bay, China	11/04/2014	Nan Pu, Bohai Bay, China
17/04/2011	Zuidong, Bohai Bay, China	13/04/2014	Nan Pu, Bohai Bay, China
07/05/2011	Nan Pu, Bohai Bay, China	14/04/2014	Nan Pu, Bohai Bay, China
		15/04/2014	Nan Pu, Bohai Bay, China
		17/04/2014	Nan Pu, Bohai Bay, China
		19/04/2014	Nan Pu, Bohai Bay, China



2YYLB 09/04/2012 Wang Gong, Chang-Hua County, Taiwan © Chih-Hui Lui

Appendix 2

New Zealand Red Knot in Bohai Bay, China

A brief review to the 2014 sightings

This introduction was written in 2013 but is still relevant in 2014.

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 capturing the bird or finding the bird dead and then reporting the band number, 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 shorebirds. 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 shorebird staging sites, and in 2000 with Yang Hongyan, 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 shorebird workers and enthusiasts visiting East Asia, these flagged birds would be seen and thus help identify more staging sites.

Counts of Red Knot and sightings of New Zealand engraved flags show that few sites outside the Luannan Coast, Bohai Bay appear to hold significant numbers of Red Knot, (see table 1). More effort does go into looking for flags in Luannan than any other part of the flyway but nevertheless some other sites are covered quite well. Yalu Jiang National Nature Reserve on the China/North Korean border in particular is well surveyed but has very few Red Knots.

In 2009 the Global Flyway Network team, led by Chris Hassell started fieldwork that focused on the Luannan coast of northwest Bohai Bay 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 an ever increasing number of New Zealand colour-banded and engraved-flagged Red Knot as well.

The team's impressive efforts over the past six years have generated a huge amount of data and clearly shown that the small area of the Luannan Coast 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.

What has changed since 2013 is the volume of data generated from the fieldwork. I was privileged to spend a week in Bohai Bay with the team in May 2014 and was impressed with the effort the team go to in identifying the marked birds. The following data summarises engraved flag sightings of New Zealand Red Knot along with Red Knot flagged in Victoria, Northwest Australia, Chongming Dintang and Chukotka, which have been seen at least once in New Zealand.

Table 1. All overseas sightings of individual New Zealand engraved-flagged Red Knot on northward and southward migration to June 2014

Bohai Bay - China	395
Newcastle – NSW, Australia	28
SE Queensland - Australia	8
Gulf of Carpentaria – Australia	5
Chongming Dongtang, China	4
NSW (other than Newcastle), Australia	3
Japan	2
Yalu Jiang – China	2
Taiwan	2
NW Australia	2
Chukotka - Russia	1
South Korea	1

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

Year	Sightings	Number of individual Birds
2007	1	1
2008	5	5
2009	21	21
2010	90	79
2011	190	136
2012	154	117
2013	344	184
2014	249	115

A total of 453 individual Red Knots have been seen outside New Zealand, of which 395 have been seen in Bohai Bay, representing 87,2% of all those Red Knot seen outside New Zealand.

Putting the Bohai sightings into context

81 of the 395 individuals seen in Bohai Bay since 2007 have only been seen there. 1,001 Red Knots have been fitted with white engraved flags. A total of 895 have been seen at least once, therefore the 395 seen in Bohai Bay represents about 39% of all birds seen. A remarkable total as the marking and resighting sites are some 10,000km apart. There have been 4,889 engraved flag sightings recorded at all sites in New Zealand and elsewhere on the Flyway, so the 1,054 sighting from Bohai Bay represent 21% of all sightings.

Chukotka, Russia

One Red Knot CKR flagged in Chukotka, Russia, was seen in New Zealand on 19.02.2012 and then seen in Bohai Bay in April 2012 and May 2014.

Chongming Dongtan National Nature Reserve

Three engraved flagged Red Knots marked in Chongming Dao, China were seen in Bohai in 2014 after being seen in New Zealand. 4T was seen at Karaka, Manukau Harbour eight times in 2010 and 2011 but not since. It has been seen twice in Bohai Bay on 14.05.13 and 19.05.14 and 9W, which was seen once in New Zealand on 20.10.13 then three times in Bohai in April 2014.

Victoria

16 Orange engraved flagged Red Knot were seen in the Bohai in 2014 having been seen previously in New Zealand between 2012 and 2014. It is likely that these orange flagged birds are now regulars in New Zealand during the non-breeding season.

Two of these were seen at Farewell Spit in the South Island and the rest were seen in the Auckland area. Flag 64 was also seen once in the far north of New Zealand possibly on northward migration before returning to Auckland the following October. The last sighting was 02.02.2014, it was then seen at Nanpu on 25.04.2014.

Northwest Australia

Four yellow engraved flags have been seen in New Zealand prior to sighting in Bohai Bay. Of particular interest was ZPW, seen in New Zealand from December 2011 to 10.03.2013. 19 days later on 30.03.2013 it was seen in Bohai Bay. During southward migration it was seen at Newcastle, NSW, Australia between 24.10.2013 and 06.11.2013. It was not seen that summer in New Zealand but was probably there, before heading north to be seen at Bohai Bay again on 16.05.2014.

These sightings show that the Luannan Coast of Bohai Bay is a vitally important staging site for birds from a variety of original sites outside New Zealand.

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
August 2014



A Red Knot marked in New Zealand © Adrian Boyle

Appendix 3

In addition to the migratory shorebirds and terns passing through the Luannan Coast there are 6 species we have recorded breeding and 2 we suspect to breed. Pied Avocet *Recurvirostra avosetta* is the most common species we record. They breed on the bare banks of salt ponds, on open areas of dry mud in unused or recently reclaimed salt ponds and on small islands within the salt ponds. Egg collecting for food by people and destruction of nests by stray dogs appears to be the main threats to breeding success. Black-winged Stilt *Himantopus himantopus* and Kentish Plover *Charadrius alexandrinus* breed in the same locations in good numbers. Little Ringed Plover *Charadrius dubius*, are assumed to breed. We have witnessed territorial behaviour but have not actually recorded nesting. Common Tern *Sterna hirundo* breed in scattered colonies numbering from a few pairs to a few hundred pairs. The terns are always on islands. The subspecies *longipennis* is the most common subspecies to breed in our study area but we have recorded and photographed birds with black-tipped red bills of the subspecies *minussensis*. Paul Holt (a Beijing-based bird tour operator) informs us that "*minussensis* is regular on the Hebei coast (and in Beijing) and often outnumbers *longipennis*. They breed in both areas too, occasionally even pairing with *longipennis*". Little Terns *Sterna albifrons* breed in small numbers in the same habitat as the Pied Avocet. Whiskered Terns *Chlidonias hybridus* breed in reed beds inland from the salt ponds, but are included here as they forage over the salt ponds and inter-tidal mudflats. We have seen Gull-billed Tern *Gelochelidon nilotica* affinis courtship feeding, but have not recorded any nests, so we cannot be certain they breed in the area although it is likely.



Kentish Plover on her nest © Mr Chen Bing

Appendix 4

Bird List

The full list of the 208 species recorded April 10 to June 5 2014

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

Light-vented Bulbul
 Zitting Cisticola
 Asian Stubtail
 Lanceolated Warbler
 Gray's Grasshopper Warbler
 Pallas's Grasshopper Warbler
 Siberian Bush Warbler
 Oriental Reed Warbler
 Thick-billed Warbler
 Black-browed Reed Warbler
 Dusky Warbler
 Radde's Warbler
 Eastern Crowned Warbler
 Arctic Warbler
 Kamchatka Leaf Warbler
 Claudia's Leaf warbler
 Yellow-browed Warbler

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

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



Saunders's Gull © Adrian Boyle



White-winged Black Tern © Adrian Boyle



Red Knots arrive at a salt pond © Adrian Boyle