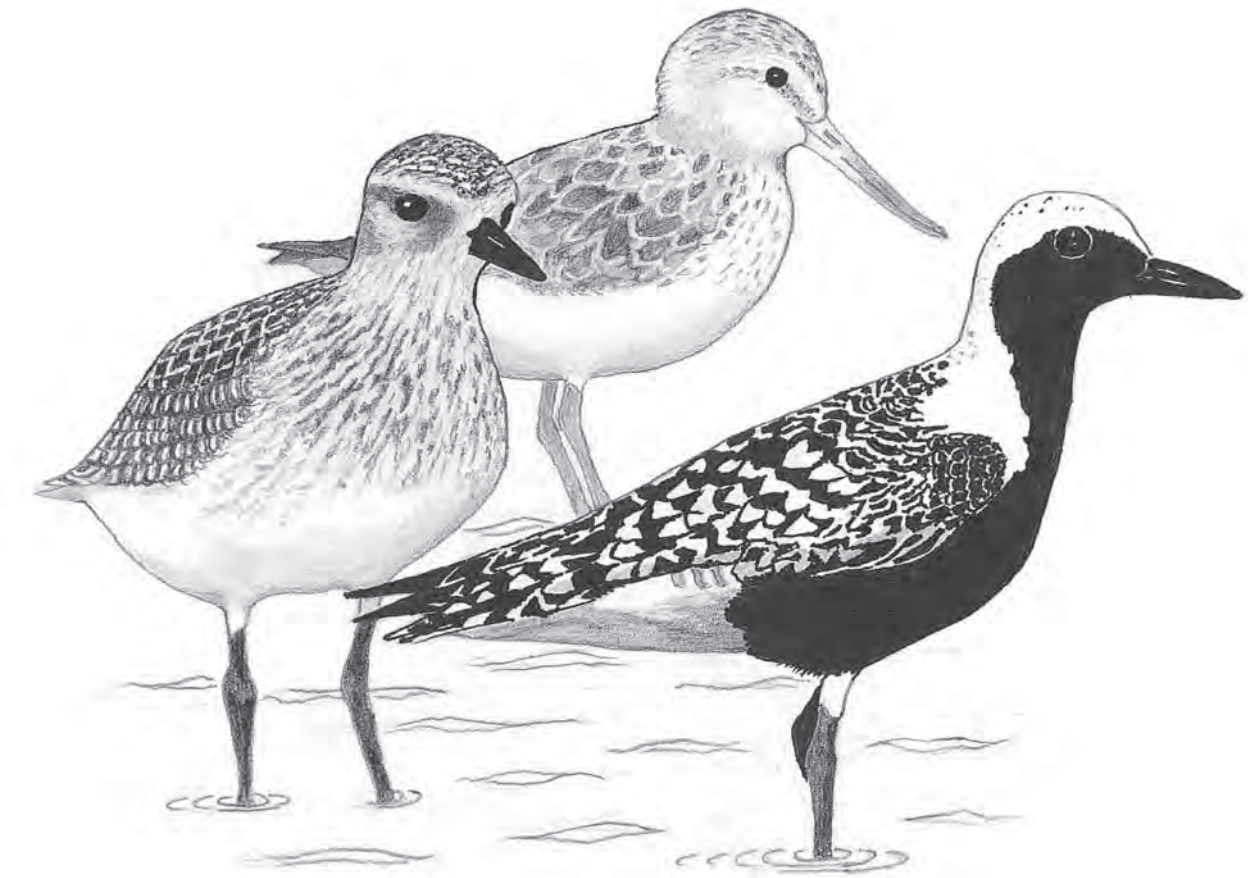
Stilt

The Journal for the East Asian-Australasian Flyway



AWSG
Australasian Wader Studies Group

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MISSION STATEMENT

To ensure the future of waders and their habitats in Australia through research and conservation programmes, and to encourage and assist similar programmes in the rest of the East Asian–Australasian Flyway.

OBJECTIVES

- Monitor wader populations through a programme of counting and banding in order to collect data on changes on a local, national and international basis.
- Study the migrations of waders through a programme of counting, banding, colour flagging, collection of biometric data and use of appropriate scientific instruments.
- Instigate and encourage other scientific studies of waders such as feeding and breeding studies.
- Communicate the results of these studies to a wide audience through its journal *Stilt* and membership newsletter the Tattler, other journals, the internet, the media, conferences and lectures.
- Formulate and promote policies for the conservation of waders and their habitat, and to make available information to local and national governmental conservation bodies and other organisations to encourage and assist them in pursuing this objective.
- Encourage and promote the involvement of a large band of amateurs, as well as professionals, to achieve these objectives.

MEMBERSHIP OF THE AUSTRALASIAN WADER STUDIES GROUP

Membership of the AWSG is open to anyone interested in the conservation and research of waders (shorebirds) in the East Asian–Australasian Flyway. Members receive the twice yearly bulletin *Stilt*, and the quarterly newsletter *Tattler*. Please direct all membership enquiries to the Membership Manager at BirdLife Australia, Suite 2-05, 60 Leicester St, Carlton Vic 3053, AUSTRALIA.
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WADERS OF KARIMUNJAWA NATIONAL PARK, CENTRAL JAVA, INDONESIA

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Wader surveys were carried out between December 2007 and December 2013 covering eight areas in Karimunjawa National Park, Central Java, Indonesia. As a result, 23 wader species were recorded, with 10 new records for the park. Terusan on Kemujan Island is an intertidal area of approximately 10 hectares and had the highest number of species recorded. In Terusan, there were 17 species recorded with nine species not recorded elsewhere on the park. Oriental Pratincole (*Glareola maldivarum*), Whimbrel (*Numenius phaeopus*), Grey-tailed Tattler (*Heteroscelus brevipes*) and Common Sandpiper (*Actitis hypoleucos*) were the most common and widespread waders in Karimunjawa National Park. A compilation of all wader species listed for Karimunjawa NP, including historical records, is presented.

INTRODUCTION

Karimunjawa National Park is one of seven marine national parks in Indonesia. It is located in the Karimunjawa Archipelago (5°40' 39"-5°55' 00"S, 110°05' 57"-110°31' 15"E) in the Java Sea between Java and Borneo. Of 27 islands in the Karimunjawa Archipelago, 22 are managed by the park, which covers 7,033 ha of land and 104,592 ha of marine waters including several natural ecosystems, such as coral reefs, seagrass, mangroves, forest beach and lowland forest (Sumaryati *et al.* 2007). The archipelago has a human population of 8,733 living in villages on four islands - Karimunjawa, Kemujan, Parang and Nyamuk Island (Badan Pusat Statistik [Statistics Indonesia] year 2010). Administratively, the park is located within Karimunjawa sub-district, part of Jepara district, Central Java province (Anon. 2013).

Karimunjawa is the largest island (around 4,300 ha), where the principal village of the sub-district and the ferry dock are located. The second-largest island is Kemujan (1,500 ha), which is adjacent to Karimunjawa Island and has the only airport in the group (Dewadaru Airport). Karimunjawa and Kemujan are connected by approximately 350 m of mangrove forest and a bridge, so appear to be one single island.

Ornithological visits

Unlike many small groups of islands in Indonesia, the ecology of the Karimunjawa Archipelago has been relatively well studied, starting with visits by Dutch colonial researchers in the late 19th Century, and early 20th Century, then followed more recently by Indonesian researchers. The avifauna of the Karimunjawa Archipelago has been studied since Koorders (1889) visited the islands in November-December 1888, and reported 29 bird species, amongst which were three waders (*Numenius* sp. and two *Tringa* spp.); Koorders' collection of six bird species was briefly described by Vorderman (1889). A collection of 36 bird species was obtained by Dr. K. W. Dammerman and collectors from Museum Zoologicum Bogoriense (MZB) in 1926-1930 (Chasen & Kloss 1933) from which new subspecies of a parakeet, bulbul, and tailorbird, all endemic to the Karimunjawa Islands, were described (Chasen & Kloss 1932, Sudaryanti *et al*. 2006). These collections also contained four wader species, including the Green Sandpiper *Tringa ochropus*, rarely recorded in the region (Chasen & Kloss 1933). Other collectors, such as J. Houwing (in Hoogerwerf 1949) and M. E. G. Bartels and sons (Hoogerwerf 1947, Hoogerwerf 1949, Hellebrekers & Hoogerwerf 1967, Whitten *et al.* 1990) visited the islands to collect eggs of several tern species and also various land birds, including a new endemic race of green pigeon (Sudaryanti *et al.* 2006). After Hoogerwerf's last visits in the 1950s, no ornithological reports were made until 1996 when a survey was conducted by Sub-Balai Konservasi Sumber Daya Alam Jawa Tengah (the Conservation and Natural Resources [Forestry] Office of Central Java) in August-September 1996 (Anon. 1996), ten years after the marine national park was established. In 2003 the second survey was conducted and thereafter surveys have become a regular activity of the park staff. Additionally, recent ornithological research has been conducted by locals (Rahman *et al.* 2004, Rahayuningsih *et al.* 2007, Rahayuningsih 2009).

Despite the number of ornithological surveys that have been made to the islands, none have been aimed solely at waders. Here we report the results of wader surveys with the objective of compiling basic information on the diversity, status, distribution and population of the Charadriiformes on the islands.

METHODS

Study areas

Surveys were made at several locations on the Karimunjawa Islands where wetland habitats are found. Visits were largely restricted to Legon Lele, Jati Kerep and Cikmas on Karimunjawa Island, and Terusan and Dewadaru Airport on Kemujan Island because of their relative accessibility (Figure 1). Bengkoang Island, Menjangan Besar Island and Karang Kapal were only visited occasionally.

Legon Lele
Legon Lele (5°51´36.646"S, 110°26´49.742"E; Figure 1, site 3) is an area located on the east side of Karimunjawa Island. This site is approximately 5 ha in area and has various wetland types, consisting of rain-fed rice fields, open grass wetlands and sandy beaches.

Jati Kerep
Jati Kerep (5°52´7.301"S, 110°26´1.324"E; Figure 1, site 2) is located on the west side of Karimunjawa Island. The area has around 5 ha of mangroves and shrimp ponds that were abandoned in 2000.

Cikmas
Cikmas (5°49´39.887"S, 110°28´3.685"E; Figure 1, site 4) is a small area of a rain-fed rice field that is located on the north side of Karimunjawa Island. The area is adjacent to a mangrove forest close to the Terusan tidal area. During the dry season the rice field is left fallow. From November to June, the rice field is wet and suitable as feeding habitat for waders.

Terusan
Terusan (5°49´11.76"S, 110°28´0.61"E; Figure 1, site 5) is a *c.*10 ha intertidal area on Kemujan Island, approximately 13 km from Karimunjawa sub-district capital city (Figure 2). The area is surrounded by well-developed mangrove forest consisting of 14 true mangrove species, such as *Rhizophora stylosa*, *R. apiculata*, *Sonneratia alba*, *Ceriops tagal* and *Lumnitzera racemosa* (Susanto *et al.* 2012). There are at least seven species of mollusc present in the intertidal and mangrove area including *Grafarium pectinatum*, *Trachycardium subrugossum*, *Corculum cardissa* and *Dosinia insularum* (H. Susanto *pers. obs.*).

Figure 2. The intertidal area of Terusan with mangroves in the background (Hary Susanto)

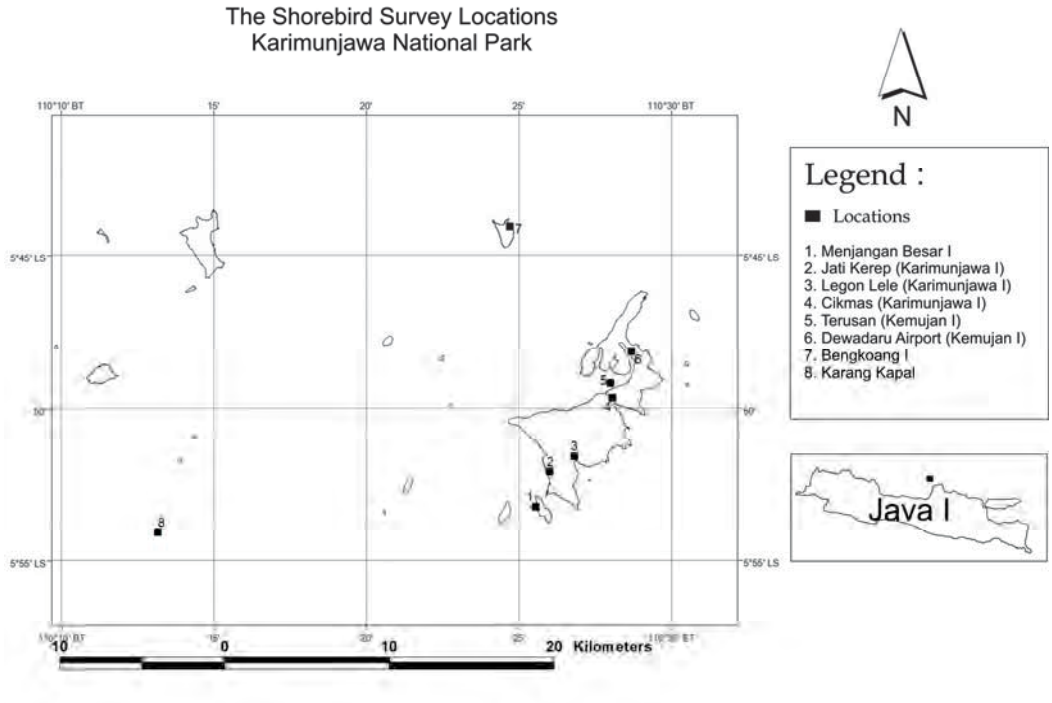

Figure 1. Map showing the wader survey locations on Karimunjawa National Park.

Dewadaru Airport
Dewadaru Airport (5°48´9.159"S, 110°28´41.881"E; Figure 1, site 6) is located in Kemujan Island, approximately 18 km from Karimunjawa sub-district capital city. An 80 m wide belt of open grasslands stretches 1 km alongside the airport's runway and provides potential habitat for migratory wader species who forage in areas of short grassland. Species known to use airport grasslands include Pacific Golden Plover *Pluvialis fulva*, Oriental Plover *Charadrius veredus*, Little Ringed Plover *Charadrius dubius*, Common Sandpiper *Actitis hypoleucos*, Oriental Pratincole *Glareola maldivarum* and Little Curlew *Numenius minutus* (Bishop 2006, Anon. 2008).

Bengkoang Island
Bengkoang Island (5°44´3.900"S, 110°24´42.400"E; Figure 1, site 7) lies north of Kemujan Island. The size of this unpopulated island is about 79 ha and it has a well-developed mangrove forest. There is a 2 ha area of intertidal habitat suitable for waders.

Menjangan Besar Island
Menjangan Besar Island (5°53´15.110"S, 110°25´33.210"E; Figure 1 site 1) lies south of Karimunjawa Island. The area is covered by mangrove forest with approximately 2 ha of intertidal area on the north side.

Karang Kapal
Karang Kapal (5°54´5.299"S, 110°13´10.958"E; Figure. 1 site 8) is 346 ha reef located near Krakal Besar Island, approximately 20 km to the west of Karimunjawa Island. There is an area of approximately 1 ha, which is anarrow stretch of reef running about 1 km in length, that is exposed at both high and low tides. This open area is habitat for sea slaters *Ligia* sp. as well as providing a nesting site for Black-naped Tern, *Sterna sumatrana*.

Wader surveys

Surveys were conducted between December 2007 and December 2013. Field observations were made mainly by HS, park staff, and IT in July-August 2010, September-October 2012 and October 2013. Birdwatchers from Paguyuban Pengamat Burung Jogja (PPBJ-Jogja Bird watchers' Community) made observations in July-August 2010, and SvB made observations in November 2013.

The wader identification and counts were made using a 20x65 spotting scope and 10x50 binoculars. Where possible, the waders were digi-scoped using a pocket camera attached to the spotting scope, to assist with identification and census taking. Counts were made directly in the field, or, in many cases, by scrutinizing photos made of the bird flocks. Approximately 2-6 hours was spent at each site over a single day, mostly done by a single observer (HS). Monthly visits were made from December 2007 to December 2013 to Cikmas, Terusan and Dewadaru Airport, with 3-6 visits in a year to Jati Kerep and Legon Lele, and at least once a year to Bengkoang Island and Menjangan Besar Island. During the study, Karang Kapal only visited once on 20 October 2013. Sites were surveyed on the same day on less than 10 occasions. All sites were surveyed at low tide except Terusan, which was visited at both low and high tide. High tide surveys, particularly those conducted in June-July, were done in order to search for over-summering birds. Maximum counts from any survey day, over all visits, are reported here.

RESULTS

Our surveys recorded 23 species of wader (Table 1), of which ten species are new records for Karimunjawa National Park – Little Ringed Plover, Oriental Plover, Eurasian Curlew, Bar-tailed Godwit, Common Greenshank, Terek Sandpiper, Long-toed Stint, Curlew Sandpiper, Ruddy Turnstone and Common Snipe. These bring the total number of wader species recorded for the park to 27 species (Table 2).

Five of ten new species for the park were recorded in the 10 ha Terusan intertidal area on Kemujan Island and revealed this area as the most important location for waders on Karimunjawa NP. In total, we recorded 17 species at Terusan, of which nine species were not recorded elsewhere. The following annotated list provides details of the waders recorded. Total counts of wader species during our survey are summarised in Table 3.

Species Accounts

Grey Plover Pluvialis squatarola
Grey Plover was uncommon and occurred in small numbers (typically 1 or 2 birds). Most records were from Terusan, with the highest count of six birds being recorded on 17 January 2008. Two birds foraging with other waders were observed in Karang Kapal on 20 October 2013.

Pacific Golden Plover Pluvialis fulva
Pacific Golden Plover was widespread and regularly observed in Terusan. This species was also recorded in Dewadaru Airport, Bengkoang Island, Menjangan Besar Island and Karang Kapal. During our survey, the highest count was of 11 birds in Terusan on 29 January 2010. The highest previous count for the park was recorded by Sumaryati *et al.* (2007) with about 30 birds being observed in Terusan on October 2007.

Little Ringed Plover Charadrius dubius
Little Ringer Plover was a new record for the park. A single bird was observed at the runway of Dewadaru Airport on 8 October 2010.

Lesser Sand Plover Charadrius mongolus
A single Lesser Sand Plover was observed in Terusan on 1 October 2012. This was only the second record for the Karimunjawa Archipelago, the only previous sighting being one bird at the same location in 2003 (Anon. 2003).

Table 1. Distributional record of waders in Karimunjawa NP during December 2007- December 2013 surveys with maximum numbers found at each site.

Species	Karimunjawa Island			Kemujan Island		Bengkoang Island	Menjangan Besar Island	Karang Kapal
	Cikmas	Legon Lele	Jati Kerep	Terusan	Dewadaru Airport			
Grey Plover				6				1
Pacific Golden Plover				23	17	2	1	2
Little Ringed Plover					1			
Lesser Sand Plover				1				
Greater Sand Plover				4				2
Oriental Plover					1			
Whimbrel		2	2	51		1	9	1
Eurasian Curlew				1				
Bar-tailed Godwit				1				
Common Redshank				8				
Common Greenshank				1				
Wood Sandpiper	2	2	1	1				
Terek Sandpiper				1				
Common Sandpiper		4	11	15		1	2	
Grey-tailed Tattler				17	1		2	
Ruddy Turnstone								3
Red-necked Stint				11				
Long-toed Stint		1						
Curlew Sandpiper				6				
White-headed Stilt				1				
Oriental Pratincole	80	1		1	155			
Pin-tailed Snipe		2						
Common Snipe			4					
No. of species	**2**	**6**	**4**	**17**	**5**	**3**	**4**	**5**

Table 2. List of wader records from Karimunjawa National Park. + represents a new record for the islands.

Species	Chasen & Kloss 1933	Anon 1996	Anon 2003	Anon 2004	Sumaryati *et al.* 2007	This Study 2007-2013
Grey Plover *Pluvialis squatarola*					*	*
Pacific Golden Plover *Pluvialis fulva*				*	*	*
Little Ringed Plover *Charadrius dubius*						+
Lesser Sand Plover *Charadrius mongolus*			*			*
Greater Sand Plover *Charadrius leschenaulti*					*	*
Oriental Plover *Charadrius veredus*						+
Little Curlew *Numenius minutus*			*			
Whimbrel *Numenius phaeopus*		*	*	*	*	*
Eurasian Curlew *Numenius arquata*						+
Far-eastern Curlew *Numenius madagascariensis*			*			
Bar-tailed Godwit *Limosa lapponica*						+
Common Redshank *Tringa totanus*			*	*	*	*
Marsh Sandpiper *Tringa stagnatilis*			*			
Common Greenshank *Tringa nebularia*						+
Wood Sandpiper *Tringa glareola*					*	*
Green Sandpiper *Tringa ochropus*	*					
Terek Sandpiper *Xenus cinereus*						+
Common Sandpiper *Actitis hypoleucos*	*	*	*	*	*	*
Grey-tailed Tattler *Heteroscelus brevipes*					*	*
Ruddy Turnstone *Arenaria interpres*						+
Red-necked Stint *Calidris ruficollis*			*		*	*
Long-toed Stint *Calidris subminuta*						+
Curlew Sandpiper *Calidris ferruginea*						+
White-headed Stilt *Himantopus leucocephalus*			*			*
Oriental Pratincole *Glareola maldivarum*	*		*		*	*
Pin-tailed Snipe *Gallinago stenura*	*					*
Common Snipe *Gallinago gallinago*						+
No. of species recorded	**4**	**2**	**10**	**4**	**11**	**23**

Table 3. Wader count totals in Karimunjawa NP, December 2007- December 2013. Shaded panels are records during the northern hemisphere summer.

Species	2007	2008										2009				
	Dec	Jan	Feb	Mar	Apr	May	Jun	Aug	Sep	Oct	Nov	Mar	Aug	Sep	Oct	Dec
Grey Plover		6							2	2						
Pacific Golden Plover	23	5			1			3	10	10	1			9	4	12
Little Ringed Plover																
Lesser Sand Plover																
Greater Sand Plover		3		2				3	2	2					3	1
Oriental Plover																
Whimbrel	19	7		2	2		21	14	28	20		1	10	5	20	17
Eurasian Curlew																
Bar-tailed Godwit	1															
Common Redshank	2	1		1	1			1		2		1			2	2
Common Greenshank																
Wood Sandpiper																
Terek Sandpiper																
Common Sandpiper		7											1		2	
Grey-tailed Tattler	10	7		5	8	12	8	8	12	8	1	8	5	4	17	9
Ruddy Turnstone																
Red-necked Stint								3					3			
Long-toed Stint																
Curlew Sandpiper																
White-headed Stilt																1
Oriental Pratincole	3		1	4						10						
Pin-tailed Snipe																
Common Snipe																
Unidentified Snipe		4		1												
Total count	**58**	**40**	**1**	**15**	**12**	**12**	**29**	**32**	**54**	**54**	**2**	**10**	**19**	**18**	**48**	**42**
Species recorded	**6**	**8**	**1**	**6**	**4**	**1**	**2**	**6**	**5**	**7**	**2**	**3**	**4**	**3**	**6**	**6**

Species	2010									2011					
	Jan	Feb	Mar	Apr	Aug	Sep	Oct	Nov	Dec	Feb	Aug	Sep	Oct	Nov	Dec
Grey Plover		2					2	1				1	2		
Pacific Golden Plover	11	9	2				25		1			7	4	6	1
Little Ringed Plover							1								
Lesser Sand Plover															
Greater Sand Plover		2	2				1		1	1		2	1	1	1
Oriental Plover							1								
Whimbrel	5	7			3	43	43	3			14	25	11	21	
Eurasian Curlew															
Bar-tailed Godwit							1								
Common Redshank		1				1	3	2			2	5	1	2	
Common Greenshank															
Wood Sandpiper											1	1			
Terek Sandpiper							1								
Common Sandpiper		5					15	1				4	1	4	
Grey-tailed Tattler	9	12	2	1	2	1	11	1	2	1	6	15	3	3	1
Ruddy Turnstone															
Red-necked Stint						2	6					8			
Long-toed Stint					1										
Curlew Sandpiper												6			
White-headed Stilt															
Oriental Pratincole					2		3	155					13		
Pin-tailed Snipe															
Common Snipe															
Unidentified Snipe															
Total count	**25**	**38**	**6**	**1**	**8**	**47**	**113**	**163**	**4**	**2**	**23**	**74**	**36**	**37**	**3**
Species recorded	**3**	**7**	**3**	**1**	**4**	**4**	**13**	**6**	**3**	**2**	**4**	**10**	**8**	**6**	**4**

Species	2012								2013										
	Feb	Mar	Apr	Aug	Sep	Oct	Nov	Dec	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Grey Plover						1	1	2	1	2	1					1	3	1	2
Pacific Golden Plover	8		5		7	6	8	8	8	9	5				6	6	6	5	6
Little Ringed Plover																			
Lesser Sand Plover						1													
Greater Sand Plover	1																		
Oriental Plover																	1		
Whimbrel	9	2	2	9	29	53	49	31	26	12	6	5	5	5	17	40	30	36	13
Eurasian Curlew		1																	
Bar-tailed Godwit																			
Common Redshank			2	3	8	5	4	4	5	2	2	1	1	1	3	4	3	2	2
Common Greenshank						1													
Wood Sandpiper	1					1													
Terek Sandpiper																			
Common Sandpiper				3		2	1	1									1		
Grey-tailed Tattler	7	2	11	4	10	8	7	15	10	9	6	2	2	2	5	1	1	1	
Ruddy Turnstone																	3		
Red-necked Stint					5	11									5	10	10	12	6
Long-toed Stint																4	1		
Curlew Sandpiper																			
White-headed Stilt																			
Oriental Pratincole					1		4	30	51	5		1					8	1	
Pin-tailed Snipe																		7	
Common Snipe																		1	
Unidentified Snipe											1						3	5	
Total count	**26**	**5**	**20**	**19**	**60**	**89**	**74**	**91**	**101**	**39**	**21**	**9**	**8**	**8**	**36**	**66**	**70**	**71**	**29**
Species recorded	**5**	**5**	**4**	**4**	**6**	**10**	**7**	**7**	**6**	**6**	**6**	**4**	**3**	**3**	**5**	**7**	**12**	**10**	**5**

Greater Sand Plover Charadrius leschenaulti
This species is uncommon, occurring only in small numbers of one or two birds and with most records from Terusan. One record in Karang Kapal consisted of two birds on 20 October 2013; four birds observed at Terusan on 15 January 2006 that were initially identified as Javan Plover *Charadrius javanicus* (Sumaryati *et al.* 2007) are now considered to be this species (on the basis of photographic evidence published with this account).

*Oriental Plover Charad*rius veredus
A single Oriental Plover was observed at Dewadaru Airport on 8 October 2010 and is the first record for the Karimunjawa National Park (Figure 3). In the Greater Sundas, the bird is known as a rare migrant (Hoogerwerf 1970, MacKinnon & Phillipps 1993), but recent records from several areas in Java, such as Angke Kapuk Protected Forest (Kristanto & Imanuddin 2008), Pantai Trisik (I. Taufiqurrahman *pers. obs.*), Alas Purwo NP (Grantham 2000) and Baluran NP (Winnasis *et al.* 2011), suggest it as an uncommon visitor to Java and perhaps not as rare as thought previously.

Whimbrel Numenius phaeopus
Whimbrel is widespread and relatively common in Karimunjawa National Park. The highest single count was of 51 birds in Terusan on 3 October 2012. It is one of three species that occurred in the area during the northern hemisphere summer. Over-summering records consist of 21 birds on 22 June 2008 and five, probably the same individuals, on 1 June 2013 and 9 July 2013 (Figure 4).

Eurasian Curlew Numenius arquata
Eurasian Curlew was a new record for the park. This species is listed as Near Threatened (BirdLife International 2014). A single bird was recorded in Terusan on 23 March 2012. This bird is a regular migrant to the Greater Sundas (MacKinnon & Phillipps 1993).

Bar-tailed Godwit Limosa lapponica
Bar-tailed Godwit was also a new record for the park. During the surveys, there were two records of a single bird at Terusan, one on 6 December 2007 and another 8 October 2010.

Common Redshank Tringa totanus
Common Redshank was only recorded at Terusan where it was regularly observed. The highest count was of eight birds on 28 September 2012. A single bird was recorded over-summering during June to July 2013.

Common Greenshank Tringa nebularia
Common Greenshank was a new record for the park. A single bird at Terusan on 4 October 2012 was the only record.

Wood Sandpiper Tringa glareola
Wood Sandpiper was uncommon with only one or two birds observed at any one time. It was recorded in Cikmas, Legon Lele and Terusan. This species was recorded as single birds on every occasion except for two birds at Legon Lele on 15 August 2010.

Terek Sandiper Xenus cinereus
Terek Sandpiper was a new record for the park. One bird was observed with black over white leg flags, indicating it had originated from Chongming Island, China. It was recorded at Terusan on 6 to 11 October 2010 (Figure 5).

Common Sandpiper Actitis hypoleucos
We found this species to be widespread in small numbers in Karimunjawa NP with records originating from Legon Lele, Jati Kerep, Terusan, Bengkoang Island and Menjangan Besar Island. The highest count was of 15 birds at Terusan on 9 October 2010.

Figure 3. Oriental Plover *Charadrius veredus* recorded on Dewadaru Airport on 8 October 2010 (Hary Susanto)

Figure 4. Five Whimbrels *Numenius phaeopus* that observed on 9 July 2013 (Hary Susanto).

Figure 5. Terek Sandiper *Xenus cinereus* with black and white flags on Terusan on 11 October 2011 (Hary Susanto).

Grey-tailed Tattler Heteroscelus brevipes
Grey-tailed Tattler was the third-most abundant wader after Oriental Pratincole and Whimbrel. The highest count was 17 birds at Terusan during October 2009. We recorded this species during northern hemisphere summer, with eight birds in June 2008 and two birds during June and July 2013.

Ruddy Turnstone Arenaria interpres
Ruddy Turnstone was a new record for the park. Three birds were seen foraging in a mixed flock with Grey and Pacific Golden Plover at Karang Kapal on 20 October 2013.

Pin-tailed Snipe Gallinago stenura
Four records of Pin-tailed Snipe came from Legon Lele: four birds on 15 January 2008, a single bird in March (undated) and on 20 April 2013, five birds on 15 November 2013, and seven birds at Legon Boyo on 17 November 2013. Several birds amongst those seen in November 2013 were positively identified as Pin-tailed, based on their flight calls (audio-recordings by SvB deposited at www.xeno-canto.org)

Common Snipe Gallinago gallinago
Common Snipe is a new provisional record for the park. A single snipe was seen on Legon Boyo near Jati Kerep on 15 November 2013 by SvB. The bird was showing a white trailing edge to its secondaries, and was tentatively identified as a Common Snipe. The species is rare on Java, for instance Vorderman (1885) reported the finding of a single Common amongst 600 Pin-tailed Snipe near Jakarta in 1885. The only other specimens from Java were collected in Jakarta in October 1930 (Olivier 1931) and October 1938 (collection Museum Zoologicum Bogoriense, Cibinong, Indonesia).

Red-necked Stint Calidris ruficollis
Red-necked Stint was infrequently observed. The highest count of 11 birds was recorded at Terusan on 1 October 2012. One of four birds seen on 17 September 2013 was bearing a yellow flag attached to its left tibia indicating it was banded in north-west Australia. It was last observed on 21 September 2013, whilst the other birds stayed a still little longer in the area (Figure 6). Previous records for the park were three birds at Terusan and a single bird at Jati Kerep in September 2007 (Anon. 2003).

Long-toed Stint Calidris subminuta
Long-toed Stint was a new record for the park. A single bird was observed at Legon Lele on 15 August 2010. This bird is a relatively rare visitor to Java and Bali (MacKinnon & Phillipps 1993).

Curlew Sandpiper Calidris ferruginea
Curlew Sandpiper was also a new record for the park. We recorded six birds foraging with Greater Sand Plover and Grey-tailed Tattler at Terusan on 11 October 2011 (Figure 7).

White-headed Stilt Himantopus leucocephalus
An immature stilt was observed on a rain-fed rice field near Terusan on 18 December 2009, constituting the second record for the park after a record from Kemujan Island during the survey in December 2003 (Anon. 2003). White-headed Stilt is a breeding resident on Java (MacKinnon & Phillipps 1993).

Oriental Pratincole Glareola maldivarum
Oriental Pratincole was recorded at Cikmas, Legon Lele, Terusan and Dewadaru Airport. Although occurring in sizeable numbers only during the migration passage periods, the Oriental Pratincole was the most numerous wader species recorded in the Karimunjawa National Park. The highest count was of 155 birds on 5 November 2010 at the Dewadaru Airport runway and the surrounding grassy area. Another noteworthy count was 80 at Cikmas on 16 November 2005 (HS). A single bird was seen on 15 November 2013 flying past the harbour of Karimunjawa (SvB).

DISCUSSION

Whimbrel was the most widespread species recorded during our surveys of Karimunjawa Archipelago and National Park, being observed at six locations. Common Sandpiper and Pacific Golden Plover were the next most widespread and were both recorded at five locations. Along with Common Redshank and Grey-tailed Tattler, these five species were the main

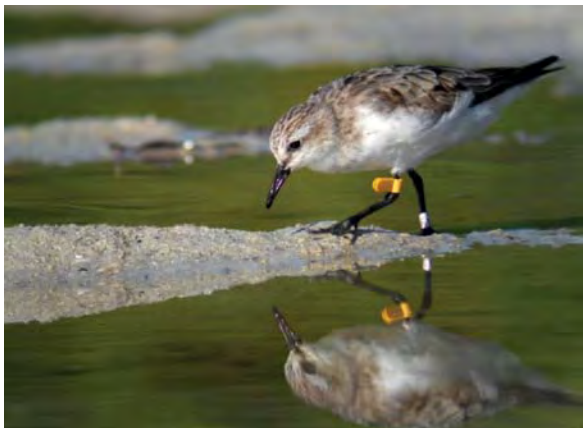

Figure 6. Red-necked Stint *Calidris ruficollis* with yellow flag on 21 September 2013 (Hary Susanto).

Figure 7. Six Curlew Sandpipers *Calidris ferruginea* on Terusan on 11 October 2011 (Hary Susanto).

regular visitors to the islands and spent their non-breeding season in the area.

Previous ornithological studies between 1889 and 2003 have recorded a total of 17 wader species in Karimunjawa Archipelago and National Park. This count of species is relatively poor compared to nearby Java and Borneo and probably reflects under-sampling of wader habitats as previous researchers focused primarily on landbirds and seabirds. Our study recorded a total of 23 wader species, including 10 new records. The total number of wader species confirmed as occurring in the Karimunjawa Archipelago and National Park now stands at 27 species. There are four species from the previous studies that were absent in our survey: Little Curlew, Far Eastern Curlew, Marsh Sandpiper, and Green Sandpiper. The first three species were seen during the 2003 survey—the curlews at Terusan and Marsh Sandpiper somewhere else on Karimunjawa Island (Anon. 2003). These three species are known as uncommon visitors to Java (MacKinnon & Phillipps 1993), but unfortunately no information was given on the number of the birds recorded. Green Sandpiper was recorded based on one female collected by Dammerman and collectors of the Bogor Zoological Museum during 1926 and 1930 visits (Chasen & Kloss 1933). Green Sandpiper is a very rare migrant and the female collected on 26 November 1930 from Karimunjawa Island is the only known record for Java. This species is also extremely rare in the Greater Sundas (MacKinnon & Phillipps 1993), with only one record on Bali in December 1982 (Klapste 1984).

Wader numbers and species richness at Karimunjawa National Park are comparable to that reported on other island groups located in the Java Sea. For example, ten species of migratory wader have been recorded from Bawean Island (Hoogerwerf 1966, Hoogerwerf 1967), 21 species from the Masalembu Islands (Putra 1998, Nandika *et al.* 2013, I. K. Muladi *pers. obs.*) and 18 (including two resident waders) from the Kangean Islands (Irham & Marakarmah 2009; SvB *pers. obs.*). The occurrence of flagged birds visiting the area may offer an opportunity to study birds on passage and under relatively controlled circumstances in this isolated and small area.

There is a lack of published information on over-summering waders on Java. Grantham (2000) reported nine species of wader during June and July in Alas Purwo National Park on Java's south coast. Ash (1984) reports 750 waders from 16 species present in June 1982 at a high-tide roost in south-east Bali. On Panaitan Island in the Sunda Straits up to seven species were recorded in June (Hoogerwerf 1953; SvB *pers. obs.*). Whimbrel and Grey Plover appeared to be the most common over-summering species in both localities. It is noteworthy that during our study three species were also recorded in June-July in Karimunjawa National Park: Whimbrel (5-21 birds), Common Redshank (1 bird) and Grey-tailed Tattler (2-8 birds).

The small size and remoteness of the islands, and the limited ornithological attention paid to wader habitats, means that information on the abundance of waders and species richness is relatively low compared to elsewhere in the region. In particular, the north coast of East Java (Solo delta / Ujung Pangkah, January 1990), south coasts of Madura (Sampang, January 1992) and southern Bali (Suwung, January 1990) have records of 3700+ (19 species), 1800+ (22 species) and 2900+ waders (13 species), respectively, collected during 1-2 day surveys (SvB *unpubl. data*). During northward migration the islands and countries between the north of Australia and Asian mainland may be largely overflown by most species, with the exception of smaller waders such as Red-necked Stint and Curlew Sandpipers that use Indonesia and other countries for stopovers (Minton *et al.* 2006). These two species are indeed amongst the most common waders found at the before-mentioned three areas and elsewhere in the region (Van Balen *et al.* 2006, Erftemeijer & Djuharsa 1988, Mason 2011). As waders can fly many thousands of kilometres non-stop they do not need to stopover on the islands in the Java Sea. However, inevitably (e.g. because of adverse weather or poor body condition) some birds will land on these islands especially where mudflats and other suitable habitat is available, but numbers will tend to be small because of the relatively paucity of such suitable habitats compared to other staging sites. The Karimunjawa Archipelago is of interest for wader studies due to the somewhat disproportionate occurrence of species that are classified as rare or vagrant in this part of Indonesia. For example, the 1930 Green Sandpiper record from Karimunjawa Island remains the only confirmed record of this species from the Javan realm. Our records of Oriental Plover, Common Snipe and Long-toed Stint are also notable. We therefore consider it important to undertake further surveys of these and other islands in the region in order to determine the frequency of use by other rare and vagrant species.

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A SURVEY OF SHOREBIRDS IN THE SUNDARBANS OF BANGLADESH

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A survey of shorebirds targeting the Critically Endangered Spoon-billed Sandpiper was carried out in the Sundarbans of Bangladesh between 14 and 16 January 2013. A total of 1691 shorebirds of 17 species were counted and the most abundant species was Lesser Sand Plover *Charadrius mongolus*, followed by Kentish Plover *Charadrius alexandrinus*, Common Redshank *Tringa totanus* and Greater Sand Plover *Charadrius leschenaultii*. Three notable species were recorded during surveys: the Near Threatened Eurasian Curlew *Numenius arquata* (n=68), Great Thick-knee *Esacus recurvirostris* (n=7) and the locally rare Eurasian Oystercatcher *Haematopus ostralegus longipes* (n=3). We find that the Sundarbans, which is designated as a Ramsar site and is still relatively intact, holds moderate numbers of shorebirds and is also an important site for Great Thick-knee. However, the site is under threat from a proposed power station and therefore warrants continued monitoring.

INTRODUCTION

Bangladesh offers key wintering and staging grounds to numerous migratory shorebirds of the East Asian-Australasian Flyway (Chowdhury *et al.* 2011). The country supports globally significant numbers of the Critically Endangered Spoon-billed Sandpiper *Eurynorhynchus pygmeus*, Endangered Nordmann's Greenshank *Tringa guttifer* and several other globally threatened shorebirds (Zöckler & Bunting 2006, Bird *et al.* 2010, Chowdhury *et al.* 2011). Regular waterbird censusing and monitoring have been undertaken along the south-central and south-east coast of Bangladesh. However, only sporadic information is available on the diversity and abundance of shorebirds in the Sundarbans (south-west Bangladesh) with a count of four Spoon-billed Sandpipers on 24 February 1992 from Egg Island, on the edge of the Sundarbans in Bangladesh, being the most significant record (Thompson *et al.* 1993). Following an ongoing program to revisit historical sites and search for new areas of the Spoon-billed

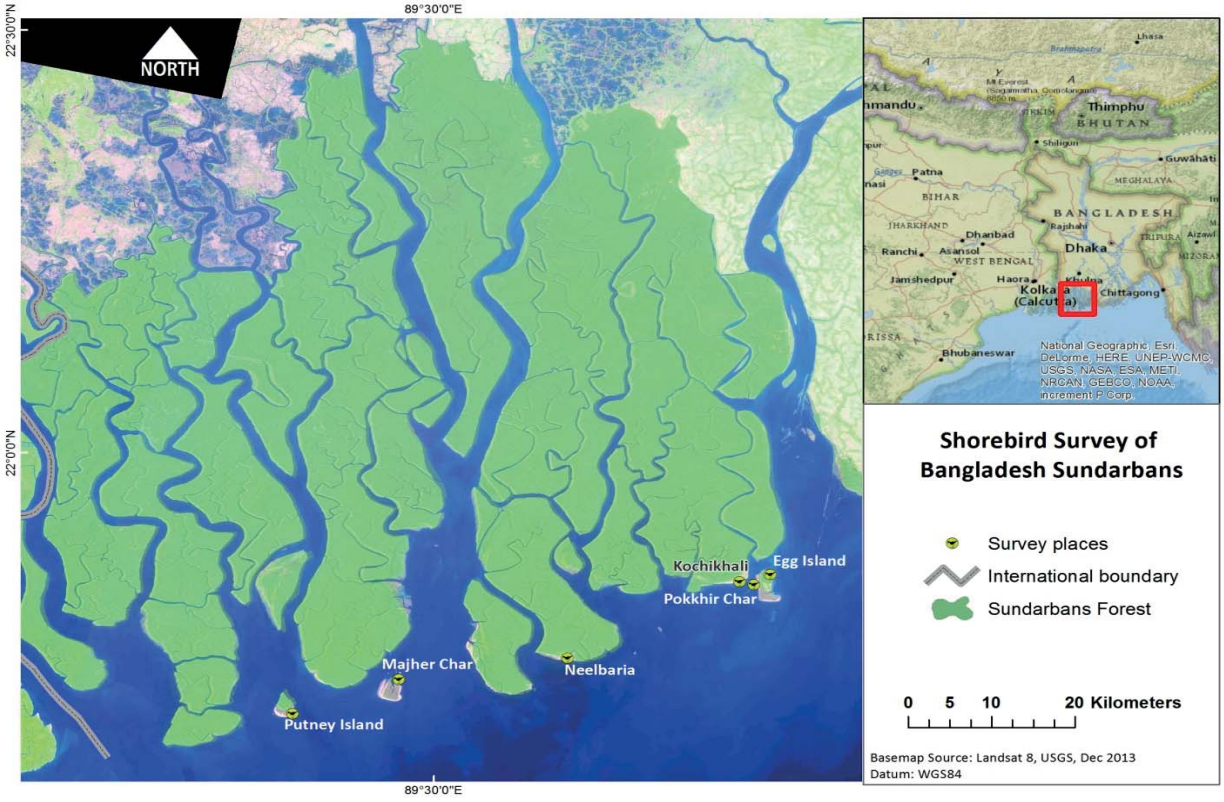

Figure 1. Shorebird survey sites along the coast of the Sundarbans, south-west Bangladesh.

Sandpiper in January 2013, the 'Bangladesh Spoon-billed Sandpiper Conservation Project' carried out a shorebird survey along the coastline of the Sundarbans in Bangladesh. The aim of this baseline survey was to determine the diversity and abundance of shorebirds, and to identify potentially important shorebird sites.

METHODS

Study area

The Sundarbans cover an area of roughly 10,000 km^2 in both Bangladesh and India. Of 6000 km^2 on the Bangladesh side, approximately 4000 km^2 are terrestrial mangrove forest and 2000 km^2 are a maze of tidal rivers and streams that vary from a few meters to several kilometers in width (Iftekhar & Islam 2004). Google Earth was used to identify new potential shorebird sites (mainly mudflats) along the coast of the Sundarbans, in addition to known historical sites, to target for survey. A total of six sites were surveyed, and results from five sites are presented here since Putney Island (the western-most site) did not support any shorebirds.

Surveys

Boat-based surveys for shorebirds were carried out for four full days between 14 and 16 January 2013 in Kochikhali beach (N 21°50'52.28" E 89°49'44.69"), Narikalbaria (N21°45'26.94" E89°38'38.97), Pokkhir Char (N21°50'39.82" E89°50'40.42"), Majhaer Char (N21°43'56.19" E 89°27'45.47), Puntney Island (N 21°41'42.69" E 89°20'54.99") and Egg Island (N21°51'23.37" E 89°51'44.16) in the Sundarbans (Figure 1). Two observers carried out the surveys at each site to minimize error in counting and identification. Time spent surveying at each site varied depending on the number of birds present, and typically ranged between 3-8 hours covering both tides. Counts were repeated twice (the second count right after the first count) in most of the occasions and the maximum number is presented here. Counts were undertaken during both high and low tides, depending on the habitat type (mudflat & high tide roost). Birds were identified using Grimmett *et al*. (2001) and Chowdhury (2011). Observations were made using 10x42 binoculars and 25-50x spotting scopes.

RESULTS

A total of 1691 shorebirds of 17 species were counted over all sites (Table 1). The most abundant species was Lesser Sand Plover *Charadrius mongolus* (40.07% of the total count), followed by Kentish Plover *Charadrius alexandrinus* (20.03%; seen in all five sites), Common Redshank *Tringa totanus* (7.13%) and Greater Sand Plover *Charadrius leschenaultii* (6.74%). The maximum number of shorebirds of 14 species was counted at Majher Char (789 individuals). No shorebirds were found at Putney Island (hence, not included in the table). The minimum number of shorebirds observed (10 individuals) was counted at Kochikhali beach.

Two globally significance species were observed, comprising 68 Eurasian Curlew *Numenius arquata* and seven Great Thick-knee *Esacus recurvirostris*, both are Near Threatened. Another notable species, the Eurasian Oystercatcher *Haematopus ostralegus*, was observed during the survey.

In addition, 11 species of other waterbirds were observed but not counted during the survey: the globally Endangered Masked Finfoot *Heliopais*

Table 1. Number of shorebirds counted at five sites in the Sundarbans, Bangladesh, 14-16 January 2013.

Sites	**Kochikhali beach**	**Pokkhir Char**	**Egg Island**	**Narikelb-aria**	**Majhaer Char**	**Total**
Habitat type	Sand dune	Mudflat	Sand dune	Mudflat	Mudflat	
Approximate area (ha)	17	69	31	75	71	
Pin-tailed Snipe *Gallinago stenura*	0	0	2	0	0	2
Great Thick-knee *Esacus recurvirostris*	0	2	3	2	0	7
Eurasian Oystercatcher *Haematopus ostralegus*	0	0	0	0	3	3
Pacific Golden Plover *Pluvialis fulva*	0	0	0	18	0	18
Grey Plover *Pluvialis squatarola*	1	0	0	4	33	38
Kentish Plover *Charadrius alexandrinus*	3	70	20	120	115	328
Lesser Sand Plover *Charadrius mongolus*	0	51	160	60	425	696
Greater Sand Plover *Charadrius leschenaultii*	0	11	12	35	58	116
Bar-tailed Godwit *Limosa lapponica*	0	0	0	4	14	18
Whimbrel *Numenius phaeopus*	0	0	0	102	0	102
Eurasian Curlew *Numenius arquata* NT	2	2	29	12	23	68
Common Redshank *Tringa totanus*	2	0	32	35	41	110
Common Greenshank *Tringa nebularia*	0	2	5	8	17	32
Terek Sandpiper *Xenus cinereus*	0	0	6	53	3	62
Common Sandpiper *Actitis hypoleucos*	2	0	1	0	0	3
Ruddy Turnstone *Arenaria interpres*	0	0	0	4	11	15
Sanderling *Calidris alba*	0	0	3	0	27	30
Red-necked Stint *Calidris ruficollis*	0	0	1	1	15	17
Little Stint *Calidris minutus*	0	0	0	0	5	5
Curlew Sandpiper *Calidris ferruginea*	0	0	1	0	20	21
Total	10	138	275	458	810	1691

personata, Great Egret *Ardea alba*, Intermediate Egret *Ardea intermedia*, Little Egret *Egretta garzetta*, Striated Heron *Butorides striata*, Grey Heron *Ardea cinerea*, Purple Heron *Ardea purpurea*, Slaty-breasted Rail *Gallirallus striatus*, Common Tern *Sterna hirundo*, Whiskered Tern *Chlidonias hybrida*, Brown-headed Gull *Chroicocephalus brunnicephalus*, Pallas's Gull *Ichthyaetus ichthyaetus*, Ruddy Shelduck *Tadorna ferruginea* and Caspian Tern *Sterna caspia*.

DISCUSSION

Bird surveys in the Bangladeshi Sundarbans have been limited, especially those targeting shorebirds. We were surprised to see so few shorebirds, as only eight years ago, in similar habitats, at sites in the adjacent Indian Sundarbans, a total of more than 4,000 small shorebirds were observed on just one outer delta island similar in size to Egg Island (Zöckler *et al.* 2005). It is unclear if the shorebird numbers and diversity at the surveyed sites vary seasonally or if numbers have generally declined due to some human impact. Neither any direct human impact nor any other impact was noticed during the survey, and in the absence of previous survey data it is not possible to demonstrate signs of decline. Therefore, further investigations are necessary to understand more about the shorebirds of the Sundarbans.

The original aim of these surveys was to search for the Spoon-billed Sandpiper, which are located at other sites in Bangladesh (Zöckler & Bunting 2006, Bird *et al.* 2010, Chowdhury *et al.* 2011). Our previous survey work revealed that Spoon-billed Sandpiper were more likely to be present when shorebird numbers exceed a certain number, usually 1000 or more, although this is not always the case (S. Chowdhury *pers. obs.*). In the early 1990s, up to four Spoon-billed Sandpipers were recorded (Thompson *et al.* 1993), which possibly indicates that the total number of shorebirds were higher at some stage and have since dropped. Shorebird numbers in the Indian Sundarbans might have also reduced, but no recent counts are available. A previous claim of 14 Spoon-billed Sandpipers in the Indian Sundarbans (Sharma 2003) has been discounted and was considered to be a case of misidentification (Zöckler *et al.* 2005). Spoon-billed Sandpipers usually occur on the newly emerged mudflats having a mix of sandy and muddy substrates, and the absence of birds may indicate that habitat conditions at surveyed sites in the Sundarbans were not ideal for the species (Zöckler & Bunting 2006, Bird *et al.* 2010, Chowdhury *et al.* 2011).

We counted internationally-significant numbers of Great Thick-knee during our shorebird surveys. The global population estimate of the Great Thick-knee is 670-17,000 mature individuals and has been uplisted to Near Threatened in 2013 due to an expected population decline over the next three generations as a result of the incessant human pressure on riverine ecosystems and the construction of dams (BirdLife International 2014). The species is considered as a rare resident of Bangladesh and known to occur mainly along the coast of the Sundarbans (Siddiqui *et al.* 2008 and Chowdhury 2011). Our total count of seven birds represents at least 1% of the global population. Recent records of this species outside the Sundarbans include: two at Char Shahjalal (central coast) on 20 January 2009, one at Sonadia Island (south-east coast), one near Pashua Haor (north-east) on 23 February 2012 and one at Char Kukri-Mukri (central coast) on 1 February 2014 (S. Chowdhury *unpubl. data*).

During our surveys, we also recorded three individual Eurasian Oystercatchers in Majhaer Char. These were identified as the *longipes* subspecies based on the white patches on the outer primaries, in contrast to the subspecies *osculans* which has no white on the 4-5 outer primaries (Chandler 2009). The Eurasian Oystercatcher is a vagrant and former rare resident of Bangladesh, and was previously recorded on the coast of Chittagong and Khulna division, south-central and south-east Bangladesh, respectively (Siddiqui *et al.* 2008). Only a single breeding record for South Asia occurred in 1930s in Sundarbans (Stanford 1937).

The result of our survey indicates that the outer islands of the Sundarbans contain significant numbers of Great Thick-knee, supporting previous observations that the Sundarbans is an important breeding site for this species (Siddiqui *et al.* 2008). The Sundarbans is designated as the first RAMSAR site of Bangladesh and is also a UNESCO World Heritage Site (Iftekhar & Islam 2004). Its forest still remains relatively intact and safe for its avifauna in Bangladesh. However, the proposed 1,320 Megawatt coal based power plant 14km away from the Sundarbans at Rampal may pose a significant long-term threat to birds and other wildlife. It is therefore important that further survey work is undertaken in the Bangladesh Sundarbans in order to obtain better information on the distribution and abundance of shorebirds and other waterbirds in the area.

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DISCOVERY OF AN INTERNATIONALLY IMPORTANT SITE FOR WOOD SANDPIPER *TRINGA GLAREOLA* AT PANTAI TRISIK, YOGYAKARTA, JAVA, INDONESIA

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Substantial numbers of Wood Sandpiper *Tringa glareola* were recorded during shorebird surveys conducted between 2007 to 2013 at Pantai Trisik, Yogyakarta, Java, Indonesia. The highest number recorded was approximately 1,390 individuals on 16 September 2012. This number exceeds the 1% population threshold for the species in the East Asian-Australasian Flyway and suggests Pantai Trisik is a potentially important site internationally for Wood Sandpiper in Indonesia.

INTRODUCTION

Wood Sandpiper *Tringa glareola* breeds in north Europe through central Siberia to Anadyrland, Kamchatka and Commander Islands and occasionally the Aleutian Islands and migrates south in the Boreal winter to Africa, Asia and Australia (Piersma *et al.* 1996). In South-east Asia, they are considered to be an uncommon to common Boreal winter visitor and passage migrant (Robson 2000). Within Indonesia, Wood Sandpiper is a widespread and common migrant in the Greater Sundas (MacKinnon & Phillipps 1993) and most parts of Wallacea (i.e., Nusa Tenggara, Sulawesi and the Moluccas) (Coates & Bishop 2000). In Papua, they are regular visitors and locally moderately common, with the highest number recorded being 10-20 birds (Bishop 2006).

Recent population estimate suggest there are 100,000-1,000,000 Wood Sandpipers using the East Asian-Australasian Flyway (Bamford *et al.* 2008). Bamford *et al.* (2008) recorded nine locations within this area that exceeded the 1% population threshold (1,000 birds); three of these are in South-east Asia: Wasan Rice Scheme, Brunei Darussalam (3,114 birds on 1 October 1986); Papar, Malaysia (2,551 birds on 1 September 1984) and Nong Han Kumphawapi, Thailand (1,000 birds on 6 January 1989). A notable previous record from Indonesia was overlooked however; that of 4,000-5,000 Wood Sandpipers at Danau Jempang in the Middle Mahakam wetlands, East Kalimantan, recorded in August-September 1997 (Gönner 2000). Recently published information has revealed even higher numbers using this same site, including an estimated 10,000 individuals on 9 November 2009, representing as much as 10% of the Flyway population (Gönner *et al.* 2014).

Pantai Trisik, on the south-central coast of Java, is recognised as an internationally important site for Sanderling *Calidris alba* with 1,845 birds present on 2 January 2010, covering 37% of the estimated Indonesian population (Taufiqurrahman *et al.* 2010) and exceeds the 1% threshold of Javan Plover *Charadrius javanicus* estimated population with 114 birds on 15 January 2009 (Iqbal *et al.*2013). In this paper we report on the results of shorebird surveys during the period 2007-2013 at Pantai Trisik, Yogyakarta, including the discovery of a further significant site for migrant Wood Sandpiper in Indonesia.

METHODS

Study area

Pantai Trisik (7°58'11.54"- 7°58'58.87"S, 110°39.19" -110°12'20.10"E) lies on the south coast of Java, Indonesia and covers an area of approximately 1,000 ha (Figure 1). Administratively, it is located in Banaran village, Galur sub-district, Kulon Progo district, Yogyakarta province. The place is approximately 30 km south-west of Yogyakarta's capital city. This sand beach (approximately 2.4 km in length) is locally known as the area to observe migrant birds, especially shorebirds. In addition to the sandy beach, several other wetland types are present in the area. Brackish lagoons lie behind the beach while rain-fed rice fields that are planted in wet season and then used to grow soybeans or chilli in dry season dominated inland areas. Nearby is the estuary of the Progo River, the biggest river in Yogyakarta, which provides additional wetland habitat.

Shorebird surveys

The Wood Sandpiper counts were part of our shorebird observations conducted from 2007-2013 and divided into two phases. The first phase was a monthly survey from April to November 2007 and January to December 2008 as part of Monitoring Burung Pantai Indonesia (MoBuPI) or Indonesian Shorebird Monitoring. The second phase was the more intensive survey over intervals of several days to

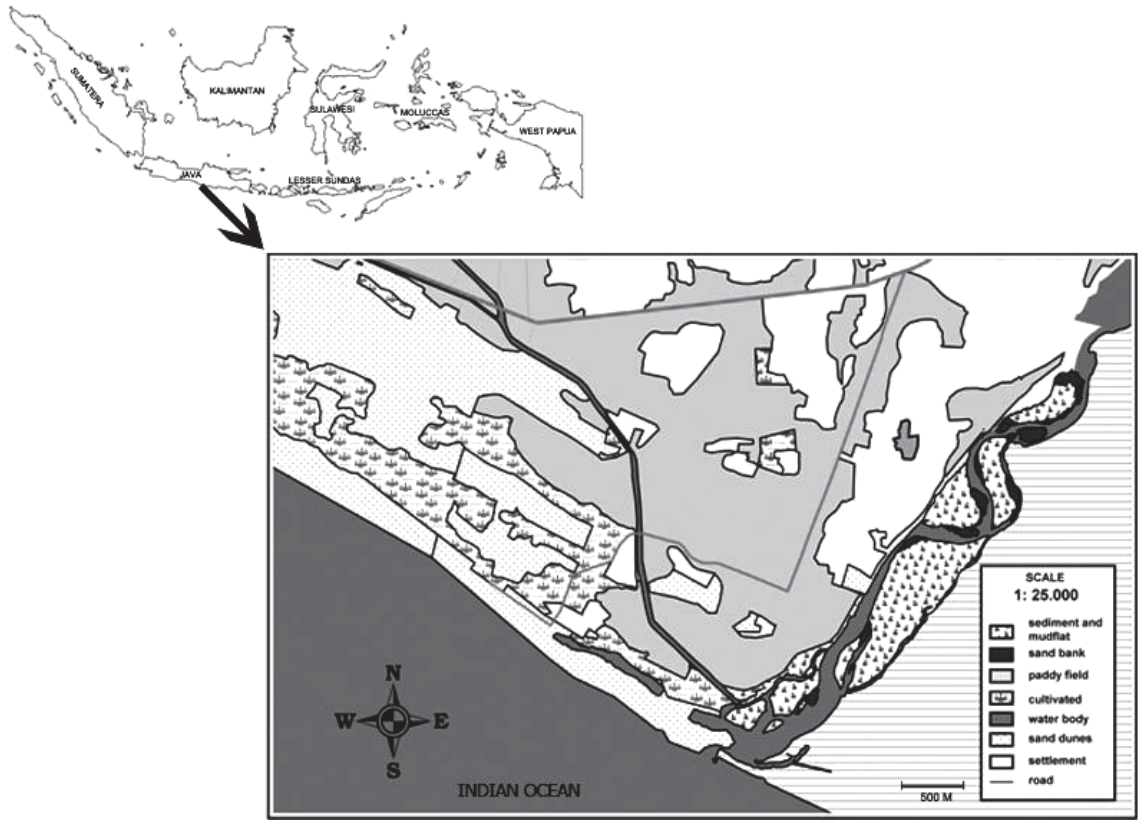

Figure 1. Map of Indonesia showing the location of the study area in Java. The inset shows details of habitats at Pantai Trisik, Yogyakarta.

a month from October to December 2009, September to December 2010, January to April 2011, December 2011, August to November 2012 and August to December 2013.

The survey area was divided into four locations, representing the wetland types present, i.e., rainfed rice field, lagoons, the Kali Progo delta and the estuary. Each survey was conducted by 2-10 people using binoculars and telescope, all observers having with experience of shorebird identification. Surveys lasted around 2-3 hours covering the whole area. In 2007-2011, the surveys were mostly conducted in the morning, while in 2012-2013 surveys were usually conducted in the afternoon until dusk, when birds were flocking and coming to roost, making them easier to count. All birds present were counted on site, or from photographs taken on site. The flight movement of the flocks were inspected to avoid double counting. At the end of each survey the total number of birds recorded was estimated by totalling the individual records. In this paper we only report Wood Sandpiper records, as other results will be published elsewhere.

RESULTS

Seasonally the highest numbers of Wood Sandpiper were recorded between August and October, during the southern migration (Figure 2). This corresponds to the time when rainfed rice fields were at the early stage of planting. Comparatively few birds were present during northward migration in January to February while in the period March to July no Wood Sandpiper were recorded in the area (Table 1).

Nine counts of Wood Sandpiper exceeded the staging threshold proposed by Bamford *et al.* (2008) for the species in the East Asian-Australasian Flyway (250 birds). These included counts of 449 (28 October 2007), 808 (25 August 2012), 733 (1 September 2012), 265 (9 September 2012), 296 birds (24 September 2012), 303 birds (2 October 2012), 337 birds (11 October 2013), 968 birds (23 October 2013) and 860 birds (24 October 2013). The highest single count, which exceeded the 1% population threshold for Wood Sandpiper was made on 16 September 2012 with approximately 1,390 birds (Table 2). Almost all the high counts originated from the rainfed rice fields or from the Kali Progo deltas, with only a few birds present in the lagoon and estuary (Table 1).

DISCUSSION

Although Wood Sandpiper is known as a common migrant in most parts of Indonesia, no population estimate has been made for the region (Bamford *et al.* 2008), probably due to the lack of observers and the lack of known aggregations. However, the recent discovery of 10,000 birds at Danau Jempang, East Kalimantan (Gönner *et al.* 2014) and the results presented here for Pantai Trisik highlight Indonesia's importance as a migration staging point for the species.

Table 1. Number of Wood Sandpiper counted in Pantai Trisik during surveys between 2007-2013.

YEAR	DATE	LOCATION				TOTAL
		Rainfed rice	*Lagoon*	*Estuary*	*Delta*	
	15 Apr	0	0	0	0	0
	13 May	0	0	0	0	0
	17 Jun	0	0	0	0	0
	8 Jul	0	0	0	0	0
2007	19 Aug	0	0	0	12	12
	02 Sep	0	0	0	13	13
	23 Sep	34	0	0	0	34
	28 Oct	449	0	0	0	449
	10 Nov	0	0	0	0	0
Maximum Count		**449**	**0**	**0**	**0**	
	19 Jan	0	0	0	0	0
	17 Feb	0	0	0	0	0
	15 Mar	0	0	0	0	0
	20 Apr	0	0	0	0	0
	25 May	0	0	0	0	0
2008	22 Jun	0	0	0	0	0
	20 Jul	0	0	0	0	0
	22 Aug	49	2	0	0	51
	28 Sep	105	0	0	4	109
	12 Oct	147	12	0	26	175
	23 Nov	1	0	0	0	1
	14 Dec	5	0	0	0	5
Maximum Count		**147**	**12**	**0**	**26**	
	13 Oct	15	0	0	0	15
	17 Oct	5	0	0	0	5
	19 Oct	17	0	0	0	17
	31 Oct	0	0	14	0	14
	3 Nov	0	0	0	0	0
2009	7 Nov	0	0	0	0	0
	8 Nov	0	5	0	0	0
	10 Nov	0	0	0	0	0
	15 Nov	0	0	0	0	0
	13 Dec	10	0	0	0	10
	22 Dec	16	0	0	0	16
	29 Dec	24	0	0	0	24
Maximum Count		**24**	**0**	**14**	**0**	
	06 Sep	11	0	0	0	11
	19 Sep	16	0	0	0	16
	23 Sep	119	0	0	0	119
	25 Sep	112	0	0	0	112
2010	02 Oct	36	0	0	0	36
	04 Oct	51	0	0	0	51
	11 Oct	30	0	0	0	30
	23 Oct	60	0	0	0	60
	18 Dec	150	0	0	0	150
	19 Dec	6	0	0	0	6
Maximum Count		**150**	**0**	**0**	**0**	
	07 Jan	146	0	0	0	146
	15 Jan	53	0	0	0	53
	21 Jan	215	0	0	0	215
	08 Feb	50	0	0	0	50
	13 Feb	24	0	0	0	24
	26 Feb	1	0	0	0	1
2011	12 Mar	0	0	0	0	0
	20 Mar	0	0	0	0	0
	27 Mar	0	0	0	0	0
	2 Apr	0	0	0	0	0
	02 Dec	0	1	0	0	1
	03 Dec	0	0	4	7	11
	04 Dec	0	0	0	1	1
Maximum Count		**215**	**1**	**4**	**7**	

Table 1. Continued

YEAR	DATE	LOCATION				TOTAL
		Rainfed rice	*Lagoon*	*Estuary*	*Delta*	
	16 Aug	79	0	0	0	79
	25 Aug	808	0	0	0	808
	27 Aug	87	0	0	0	87
	01 Sep	733	0	0	0	733
	02 Sep	93	0	0	60	153
	04 Sep	117	0	0	0	117
	09 Sep	113	0	0	152	265
	16 Sep	1,390	0	0	0	1,390
2012	18 Sep	75	0	0	0	75
	22 Sep	202	0	0	34	236
	24 Sep	77	0	0	219	296
	30 Sep	141	0	0	46	187
	02 Oct	183	0	0	120	303
	07 Oct	0	0	0	241	241
	20 Oct	96	0	0	0	96
	28 Oct	30	0	0	102	132
	8 Nov	8	0	0	9	17
Maximum Count		**1,390**	**0**	**0**	**241**	
	15 Aug	26	0	0	35	61
	17 Aug	14	1	0	0	15
	1 Sep	75	0	0	0	75
	8 Sep	51	0	0	123	174
	22 Sep	61	0	0	0	61
	11 Oct	337	0	0	0	337
	12 Oct	147	0	0	0	147
2013	23 Oct	0	0	0	968	968
	24 Oct	0	0	0	860	860
	2 Nov	0	0	0	120	120
	16 Nov	0	0	0	7	7
	24 Nov	0	0	0	38	38
	25 Nov	0	0	0	4	4
	2 Dec	83	0	0	0	83
	3 Dec	56	0	0	2	58
Maximum Count		**337**	**1**	**0**	**968**	

Table 2. Summary count of Wood Sandpiper at Pantai Trisik during 2007-2013 that meet the staging threshold and 1% threshold criteria for the Flyway.

Date	Number of birds
28/10/07	449
25/08/12	808
01/09/12	733
09/09/12	265
16/09/12	1,390
24/09/12	296
02/10/12	303
11/10/13	337
23/10/13	968
24/10/13	860

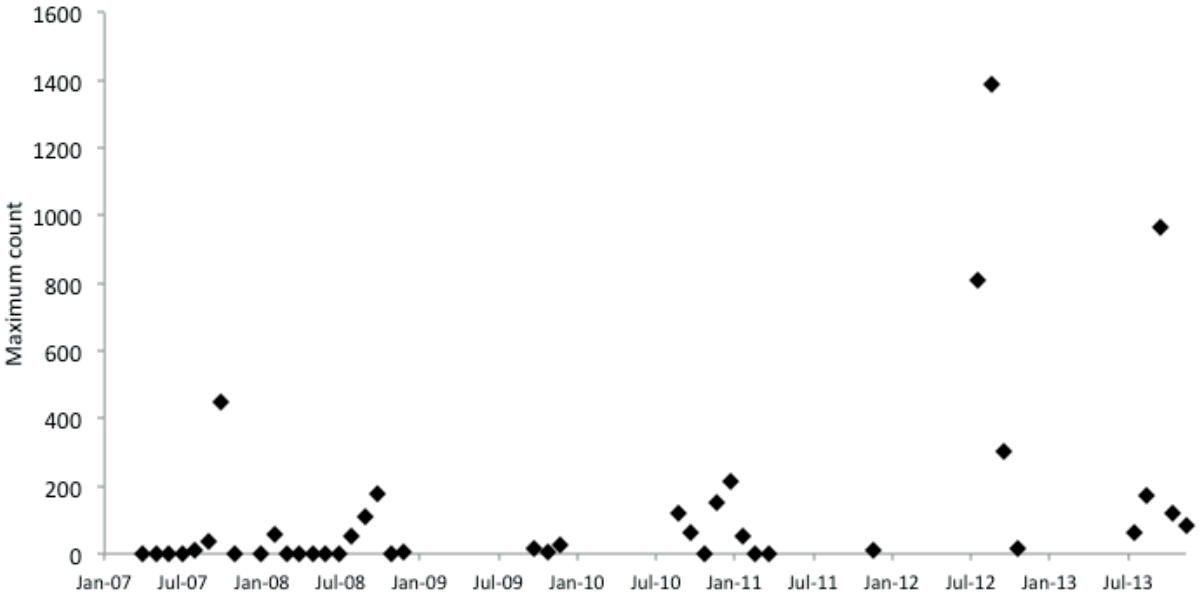

Figure 2. Graph show maximum count in any month of Wood Sandpiper recorded in Pantai Trisik during 2007-2013.

Larger flocks were encountered in 2012-2013 compared with 2007-2011. We believe this may in part be an artifact of the survey methodology as during 2007-2011 counts were made in the morning when farmers had already begun their activities in the rice fields possibly resulting in birds being more scattered and harder to count (Figure 3). In 2012-2013 counts were conducted in the afternoon and evening when human activity was lower and birds had begun to aggregate to roost (Figure 4).

In our study rain-fed rice fields were the most frequently used habitat by Wood Sandpipers, possibly reflecting the availability of their preferred prey. Core sampling by Lestari (2009) during the Wood Sandpiper migration period (October-December and January-February), found 10 invertebrate species in the rain-fed rice fields that were potential food for shorebirds, with *Tubifex* sp worm (from phylum Annelida, class Clitellata, order Haplotaxida, family Naididae) became the most abundant species.

Our study has highlighted the importance of the Pantai Trisik area for Wood Sandpiper in the East Asian-Australasian Flyway and identified it alongside Danau Jempang in East Kalimantan (Gönner 2000, Gönner *et al.* 2014) as an important known site within Indonesia. Survey work at other potential wetland areas in Java during the migration period, may result in the identification of further important sites for this species and others.

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Figure 3. A high aggregation of Wood Sandpiper in PantaiTrisik at dusk containing 50+ birds. Photographed on 9 October 2012 by Shaim Basyari.

Figure 4. During the day, Wood Sandpipers prefer to hide in the paddies. Photographed on 16 September 2012 by Zulqarnain Assiddiqi.

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THE USE OF RICE FIELDS BY THE ENDANGERED AUSTRALIAN PAINTED SNIPE (*ROSTRATULA AUSTRALIS*): A RARE OPPORTUNITY TO COMBINE FOOD PRODUCTION AND CONSERVATION?

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We document widespread use of rice fields by the globally endangered Australian Painted Snipe (*Rostratula australis*), highlighting the potential for 'wildlife-friendly' food production in Australia. A total of 44 Australian Painted Snipe from five of 93 surveyed rice field study sites, and an additional 43 Australian Painted Snipe from three other rice fields, were recorded during the 2012-2013 rice-growing season in the Riverina region of New South Wales. The overall total of 87 birds at these eight widely distributed sites was likely to be indicative of at least several hundred Australian Painted Snipe using the 113 500 ha of rice fields during that period particularly given the limited survey effort. This is remarkable given the most recent estimate of total population size for the species ranges only from 1 000 to 2 500 birds. The birds were primarily recorded using the shallow edges of rice fields, along banks and channels. Future research should focus on (1) determining if significant numbers of Australian Painted Snipe use rice fields regularly, (2) whether or not rice fields provide suboptimal habitat, (3) the extent to which Australian Painted Snipe breed in these habitats, and (4) optimal rice-growing practices that benefit Australian Painted Snipe without hindering conservation management of the Endangered Australasian Bittern (*Botaurus poiciloptilus*), which also occurs in these habitats. There are clear environmental costs of extracting water from rivers for irrigation and rice fields are no substitute for natural wetlands. However, given the recognised need for food production and the large area where rice is still grown, targeted management of rice fields to benefit Australian Painted Snipe and other species may be important in complementing traditional conservation measures like protected areas and ecological restoration.

INTRODUCTION

The modification of natural ecosystems to develop modern agriculture is recognised globally as a major cause of biodiversity loss (Millennium Ecosystem Assessment 2005). However, the potential biodiversity conservation value of the resulting novel, anthropogenic habitats and landscapes is often overlooked. They may also support populations of rare or threatened species, thus providing opportunities for both viable agricultural production and biodiversity conservation (e.g. Longoni *et al.* 2011, Chester & Robson 2013, Luck *et al.* 2013). Central to the 'land-sparing' and 'land-sharing' debates in conservation science is the inevitable need for increased agricultural production (Green *et al.* 2005, Fischer *et al.* 2008, Phalan *et al.* 2011). The ensuing question is how effectively can the expansion of 'wildlife-friendly' farming ('land-sharing') conserve biodiversity compared to more intensive farming with protected conservation areas ('land-sparing').

Globally, rice fields are well known for their value as waterbird habitat, and although they are no substitute for natural wetlands, their potential contribution to conservation as agricultural wetlands is well established in the literature (e.g. Fasola & Ruiz 1996, Elphick 2000, Elphick *et al.* 2010, Tourenq *et al.* 2001, Czech & Parsons 2002). Despite this, little is known of the use of rice fields by cryptic and threatened waterbird species (Taylor & Schultz 2010).

The Australian Painted Snipe (*Rostratula australis*), referred to hereafter as 'APS', is a poorly known, cryptic shorebird, primarily an inhabitant of shallow freshwater wetlands (Marchant & Higgins 1993, Department of the Environment 2013a). It was only recently recognised as a full species, distinct from its closest relative the Greater Painted Snipe (*Rostratula benghalensis*) of Asia and Africa. This distinction was made initially by morphological differences and subsequently confirmed by mitochondrial-DNA analysis (Lane & Rogers 2000, Baker *et al.* 2007). It is endemic to Australia and has been recorded using a wide range of freshwater wetland habitats. However, its breeding habitat requirements are more specific: temporarily inundated wetlands, during the transitional stage after flooding when drying out, at which time they have a combination of shallow receding water levels, open mudflats, patches of dense low cover, complex shorelines and small islands (Rogers *et al.* 2005).

APS is listed as Endangered by the International Union for the Conservation of Nature because it has a single, small population that has declined rapidly

(BirdLife International 2012). The decline of the APS has been primarily attributed to the loss of suitable wetland habitat through drainage and the diversion of water for agriculture and other human uses. In Australia, its conservation status was upgraded from Vulnerable to Endangered under the *Environmental Protection and Biodiversity Conservation Act 1999* in May 2013 following continued evidence of significant decline (Department of the Environment 2013a). There is only one other Australian wetland bird species – the Australasian Bittern (*Botaurus poiciloptilus*) – that is listed as Endangered at the global or national level (Department of the Environment 2013b; Birdlife International 2014).

The reporting rate of the APS has declined steadily since the 1950s, with its apparent stronghold – the Murray-Darling Basin – sustaining the largest decline (Lane & Rogers 2000). In 2005, it was suggested the total APS population could be a tenth of what it was in the 1970s – a 90% decline – but there were significant limitations in the dataset used (Rogers *et al*. 2005). In 2010, the total population was estimated to be 1250 mature individuals (1000-1500, medium reliability), and highly unlikely to exceed 2500 mature individuals (Garnett *et al.* 2011).

Rice fields are known to be of importance to the Greater Painted Snipe, which nest on embankments in inundated rice fields (Ali 1968, Fujioka & Yoshida 2001, Amano *et al.* 2010). APS have also been recorded using rice fields (Marchant & Higgins 1993) although their abundance in rice fields and the relative importance of this habitat are not known. The most recent major work on the ecology and conservation of the species found no evidence to suggest that rice fields were important to the APS (Rogers *et al.* 2005).

In Australia, approximately 95% of rice is produced in the Riverina region of southern New South Wales, which is a region containing wetlands known to support substantial numbers of waterbirds (Kingsford *et al.* 2013). Rice is grown from September to May in irrigated bays (Figure 1) with water that has been stored in upstream reservoirs (or diverted directly from rivers), then distributed through networks of channels. Seed is usually sown aerially into flooded bays (approximately 5 cm deep). After about four weeks the water level is increased. By around 12 weeks, water levels are approximately 25-30 cm and are maintained at this level until about March, when water levels gradually recede in preparation for harvest, with any excess water drained. The agronomic practice of 'lasering' (the use of geographic information systems with earth-moving machinery to implement desired microtopography) results in relatively uniform water levels in each rice bay except in toe furrows, which are deeper (Figure 1). The total area of rice crop varies greatly between years and depends on the amount of water available for irrigation, which is determined through regional allocations that are strongly influenced by dam levels as a result of floods and droughts. The rice crop area ranged from approximately 180 000 ha in 2000-2001 (prior to the millennium drought and environmental water recovery), to 2160 ha in 2007-2008. The largest crop since 2001–2002 was 113

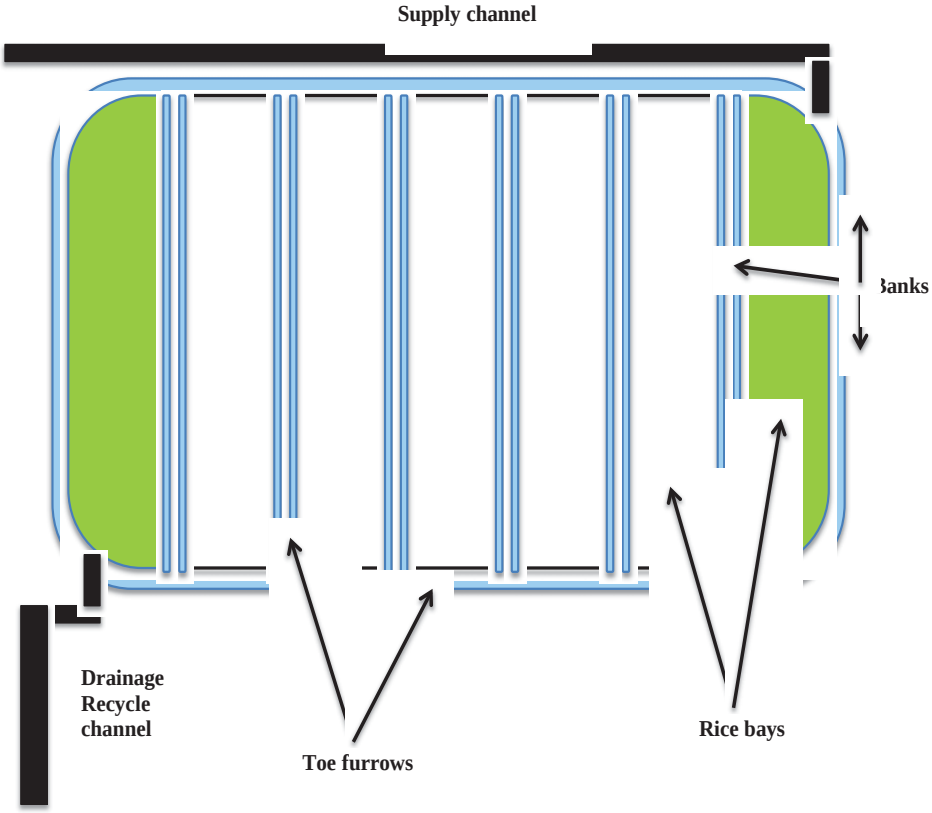

Figure 1. Schematic diagram of a rice field, typical of a single study site, with seven rice bays, each surrounded by toe furrows (a thin area surrounding the bay, deeper than the crop) and banks, and with the supply and drainage/recycle channels. Surveys were conducted by walking and driving along banks.

500 ha in 2012–2013 (RGA 2013, Sunrice 2013, Sunrice *unpubl. data*).

The aim of this paper is to report unexpected and widespread APS records made during waterbird surveys in rice fields in the NSW Riverina during the 2012-2013 season, along with additional records. We describe methods that we applied and the observations made, review the knowledge of use of rice fields by APS prior to our study period, and discuss the significance and implications of the results.

METHODS

Study region

The Riverina region of southern New South Wales, Australia, is recognised as one of Australia's most important agricultural regions and now contains heavily modified landscapes, including vast irrigation areas. The Riverina incorporates the Murrumbidgee and Murray Rivers, once they have flowed out of the Great Dividing Range in the east, until their confluence in the west near Boundary Bend in Victoria. Major regional centres of the NSW Riverina include Griffith, Leeton and Deniliquin, with Albury and Wagga Wagga on the eastern edge of the region. As the Riverina is characterised by broad floodplains with braided channels, it contains numerous wetland systems. Its flat plains support chenopod shrubland, grassland, and woodlands of Boree (*Acacia pendula*), Grey Box (*Eucalyptus microcarpa*), Black Box (*E. largiflorens*) and River Red Gum (*E. camaldulensis*) (Kent *et al.* 2002). It is classified as a hot dry zone (with cooler winters), with mean monthly rainfall similar throughout the year. The mean daily maximum temperature for Deniliquin is 32.5°C in January and 14.4°C in July with 405 mm rainfall, with similar ures for Griffith of 32.9°C, 14.5°C and 403 mm, respectively (BOM 2014a).

Study Design

During the 2012-2013 rice-growing season, 93 study sites were established in rice fields throughout the Riverina as part of a study targeting Australasian Bittern (Herring *et al.* 2014) (Figure 2). Community engagement activities in November and December 2012 led to new records of bittern sightings. Each of the 93 study sites was a discrete rice field (encompassing multiple bays) situated greater than 30 metres from an adjacent rice field (Figure 1). Most sites were between 20 ha and 40 ha, typical of a rice field, but ranged in area from 7.3 to 93.5 ha. The precise area for some sites was not determined but the area of the 93 sites accounted for somewhere between 3 and 4 per cent of the total 2012-2013 rice crop area of 113 500 ha.

There were four different site types, each specifically related to the bittern study: (1) sites based on reported bittern sightings with the aim of verifying these records (n=28); (2) control sites where no sightings had been made, located adjacent

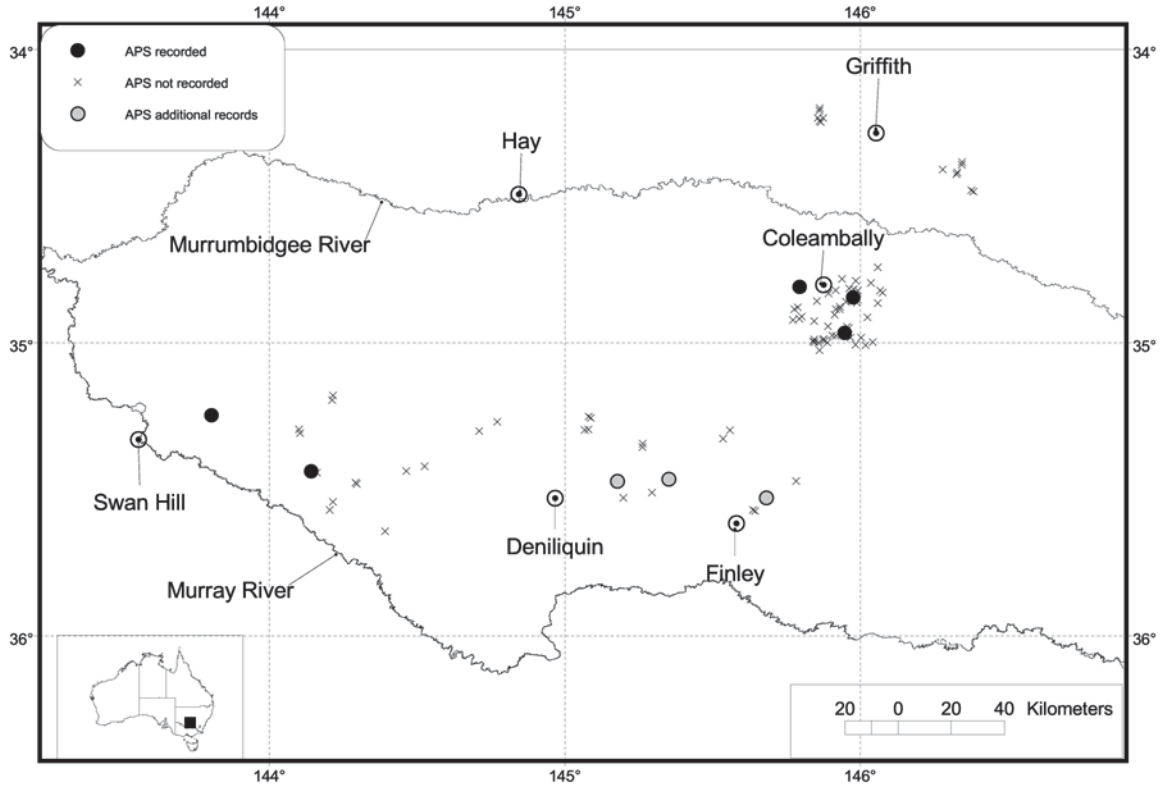

Figure 2. Records of the Australian Painted Snipe (APS) associated with rice fields during the 2012-2013 rice-growing season in the Riverina region of New South Wales, including the 93 study sites (grey crosses), five of which produced APS (black dots), along with three additional APS sites (grey dots).

to the above verified sites (n=13); (3) targeted sites where there were either previous confirmed bittern reports or which were visited to ensure coverage of the study area (n=22); and (4) sites from randomly selected rice farms (n=30). The 30 randomly selected rice farms were exclusively in the Coleambally region because of the relatively high densities of bitterns in that region. The remaining 63 sites included 34 in the Murrumbidgee catchment and 29 in the Murray catchment. Of the 34 Murrumbidgee sites, 24 were verification sites based on reported sightings, while the remaining ten were control sites. Only four of the 29 Murray sites were verification sites based on reported sightings, with three control sites, and the remaining 22 being targeted sites.

Waterbird surveys

All waterbirds were surveyed once at each of the 93 study sites between 11 December 2012 and 8 February 2013. This retrospectively formed the basis for identifying sites where APS were present for subsequent repeat surveying. Each survey entailed one hour of scanning for birds from banks adjacent to rice bays in a vehicle and on foot. The only surveying that took place within the crop itself was from these banks. All surveys were conducted within three hours of first light in the morning or three hours before sunset, with the exception of six surveys that were conducted mid-afternoon.

Australian Painted Snipe sites

Once APS sites had been identified, the detection method was noted and a second count was made to determine the minimum number of individuals and, where possible, the gender of each bird (this was not possible for some sub-adult or poorly seen individuals). Views were not sufficient to determine if there were any juvenile birds present. In order to obtain accurate minimum counts of the number of individuals and determine sex ratio, the observer flushed birds by walking along banks. The specific microhabitat was recorded (e.g. toe furrow, adjacent channel). Subsequent visits, where possible, helped determine minimum length of stay at each site. Further information on habitat use was also recorded. These additional visits are detailed in the results.

Review of the APS database

Birdlife Australia established the APS Project in 2001 and has been encouraging birdwatchers to undertake targeted surveys for the species. It maintains a database of all reported records of the species and endeavours to include those not directly contributed to Birdlife Australia. The database was searched for APS records associated with rice fields.

RESULTS

A total of 44 APS was recorded at five of the 93 study sites in 2012-2013. The APS database revealed an additional 43 birds within this same period at three different rice fields (‘Mayrung 1 & 2’ and ‘Finley’) located within the study area. Thus, the overall total was 87 APS associated with rice fields during the 2012-2013 rice-growing season. The 87 birds comprised 19 females, 19 males and 49 individuals where sex could not be determined or was not recorded (Table 1). APS observations at the five sites where they were recorded during the core study (93 sites) included two from morning surveys and three from afternoon surveys. All eight APS sites (our five plus the three in the APS database) were distributed across the rice growing regions of the Riverina in New South Wales, except for the northern Murrumbidgee region around Griffith (Figure 2). Three of the five APS sites (from the 93 study sites) were from randomly selected rice farms in Coleambally.

The initial detection was as a result of either walking or driving around the edges of rice fields, where APS were seen or, most often, flushed as a result of that disturbance. The majority of observations were of birds using the edges of bays within rice fields (Figure 3), particularly the toe furrows, which are the surrounding channels within individual rice bays (Figure 1, Table 1). At four sites, the drainage or supply channels were used, while at two sites, areas where water had overflowed or seeped from the rice field were used. APS were recorded in the actual crop, rather than the toe furrow, at only one site, where 12 birds were flushed from the crop edge (Figure 4, Table 1). The rice height at this site was considerably shorter than at least four of the other seven APS sites (‘Coleambally 2 & 3’, ‘Barham’ and ‘Swan Hill’), which supported rice over 30 cm in height, with water depths of 12-17 cm at the time APS were present.

The observations were made in a period ranging from 1 to 102 days. This represents the best estimate of minimum duration of APS occupancy in rice fields as systematic monitoring of each site was not possible, and it was unknown how long APS were present before detection. A return visit to the Coleambally 1 site (Figure 2, Figure 4) on 5 January 2013 failed to relocate any of the 12 birds seen previously, while return visits were not possible to the ‘Coleambally 3’ and ‘Swan Hill’ sites, meaning the observation period for all three of these sites was only 1 day. At the ‘Coleambally 2’ site, only two birds were initially found, with a return visit yielding four on the 14 January 2013, but no birds on 13 March 2013. At all other sites, the observation period has been deduced by the observations made by other people.

Figure 3. An Australian Painted Snipe foraging on dusk, using the shallows on the edge of a rice field adjacent to the crop. Photo: M. Herring.

Figure 4. One of 12 Australian Painted Snipe recorded using this rice field (in the shade, at the bottom, centre of image), found roosting within the crop edge. Photo: M. Herring.

Figure 5. Australian Painted Snipe nesting on the bank of a rice field in 1974, including incubating male, three eggs and recently hatched chick (Thomas 1975). This rice farm produced seven of the ten Riverina records associated with rice, prior to the 2012-2013 season and spanning 39 years, on the Birdlife Australia APS database. The apparent significance of this particular rice farm is probably best explained by the family that owns it, which includes several avid birdwatchers who have reported their sightings. It was also one of the eight 2012-2013 APS sites. Photos: E. Thomas.

Table 1. Records of the Australian Painted Snipe associated with rice fields during the 2012-2013 rice-growing season, showing the minimum number of birds, their habitat use and observation period. M=Male, F=Female & U=Unknown sex.

Location (Site Name)	Minimum number of birds	Habitat use	How were APS initially located?	Observation period (first and last obs.)
Coleambally 1	12 (2F, 2M, 8U)	Crop edge, edges of toe furrows, along supply channel	Walking	1 day *23 Dec. 2013*
Coleambally 2	4 (1F, 3U)	Along drainage channel and edges of toe furrows	Walking	24 days *22 Dec. 2012 -14 Jan. 2013*
Coleambally 3	2 (1F, 1M)	Edges of toe furrows	Driving	1 day *22 Dec. 2012*
Barham	25 (5F, 3M, 17U)	Edges of toe furrows, as well as seepage/ overflow and adjacent grassland	Driving	46 days *19 Dec. 2012 - 23 Jan. 2013*
Swan Hill	1 (1U)	Edges of toe furrows and adjacent overflow/seepage	Driving	1 day *6 Jan. 2013*
Mayrung 1	4 (1M, 3U)	Edges of toe furrows	Walking	102 days *15 Dec. 2012 - 27 March 2013*
Mayrung 2	34 (10F, 10M, 14U)	Along drainage channel, edges of toe furrows	Driving	14 Days *30 Dec. 2012 - 13 Jan. 2013*
Finley	5 (2M, 3U)	Drainage channel, edges of toe furrows	Driving	14 days *15-29 Nov. 2012*

Records prior to 2012-2013

Prior to the 2012-2013 season the Birdlife Australia APS database held 13 records associated with rice fields. Three of these records were from outside of the Riverina region of New South Wales: one on the Gwydir River floodplain in north-eastern New South Wales, and two from Queensland. Seven of the 10 historical Riverina records were from the same farm near Barham where 25 APS were recorded during the 2012-2013 season; they include the only documented case of Australian Painted Snipe nesting in rice fields (Thomas 1975, Figure 5). The 10 Riverina records span six different rice-growing seasons: 1974-75, 1978-79, 1979-80, 1992-93, 2003-04 and 2004-05.

DISCUSSION

The large numbers and widespread distribution of APS found during the 2012-2013 rice-growing season suggest that rice fields are more important as habitat for the species than previously recognised (Marchant & Higgins 1993, Rogers *et al.* 2005, Department of the Environment 2013a). The value of rice fields as APS habitat appears to have been overlooked because of a lack of broad scale surveys by observers familiar with the species and its conservation status.

The total of 87 APS recorded at eight widely distributed rice paddocks during the 2012-2013 season was likely to be indicative of many more, probably at least several hundred, using rice fields during that period in the Riverina region of New South Wales. We make this inference because of:

1. the limited primary survey effort of 93 1-hour surveys (which yielded 44 birds).
2. the rice crop area of the 93 sites was less than 4 per cent of the total rice crop area of 113 500 ha.
3. the limited total rice field edge surveyed. A coarse estimate of the entire length of edges for a 42 ha (600 m x 700 m) rice field with seven bays, is 6.2 km (not including both sides of bay edges). So during the 2012-2013 season there was approximately 16 755 km of rice field edge across the 113 500 ha crop, not including the edges of adjacent supply and drainage channels. A maximum of approximately 2.5 km was surveyed at each of the 93 sites, representing 1.4% (232.5 km of 16 755 km) of the estimated total rice field edge in the Riverina.
4. the occurrence of APS at three of the 30 randomly selected rice farms in Coleambally.
5. the likelihood of double counting is considered very low because many of the observation periods occurred concurrently (Table 1), including the two sites with the largest numbers ('Barham' and 'Mayrung 2'). Additionally, there are large distances between the sites (Figure 2), with substantial intervening areas of potentially suitable habitat.
6. the APS is a cryptic species and often difficult to detect, so some individuals were probably overlooked.
7. the likelihood of rice farmers or other observers at rice fields being aware of the species, its significance and reporting sightings is considered very low.
8. the relatively homogenous nature of rice field habitat means that extrapolation of the results at this scale is much more reasonable than with other wetland types.

The likelihood of rice fields supporting hundreds of APS is highly significant for a globally endangered species with a very small estimated population size (1250 mature individuals; Garnett *et al.* 2011). Indeed, the apparent adaptability of APS to novel, anthropogenic habitat is encouraging and this provides numerous opportunities for targeted conservation management on rice farms. However, there are important questions that need to be addressed.

How regularly do APS use rice fields?

It is unclear how regularly APS use rice fields, especially in significant numbers. Prior to the 2012-2013 rice-growing season, the Birdlife Australia APS database held only ten Riverina records (spanning six seasons over 39 years) where birds were associated with rice fields, seven of which came from a single rice farm that is owned by a family that includes several avid birdwatchers. It would appear that the 2012-2013 season was an exceptional year but the increased survey effort as a result of the 'Bitterns in Rice Project' (Herring *et al.* 2014) at least partly explains this. APS may use rice fields in most or all seasons, sometimes in significant numbers, but until now this has gone undetected. On 29 December 2013, four APS were observed approximately three kilometres from the 'Mayrung 2' site (L. Moore, *pers. comm.*), confirming the use of rice fields following the season described in detail in this paper. In November 2011, a group of at least 30 APS were found using a rice field in the Jerilderie region, New South Wales (P. Merritt, *pers. comm.* – note this record was not contained in the APS database at the time of searching). In sum, APS have been recorded using rice fields in each of the last three rice-growing seasons, with large numbers found in two of them (30 and 87).

What roles do rainfall and natural wetland availability play?

Overall abundance of APS is known to fluctuate substantially between wet and dry periods in Australia. The relatively large numbers recorded using rice fields during the 2012-2013 season are consistent with a documented recovery for the species after two exceptionally wet years following the millennium drought of 2001-2009 (Purnell *et al.* 2014). Toward the end of the drought, during the 2008-2009 survey period, only 11 APS were reported nationally to BirdLife Australia, whereas in the record two-year high rainfall period prior to May 2012, there were over 400 individual APS recorded (APS Database, Birdlife Australia; BOM 2014b).

The use of rice fields by the APS might be determined by the extent of suitable natural wetland habitat during the rice-growing season in the surrounding region. In the Riverina region of New South Wales, almost all of the natural wetland areas had dried out before the 2012-2013 season and had no habitat suitable for the APS. The 100% water allocations in the 2012-2013 rice-growing season were largely as a result of water captured during the floods of 2010-2012 (RGA 2013, Sunrice 2013). During dry periods in the Riverina prior to rice-growing, the APS may have simply moved elsewhere in their large Australian range. Rice fields may represent alternative, sub-optimal habitat that only support APS in relatively large numbers during dry periods (following a population boom) when their preferred habitat is unavailable.

How do APS use rice field habitats?

Our results show that rice fields can provide suitable temporary wetland habitat to support large numbers of APS. The edges of rice fields appear to be most important to the APS. The edges surrounding individual bays and their toe furrows, bank and channel edges, and areas where water from overflow or seepage had pooled adjacent to the rice field, all supported the APS. APS is known to avoid habitats dominated by tall, dense wetland vegetation and prefers substantial areas of patchy, low vegetation in combination with exposed mud and shallow water (Rogers *et al.* 2005). Any use of the actual rice crop by the APS (e.g. Figure 4) is therefore likely to occur only for a short period some time after sowing when water depths remain sufficiently low and before the crop has grown prohibitively tall. Thus, APS may primarily be associated with rice fields during the early and mid-season periods.

How regularly do APS breed in rice fields?

Breeding habitat appears to be critical in limiting the APS population and is probably the most important conservation challenge for the species (Rogers *et al.* 2005). There is one published record of APS breeding in association with rice: on the bank of a rice field near Barham during the early-mid season (December) of 1974 (Thomas 1975; Figure 5). It seems unlikely that this record is a 'one-off', with other breeding events having gone undetected or unreported. The comparatively well-studied congener of the APS, Greater Painted Snipe, is known to nest on the banks of rice fields (Ali 1968). However, rice fields typically lack sustained provision of some of the key breeding habitat attributes for APS identified by Rogers *et al.* (2005), notably the small islands, shallow water and exposed mud that is associated with receding water levels during a successional stage of temporarily inundated wetlands. Nevertheless, the banks between rice bays may provide a similar role to islands, as they are almost entirely surrounded by water, and the shallow water, exposed mud and short, dense cover often found along the edges of rice fields may be an adequate linear alternative to that found in natural wetlands. If the single published breeding record is indicative of a lack of

breeding, then there are numerous habitat management opportunities to enhance the potential for APS to breed in association with rice fields.

Could rice fields affect APS negatively?

The concept of ecological traps (Dwernych & Boag 1972, Donovan & Thompson 2001) may apply to rice fields and the APS. For example, birds might be lured away from better quality habitat in natural wetlands where their chances of breeding successfully are higher. Agronomic practices, including the speed at which modern rice varieties grow, could alter the required habitats before successful breeding is completed. Similarly, increased water levels after the APS have started nesting in a rice field might result in chicks hatching in a habitat where they cannot forage. There is also a potential risk associated with the use of pesticides in rice fields (Suhling *et al.* 2000, Wilson *et al.* 2005), which may impact on APS, either via their prey or through changes in water quality. The risk of pesticide contamination or rice fields acting as ecological traps should be a target for further research as there are likely to be numerous opportunities to ameliorate these risks through careful management.

How can rice fields be managed to benefit APS?

Rice-growing methods and the configuration of rice fields could be altered to benefit APS. Management prescriptions with little or no impact on production would likely result in the greatest uptake. Targeted management of toe furrows, banks, channels and overflows/seepage could increase the amount of potential APS habitat in rice fields. For example, rice farmers could be encouraged to have smaller bays and wider, shallower toe furrows, which would result in more edges and mudflats. Sheep grazing could be used to keep vegetation at heights that are not prohibitively tall for APS. In Japan, the Greater Painted Snipe is closely associated with rice fields and appears to have declined severely from changes to rice field management (Fujioka & Yoshida 2001, Amano *et al.* 2010). This highlights the need to monitor agronomic developments in the Riverina rice industry.

In developing APS-friendly rice-growing guidelines, it will be important not to hinder conservation efforts for the Australasian Bittern. Taylor & Schultz (2010) highlight the importance of the early stages of the rice-growing season for shorebirds. At this time, the water depth and rice height are both low. They advocate the development of new varieties of rice that would reduce the need for increasing water depths later in the season. While these recommendations may benefit the APS, they are likely to disadvantage the Australasian Bittern. Similarly, toe furrows and banks managed to benefit the Australasian Bittern presently include the retention of Cumbungi (*Typha* spp.) and the promotion of Barnyard Grass (*Echinochloa* spp.) (Bitterns in Rice Project 2014a), which would both likely render areas less suitable or unsuitable for the APS. The potential habitat management trade-offs for these key threatened species now represent one of the primary challenges for biodiversity conservation in Australian rice fields.

The potential for 'wildlife-friendly' rice farming

Our findings highlight the potential for 'land sharing' and 'wildlife-friendly farming' approaches (Green *et al.* 2005, Fischer *et al.* 2008, Phalan *et al.* 2011) to conserve biodiversity using agricultural wetlands in Australia. More specifically, the results identify the potential role that rice farmers can play in the conservation of Australia's most threatened shorebird. There are clear environmental costs of extracting water from rivers for irrigation, and rice fields are no substitute for natural wetlands. However, given the recognised need for food production and the large area where rice is still grown, targeted management of rice fields to benefit Australian Painted Snipe and other species may be important in complementing traditional conservation measures like protected areas and ecological restoration.

Future research priorities

We recommend the following interrelated priorities for future research of the use of rice fields by the APS in the Riverina region of New South Wales:

1. To determine spatial and temporal variation in abundance of the APS in rice fields throughout and between rice-growing seasons through an extensive long-term targeted monitoring program. Ideally, sites could be surveyed weekly or fortnightly and include all sites with previous APS records. Potentially, this work could be incorporated into the *Bitterns in Rice Project* (Bitterns in Rice Project 2014b), although the survey method for APS would need to be different, incorporating the association of APS with shallow edges. We recommend that a standardised 1-hour APS survey in rice fields consist of approximately 30 minutes of driving along tracks adjacent to rice fields and approximately 30 minutes of walking 1 km, both in an attempt to flush birds. Surveys could begin as early as one month after sowing, when some cover would have emerged, and be conducted throughout the day
2. to maximise the number of sites covered each day.
3. To explore the relationship between the APS, rice fields and natural wetlands. This work could test the sub-optimal habitat hypothesis and investigate the potential association of significant numbers in rice fields with population booms following exceptionally wet periods.

4. When APS are located in rice fields, intensive systematic monitoring should aim to determine the extent to which they breed therein and the factors affecting breeding success.
5. To investigate which agronomic factors, such as water management and pesticide application, influence APS use of rice fields and any potential impacts, with particular attention being paid to prey availability and breeding. This would inform the development of APS-friendly rice-growing guidelines in conjunction with guidelines for managing habitat for the Australasian Bittern.

Raising awareness of the APS among rice farmers and encouraging them to report sightings to Birdlife Australia is a priority for education and advocacy.

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LAND USE CHANGE IMPACTS SHOREBIRD HABITAT AT AN IMPORTANT SITE FOR JAVAN PLOVER *CHARADRIUS JAVANICUS* AND SANDERLING *CALIDRIS ALBA* IN JAVA, INDONESIA

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Pantai Glagah, a coastal wetland on the south coast of Java, Indonesia, is a breeding site for Javan Plover *Charadrius javanicus* and is both a nationally and internationally significant migration staging and non-breeding site for Sanderling *Calidris alba.* These species are classified as near threatened and least concern, respectively, by BirdLife International (2014). Visits, seven years apart, recorded substantial land use changes associated with a marked expansion in human recreational use of this site. We document a number of pressures that are likely to be detrimental to shorebirds. These pressures include high levels of habitat modification and degradation, human disturbance, and increased risk of nest trampling and predation by wandering domestic animals. We identify the need for management interventions to protect the notable wildlife values of Pantai Glagah and similar sites. Recommendations include identification and protection of high value areas for shorebirds,, restriction of public access to Javan Plover breeding sites,, habitat enhancement, community outreach and visitor education.

INTRODUCTION

The Yogyakarta Special Region (Daerah Istimewa Yogyakarta) is the second smallest of Indonesia's 34 provinces, with an area of 3,133 km^2 and an estimated population of 3,594,290 (Badan Pusat Statistik 2014). With an average density of 1,100 people per km^2 there are considerable pressures on the natural environment including the coastline. Within this region, sand spit and estuarine environments are of scarce occurrence and are important for shorebirds and people alike. Over the past decade a growing and increasingly mobile population, with more leisure time available than in the past, has expanded its recreational footprint along the coastline south of Yogyakarta. There is also a local drive to improve tourism and encourage further development in this area (Anggraeni 2013, Kusuma 2014). International research has shown that human recreational activity and habitat modifications frequently reduce the availability and quality of habitat for shorebirds (Jeffery 1987, Lord *et al.* 1997, Dowling & Weston 1999, Yasue & Dearden 2006). Because sandy tropical coastlines have high economic value there is often considerable incentive to develop them for recreation and tourism (Clark 1997). Such developments can occur rapidly and be poorly regulated, but very little research has been published to date on the extent of environmental impacts in Asia (Yasue & Dearden 2006).

One such site is Pantai Glagah, a small estuary on the southern coast of Java, Indonesia. It is located approximately 30 km south-west of the city of Yogyakarta and 16 km west of Pantai Trisik, a well-studied shorebird site (Taufiquarrahman *et al.* 2010, Tampubolon 2012, Assiddiqi *et al.* 2014). Pantai Glagah supports a resident population of the indigenous Javan Plover *Charadrius javanicus*, a near threatened species (Birdlife International 2014). Recent counts include 25 birds on 14 October 2005 (A. Crossland, *pers. obs.*) and 15 birds on 16 October 2010 (Iqbal *et al.* 2013a). Pantai Glagah is also one of only two sites in Java (and Indonesia) where internationally important numbers of Sanderling *Calidris alba* have been reported to date (Taufiquarrahman *et al.* 2010). It is used by this species both during migration periods and during the Northern Hemisphere winter. Notable counts have included 432+ on 14 October 2005 (Crossland *et al.* 2010), around 1,000 during the southern migration period 2005 (no precise date) and around 2025 on 24 December 2006 (Setiawan 2007). Although classified by Birdlife International (2014) as a species of least concern, Sanderling are generally uncommon and sparsely distributed in Indonesia (MacKinnon & Phillipps 1993) and this site has Indonesian national significance for the species (Taufiquarrahman *et al.* 2010).

Here we document changes in land use observed at Pantai Glagah, in a region of the East Asian-Australasian Flyway that is relatively under-studied but is nevertheless ecologically significant for hosting species of conservation significance. We highlight the impact of recreational development on coastal bird habitat within the Yogyakarta region and implications for shorebird management. We offer recommendations for monitoring, conservation activities and community engagement that may assist with protection of important shorebird habitat within the wider context of managing development in this coastal region.

METHODS

Site description

The Pantai Glagah estuary (7°54'50" S, 110°04'22" E) is located at the mouth of the Serang River within the Kulonprogo District, Yogyakarta Special Region, on the southern coast of Java, Indonesia. It is shallow (generally <2 m), 1.4 km long, 30-150 m wide, orientated approximately east to west and separated from the sea by a partially-vegetated sand spit measuring 1.1 km long and 30-110 m wide.

Survey methods

We made two visits to Pantai Glagah seven years apart, and undertook a qualitative habitat assessment and bird survey on each visit. Survey dates were 14 October 2005 and 22 August 2012. Both visits were made during the southward migration period for Arctic-breeding shorebirds and the second visit coincided with the breeding season for Javan Plover (Iqbal *et al.* 2013b, Taufiqurrahman & Subekti 2013). Our survey involved walking the length of the sand spit, scanning both the ocean beach and the estuary shorelines for shorebirds (including terns) and signs of breeding, as well as making observations on land use and habitat condition.

RESULTS AND DISCUSSION

Habitat modifications and increased human disturbance

We first visited Pantai Glagah on 14 October 2005 (Crossland *et al.* 2010). Although already a recreational area, development was mainly focused around a small cluster of houses on the northern shoreline of the estuary near the Serang River, and at another cluster of houses and food stalls on the ocean beach approximately 400 m west of the estuary (Figure 1A). Human recreational activity was centred on these two clusters of houses and food stalls. Elsewhere the sand spit and shorelines of the estuary were in a largely unmodified state. Most of the sand spit's surface comprised bare sand but the slope facing the estuary was vegetated in large patches of *Spinifex longifolius, Ipomoea* sp. and other coastal plants. In addition to previous reports of >430 Sanderling (Crossland *et al.* 2010) and 25 Javan Plover (A. Crossland *unpubl. data*), the area supported common coastal bird species such as Grey Heron *Ardea cinerea*, Little Egret *Egretta garzetta*, Pacific Golden Plover *Pluvialis fulva*, Common Sandpiper *Actitis hypoleucos*, Little Tern *Sternula albifrons*, Savanna Nightjar *Caprimulgus affinis* and Zitting Cisticola *Cisticola juncidis*. These are all typical species of Javan coastal wetlands (MacKinnon 1990). The absence of buildings, beach huts and informal shelters; the absence of pathways built for motorcycle access; low densities of human footprints; minimal litter; and large intact patches of beach vegetation all indicated that the sand spit had relatively low levels of human disturbance, particularly the eastern half towards the distal tip.

On 22 August 2012 we made a second visit to Pantai Glagah, seven years after our first visit. Over the intervening period the site had been developed into a busy recreational resort with a focus on

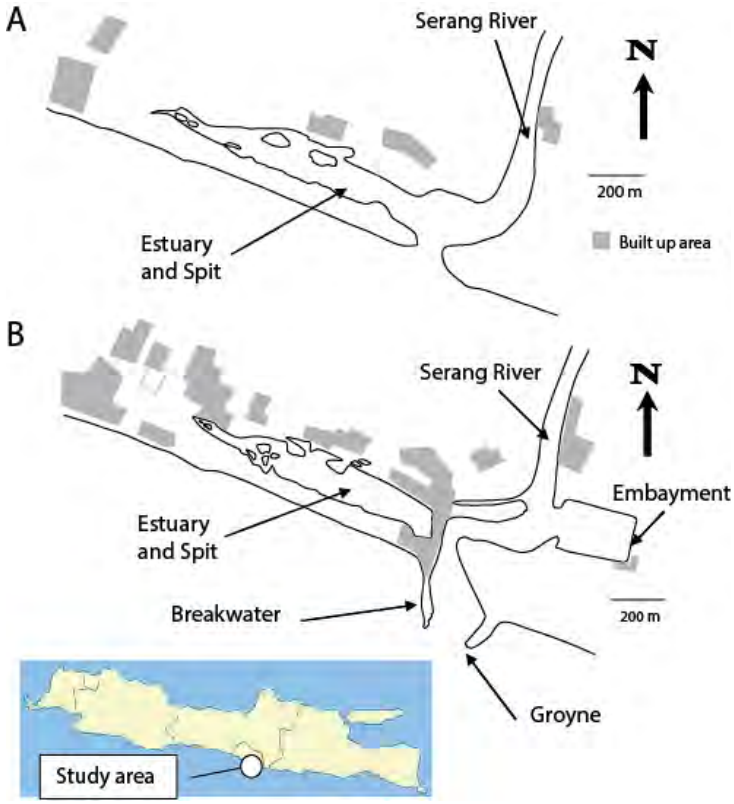

Figure 1. Map of Pantai Glagah and environs, October 2005 (A) and August 2012 (B). Inset shows the location within Java, Indonesia (A. Crossland ©).

boating and shoreline leisure activities (Anggraeni 2013, Kusuma 2014). We observed that considerable physical modification to the estuary, river mouth and sand spit had occurred since our previous visit (Figure 1B). A large breakwater had been built from the north-eastern shoreline to the tip of the spit and then extended a further 280 m seaward (Figure 1B). This had the effect of closing off the mouth of the estuary and converting it into a lake. The Serang River mouth was considerably modified by construction of the aforementioned breakwater on one side and a groyne on the other. In addition, a sizeable embayment had been constructed on the eastern side of the river just above the mouth. Much of the northern side of the estuary had become a recreational area with shoreline modifications and many new buildings. A promenade had been built along the riverbank and continued seaward along the top of the breakwater. This was lined with guest houses, restaurants and shops. A new cluster of buildings had been established on the former tip of the sand spit. The small beach settlement 400 m west of the estuary had also expanded into a more substantial recreation hub.

The sand spit had narrowed considerably since 2005 with beach erosion evident along the ocean side. The wide high-tide wrack line present in 2005 had been replaced by a much steeper foreshore slope and by vertical 0.5-2.5 m erosion scarps in places (Figure 2). Beach erosion is often triggered by breakwater or groyne construction and subsequent disruption to longshore drift and beach dynamics (Mangor 2004). Consequently, potential nesting habitat for Javan Plover on the upper foreshore, and foraging habitat for both Javan Plover and Sanderling on the lower foreshore, had become limited and also prone to human disturbance. In addition, we noted much greater quantities of litter (particularly plastics and polystyrene) in 2012 than had been evident in 2005, and this was found along the beach, atop the sand spit and around the shoreline of the estuary, including mudflats and marsh areas at the western end. Beach litter has been identified as an entanglement hazard for shorebirds (Weston *et al.* 2009).

While the physical impacts of land use changes were very evident, the scale of change in human activity, particularly in relation to numbers and spatial distribution of people using the site, was more difficult to assess. However, the visit on 22 August 2012 probably gave a fair indication of peak current human use because it occurred on a busy public holiday, part of the extended Idul Fitri celebrations marking the end of Ramadan, the Muslim month of fasting. Between 11:00 and 16:00 hrs on 22 August 2012 we counted more than 700 people at Pantai Glagah, with highest human densities on the northern shoreline of the estuary, on the promenade along the breakwater, at the eastern end (former tip) of the sand spit, and at the beach immediately west of the spit. Moderate densities were: along the western and middle parts of the spit, on mudflats at the western end of the estuary, and in pleasure boats on the water. Lowest human densities were on the southern shoreline of the estuary (north side of the sand spit), where dense ground vegetation made access more difficult and much less appealing for recreational activities. On this busy public holiday people were observed occupying or passing through almost all habitats that would otherwise be available to shorebirds. On less busy days, we assume the number of people using the site would be much lower, but the expanded distribution of buildings and other infrastructure indicates that disturbance and displacement pressures on birds at Pantai Glagah have increased substantially since 2005, and replicate those documented for coastal sites elsewhere in Indonesia (Crossland & Sitorus 2014), and internationally (Yasue & Dearden 2006, Dowling & Weston 1999, Huijbers *et al.* 2013, Schlacher *et al.* 2014).

Impacts on Sanderling and other shorebirds

Shorebirds observed at Pantai Glagah on 22 August 2012 were few, comprising small numbers of Black-naped Tern *Sterna sumatrana*, Little Tern *Sternula albifrons* and Great Crested Tern *Thalasseus bergii* feeding just off the beach; one pair of Javan Plover on the sand spit; three more pairs on the mudflats at the western end of the estuary; one Whimbrel *Numenius phaeopus* and two Common Sandpipers feeding on the southern shoreline of the estuary. No Sanderling were seen, a contrast to the approximately 1,000 recorded at this site by Setiawan (2007) during southern migration in 2005. Although early in the migration period, we confirmed that Sanderling were already present at nearby sites, including 27 at Pantai Trisik on 21 August 2012 (A. Crossland, *pers. obs.*). An influx may have occurred after our visit but habitat for this

Figure 2. Seaward (southern) side of the sand spit. Note the breakwater and promenade, large numbers of people and evidence of erosion along the beach.

species was certainly much reduced compared to what had been available in 2005 and the likely incidence of human disturbance to Sanderling flocks was certainly much higher.

Impacts on breeding Javan Plover by people and domestic animals

On 22 August 2012 we located four pairs of Javan Plover, considerably fewer than the 25 birds we counted in October 2005. Behaviour, including alarm calls, distraction displays, and "rodent-running" (as described by Taufiqurrahman & Subekti 2013) indicated they were all defending territories and thus, we infer they were breeding. Groups of people were dispersed through the plover breeding area (Figure 3) and we noted birds directing distraction displays toward people (who were generally oblivious) on both the sand spit and in the muddy, marshy areas at the western end of the estuary. We found one nest belonging to the sand spit pair. This nest was located on the estuary side of the spit just downslope of the crest. It was positioned between several small pieces of driftwood and comprised a shallow bowl lined with pebbles, twigs and dry grass stems (Figure 4). It contained a single, recently predated egg and was still being actively defended by both parent birds. Crush marks on the egg appeared consistent with predation by a mammal, possibly domestic dog *Canis lupus familiaris*, as dog tracks were abundant in very close proximity to the nest and we noted several domestic dogs freely wandering in the area. The egg contained a well-developed unhatched chick that had not been eaten, again suggesting that a domestic dog was the culprit as wild predators would usually consume prey or remove it from the nest, while domestic dogs will often play with eggs and chicks but not necessarily eat them (Weston *et al.* 2014).

Three pairs of Javan Plover were observed foraging and apparently defending territories on small patches of mudflat and marsh at the western end of the estuary. Their behaviour indicated that they were probably guarding nests or chicks. We located a well-concealed chick lying prostrate beside a discarded plastic bottle. The chick was well feathered, but still growing tail feathers and close to fledging (Figure 5). Abundant plover, human and animal footprints in the muddy substrate indicated that the plover family group were sharing their tiny (<2000 m^2) island of mudflat and marsh with visiting fishermen, domestic dogs and a small flock of sheep *Ovis aries*. In the general vicinity we also noticed wandering domestic goats *Capra aegagrus hircus* and domestic cats *Felis catus*. We observed strong anti-intruder behaviour directed toward a curious sheep that ceased grazing to follow a pair of plover across the bare mudflat (Figure 6). Our assessment is that domestic animals pose a potential threat to breeding Javan Plover at this site by disturbing incubating and brooding

Figure 3. View from the western end of the sand spit looking east. The estuary (now lake) with marshy islands and mudflats is in the middle distance. The young people playing football on the bare sand are less than 15 m from a Javan Plover nest containing a single recently predated egg.

Figure 4. Javan Plover nest on sand spit containing a recently predated egg.

adult birds, by trampling nests, and in the case of dogs, by predation of eggs and chicks.Our observations of Javan Plover at Pantai Glagah and at several other sites on the southern coast near Yogyakarta in 2005 and 2012 (A. Crossland & A.W. Sitorus *unpubl. data*) agree with the findings of Centurioni (2010) and Iqbal *et al.* (2013a, 2013b) that the species has a marked preference for sandy beaches and bare or sparsely vegetated sand spits backed by shallow coastal lagoons or estuaries that feature areas of mudflat or muddy shoreline margins. They also readily use dry aquaculture ponds and short sward coastal grasslands. We found that Javan Plovers were usually absent from public recreation access points but some birds maintained territories as close as 100 m from the edges of such points (A. Crossland & A.W. Sitorus *unpubl. data*). Despite centuries of human occupancy immediately adjacent to their breeding habitat, Javan Plovers still seem to be well established on suitable habitats along the coastline near Yogyakarta. However, the changes we observed between 2005 and 2012 at Pantai Glagah and at several neighbouring sites indicate that the human recreation footprint has expanded markedly, and we infer that this must inevitably impact detrimentally on Javan Plover, Sanderling and other shorebirds.

The need for management intervention to protect shorebird habitat

Intensification of human recreational activity at Pantai Glagah and similar sites along the coastline south of Yogyakarta is surely inevitable. Sand spit and estuarine environments have been identified as key habitats for resident Javan Plover and important numbers of migratory Sanderling. They may also be important for other migratory shorebirds and nesting terns, but more survey work is required to determine this. The same environments are coveted as important recreational areas because they offer safe swimming and boating opportunities, in contrast to ocean beaches along this coastline where powerful surf, rips and strong undertows make swimming dangerous.

We suggest a management approach where sectors of sand spits and estuaries with high conservation values for shorebirds are identified and protection measures implemented following international best practice (e.g. Bridson 2000, Dowding & Davis 2007, ICF International 2010, Florida Fish and Wildlife Conservation Commission 2013, Environment Canada 2013). Human disturbance impacts on Javan Plover can be reduced by restricting public access to key breeding areas, possibly through exclusion fencing, signage and patrolling by wardens (Wills *et al.* 2003, Weston *et al.* 2012, Rimmer *et al.* 2013). Activities such as plover egg collecting (identified as an issue by Iqbal *et al*. 2013a) should be stopped. Habitat manipulation and enhancement including litter removal, provision of artificial shelters for chicks (Maguire *et al.* 2011) and possibly predator control or exclusion (Johnson & Oring 2002) would likely prove beneficial. Public outreach and education initiatives could inform local communities and visitors about shorebirds and other species characteristic of the coastal zone (Wills *et al.* 2003), thereby developing a higher level of awareness and sense of identity with local wildlife (Maguire *et al.* 2013).

Figure 5. Javan Plover chick close to fledging.

Figure 6. Interaction between a curious sheep and a pair of Javan Plover (circled) guarding a chick. Note also the close proximity of human recreational activity on the estuary shore beyond.

These approaches have worked elsewhere in Indonesia; for example, in the protected mangrove areas of the Deli-Serdang District in North Sumatra, which support locally iconic species like Asian Dowitcher *Limnodromus semipalmatus* and Milky Stork *Mycteria cinerea* (Dongoran 2007). They have also been applied widely in the conservation management of beach-nesting plovers in other countries, including for Piping Plover *Charadrius melodus* (U.S. Fish and Wildlife Service 1996, Environment Canada 2013), Snowy Plover *Charadrius nivosus* (ICF International 2010), Hooded Plover *Thinornis rubricollis* (Dowling & Weston 1999) and New Zealand Plover *Charadrius obscurus* (Wills *et al.* 2003). Access controls and public education are also widely used at protected turtle breeding beaches in parts of South- East Asia (Chan 2006).

Kusuma (2014) identified the need to investigate the environmental carrying capacity of the Pantai Glagah area in order to better plan a more balanced development of the area. As part of this we suggest that a census project (ideally repeated every five years) could be implemented to determine the local population trends and distribution of Javan Plover and Sanderling. Birds are considered among the best indicators of beach health and these two shorebirds are obvious candidates as local indicator species. Census information can also inform local government agencies on both the location of key sites for birds, and on locations where bird densities are low and therefore where recreation and other human activities might be positioned so that negative impacts are diverted from the most sensitive areas.

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THE IMPORTANCE OF THE MYANMAR COAST FOR WATER BIRDS

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Surveys of water birds at eight sites along the 3000 km long coast of Myanmar from 2008-2013 have shown that the country hosts a number of significant intertidal mudflat areas. It regularly provides home to more than 150,000 wintering and migrating water birds of 80 different species. The large majority of these birds occur in the Gulf of Mottama and in the adjacent Ayeyarwaddy Delta. Together with other sites, the Myanmar coast proved to be important for many water birds, and included a total of 10 globally threatened species. The waders were most prominent with 39 species being recorded. Among those was the Critically Endangered Spoon-billed Sandpiper *(Calidris pygmeus)* for which coastal habitats in Myanmar hold more than 50% of the world population. Also, the Endangered Nordmann's Greenshank *(Tringa guttifer)* has been found in significant numbers and is one of 24 species where at least 1% of the global population is occurring on Myanmar's coast. Often, the combination of the intertidal mudflats with adjacent mangroves proved to be crucial for several water bird species, as shown in the case of the Vulnerable Lesser Adjutant Stork. *(Leptoptilos javanicus)* Despite the significance of this coastline for water birds, hardly any of the intertidal sites or adjacent mangroves has any formal protection. With rapid coastal development threatening most of the sites, the protection of the most important of these sites is of high priority.

INTRODUCTION

Myanmar is the largest country in mainland south-east Asia and has a continuous coastline of almost 3,000 km extending along the Bay of Bengal and the Andaman Sea. In the coastal zone, besides mangroves, coral reefs, sea grass beds, sandy beaches there are many intertidal mudflats. These are home to many globally threatened water bird species, such as the Spoon-billed Sandpiper *(Calidris pygmeus)* Nordmann's Greenshank *(Tringa guttifer)* and Lesser Adjutant Stork (*Leptoptilos javanicus),* among others (Ministry of Environmental Conservation and Forestry 2011), but also water birds in internationally important numbers. However, very little is known on the distribution and numbers of these water bird species in Myanmar. Thet (2006), Thet & Veen (2008) summarised observations from the Ayeyarwaddy Delta, but no information has been published from other coastal sites.

The Myanmar coastal zone is also important for fish stocks, which support artisanal fishery, and other livelihoods for local people. Rapid and often unsustainable development (Zöckler *et al.* 2013) is beginning to jeopardise the fragile relationship between these crucial habitats and the livelihoods of rural people who make up a high proportion of the population of Myanmar.

The aim of this paper is to summarise the surveys of water birds and their numbers and distribution in coastal Myanmar, and highlight threats and conservation issues. This is based on survey data collected from 2008-2013 across eight sites along the Myanmar coast, documenting the status and threatening processes at these sites.

METHODS

Site descriptions

Nine major intertidal mudflat complexes in Myanmar were identified as large enough in size to potentially qualify as sites of international and national importance for migratory and non-breeding water birds (see Figure 1). These are from north to south: Nan Thar Island, Hunters Bay, Natkan, the Ayeyarwaddy Delta (East and West), the area around the outer islands, the Gulf of Mottama, Ahlat and the mudflats around Bilugyun Island and in the south the Dawei River mouth and mudflats south of Myeik in Tanintharyi. These locations cover all coastal provinces, including Rakhine in the north, Ayeyarwaddy in the delta area, Yangon, Bago and Mon State in central Myanmar and Tanintharyi Region in the south. Sites were selected using satellite images on the basis of existing extensive intertidal mud and sandflats that are considered essential habitats for large numbers of waders and other water birds.

Nan Thar Island

Nan Thar Island (Rakhine Province) is about 120 km south of the Myanmar-Bangladesh border off the mouth of the Kaladan River and harbours about 300 ha of intertidal sand and mudflats encircled by

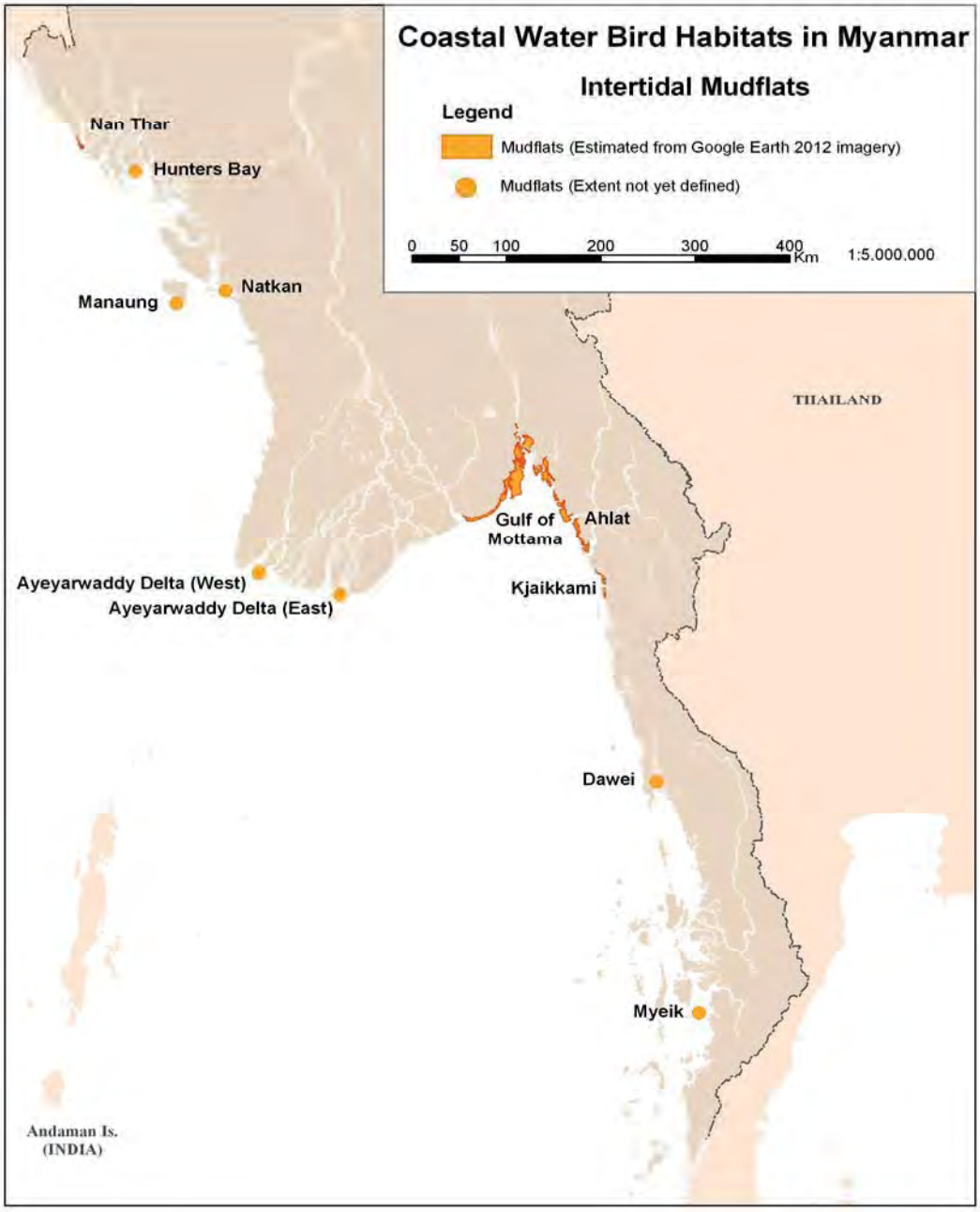

Figure 1. Distribution of intertidal mud and sand flats in Myanmar (Zöckler *et al*. 2013, see also Table 1) circled areas have not yet been delineated.

a set of sandy islands. It has a small fishing community of about 150 people. Nan Thar has been visited annually since 2008.

Hunters Bay

The area around Hunters Bay (Rakhine Province) was visited in January 2009 and the most important mudflats for Spoon-billed Sandpiper and other water birds were determined. The area is an estimated 1000 ha, but much of the area is less suitable for large flocks of water birds due to deep mud and adjacent mangroves.

Natkan

South of Hunters Bay lies Natkan (Rakhine Province), a small but potentially important mudflat area for water birds, approximately 200 ha in size, and surrounded by extensive agricultural fields with mangroves to the north. The site was only surveyed once in January 2009.

Ayeyarwaddy Delta

The Ayeyarwaddy Delta (Ayeyarwaddy Province) stretches over 140 km from west to east with many huge mudflats scattered along the coast often accompanied by outer islands, especially at the western and eastern edges of the delta. As the area is very large, not all potential sites have been visited. The western and eastern areas, covering an estimated 5000 – 6000 ha, were visited in 2010 and the eastern part again in 2013. Some areas in the eastern part have been surveyed previously in 2003 and 2006 (Thet & Veen 2008).

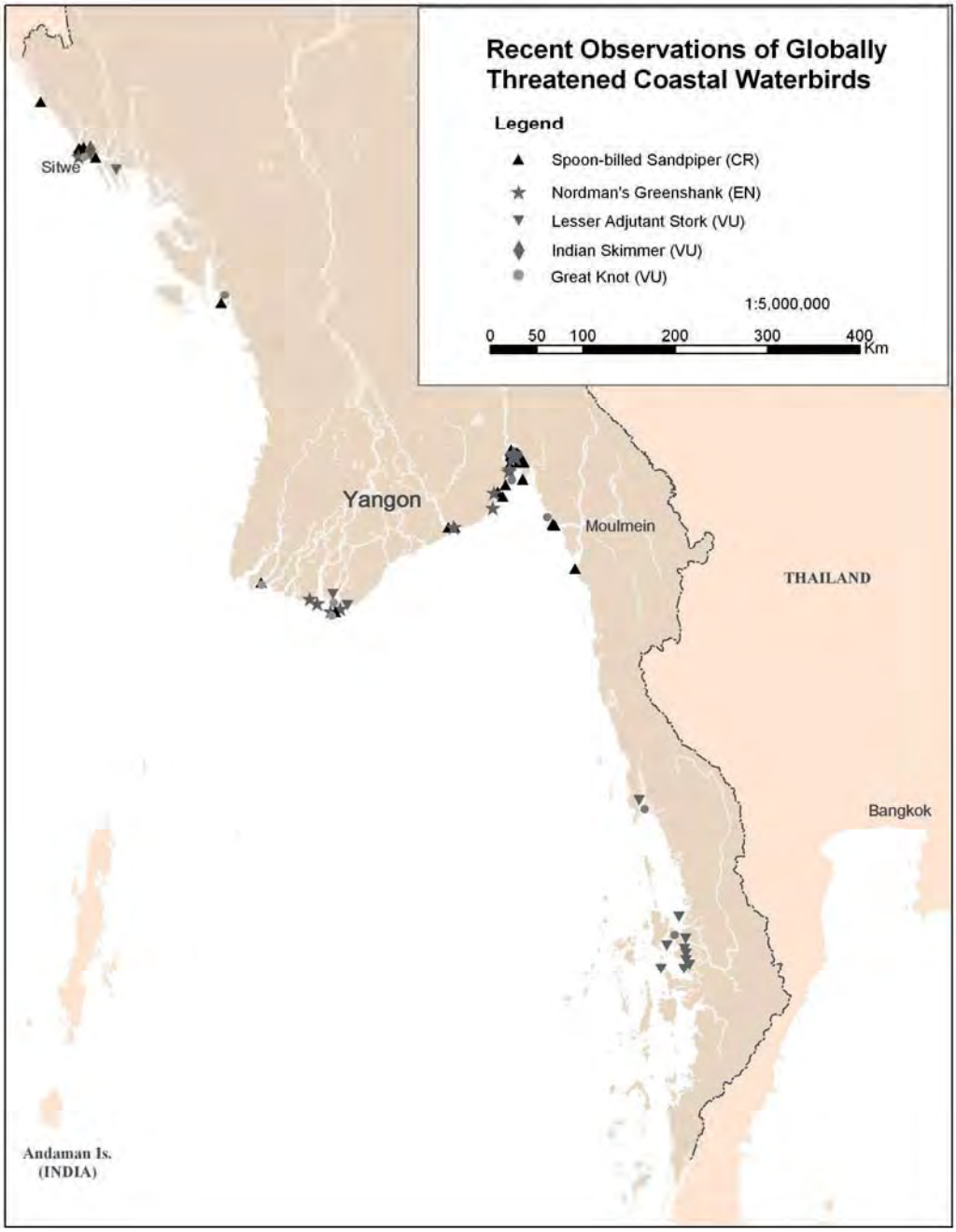

Figure 2. Observations of selected Globally Threatened coastal water birds recorded by these expeditions.

Gulf of Mottama

The Gulf of Mottama or Martaban has the most extensive intertidal mudflats in Myanmar and is one of the largest of its type in south-east Asia (Figure 1). It is formed by the delta of the Sittaung River, which is in turn supported by smaller rivers such as the Bilin River. It is also fed by the large Salween River from the east and is clearly influenced by the gigantic Ayeyarwaddy River from the west. The Sittuang and Bilin River have no in-stream dams and the Salween and Ayeyarwaddy have only a few dams. All contribute massive quantities of crucial sediments, creating vast and productive mudflats, stretching across the Yangon, Bago and Mon State provinces, covering an area of over 4000 km^2. The funnel shaped geomorphology of the Gulf and the relatively low physical disruption to the flow of its major contributing rivers, makes the Gulf a very special site for water birds and other biota. At spring tides, the regular occurrence of huge tidal bores results in high turbidity in the system, creating a dynamic flow of sediments and nutrients within the Gulf that supports a wide density of benthos for water birds to thrive on (Z. Lunn *in litt*.). The Gulf has been visited annually from 2008-2012, mostly in January and February. It is impossible to survey the vast mudflats entirely but in January 2010 at least the eastern part have been surveyed almost completely, while in previous years the focus was more on the western part.

Ahlat
Ahlat (Mon State) is situated at the southern edge of the Gulf of Mottama at the Salween-Thanlwin River Mouth. It is connected with the Gulf of Mottama by a long stretch of mudflats but a distinct area by the river mouth of the Salween River mouth. It hosts big flocks of water birds that do not intermingle with flocks occurring in the central Gulf. The area has been surveyed annually from 2010-2013.

Kjaikkami
Further south the mudflats around the Island of Bi lu Gyun and south near Kjaikkami in Mon State are known to hold big flocks of waders. Most of these mudflats have not been surveyed so counts presented here are probably an underestimate of the site's population.

Dawei River estuary
Further south in the Tanintharyi Province lies the Dawei River estuary, close to the regional capital Dawei. This is another big mudflat area adjacent to mangroves with many water birds. The mudflats extend south of Dawei 30 miles to the village of Kennet Thiri, covering about 2,500 ha of mudflats. The site has been visited only once in 2011.

Myeik mudflats
In the most southern of the Tanintharyi Region south of the town Myeik is the huge area of mudflats, approximately 4,000 ha in size, surrounded by mature mangroves. About one thousand hectares of mudflats north of the town were included in the survey in December 2013, but extensive areas to the south have not been surveyed and could host more water birds.

Water bird surveys

Seven different expeditions were carried out between 2008 and 2013 by the authors during the dry season between November and March, but mostly in mid-winter in January and February. The prime purpose of the search was to locate globally threatened Spoon-billed Sandpiper, but numbers of all water birds were also recorded, when possible. Binoculars and telescopes with at least 30-60x magnification were required to identify all water birds to species level.

Many sites could be accessed by boat and on foot. Where boat-based surveys were carried out, boats small enough to negotiate the shallow intertidal waters were used. Often larger boats were needed to cover longer distances and smaller boats were carried and used to explore areas at the sites. This approach was not always possible and also took time to develop, meaning that many areas, especially in the Gulf of Mottama, were not accessible for a long time. Thus, they were overlooked in some years. In addition, vast areas of mudflats in the Myeik Archipelago were not surveyed due to long distances, difficult access and permit restrictions.

Most sites were visited on only one or two (and sometimes three) days. Some sites have been visited multiple times, but at different times of the year and by different teams. At sites with more than one count from more than one year, the maximum number observed was included. The difference in survey effort prevented an analysis of species trend at individual sites. For the Ayeyarwaddy Delta, count data from years prior to 2008 was made available (Thet & Veen 2008) and has been included into our survey results.

It was not possible to obtain complete counts of the extensive intertidal area in the Gulf of Mottama in any survey year. Several teams covered different parts of the Gulf in different years. The area is extremely difficult to access and only special boats and fishermen with local knowledge of the intertidal areas can negotiate the difficult tidal waters. The best coverage was achieved in 2010, when over a period of 12 days a total of three teams covered most of the sites along the eastern side of the Gulf, and the crucial central part that hosts the majority of small calidrid waders and small plovers (comprising more than 50% of the mudflats). The central mudflat area was repeatedly surveyed in 2011 and 2012 for Spoon-billed Sandpipers, but in those years very few additional numbers for other water birds were obtained. In 2008 and 2009 different areas of the western and central part were covered, but with some overlap in both years. The 2008 counting sites were entirely different from those counted in 2010.

In both the Gulf of Mottama and Ayeyarwaddy there was a high risk of double-counting birds. In order to avoid this, we took a very cautious and conservative approach to tallying counts from different mudflat areas. Congregations in the Ayeyarwaddy Delta were distinctly spatially separated and there was very little risk of double-counting, thus we summed counts across areas. In the Gulf, there is more mixing amongst birds but having covered almost all mudflats in at least one year, we know roughly about the uneven distribution of the water birds and the estimated totals are more a conservative estimate. Counts that originated from areas or from a different survey period, potentially too close to other sites, were not included in the total. Using this conservative approach, some counts were discounted and therefore, the overall total is likely to be an underestimate.

Total figures for the Gulf of Mottama were generated by calculating numbers from surveyed areas, taking unsurveyed sites into account when they were spatially distinct. The 2008 counts were added to those from 2010 due to the counting sites being different, providing the minimum in le 2. Using the conservative approach outlined above,

the 2009 results were not be added, as we observed much movement between mudflat areas within and between the years, due to large shifts in sediments. Counts from 2012 we only added to the totals for the Gulf when previous maxima from other parts of the gulf were surpassed. However, it is likely that this approach is underestimating the total numbers and counts from 2009 indicate potentially much higher numbers for some species and higher totals for the Gulf of Mottama.

Estimate of Spoon-billed Sandpiper numbers

Small calidrids, namely Spoon-billed Sandpipers and small plovers, were mixed in huge flocks of 30,000 – 40,000 birds at high tide roosts. From there they would scatter to feed in smaller flocks on the receding tides. Surveyors estimated numbers of small wader species by counting several sample wader flocks of varying sizes (ranging from 100 to almost 2000 birds, also called flock counts) in the same area, and determining the proportion of Spoon-billed Sandpipers and other species within each. This was modelled for the Spoon-billed Sandpiper to give an estimate with confidence limits of the total number of individuals in an area at the time of the survey (for details see Zöckler *et al.* 2010). For this purpose, among several observers more than 100 flock counts were available. The total number of Spoon-billed sandpiper and other small waders was estimated by multiplying the average proportion of Spoon-billed Sandpipers observed in the small flocks by an estimate of the total number of small waders in the mudflats present. For further details of the calculations and statistics see Zöckler *et al.* (2010). This method has also been applied to other small calidrids like the Broad-billed Sandpiper (*Limicola falcinellus)*. The more common species in the flocks were also estimated based on the average proportion from the multiple flock counts.

RESULTS

Water bird abundance and distribution

The Gulf of Mottama (Figure 1) is clearly the most extensive and also the most significant intertidal site for water birds with more than 120,000 individuals being recorded. Other mudflat areas were smaller and often associated with adjacent mangroves, and generally hosted much fewer water birds (Table 1).

In total 80 species of water birds were recorded along the entire coast. The majority consisted of waders numbering 39 species and an estimated total of 140,000-160,000 individuals, followed by 12 gulls and tern species of approximately 30,000 individuals, 11 duck and goose species and seven heron and egrets. The Gulf of Mottama and Ahlat and almost all the other sites feature in importance for at least in one or more species. Below we list the highlights of the most important and globally threatened species at each site.

Nan Thar Island

The mudflats supported between 7,000-8,000 water birds, including the Critically Endangered (CR) Spoon-billed Sandpiper. The area is the second largest wintering site in Myanmar and possibly in the entire wintering region for the Spoon-billed Sandpiper, with a maximum of 34 (2008) recorded, and regularly holding 20 individuals (Zöckler *et al.* 2010). The area also had regular records of between three to five Nordmann's Greenshank (see Appendix 1 and Zöckler & Frew 2011) and was a night roosting site for up to 1,400 Bar-headed Geese (*Anser indicus)*. In total, five species reached the 1% flyway population levels on Nan Thar. In the adjacent coastal mudflats at the Pyang Pie River mouth, up to 27 Indian Skimmers (*Rynchops albicollis)* were recorded in 2008 and nine in 2012, but none were recorded in 2013 and 2014. Appendix 1 gives a summary of all water birds counted at Nan Thar Island in the years 2008-2012.

Hunters Bay

The species composition at Hunters Bay was slightly different from Nan Thar and only about 1,000 water birds were observed. There was one record of six Lesser Adjutant Storks as well as a breeding pair of Sarus Crane (*Grus antigone*) in the neighbouring area.

Natkan

This area holding up to 1,000 water birds, and had at least one Spoon-billed Sandpiper and five Great Knots (*Calidris tenuirostris*) recorded in 2009. There were 750 Lesser Crested Terns (*Sterna bengalensis)* recorded at the entrance to the Sin Guang Chuang River mouth about 100 km further south.

Ayeyarwaddy Delta

The Ayeyarwaddy Delta held tens of thousands of water birds. No detailed estimates were available, but based on counts for some parts in the eastern delta from previous surveys and our recent surveys (Thet 2006, Moses & Zöckler 2013), we estimated the total population to exceed 10,000 birds. Morozov & Archipov (2010) estimated about 4,000-5,000 birds in the western delta and 10,000-15,000 birds in the eastern part of the delta in 2010. A visit in November 2013 (Moses & Zöckler 2013) only recorded 5,000-6,000 birds, including one Spoon-billed Sandpiper and a record number of 26 Nordmann's Greenshank in the most easterly part. Both, the eastern and western part of the delta together hosts up to 800 of the globally threatened Great Knot. More intensive coverage of the delta area might reveal significant higher numbers of this globally threatened species. In addition the delta hosts the highest counts of more than 300 birds for the globally near threatened Black-headed Ibis *Threskiornis melanocephalus* (Table1, Appendix2).

Table 1. Numbers of water birds, counted at nine different intertidal mudflat sites on the Myanmar coast between 2008 and 2013. These are from North to south Nan Thar Island, Hunters Bay (HB), Natkan, Ayeyarwaddy Delta (east Ayey. and west Ayey.), Gulf of Mottama (GoM), Ahlat, Dawei and Myeik mudflats. The figure for each species lists the maximum number for each site recorded at any year within the period 2008-2013. For some sites, such as Nan Thar, east Ayeyarwaddy Delta, Gulf of Mottama and Ahlat multiple counts from different years are available (see appendices). IUCN status is given after latin names in first column (CR critically endangered, EN endangered, VU vulnerable, NT near threatened) Species in bold are globally threatened; numbers in bold are those reaching or surpassing the 1% of the flyway population (Wetlands International 2012). Nomenclature and taxonomy follows Waterbird Population Estimates (Delany & Scott 2006).

Species	**Nan Thar**	**HB**	**Natkan**	**West Ayey.**	**East Ayey.**	**GoM**	***GoM †***	**Ahlat**	**Dawei**	**Myeik**
Little Cormorant *Phalacrocorax niger*		250		20		40	*100*		30	150
Grey Heron *Ardea cinerea*	7	1	7	6	30	203	*300*			30
Great Egret *Ardea alba*	11	70	7	17	140	285	*450*	50	20	171
Intermediate Egret *Egretta intermedius*	2		3		16	370	*600*			2
Purple Heron *Ardea purpurea*				1		11	*40*			
Cattle Egret *Ardea ibis*		200	2							30
Little (Striated) Heron *Butorides striata*		2				3	*10*			38
Indian Pond Heron *Ardeola grayii*		20	20			140	*200*		30	140
Little Egret *Egretta garzetta*	31		80	60	120	150	*200*		45	277
Night Heron *Nycticorax nycticorax*						30	*200*			32
Painted Stork *Mycteria leucocephala* (NT)						**140**	***150***			
Asian Openbill *Anastomus oscitans*						10	*10*			
Lesser Adjutant Stork *Leptoptilos javanicus* (VU)		6			3				6	19
Black-headed Ibis *Threskiornis melanocephalus* (NT)	20	48	1	**200**	**120**	**133**	***200***	60	12	10
Glossy Ibis *Plegadis falcinellus*						80	*80*			
Lesser Whistling Duck *Denrocygna javanica*						2,400	*2,500*			2,330
White-fronted Goose *Anser albifrons*	2									
Greylag Goose *Anser anser*										
Bar-headed Goose *Anser indicus*	**1,400**	19					*1*			
Ruddy Shelduck *Tadorna ferruginea*	92	33		15	4	**950**	***1,200***			
Common Shelduck *Tadorna tadorna*							*1*			
Eurasian Wigeon *Anas penelope*	1,200					284	*300*			
Northern Pintail *Anas acuta*	**3,000**					80	*150*			
Garganey *Anas querquedula*	2									
Northern Shoveler *Anas clypeata*	10									
Tufted Duck *Aythya fuligula*	2									
Sarus Crane *Grus Antigone* (VU)		2								
Pied Avocet *Recurvirostra avosetta*						1	*1*			
Grey-headed Lapwing *Vanellus cinereus*		10						2		

Table 1. Continued

Species	Nan Thar	HB	Natkan	West Ayey.	East Ayey.	GoM	*GoM †*	Ahlat	Dawei	Myeik
Red-Wattled Lapwing *Vanellus indicus*						6	*6*		10	
Pacific Golden Plover *Pluvialis fulva*	30	35	2	6		**7,726**	***9,000***	40	45	8
Grey Plover *Pluvialis squatarola*	195		27	4	250	224	*350*		50	31
Common Ringed Plover *Charadrius hiaticula*	1					12	*12*			
Little Ringed Plover *Charadrius dubius*	2					606	*1,200*	65		
Kentish Plover *Charadrius alexandrinus*	55	10	17	180	40	**8,131**	***15,000***	500	45	276
Lesser Sand Plover *Charadrius mongolus*	1,000	150	400	1,150	**3,500**	**18,032**	***32,000***	**1,500**	700	326
Greater Sand Plover *Charadrius leschenaultii*	440		100	21	**1,500**	**1,320**	***1,800***	200	500	**1,846**
Pintail Snipe *Gallinago stenura*	1								2	
Common Snipe *Gallinago gallinago*						12	*12*			
Long-billed Dowitcher *Limnodromus scolopaceus*						42	*42*			
Black-tailed Godwit *Limosa limosa* (NT)	**1,800**		1		400	**3,405**	***4,200***	57		3
Bar-tailed Godwit *Limosa lapponica*	5				110	227	*300*		30	150
Whimbrel *Numenius phaeopus*	10	60	14	1	70	**1,597**	***2,000***	20	170	**1,200**
Eurasian Curlew *Numenius arquata* (NT)	61	40	8		190	**2,141**	***3,000***	15	400	221
Spotted Redshank *Tringa erythropus*	5					**1,312**	***1,600***	20		
Common Redshank *Tringa tetanus*	335	300	20	19	600	**4,617**	***6,000***	200	45	3,400
Marsh Sandpiper *Tringa stagnatilis*	1		1	50	8	149	*250*	2		5
Common Greenshank *Tringa nebularia*	20	6	7	30	50	**1,776**	***2,000***	15	15	6
Nordmann's Greenshank *Tringa guttifer* (EN)	5				**26**	7	*10*			
Green Sandpiper *Tringa ochropus*						3	*10*			
Wood Sandpiper *Tringa glareola*	1	1		3		11	*20*			
Terek Sandpiper *Xenus cinereus*	85	2	53	3	150	317	*400*	4	280	235
Common Sandpiper *Actitis hypoleucos*		30	6	1		211	*350*		40	50
Ruddy Turnstone *Arenaria interpres*	35		4		40	29	*50*	1	100	4
Great Knot *Calidris tenuirostris* (VU)	40		5	90	600	458	*600*	2	6	2
Red Knot *Calidris canutus*	35			20	120	18	*30*	1		3
Sanderling *Calidris alba*	215				20	12	*30*	10		2
Red-necked/Little Stint *Calidris ruficollis/minutus*	280	10	107	200	90	**6,353**	***11,000***	120	80	96
Long-toed Stint *Calidris subminuta*						80	*100*			
Curlew Sandpiper *Calidris ferruginea*	150			800	150	**6,762**	***1,0000***	25	15	56
Dunlin *Calidris alpina*	2					2	*2*			6
Spoon-billed Sandpiper *Calidris pygmeus* (CR)	**34**		1	1	1	**75**	***180 (140-220)***	4		
Broad-billed Sandpiper *Limicola falcinellus*	**330**		40	**600**	200	**4,000**	***4,500***	50	50	6

Table 1. Continued

Species	Nan Thar	HB	Natkan	West Ayey.	East Ayey.	GoM	*GoM †*	Ahlat	Dawei	Myeik
Ruff *Philomachus pugnax*						33	*80*			
Heuglin's Gull *Larus heuglini*	1				2					
Pallas's Gull *Larus ichthyaetus*	75		18		850	**2,473**	***2,700***			
Brown-headed Gull *Larus brunnicephalus*	340		270		**2,800**	667	*1,800*	230	300	2,700
Gull-billed Tern *Sterna nilotica*	130	2			2	125	*200*	3	3	
Caspian Tern *Sterna caspia*	3	2			37	56	*70*			
Lesser Crested Tern *Sterna bengalensis*	20	4	750†††						20	200
Greater Crested Tern *Sterna bergii*	35	1	1						100	280
Common Tern *Sterna hirundo*	10	1	2			50	*50*			60
Little Tern *Sterna albifrons*	365			250	120	120	*300*		250	700
Whiskered Tern *Chlidonias hybrida*	200	20		700	800	7,345	***12,000***	200		335
White-winged Tern *Chlidonias leucopterus*						3,000	*4,000*	60	30	34
Black Tern *Chlidonias niger*						10	*10*			
Indian Skimmer *Rynchops albicollis*	27††									

† extrapolated number of birds for GoM are listed in a separate column,
†† Indian Skimmer have been observed at an adjacent site 50 km near the coast,
††† a different site 100km south at Sin Gaung Chaung,

Gulf of Mottama
During our surveys from 2008 - 2012 an estimated 120,000 – 150,000 water birds, mostly waders, terns and egrets were regularly recorded each year in the Gulf. (Table 1, Appendix 3)

This site has previously been found to be the key wintering area for Spoon-billed Sandpiper, hosting an estimated 200 individuals (Zöckler *et al.* 2010). During our surveys it regularly held high numbers of six other globally threatened species (Painted Stork *Mycteria leucocephala*, Black-headed Ibis, Black-tailed Godwit *Limosa limosa*, Eurasian Curlew *Numenius arquata*, Nordmann's Greenshank and Great Knot), as well as regularly holding more than 1% of the flyway population of 17 other species, among them Broad-billed Sandpiper and Red-necked Stint (*Calidris ruficollis)*.

Ahlat (Salween-Thanwlin River mouth)
Ahlat hosted large flocks of water birds. Among the estimated 4,000 small waders recorded, three to four, and possibly as many as eight Spoon-billed Sandpipers were recorded in 2012 (Appendix 4). The mudflats around the Island of Bi lu Kyun and south near Kjaikkami also supported large flocks of waders. Most of these were not surveyed and could hold many more water birds. Large waders, such as Eurasian Curlew and Whimbrel (*Numenius phaeopus)* and herons and egrets in particular were noticed during a brief visit in 2010, but no numbers were recorded during our expeditions.

Dawei River estuary
The mudflats held approximately 3,000 water birds. In February 2011, six Lesser Adjutant Storks were counted. There were also high numbers of Eurasian Curlew and Whimbrel, as well as 280 Terek Sandpipers (*Xenus cinereus)*.

Myeik mangroves and mudflats
The mudflats held large numbers of water birds, which were widely dispersed. Mudflats north of the town Myeik hosted larger aggregations. We estimate the total number of water birds to be over 13,000. Two species, Greater Sand Plover (*Charadrius leschenaultii*) and Whimbrel reached high numbers, fulfilling the Ramsar criteria (Wetlands International 2012). Nineteen Lesser Adjutant Storks were recorded here. The extensive mudflats to the south and also north of the town have not been surveyed extensively and could host more water birds.

Manaung Island
A brief visit was made in 2013 to Manaung Island (constituting a tenth location and not part of the formal surveys) by one of the authors (YNS) and revealed about 1,000 water birds in parts of the island, including 14 globally near-threatened Painted Storks.

Globally Threatened Water Birds

The selected mudflats host a range of globally threatened water bird species (ure 2) and often in significant numbers that fulfil the Ramsar criteria (Table 1). A total of ten globally threatened water bird species have been recorded, including the Spoon-billed Sandpiper (CR), Nordmann's Greenshank (EN), Lesser Adjutant Stork (VU), Sarus Crane (VU), Great Knot (VU) and a further five near-threatened species.

DISCUSSION

Importance of intertidal mudflats in Myanmar for migratory water birds

In this report, we emphasise the importance of the intertidal mudflats in Myanmar for water birds. These are mostly migrating and non-breeding water birds using the mudflats as feeding and roosting places on their migration routes, or during the wintering period before returning on migration to northern breeding grounds as far away as Arctic Russia, Alaska, China and Mongolia. In fact, most water birds spend more time at wintering and stopover sites in Myanmar (October – April) than in the breeding areas (June -August). First-year birds among the waders also spend their first boreal summer in or near these wintering grounds, which highlights the importance of the intertidal mudflats in Myanmar for these water birds (Zöckler *et al.* 2010).

Our surveys show that several coastal wetlands in Myanmar fulfil one or both of two criteria for internationally important wetlands under the Ramsar convention, exceeding a total of 20,000 water birds or 1% of the flyway population and a number of species (Wetlands International 2012). The most important site is the Gulf of Mottama, which hosts 120,000 - 150,000 wintering water birds and is critically important for the globally threatened Spoon-billed Sandpiper. A further 16 species reach the 1% Ramsar criterion in the Gulf of Mottama. The site is currently under government consideration to be designated as Ramsar site. At present, Myanmar has listed only one inland wetland as Ramsar site and none of several potential coastal wetlands have yet been listed.

The extensive intertidal mudflats of the Ayeyarwaddy Delta are habitat for over 10,000 water birds and are important wintering areas for the endangered Nordmann's Greenshank and the vulnerable Great Knot. The surveys only covered a small part of the delta but internationally important numbers, exceeding 1% of the flyway population were recorded for Nordmann's Greenshank and five more species in the Delta: Black-headed Ibis, Greater Sand Plover, Lesser Sand Plover, Nordmann's Greenshank and Brown-headed Gull (*Larus brunnicephalus).* On the basis of these counts, this site also qualifies as a Ramsar Site (Wetlands International 2012). Equally, Nan Thar Island has five species reaching the 1% criterion, qualifies for Ramsar designation , including 34 Spoon-billed Sandpiper and a regular night roost for up to 1,400 Bar-headed Geese (see also Zöckler *et al.* 2012).

Some individual sites like Hunters Bay were less suitable for large flocks of water birds due to the close proximity to mangrove areas of varying extent. However, the vast expanses of intertidal mud- and sandflats along the Myanmar coast are important in their entirety, as different parts serve as feeding and roosting grounds for different water birds at different times within the lunar tidal cycle.

Records of threatened water bird species

Spoon-billed Sandpiper (CR)

There are currently six locations that host Spoon-billed Sandpiper in Myanmar (Figure 2). However, it is likely that other sites might host single birds of this species. The majority of wintering and passage birds are found in the Gulf of Mottama and also in Nan Thar Island in the west of the country. A total of an estimated 200-250 birds are estimated to winter regularly in Myanmar (Zöckler *et al.* 2010). This is more than 50% of the total global population of this species (E.E. Syroechkovskiy *in litt*.) demonstrating that Myanmar is the most important wintering area for this species. Both the Gulf and Nan Thar Island are therefore essential for the survival of the species and require immediate protection.

Nordmann's Greenshank (EN)

Nordmann's Greenshank was recorded at three sites. Numbers exceeding eight birds or the 1% threshold, have only been recorded in the Eastern Ayeyarwaddy Delta, which appears to be a stronghold for the species in Myanmar. The total global population is estimated at around 1,000 birds (BirdLife International 2013). Tong *et al.* (2014) counted over 1,100 at stop over sites in Rudong, China suggesting the current population estimate may be too low. Regardless, the 26 individuals in 2013 the eastern delta substantially exceeds the 1% threshold for the species even taking into account a potential increase in the population estimate to reflect the Rudong count. In 2006, 23 Nordmann's Greenshank were observed at two different locations further west in the delta (Thet 2006) and considering that large areas within the delta have not been surveyed, it is likely that the total number over-wintering in the delta could be much higher. The species was widely dispersed in the Gulf of Mottama, so surveys of the vast sand and mudflats might have overlooked some individuals. Birds of this species forage in mudflats with deep sediments, and are often seen near mangroves. Its special feeding techniques allow for larger prey, including mud skimmers and

crabs that occur in deeper mud at Nan Thar (Zöckler & Frew 2011) and in the Ayeyarwaddy Delta (Zöckler *et al.* 2013). Nordmann's Greenshank is often associated with Great Knot and Grey Plovers (*Pluvialis squatarola)* when roosting.

Lesser Adjutant Stork (VU)
The Lesser Adjutant was formerly common in Myanmar (Smythies 1986) but it is now rare with only few recent records. More extensive surveys of the remaining coastal areas are needed to assess the current status of the species. This globally threatened stork species has been found widely dispersed along the coast and listed for four sites. It prefers less disturbed mangrove areas, as in the Hunters Bay area and Dawei River mouth, with six birds each, the Ayeyarwaddy Delta and Myeik mangroves and mudflats over 10 each. The stork seems to prefer wetlands for foraging and tall trees for nesting, although most of the mangrove forests are being rapidly cleared due to increased agricultural conversion, fuelwood consumption, charcoal production, commercial logging, shrimp and fish farms conversion and plantation development. These activities are, particularly noticeable and have been described for the Ayeyarwaddy Delta area (FREDA & ACTMANG 2012). In the face of these pressures, the Lesser Adjutant has almost disappeared from Myanmar as a breeding species. No breeding record has been confirmed for Myanmar since 1987 (Luthin 1987). However, in 2013, it was found breeding by the staff of Meinmahla Kyun Wildlife Sanctuary in the eastern Ayeyarwaddy delta, as it did in 2006, when a total of 10 birds were recorded at eight different sites in the delta (Thet 2006). The majority of birds were observed in the neighbourhood of mature mangroves in the Auckland Bay region south of Myeik where in total 19 birds were observed in December 2013 (see also Figure 2). Breeding is highly likely in these areas, but not yet verified.

Sarus Crane (VU)
This species is usually not associated with coastal wetlands, but in Rakhine State near Hunters Bay at least two birds were observed close to mangrove areas. Also further inland and north from this area, we observed several territorial birds near coastal wetlands in the Kaladan catchment area.

Great Knot (VU)
Great Knot has been classified as 'vulnerable' due to heavy losses of the population monitored in the Yellow Sea area (Moores *et al.* 2009). The total population is estimated now at 290,000, dropping from the previous estimate of 380,000 (Barter 2002). Maximum numbers of 600 or more birds in the Ayeyarwaddy Delta and Gulf of Mottama do not reaching Ramsar 1% level (Wetlands International 2012), but demonstrate that the Myanmar coast line is on the migration route. More surveys are required to establish a full understanding of the species' distribution in Myanmar.

Indian Skimmer (VU)
There is only one site on the coast of Myanmar for this species. In 2008, 27 birds were observed in the Pyang Pie River mouth approximately 50 km from Nan Thar Island (see Figure 2). In subsequent years the number declined steadily to only nine birds in 2011. There have been no records in 2012 and 2013 and it is believed the population may have perished, but no recent surveys have been undertaken. As this is the only known site along the Myanmar coast, it is important to continue searching for the species.

Threats to water birds on the Myanmar coast

Whilst many intertidal mudflats in most East Asian countries are threatened by coastal development (MacKinnon *et al.* 2012), Myanmar's intertidal mudflats are still largely unaffected and mostly pristine. Hunting and mist-netting are the major immediate threats to the water birds in many areas (Zöckler *et al*. 2010). Many hunting-related threats to water birds have been addressed, namely in the Gulf of Mottama and Nan Thar Island respectively (Htin Hla & Eberhardt 2011, Ren 2013). However, hunting and trapping remains an issue in many areas, especially in the Ayeyarwaddy Delta. Local people regularly hunt and poach birds using mist-nets and poison (pesticides) both for food and to trade locally. All shorebird species are legally protected under the Wildlife Act of Myanmar, which prohibits their killing or capturing. However, most people are unaware of this legislation. Consequently, local people poach birds throughout the survey area.

Intertidal mudflats are not only important as fish nurseries and as habitat for small marine invertebrates, but also play an important role in the nutrient cycle, sedimentation and the purification of near coastal, coastal, marine and estuarine waters. Fishermen regularly fish on the muddy shores at low tide, a time when waders feed. Hence low-tide harvesting activities can be a threat to foraging water birds. The degradation of mangroves, conversion into agricultural land and introduction of shrimp aquaculture is another major threat to the habitats of water birds in coastal Myanmar. These threats are not only restricted to water birds but also potentially impact other parts of the intertidal ecosystem, and ultimately threaten the local human population that rely on its ecological integrity. We recommend that awareness and education programmes should be carried out in these areas to encourage protection and discourage activities such as hunting, netting and habitat destruction. If action is not taken, it is likely that more species and habitats will be lost.

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Appendix 1. Water birds counted at Nan Thar island, 2008-2013 (January).

Species	2008	2009	2010	2011	2012	2013
Grey Heron		7	?			
Great Egret	6	11	?			
Intermediate Egret		2	?			
Little Egret		31	?			
Black-headed Ibis		13	20			
Bar-headed Goose	400+	1,400	900	?	1,100	
Ruddy Shelduck	2	92	4			
Eurasian Wigeon	?	1,150	1,200			
Northern Pintail	1,500	1,600	3,000			
Garganey	-	1	2			
Northern Shoveler	-	-	10			
Tufted Duck	-	-	2			
Great Thick-knee	8	-	-			-
Small Pratincole		3				14
Pacific Golden Plover	12	30	?			
Grey Plover	52	195	40			
Common Ringed Plover	1	-				
Little Ringed Plover		2	?			
Kentish Plover	55	13	?			
Greater Sand Plover	440	250	?			
Lesser Sand Plover	380	1,000	?			
Pintail Snipe		1	-			
Black-tailed Godwit	326	1,800	400			250?
Bar-tailed Godwit	4	5	2			
Whimbrel	10	10	14			
Eurasian Curlew	41	69	20			
Northern Greenshank	7	20	10			
Spotted Redshank	-	-	5			
Common Redshank	335	300	60			
Marsh Sandpiper	1	1	-			
Nordmann's Greenshank		**2**	**5**			**4**
Wood Sandpiper						1
Terek Sandpiper	50	85	20+			
Ruddy Turnstone	19	35				
Great Knot	13	40	-			30
Red Knot	3	8	-			35
Sanderling	90	215	20			45
Red-necked Stint	68	280	200			200
Curlew Sandpiper	87	130	150			32?
Dunlin		1	1			2
Spoon-billed Sandpiper	**34**	**14**	**14**	**22**	**25**	**20**
Broad-billed Sandpiper	63	330	80			100
Pallas's Gull	54	18	75			
Brown-headed Gull	50	340				
Gull-billed Tern	97	130	60			
Caspian Tern	2	1	3			
Lesser Crested Tern	2	20				
Greater Crested Tern	35	1	1			
Common Tern	1	1	10			
Little Tern	200	365	100			
Whiskered Tern	103	14	200			

Appendix 2. Water bird counts in Eastern Ayayewaddy Delta near Kei-ye-gy Island. And Kaing Thaung Island. in January 2010 (Morozov & Archipov 2010) and November 2013 at Kei-ye-gy Island area only (Moses & Zöckler 2013).

Species	**2010 (Jan)**	**2013 (Nov)**
Grey Heron	30	26
Great Egret	70	140
Intermediate Egret	16	
Little Egret	?	120
Black-headed Ibis	120	35
Ruddy Shelduck	4	
Pacific Golden Plover	30	3
Grey Plover	60	250
Kentish Plover	40	20
Lesser Sand Plover	3,500	500
Greater Sand Plover	30	1,500
Black-tailed Godwit	400	16
Bar-tailed Godwit	110	30
Whimbrel	10	70
Eurasian Curlew	190	120
Common Redshank	600	250
Marsh Sandpiper	8	2
Common Greenshank	50	50
Nordmann's Greenshank	**8**	**26**
Terek Sandpiper	150	30
Ruddy Turnstone	40	25
Great Knot	**600**	**146**
Red Knot	120	12
Sanderling	20	20
Red-necked Stint	90	36
Little Stint		4
Curlew Sandpiper	150	80
Spoon-billed Sandpiper		**1-2**
Broad-billed Sandpiper	200	100
Heuglin's Gull		2
Pallas's Gull	850	142
Brown-headed Gull	2,800	90
Gull-billed Tern	2	
Caspian Tern	5	37
Greater Crested Tern	170	
Common Tern	10	
Little Tern	100	120
Whiskered Tern	800	500

Appendix 3. Water bird counts at the Gulf of Martaban, 2008-2012 (January-February). Av.ann.total = Estimated average annual Total (2008-2012). Species in bold fulfil 1% Ramsar criteria.

Species	**2008**	**2009**	**2010**	**2011**	**2012**	**Av.ann.total**
Little Cormorant			40			40-100
Grey Heron	4	203	20			200-400
Great Egret	3	285	120			300-600
Intermediate Egret		10	370			400-800
Purple Heron			11			40
Little (Striated) Heron			3			10
Indian Pond Heron	13	11	140			150-300
Little Egret	5	150	140			150-300
Night Heron		6	30			200
Painted Stork	**140**			**4**	**4**	**150**
Asian Openbill		2				10
Black-headed Ibis		**133**	**6**			**150-300**
Glossy Ibis					80	80
Lesser Whistling Duck			2,400			2,400
Bar-headed Goose			1			1
Ruddy Shelduck	**950**	**118**	**24**			**1,200**
Common Shelduck		1				
Eurasian Wigeon		284				300
Northern Pintail	80		60			150
Pied Avocet		1				-
Small Pratincole	145	123				120-250
Red-Wattled Lapwing	6	1				-
Pacific Golden Plover	**1,013**	**7,726**	**250**			**9,000-10,000**
Grey Plover	9	224	220			250-500

Appendix 3. Continued

Species	2008	2009	2010	2011	2012	Av.ann.total
Common Ringed Plover	1	12	1	1		1
Little Ringed Plover	348	606	8			800-1,000
Kentish Plover	**2,504**	**8,131**	**7,193**			**10,000-20,000**
Lesser Sand Plover	**8,963**	**18,032**	**13,850**			**23,000-40,000**
Greater Sand Plover	**1,320**	**418**	**1,102**			**1,300-2,500**
Common Snipe	12					
Long-billed Dowitcher		42				40
Black-tailed Godwit	**252**	**3,405**				**3,500-5,000**
Bar-tailed Godwit	136	227				250-400
Whimbrel	**1,597**	**969**	**140**			**1,500-2,500**
Eurasian Curlew	**965**	**2,141**	**770**			**2,200-4,000**
Spotted Redshank		**1,312**	**190**			**1,400-2,000**
Common Redshank	**1,958**	**4,617**	**640**		**1,800**	**4,500-8,000**
Marsh Sandpiper	70	149	40		100	150-300
Common Greenshank	**372**	**1,776**	**90**			**2,000-3,500**
Nordmann's Greenshank	2	7	1	1		7-20
Green Sandpiper	3	3	1			10
Wood Sandpiper	12	11	6			20
Terek Sandpiper	317	316	1			320-600
Common Sandpiper	211	43	152			300-400
Ruddy Turnstone	17	29				30-60
Great Knot		458				500-1,000
Red Knot	3	18	2			20-40
Sanderling	12	12				20-40
Red-necked Stint	**4,245**	**6,353**	**4,801**			**9,000-13,000**
Temminck's Stint	8	23	8			40-100
Long-toed Stint		4			80	100
Curlew Sandpiper	**2,323**	**6,762**	**5,728**			**8,000-12,000**
Dunlin		2	2		1	2
Spoon-billed Sandpiper	**48**	**75**	**74 (140-220)**	**33**	**53**	**180**
Broad-billed Sandpiper	**1,734**	**1,224**	**2,121**		**4,000**	**4,000-5,000**
Ruff		33	6			50-100
Pallas's Gull	**2,473**	**521**	**405**			**2,500-3,000**
Brown-headed Gull	43	667	250			1,000-2,500
Gull-billed Tern		125	15			130-250
Caspian Tern	25	56	15			60-80
Lesser Crested Tern						
Greater Crested Tern						
Common Tern			50			50
Little Tern		68	120		10	250-400
Whiskered Tern	715	7,345	615	4,000	4,000	7,500-12,000
White-winged Tern		2,815	225		3,000	3,000-5,000
Black Tern			10			10

Appendix 4. Water bird counts at Ahlat, Salween River mouth (January), 2010-2013.

Species	**2010**	**2012**	**2013**
Grey Heron	29		
Great Egret	50		50
Intermediate Egret			
Purple Heron	1		
Little Egret			
Black-headed Ibis	53	60	
Grey headed Lapwing			2
Pacific Golden Plover			40
Grey Plover			
Little Ringed Plover	35		65
Kentish Plover		500	500
Lesser Sand Plover		300	1,500
Greater Sand Plover			200
Black-tailed Godwit	10	33	57
Bar-tailed Godwit			
Whimbrel	20		20
Eurasian Curlew	125		15
Spotted Redshank			20
Common Redshank	220		200
Marsh Sandpiper			2
Common Greenshank	8	35	15
Terek Sandpiper			4
Ruddy Turnstone			1
Great Knot			2
Red Knot			1
Sanderling			10
Red-necked Stint			120
Curlew Sandpiper			25
Spoon-billed Sandpiper	**?**	**4-8**	**3**
Broad-billed Sandpiper			50
Pallas's Gull			
Brown-headed Gull			230
Gull-billed Tern	1		3
Greater Crested Tern			
Common Tern			
Little Tern			
Whiskered Tern	45		200
White-winged Tern			60

BIRDS SHOWING CHARACTERISTICS OF AUSTRALIAN (WHITE-HEADED) STILT (*HIMANTOPUS LEUCOCEPHALUS* GOULD, 1837) REVEAL POTENTIAL NORTH-WESTERN RANGE EXTENSION

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The Black-winged Stilt *Himantopus himantopus* (Linneaus, 1758) is a resident species in Gujarat in western India, with a huge influx of migratory population during the non-breeding season (Ali & Ripley 1987, Rasmussen & Anderton, 2012). Variations in the plumage of *H. himantopus* though known (Hayman *et al.* 1986), are not well documented in relevant field guides such as Grimmet *et al.* (2011), Kazmirczeck (2000) and Rasmussen & Anderton (2012). Parasharya *et al.* (2010) described plumage variations in *H. himantopus* with supporting photographs and ruled out the occurrence of Australian (White-headed) Stilt (*H. leucocephalus*) in the birds in question. They concluded that occurrence of various species / subspecies of the genus *Himantopus* with reference to the Indian subcontinent need further monitoring, especially during the migratory seasons. Although there are several reports of *H. leucocephalus* from Sri Lanka (Kottagama & De Silva 2009), Rasmussen & Anderton (2012) considered Australian (White-headed) Stilt *Himantopus leucocephalus* as a hypothetical species for Indian subcontinent. In this paper, we report the occurrence of birds showing characteristics of *H. leucocephalus* from four locations in Gujarat.

OBSERVATIONS

During December 2012, two birds showing characteristics of *H. leucocephalus* were observed in the salt pans of Bhavnagar (21^{0}46'21.40"N, 72^{0}12'10.70"E; 1), Gujarat, in western India. Initially, they were identified as *H. himantopus*. However, further observations and comparison of photographic details (Figure 2) with standard publications (Hayman *et al.* 1986, Ali & Ripley 1987) suggested that both the birds showed characteristics of *H. leucocephalus* which are migratory to India and may not be variants of the resident *H. himantopus*. Photographs of these birds were sent to R. De Silva who works on the genus in Sri Lanka. He considered that both the birds showed resemblance to *H. leucocephalus* due to the presence of black feathers on the hind neck patch which were more elongated than the other feathers, and crown feathers that were all white (without any black feathers). One of the morphological characteristics of *H. leucocephalus* is a white head and elongated black hindneck feathers, which form a sharply defined raised hindneck patch or ridge (De Silva 2002).

Subsequently, a third stilt (Figure 3) was recorded at Rohini (Anand district) marsh near Khambhat on 24 May 2014 and a fourth (Figure 4)

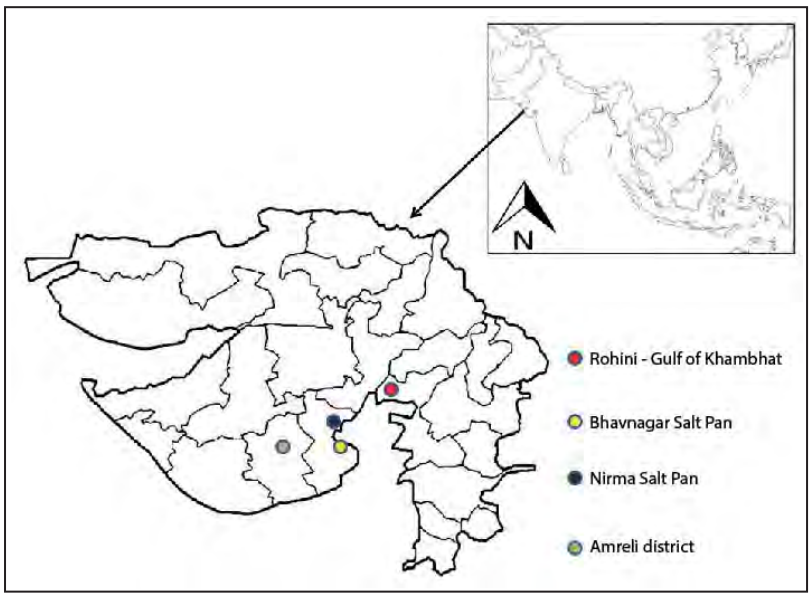

Figure 1. Geographical location of the study areas in Gujarat, north-western India.

Figure 2. Peculiar elongated hindneck feathers creating a black coloured raised bar on the neck (Bhavnagar saltpan bird, December 2012).

Figure 3. A single stilt observed at Rohini on 24 May 2014.

was recorded at Nirma salt pans (Bhavnagar district) on 03 June 2014. Both showed a prominent black hindneck patch with elongated feathers and a clear white head. A photograph taken of two stilts on 24 April 2014 by Chetan Vala at Amreli (21°35'41.77"N; 71°12'36.42"E), shows one potential *H. leucocephalus* and the other a variant of *H. himantopus* (Figure 5). Sightings in Anand and Bhavnagar districts are 70 km apart, whereas the record from Amreli is 110 km west of Bhavnagar and 150 km south-west of Khambhat. These four records suggest a potential range extension of *H. leucocephalus* in north-western India.

DISCUSSION

This may represent the first record of the species from the western part of India, and also the northern-most extent of the species' range. *H. leucocephalus* is a resident of Australia, New Zealand, Java, Southern Sumatra, Sulawesi, east Kalimantan and a non-breeding visitor to New Guinea, Maluku, Timor, east Malaysian states of Sabah and Sarawak and some Philippine islands (Birdlife International 2012). Stilts showing characteristics of this taxon have been frequently reported from Sri Lanka during the Boreal winter (Kottagama & De Silva 2009).

Sonobe & Usui (1993) and Perennou *et al.* (1994) distinguish *H. leucocephalus* from *H. himantopus*; however Marchant & Higgins (1993) treat *leucocephalus* as a sub-species of *H. himantopus.* In the recent International Ornithological Committee (IOC) checklist of the birds of the world (Gill & Donsker 2014) and in Clement (2013), it is listed as a full species *H. leucocephalus*. However, most of these publications consider only morphological variations as their basis for distinguishing the species.

A stilt showing characteristics of *H. leucocephalus* was the first potential record from Sri Lanka in the Indian subcontinent (De Silva 1996, 2000). Since then there have been records of the species from Sri Lanka mostly in the migratory season, that is, from November to April (Kotagama & De Silva 2009). Until now, most of the records of the species are from south and south-eastern India and Sri Lanka (Kotagama & De Silva 2009). *H. leucocephalus* is well documented from Sumatra (Iqbal *et al.* 2009) and from Sri Lanka (Kotagama & De Silva 2009). In India, *H. leucocephalus* was reported from Orissa during 1994 to 1996, with photographic evidence provided for one bird in 1994 (Lopez & Mundkur 1997). However, from the west coast of the Indian subcontinent ours is the first potential record. Our records are from much higher latitudes than earlier records, considering the previously known distribution records of the species.

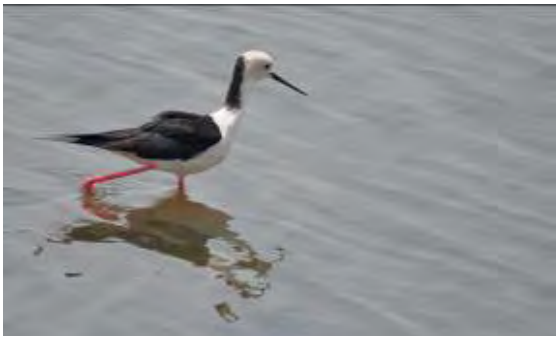

Figure 4. A single stilt observed at Nirma saltpan on 03 June 2014.

Figure 5. A single stilt photographed by Mr. Chetan Vala in Amreli district 24 April 2014.

More information on the distribution of this species is required before any firm conclusions can be made regarding its range (Lopez & Mundkur 1997). Our records from Gujarat also give rise to a valid question of possible cross-breeding between *H. himantopus* and *H. leucocephalus* (Kotagama & De Silva 2009), and subsequent variations in the plumage of crossbred offspring, if any (Parasharya *et al.* 2010). However, the latter two records of the species during the current study were made during the non-migratory season of the *H. leucocephalus* and overlap the breeding season of the *H. himantopus*. This raises serious questions about the distribution, migration, breeding patterns and potential for interbreeding of *H. leucocephalus* with *H. himantopus*.

To differentiate the Australian species from the Black-winged species, Bakewell (2012) has suggested considering not only the plumage but also the vocalisations, and measurements of wing, bill and tarsus if the bird is handled. Bakewell (2012) also suggested that the black feathering on the hind neck is an ancestral character that is occasionally expressed in stilts and might be therefore a part of normal variation in Black winged – even in the case of birds which look virtually identical to the White-headed. As this information was not collected during our sightings, we acknowledge the possibility that these do not represent definitive records of *H. leucocephalus*.

The timing of the occurrence of birds showing characteristics of *H. leucocephalus* in Gujarat overlaps the breeding season of the resident *H. himantopus* and hence there would appear to an opportunity for cross-breeding. Thus, it is essential to observe both the species comprehensively in breeding as well as non-breeding seasons. It is also essential to capture a few such birds for measurements, to be more definite about the occurrence of *H. leucocephalus*. Genetic studies of the genus *Himantopus* should be carried out on global scale to determine gene flow amongst the species and check cross-breeding and sub-species variations.

ACKNOWLEDGEMENTS

We thank Mr. Chetan Vala for sharing his photograph of stilts for this publication. We are also thankful to Dr. Rex De Silva of Sri Lanka for identification of the bird and further guidance in the species. We would also like to thank two anonymous reviewers for comments on an earlier version of this manuscript. We are also thankful to Dr. Birgita Hansen for valuable inputs in editing the manuscript.

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PLENARY:

WHY ARE AUSTRALIA'S MIGRATORY SHOREBIRDS DISAPPEARING?

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Millions of migratory shorebirds migrate from Arctic Russia and Alaska to Australia and New Zealand. There are population declines in our flyway of staggering severity and rapidity, with some populations crashing by 80% in 20 years. Data from Moreton Bay in Eastern Australia show that migratory shorebirds are declining while resident species are not, and there is huge spatial heterogeneity in population declines across the continent, suggesting that the causes might lie outside Australasia. Using satellite data we have documented rapid loss of intertidal wetlands in eastern Asia, a region known to be of critical importance as stopover habitat for many migratory shorebirds. Our modelling work suggests that habitat loss in this region could have profound implications for shorebird populations at a flyway level, and comprehensive analysis of Australasian shorebird data indicate severe declines in several species dependent on East Asian stopover sites.

PLENARY:

WHAT ARE WE DOING TO HALT DECLINES IN MIGRATORY SHOREBIRDS IN THE EAST ASIAN-AUSTRALASIAN FLYWAY?

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Migratory waterbirds connect far-away countries by covering immense distances during their annual migration. This mobility makes their conservation especially challenging, particularly when the same individual has to cope with various pressures at breeding, staging and wintering sites. There is an urgent need to identify robust and workable conservation solutions. The East Asian – Australasian Flyway Partnership brings together 30 governmental and non-governmental partners to address this issue of habitat loss and species declines and is working to develop solutions. One initiative is creating Flyway Network Sites along the Flyway. All of the current 113 sites and 900 potential sites host migratory waterbirds in internationally important numbers, but only some of these are protected. After an overview of monitoring and management of Flyway Network Sites, I will give examples of conservation work and government involvement and discuss current activities in different countries in Communication, Education, and Public Awareness, as well as our efforts to influence policy in China and South Korea.

LATITUDINAL TREND IN DEPOSITION OF MIGRATORY FUEL AS DRIVER OF TRANS-EQUATORIAL LONG DISTANCE MIGRATION IN SHOREBIRDS

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Migration has evolved as an adaptation towards avoiding problems (unfavourable thermal conditions, food shortage, predation, disease) and seizing opportunities where and when they arise. For many high latitude breeders, cold and food shortage are important drivers to migrate towards the equator during winter. Some, however, surpass the equator, often involving extremely long migrations. The suggested prime reason for these trans-equatorial migrations is that migrants will thus be using equivalent habitats (to which they are specialised) at both sides of the equator during the most productive season. But in some cases, such as in the case of many Arctic-breeding, long-distance migratory shorebirds, apparently suile and similar habitat is passed or used and next left, for more southern destinations. We here build a case that, possibly counter-intuitively, these trans-equatorial flights, the flying of the extra mile, may actually enhance the chances of a successful, speedy and timely migration back to the breeding grounds. To support our hypothesis we comprehensively investigated (a) the effect of latitude on fuelling rates in different migratory shorebirds on a global scale; (b) the potential underlying factors to such a pattern with latitude; and, (c) whether these patterns explain migratory strategy of some long distance cross-equatorial migratory shorebirds.

DEVELOPING A NEW WILDLIFE CONSERVATION PLAN FOR AUSTRALIA'S MIGRATORY SHOREBIRDS

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Listed migratory species which visit Australia received national protection as a matter of national environmental significance when the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) took effect in July 2000. Under the EPBC Act, wildlife conservation plans may be prepared for the purposes of protection, conservation and management of listed migratory, marine, cetacean or conservation dependant species. In February 2006, the Wildlife Conservation Plan for Migratory Shorebirds came into effect, the first wildlife conservation plan developed under the EPBC Act. A mandatory review of the plan in 2013 recommended that, given the contemporary and likely future threats to migratory shorebirds in Australia and the East Asian-Australasian Flyway (EAAF), the 36 listed species still required a national framework identifying research and management actions. The review further recommended that the wildlife conservation plan required updating to remove completed actions and include new, focused conservation priorities. The draft plan builds upon the previous plan's achievements and was made in consultation with representatives from Commonwealth, state and territory governments, Non-Government Organisations, industry and research agencies. The revised Wildlife Conservation Plan for Migratory Shorebirds will provide a framework to guide conservation of migratory shorebirds and their habitat in Australia over the next 5–10 years. In recognition of their migratory habits, it outlines national activities to support their appreciation and conservation throughout the EAAF. The draft plan contains clarification of statutory elements of the EPBC Act by addressing topics relevant to the conservation of migratory shorebirds, including a summary of Australia's commitments under international conventions and agreements, and identification of important habitat. It also outlines national actions to support flyway shorebird conservation, and should be used to ensure these activities are integrated and remain focused on the long-term survival of Australia's migratory shorebird populations and their habitats.

NORTHERN TERRITORY MIGRATORY SHOREBIRDS – ARE WE BUCKING THE TREND?

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Recent research has suggested large decreases in migratory shorebird numbers over recent years in eastern Australia. Surveys of coastal shorebird sites along the western and northern coasts of the Northern Territory were undertaken between 2010 and 2012, in both March and December, and then compared to counts using similar methods from the same sites between 1991 and 1999. Overall, the results indicate little or no change in total abundance of shorebirds between the pre-2000 and post-2009 periods. Six sites showed increased abundances of total shorebirds between the two periods, while five showed decreases in abundance. Detecting change for individual migratory species is difficult because of variability in roost location and tidal conditions on the day of survey. Nonetheless, Great Knots showed increases in proportional abundance at seven sites and a decrease at one site. Bar-tailed Godwits showed increases in proportional abundance at four sites, decreases at three sites and remained similar at one site. Eastern Curlews showed increases in proportional abundance at three sites, decreases at two sites and remained similar at two sites (although only small numbers were usually available for comparisons). The availability of large areas of habitat, combined with continued low levels of human disturbance, may mean that global decreases in shorebird numbers are being offset in the Northern Territory by more shorebirds choosing to stay in the north when they arrive in Australia, rather than continuing their migration to their previous over-wintering grounds further south. Previous surveys done outside the scope of this project have also indicated the possibility of some shorebirds migrating from southern Australia to the Northern Territory but remaining there during the breeding season rather than continuing on to northern hemisphere breeding grounds. An increase in shorebird banding and flagging around the Northern Territory coast may provide some confirmation along these lines.

THE RECLAMATION ON THE TIDAL WETLANDS ALONG THE CHINESE YELLOW SEA COAST FROM 1980-2013

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The extensive tidal flats of the Yellow Sea Region (YSR) provide important migratory stopovers for many shorebird species of the East Asian-Australasian Flyway. During the 20th century, the area of Chinese tidal wetlands decreased by around 51%, of which 82% resulted from land reclamation. Based on Landsat satellite images from 1980 to 2013 analysed in 5-yr intervals, utilizing visual interpretation and change detection technique, the total area of reclamation in the Chinese part of the YSR in the past 30 years was about 8,000 km^2. The reclamation rate showed a sudden upward trend around 2005, which has been maintained subsequently. The claimed lands were classified into five land use types: farmland, open waters (saltpans or aquaculture ponds), construction, oil fields and unused land. Over the past 30 years, the area of oil fields showed a downward trend, open waters continued to rise substantially, farmland increased slightly, and the construction and unused land categories rapidly increased corresponding with large-scale reclamation during the past decade. Current provincial reclamation plans include further extensive loss of tidal lands, with Jiangsu Province alone planning to reclaim 1,800 km^2 between 2010 and 2020. Moreover, with sea level rise, reduction of river runoff and sediment deposition, rapid expansion of invasive species like *Spartina alterniflora*, the threats facing the remaining tidal wetland ecosystems of the Chinese YSR will continue to intensify. This region is in urgent need of national macro-control policies to safeguard ecosystem functions.

THE HUNTER ESTUARY - A SIGNIFICANT STOPOVER/STAGING SITE FOR RED KNOT ON SOUTHWARD MIGRATION

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Red Knot are considered 'birds of passage' in the Hunter Estuary in New South Wales as they generally stay for only a short period while on southward migration to their preferred non-breeding grounds in Victoria and New Zealand. Between September 2011 and March 2014, Red Knot were observed at high-tide roosts in the Hunter Estuary during three successive non-breeding seasons. The flocks were searched for leg flags and colour bands every two to three days during their peak migration period from mid-September to late October, then weekly for the remainder of the non-breeding season. Of 88 flagged Red Knot seen during the study period, 50 were individually marked with engraved leg flags or colour bands. Since flagging, most have been seen in New Zealand, but none have been seen in Victoria. It is likely that the majority of mature Red Knot passing through the Hunter Estuary fly directly across the Tasman Sea to New Zealand and not via Victoria. Only seven of the 50 individually marked birds made repeat visits, suggesting that the estuary is an opportunistic stopover location for Red Knot on southward migration. For birds flying south from a stopover in the Gulf of Carpentaria, a stopover in the Hunter Estuary breaks the journey to New Zealand into two flights of approximately 2,000 km rather than one longer 4,000 km flight. During southward migration there is evidence for at least two waves of Red Knot passing through the Hunter Estuary, in addition to minor arrivals and departures. Prior to this study, flocks of up to 2,000 Red Knot have been seen in the Hunter Estuary, making it a very significant stopover/staging site for Red Knot with, at times, up to 5% of the *rogersi* population in south-eastern Australia and New Zealand passing through.

OPTIMIZING DISTURBANCE MANAGEMENT OF MIGRATORY SHOREBIRDS IN MORETON BAY, AUSTRALIA

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In Moreton Bay Marine Park, Australia, disturbance is a major threat to declining migratory shorebirds and impacts individual species differently. On some tidal flats, disturbance from dogs, people or horses illegally causing feeding or roosting birds to take flight is almost continuous. Marine Park personnel therefore enforce regulations through patrols, yet have limited resources with which to carry out enforcement. We therefore determine how Moreton Bay Marine Park personnel can spatially allocate their patrol effort between sites to identify which

combinations deliver the greatest reduction in disturbance to the largest number of birds for the least cost. We find that the management of sites with low disturbance rates provide little return on investment compared to sites with high disturbance rates, regardless of bird numbers. All in all, the sites which provide the greatest management benefit are those which are cheap, have high disturbance rates and large numbers of birds. For migratory species such as shorebirds, local scale management solutions can therefore play an important role in helping reverse international scale declines.

SHOREBIRD FORAGING ECOLOGY IN SALT WORKS OF WESTERN AUSTRALIA: MANAGEMENT IMPLICATIONS

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Many species of shorebird undertake long distance migrations, which impose extremely high energetic demands upon them. During these migrations, they depend on a limited number of specific habitats as stop-over points, which make them extremely vulnerable to the loss or degradation of these habitats. The East Asian-Australasian Flyway has experienced rapid shorebird population declines that appear to be related to ongoing major habitat loss. However, some species of shorebirds have the capacity to use alternative anthropogenic habitats such as salt works (salt production sites) as feeding grounds. Although numerous studies on the utilisation of salt works by shorebirds have occurred in other regions of the world, there is a lack of knowledge about shorebird foraging ecology and utilisation of salt works in Australia. Here we outline the abiotic (i.e. water depth) and biotic (i.e. prey availability) parameters determining shorebird use of two salt works in north-western Australia, Port Hedland and Dampier, and examine the management implications of our findings.

SHOREBIRDS ALSO LIVE ON ROCKS: A CASE STUDY FROM A REEF IN EASTERN AUSTRALIA

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Shorebirds in habitats other than intertidal mudflats are not as frequently studied. Rock platforms are not uncommon along Australia's coastline, but little is known about the ecology of shorebirds living on them. Thus, a shorebird monitoring project was implemented at Long Reef, a rock platform on Australia's east coast, with the aims to determine the community composition and estimate species' seasonality. Volunteers collected data from January 2008 to December 2013. A total of 17 species were recorded, 11 of which were vagrant and six were regular visitors. Amongst the latter, there were northern hemisphere breeders, with Ruddy Turnstone and Red-necked Stint staying during winter on a regular basis, Pacific Golden Plover not staying during winter at all, and Grey-tailed Tattler presenting an erratic pattern with lower numbers than any other regular visitor. Double-banded Plover visited the reef exclusively during the winter months, returning to New Zealand during summer. Finally, Sooty Oystercatcher, even though a resident species to Australia, was more abundant during summer. Although this site is not of international significance, its conservation value within the Sydney region is paramount as it contributes to the gamma diversity. This site is one of the regional strongholds for Red-necked Stint, Ruddy Turnstone, and Pacific Golden Plover. This study demonstrates the importance of monitoring habitats besides intertidal mudflats.

CHARACTERISATION AND ANALYSIS OF THE INTERNATIONAL CONSERVATION REGIME FOR MIGRATORY SHOREBIRDS IN THE EAST ASIAN-AUSTRALASIAN FLYWAY

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International regimes are cross-boundary arrangements to tackle specific issues, such as migratory species conservation. Within the East Asian-Australasian Flyway, an international regime has emerged to promote conservation of migratory shorebirds. Understanding the policy instruments comprising such a regime is paramount to ensure they are used to their full potential and that weaknesses are rectified. Here we identify the international policy instruments relevant to shorebird conservation in this flyway, and analyse their spatial coverage and provisions. We reviewed policy documents and interviewed key stakeholders. We located 15 instruments that have had significant involvement by Australia and northern hemisphere countries at mid and high latitudes. The regime covers most of the regions that shorebirds require for their life cycle, especially for breeding and migration. The weakest link of the regime is South-east Asia, which constitutes important non-breeding grounds for several species. The instruments' provisions in combination address the main threats to shorebirds, namely habitat loss and hunting. The decline of migratory shorebirds despite the existence of what may seem to be a comprehensive international regime could be related to lag effects, misfits, or implementation gaps. Consequently, it is imperative to further appraise this regime to try to ensure its objectives are actually met.

REHABILITATION OF PENRHYN ESTUARY: SEVEN YEARS OF SHOREBIRD MONITORING

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Penrhyn Estuary is the only significant shorebird habitat remaining on the northern side of Botany Bay (Sydney) today. The small estuary was artificially created during the reclamation of the Botany foreshore between 1975 and 1978, and has been utilised by a diverse group of migratory birds. When Port Botany was expanded adjacent to Penrhyn in 2008, Sydney Ports Corporation rehabilitated the estuary, and enlarged the size of primary foraging habitat from 2.5 ha to over 16 ha. To measure the success of habitat enhancement works, the abundance of key species is monitored and compared with target numbers derived from pre-construction data, as well as counts at reference sites. We have monitored the shorebirds that use Penrhyn Estuary since the pre-construction phase in 2006, and now have accumulated seven full years of data, including three years during and three years post construction. Six key species were selected to indicate the success of the rehabilitation project: Bar-tailed Godwit, Red-necked Stint, Double-banded Plover, Curlew Sandpiper, Red Knot and Pacific Golden Plover. The 2013-2014 peak period, September 2013 to March 2014, marked the first season during which, for the first time since pre-construction records, all six key species were observed in Penrhyn Estuary. The diversity of migratory species has increased in post-construction years, approaching pre-construction conditions. The target count for three species was met or exceeded, indicating a positive result. Future research will look at implications for remaining species and constraints of constructed habitats of this nature. In this paper, we will discuss our findings in detail.

INDUSTRIALISATION THREATENS NORTHWEST AUSTRALIAN MIGRATORY SHOREBIRDS ON THE LUANNAN COAST OF THE NORTHERN YELLOW SEA, CHINA

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Global Flyway Network's colour-banding project has been running for eight years and is now producing survival rate data for the populations of Bar-tailed Godwits, Red Knots and Great Knots that live, predominately, in Roebuck Bay, northwest Australia. These results show an alarming drop in survival over the last two years. We argue that this decline is linked to habitat loss in the Yellow Sea as our models show that survival is very high in Roebuck Bay and on migration but the birds 'disappear' between the Yellow Sea and their return (or non-return) to Roebuck Bay. We

present details on a small area of mudflat in the northwest of Bohai Bay, China where up to 75% of both the *piersmai* and *rogersi* subspecies of Red Knot stage on northward migration. This staging site is bordered on all sides by industrial development and there are plans for development of this site as well. Numbers of Red Knot at our study site are increasing but this is not positive. This is due to the loss of other areas of mudflat in Bohai Bay. The *rogersi* and *piersmai* subspecies of Red Knot can be reliably separated on plumage characteristics when they are in full breeding plumage. We have shown the different timing of migration through the site by separating birds on plumage and by using field observations of birds abdominal profiles (a visual score of fat stores). We discuss an on-going research programme on the staging of Red Knots in north-west Bohai Bay and the work of the Global Flyway Network. The majority of the funding for this project comes from outside Australia; indeed the bulk of funding comes from Europe and China (BirdLife-Netherlands, World Wildlife Fund-Netherlands, University of Groningen, Beijing Normal University, World Wildlife Fund-China) with further support from AWSG in 2014.

SHOREBIRD MONITORING BY INDIGENOUS COMMUNITIES OF THE GULF OF CARPENTARIA REGION

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Australia provides overwintering habitat for many of the five million migratory shorebirds in the East Asian-Australasian Flyway, and is also home to important populations of resident shorebird species. Much of the important shorebird habitat in Australia is on Indigenous land, particularly in remote northern Australia, where beach and mudflat habitat is assumed to be more pristine than in more heavily populated areas. In these same remote areas, however, shorebird data are often scarce. The growing workforce of professional Indigenous land and sea managers is well placed to play a key role in shorebird management, including the critical task of collecting accurate data on shorebird numbers and distribution, as well as implementing on-ground management actions and education of local communities and visitors to protect shorebird feeding, roosting and nesting habitat. In 2012-13, BirdLife Australia, the North Australian Indigenous Land and Sea Management Alliance Limited (NAILSMA) and the Indigenous land and sea ranger groups of Mapoon, Nanum Wungthim (Napranum), Pormpuraaw and li-Anthawirriyarra (Borroloola) partnered to establish regular monitoring of shorebirds in the Gulf of Carpentaria. This included a program of ranger training, a custom-designed electronic identification and monitoring tool (I-Tracker) and a series of bird counts. Through this collaborative project, 18 shorebird count sites were established and registered with BirdLife Australia. Twenty-six counts were completed during the 2012-13 overwintering season with 19,032 birds counted including 10,941 migratory shorebirds. Indigenous Ranger groups are regularly completing shorebird counts in these key areas, as well as implementing management strategies to protect nesting shorebirds and Little Tern nesting colonies (Mapoon). Through a partnership approach, these data are being put into a regional and global context, as well as informing local management priorities articulated through community-based planning.

This abstract encompasses the following four presentations:

1. A presentation from NAILSMA on the I-Tracker data collection and mapping platform developed to support shorebird, tern and wetland bird counts by Indigenous ranger groups;
2. A presentation from the Mapoon Land and Sea Rangers on shorebird and Little Tern management and conservation around Mapoon, Cape York, Queensland;
3. A presentation from the Nanum Wungthim Land and Sea Rangers on shorebird management and conservation around Napranum, Cape York, Queensland; and,
4. A presentation from BirdLife Australia on its engagement with Indigenous ranger programs.

SUITABILITY OF COASTAL WETLANDS AS WATERBIRD HABITAT IN REPUBLIC OF KOREA

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Management and conservation of animal populations requires information on where they are, why they are there, and where else they could be. Spatial and temporal variation in habitat conditions thus generate strong selective pressure for habitat selection, which in turn affects survival and reproduction of individual birds, and contributes to the regulation of bird populations. Thus, increased energy availability in potential and current foraging habitats may support a higher foraging capacity for a bird population than areas with less available energy. The objectives of this study are 1) to determine whether different microhabitat types in wetlands can support enough daily digestible energy density for waterbird populations; and 2) to develop indicator metrics of habitat suitability in different wetland and microhabitat types based on time and energy budgets, seasonal water depth, prey biomass, and digestible energy density. A clear understanding of habitat characteristics found on prey assemblages and vulnerability, and digestible energy density in different wetland systems would help the long-term implementation of habitat monitoring, management, and conservation planning.

SHOREBIRDS – KEY TO THE FUTURE OF THE SAMPHIRE COAST?

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The Upper Gulf St. Vincent in South Australia is widely recognized as internationally significant for shorebirds. At least 52 shorebird species have been recorded in this area commonly referred to as the 'Samphire Coast', including 11 resident species and 26, which migrate here annually. Thirteen species occur in internationally significant numbers and five in nationally significant numbers, reinforcing the importance of protecting and actively managing the area for shorebirds. The shorebird species diversity and abundance stems from the mosaic of saline and freshwater habitats, natural and artificial, available along this coast. These include extensive tidal mudflats, samphire saltmarshes, claypans and mangrove forests, which are augmented by artificial wetlands, effluent treatment ponds and salt evaporation ponds. Collectively, these habitats provide shorebirds with a diverse range of food resources, roosting areas, high-tide feeding options and breeding sites for some resident species. Recently, the SA Government committed to establishing an International Bird Sanctuary to protect shorebird habitat along the Samphire Coast. Still, native species and remnant habitats are subject to a variety of threats including invasive species, urban development and human impacts, particularly from off-road vehicles. Climate change and sea level rise also have potential to impact and significantly change the nature of the Samphire Coast. The Adelaide and Mount Lofty Ranges Natural Resources Management Board's *Samphire Coast Icon Project* provides a framework for strategic efforts across agency, local government, community and industry partners to better protect and manage this area for the future. Supported by the Australian Government, the project is being delivered in partnership with the SA Department of Environment, Water and Natural Resources and BirdLife Australia. We outline approaches the project is taking to retain the natural values of the Samphire Coast, giving examples of achievements to date and future activities. Shorebird conservation is a major focus and may just be the key to the region's future.

MIGRATORY SHOREBIRDS AND THE LNG BOOM: FOUR YEARS OF SURVEYS IN GLADSTONE HARBOUR AND THE CURTIS COAST, QUEENSLAND

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Gladstone Ports Corporation (GPC) obtained approval for a major port development, the Western Basin Dredging and Disposal Project in July 2010. The project involved dredging of new shipping channels and berths in Port Curtis (Gladstone Harbour) and construction of a 265 ha land reclamation on an adjacent mud flat. A condition of the approval was that GPC establish a 10 year Environmental Research and Monitoring Program (ERMP) on the Curtis Coast, which included a focus on migratory shorebirds. Migratory shorebird monitoring commenced in January 2011 with an intensive phase involving two summer surveys in January and February, a northward migration survey in March, a winter survey in August and a southward migration survey in October. This was to

take place for two years followed by six years of annual summer surveys and a further two years of intensive surveying. The data have been collected by three contractors following the same method. Here, we present the results of the first four years of surveys. Migratory shorebird abundance on the Curtis Coast in summer has been relatively stable during the study (11,856 ± 837). Abundance in October and March appeared to be slightly greater than summer suggesting that the Curtis Coast may be an important site during migration. Winter abundance was 4,293 ± 148, which is 36 percent of the summer abundance. The apparent stability in the total abundance of migratory shorebirds hides considerable variation in species abundance and distribution – e.g. summer abundance of Red-necked Stints ranged from 860 to 3023. A total of 24 migratory shorebird species have been recorded. Of these, the abundance of four (Eastern Curlew, Grey-tailed Tattler, Whimbrel and Terek Sandpiper) has been consistently >1 percent of the East Asian-Australasian Flyway population estimates, suggesting that the region is of international importance for them.

THE ROLE OF MODIFIED ROOST SITES FOR MIGRATORY SHOREBIRDS IN DARWIN HARBOUR

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Coastal development can displace migratory shorebirds from natural habitat and alter population assemblages. Darwin in the Northern Territory is one region where important migratory shorebird habitats are progressively coming into conflict with rapidly expanding urban and industrial developments. However, not all developments appear to be detrimental to shorebirds, with one developed site in the Darwin area showing increased species diversity and high abundances of shorebirds. Increasingly, developers are capitalising on this positive dynamic to offset habitat destruction with artificial habitat creation; however, the causes and longer-term consequences of this practice remain understudied. Understanding habitat use by shorebirds can provide insights into the potential responses of species to various habitat change scenarios associated with development. This is particularly important where shorebirds use a network of foraging and roosting sites on a daily basis and habitat may need to be preserved to maintain connectivity. From 2013 to 2014 natural and modified roost sites were monitored in Darwin to examine shorebird community dynamics. Natural roosts regularly supported high abundances of various species during the austral summer, while the modified roost supported the highest species richness but the lowest species abundances observed across sites. Species composition varied according to habitat type, with similar community structure observed for the sandy beaches and the rocky outcrop sites. While the use of artificial habitat by migratory shorebirds appears to be a valuable management tool, the creation of artificial sites should not be prioritised over the protection of natural sites. Importantly, habitat offsetting for roosting shorebirds may be the only viable option in the face of rapid development in Darwin.

THE PORT OF BRISBANE SHOREBIRD ROOST: MONITORING AND MANAGEMENT

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Ports are critical to the economic well-being of Australia. National population and consumption growth will inevitably lead to the need for additional port infrastructure. Ports, along with other forms of coastal development, are generally considered to be a threat to shorebirds. As such environmental groups tend to view port development in a negative light. However, experience at Port of Brisbane, supported by an extensive monitoring program, has shown that port development can lead to positive outcomes for shorebirds. The Port of Brisbane Pty Ltd (PBPL) is currently undertaking a long term land reclamation project of 230 hectares of sea through the progressive placement of dredge material in constructed bunds to form usable land. Central to PBPL's strategy to manage impacts on shorebirds is a purpose built 12 hectare shorebird roost. The roost was voluntarily constructed in 2005. Ongoing monitoring demonstrated declines in shorebird utilisation of the roost commencing in 2010. It was identified that excessive vegetation growth in the roost was inhibiting usage. Improvement works were undertaken and monitoring has demonstrated substantially increased bird numbers and species diversity. It is concluded that adaptive management is necessary to maximise the ecological values of constructed shorebird roosts.

INSIGHTS INTO MIGRATION PATTERN OF SANDERLINGS USING GEOLOCATORS: FROM RAW LIGHT DATA TO ECOLOGICAL INSIGHTS

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Reconstructing animal migration paths using light intensity loggers has been done for about 20 years but recent developments towards smaller and cheaper tags with even higher resolution has increased the usage and applicability of this technique enabling small and medium shorebirds to be tracked. However, the complexity of the data analysis and the problems in handling the major drawbacks of this technique, including the accuracy and limitations inherent in the technique such as positions within the Arctic circle, still give the majority of users a headache. Here we review and evaluate the different methodologies and tools in relation to the questions one might potentially tackle with the retrieved data. Furthermore, we will present results from a two-year geolocator dataset of Sanderlings from South Australia (14 individual tracks) and discuss how newly developed techniques will extend the capability to make ecological insights and identify key parameters of migration and breeding which are essential for conservation management.

DOGS AND LEASHES, BIRDS AND BEACHES

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Domestic dogs and coastal open spaces go hand in hand, as do shorebirds and coastal habitats. When the two overlap there is potential for significant impacts on shorebird populations, particularly beach-nesting species. Coastal zoning and regulations are often poorly planned in relation to the presence of important shorebird sites, more often focusing on providing dog free spaces where there are heavy concentrations of beach users, in particular families. This can result in off leash dog areas commonly designated at key shorebird sites. Furthermore, while regulations exist on beaches for the benefit of wildlife, i.e. dogs must be on a lead, compliance with leashing is incredibly low, resulting in a loss of coexistence opportunities. Via the Beach-nesting Birds project at BirdLife Australia we have been involved in several research projects to investigate (a) barriers toward leashing on Victorian beaches via social surveys; (b) space use by dogs on beaches using GPS loggers; and, (c) the effectiveness of different dog regulations on Victorian beaches via observations of dogs at beaches across six different regulation types. Key findings will be discussed including observed levels of compliance as low as 10-30%, variation in compliance according to the severity of restrictions in place, and barriers to compliance including social norms and lack of awareness of dog-shorebird interactions and impacts.

RESEARCHING THE SHOREBIRDS OF YAWURU COUNTRY

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The Broome region is regarded as the most significant site in Australia for shorebirds as well as being of high significance among other locations for shorebirds across the world. Roebuck Bay has the greatest diversity of shorebird species of any site on the planet and around 150,000 of these birds visit annually. The Australasian Wader Studies Group (AWSG) have been conducting research on migratory and resident shorebirds at Roebuck Bay and Eighty Mile Beach since 1981. The studies involve both catching and population monitoring. Community involvement is a core component of the shorebird studies at Roebuck Bay with a strong network of volunteers and open support from local organisations such as the Broome Bird Observatory and Environs Kimberley. In addition, the WA State Government (through the Department of Parks and Wildlife WA) has maintained logistical and funding support to AWSG since the project began 33 years ago. More recently since 2006, the AWSG work has been complemented with the migratory shorebird studies conducted by the Global Flyway Network. Indigenous involvement in shorebird research within the West Kimberley has increased since the formalisation of the Yawuru, Karajarri and Nyangumarta Native Title Agreements and the establishment of the Yawuru Conservation Estate and the Eighty Mile Beach Marine Park. The Yawuru Joint Management Team at the Department of Parks and Wildlife WA assists with Roebuck

Bay shorebird research on a seasonal basis providing in-kind logistical support and participating in the catching projects. Concurrently to this, the Yawuru team coordinates (with assistance from the Broome Bird Observatory) monthly benthic sample collection under the MONROEB program. This fourteen year old sample set will help to provide key insights into the local shorebird food source.

DUNE-NESTING PLOVERS SELECT NEST SITES TO MINIMISE THE RISK OF CLUTCH DEPREDATION

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Birds choose nest sites for a variety of reasons, including the avoidance of egg depredation. This study deployed artificial clutches in dunes to examine factors, which were correlated with the risk of clutch depredation. Clutches further from dead objects (e.g. sticks) were at greater risk of depredation, however vegetation cover around the nest did not influence likelihood of depredation. These randomly placed dune nests were then compared with real Hooded Plover dune nests to examine whether plovers place their nests to minimise clutch depredation. Real nests were closer to dead objects (perhaps improving egg crypsis) than random nests, suggesting that real nest placement is at least partly driven by predator avoidance. Real nests were also in less grassy areas and closer to the beach than artificially placed nests, which occurred further into the dunes. This could explain the significant difference in the occurrence of rodent depredation between real and artificial nest observations. Results suggest that maintaining open areas in dunes, which are not dominated by grass, and not removing dead objects such as beach and dune debris, will help maintain or improve the low reproductive success experienced by this species.

DDT AND OTHER POPS – A CONTINUING THREAT TO WADERS IN THE YELLOW SEA?

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Dichlorodiphenyltrichloroethane (DDT) continued to be manufactured in China until 2011, being widely used in anti-fouling paint, especially for the 330,000 strong fleet of wooden-hulled fishing vessels. Some 250 tonnes of DDT was used in paints annually and is thought to be largely responsible for the continuing high levels found in coastal sediments and marine life. Waders staging at sites in the Yellow Sea may accumulate lipid-soluble organochlorine pollutants in fat deposits, these then being released into the blood as fat stores are used during migration. We review the potential impacts on waders from Persistent Organic Pollutants (POPs) along the Chinese coast and consider actions being taken to improve the situation.

TRACKING LITTLE CURLEW FROM ROEBUCK PLAINS TO SIBERIA

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Nearly 11,000 Little Curlew have been colour flagged in northwest Australia. However, none have been reported overseas and few Little Curlew have ever been recorded on migration in Asia. Knowledge on the Little Curlew migration along the flyway is therefore very poor. The main objective of this study is a preliminary attempt to document migratory paths and strategies of Little Curlew, their habitat use on migration, eventual breeding site locations and habitat use and movements at the non-breeding grounds in northwest Australia. The Australasian Wader Studies Group captured 23 Little Curlew on Roebuck Plains in November 2013. We fitted 5 gram solar powered satellite transmitters on five birds, using a ‘leg-loop harness’, programmed on a

10 hours ON/48 hours OFF duty cycle. Weekly movements of Little Curlew around Roebuck Plains and Roebuck Bay ranged 5-10 km between November and January. We lost two transmitters in January, either due to them being shed or from birds dying. The other three Little Curlew moved 200 km to Anna Plains, and one continued 230 km further to Port Hedland. All three returned to Roebuck Plains in March. The first Little Curlew departed on migration in late-April and reached Siberian breeding grounds in late May. It stopped over in the Philippines and several times in China. The other two departed Roebuck Plains in mid-May, with one stopping over in Taiwan and China and the other diverting from its migratory path and turning back south to Indonesia. This is the first study to reveal information about Little Curlew migration and will help identify key areas for future work and conservation efforts.

5 YEARS ON – WHAT HAVE WE LEARNED FROM GEOLOCATORS DEPLOYED IN AUSTRALIA?

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From the experimental deployment of six geolocators on Ruddy Turnstone in March 2009, we have now deployed 422 geolocators on six wader species; three in southeast Australia and three in northwest Australia. The overall retrieval rates have been good (20% to 40%) on five of the species but lower on Red Knot. These have provided excellent information on migration routes and stopover locations; in some species this is markedly different from the information derived from recoveries and flag sightings. In some species, migration routes of individuals are similar on both northward and southward migration while in other species there are wide variations. The importance of the Yellow Sea as a key stopover location, particularly on northward migration, is even more emphasised. Novel analytical techniques are now being employed to determine breeding locations in the Arctic. Temperature data as well as light level variation is also being used to study breeding activities in detail. Plans for future geolocator deployment and limitations thereof will be discussed.

SUCCESSFUL RETURN OF SHOREBIRDS TO SYDNEY OLYMPIC PARK

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Sydney Olympic Park includes a diverse range of wetlands that had previously been lost or degraded, a process halted only after the initiation of the staging of the Sydney 2000 Olympic Games at Homebush Bay. Since then, many initiatives have been taken for the reconstruction and restoration of wetland habitats for waterbirds including migratory shorebirds. Measures included the complete reconstruction and regeneration of a freshwater wetland corridor from a rubbish tip and the reinstatement of a natural regime of daily tidal exchange of dredge spoil reclamation ponds to provide feeding and roosting habitat for shorebirds. Additional works included the creation of more mudflats for shorebirds, the restoration of degraded freshwater ecosystems and the design and construction of new freshwater wetlands while at the same time providing active education and training initiatives to enhance the capacity of conservation management personnel from a wide range of agencies. In the context of regional and national declines in shorebird abundance and diversity, the combination of the above initiatives have resulted in not only the return of shorebirds to the Park but an increase in relative abundance and diversity not seen for many decades.

A PERFECT STORM? – THE DECREASE OF GREAT KNOT FOOD AT YALU JIANG COASTAL WETLAND IN THE NORTHERN YELLOW SEA, CHINA

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Yalu Jiang coastal wetland in the northern Yellow Sea, China supports over 250,000 waders annually and is internationally important for at least 14

species of waders during northward migration. The intertidal clam *Potamaocorbula laevis* has been super abundant and is the principal food source for Great Knots and an important item in the diets of Bar-tailed Godwits and Far Eastern Oystercatchers. The density of *P. laevis* decreased from 2012, and the percentage and number of young *P. laevis* (less than 5 mm) were far less in 2012–2014 compared to 2011; we even found no *P. laevis* in some of the transects in May 2014. The collapse of the *P. laevis* population that appears to have been initiated by a major mortality event from spring 2012, coinciding with the behaviour of *P. laevis* and the variation of environment, parasites and pollution were considered to be the most possible reasons. We explore and forecast the future of *P. laevis* by distribution of size and density, and consider what the future holds for waders at this site. Waders using the ever diminishing area of intertidal flats around the Yellow Sea are increasingly at risk of stochastic events such as those that appear to be occurring at Yalu Jiang coastal wetland, highlighting the need for a precautionary approach to future land use planning.

A SALINE SOLUTION - MANAGEMENT PLANNING FOR SHOREBIRD HABITAT AT DECOMMISSIONED SALTFIELDS

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South Australia's Dry Creek Saltfields have long been recognised as internationally significant for shorebirds and waterbirds. Records of over 50,000 shorebirds of have been documented during the operation's 60 year history. By maintaining a consistent flow regime throughout the 4,000 ha of salinas, commercial salt operators have provided a mosaic of reliable feeding and roosting habitats which are available year to year and throughout the tide cycle thus providing higher ecological service than neighbouring natural habitats. However, the recent decommissioning of the operation has jeopardised the established salinity gradient and the communities, which have come to rely upon them. With the backing of the state government, local land managers are now working towards a long term solution for the site which is to be incorporated into the newly proclaimed Adelaide International Bird Sanctuary.

SHOREBIRD SURVEYS IN THE SOUTH-EAST GULF OF CARPENTARIA, 1999 AND 2012-2013

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The south-east Gulf of Carpentaria in northern Queensland is a major site for Arctic and resident shorebirds but is one of the least studied sites in Australia. Reasons include its remoteness, limited vehicular access, a wet season when maximum numbers of shorebirds are present and a one high tide a day regime. Some years there are several weeks in April and May when surveys can be undertaken and again a brief period in September. Otherwise large parts of the year are unconducive to high tide counts. Extensive surveys were undertaken in March–April 1999, however, from 1999 to 2012 almost no survey work was undertaken. A brief, mostly aerial, survey of 300+ km of the Gulf coast in September 2012 was undertaken ahead of a bigger survey using boats, a light plane and helicopters. Over two tide cycles in March and April 2013 aerial counts of the coastline and ground counts at roosts were conducted, with most roosts counted several times. Twenty-three species of shorebird were recorded with Great Knot and Black-tailed Godwit being the most abundant species present, with estimated numbers in 2013 of ~40,000 Great Knot and ~14,000 Black-tailed Godwit. Other important species included Red Knot (~10,000), Red-necked Stint (~6,000) and Greater Sand Plover (~6,000). The nearby Karumba Plains wetlands are also important for shorebirds and other waterbirds, in particular Little Curlew and Sharp-tailed Sandpiper. The year 2013 was a dry 'wet' season, which may have contributed to the lower numbers on the plains than in 1999.

THE IMPORTANCE OF YALU JIANG WETLAND NATIONAL NATURE RESERVE FOR SHOREBIRDS DURING NORTHWARD MIGRATION

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The 101,000 ha Yalu Jiang Estuary Wetland National Nature Reserve stretches 60 km westwards from the North Korean border along the shores of the Chinese part of the Yellow Sea. The reserve includes approximately 9,000 ha of aquaculture ponds and mudflats extend several kilometres south

from the seawall. The first shorebird survey in May 1999 found over 152,000 shorebirds of 26 species. A survey in late May 2000 found over 92,000 shorebirds. The Miranda Naturalists' Trust became involved in 2004 and surveys of the reserve continued annually in April or May until 2010. The findings were published in a report in March 2014. The results show the Yalu Jiang Reserve and a nearby river estuary supported at least 250,000 shorebirds annually on northward migration during the survey periods. Forty-one species were recorded, of which 15 occurred annually or regularly in internationally important numbers, including Bar-tailed Godwit (>90,000), Great Knot (>55,000), Dunlin (>45,000), Eurasian Curlew (>13,000), Grey Plover (>9,000), Eastern Curlew (>6,000), Far Eastern Oystercatcher (>1,000) and the Critically Endangered Spotted Greenshank (24). Over 1,000 banded and other marked shorebirds from 19 regions in eight countries were identified in the region to 2010. Since the demise in 2006 of Saemangeum in South Korea, Yalu Jiang has become the most important shorebird staging site in East Asia. However, the area is coming under increasing threat from reclamation, industrial development, habitat loss and changed hydrology, which are all likely to affect the number of shorebirds able to refuel at Yalu Jiang in the coming years.

WHAT EFFECT DID THE DESTRUCTION OF THE SAEMANGUEM TIDAL FLATS HAVE ON THE GREAT KNOT?

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Saemangeum, a tidal flat system on the west coast of South Korea, used to be the single most important staging site for migratory shorebirds in the East Asian-Australasian Flyway. It was of particular importance to Great Knot, with 20-30% of the flyway population staging there on northwards migration. Saemangeum has been largely lost to shorebirds through a huge ongoing 'reclamation' project in which tidal flats are converted to dry land and permanent lakes. Most of this habitat loss occurred following completion of a 33 km sea-wall in 2006, causing a dramatic decline in the numbers of Great Knots staging in Saemangeum. A Korea-wide survey in 2008 showed that few Great Knots relocated to other Korean staging sites, and that some 80,000 were 'missing'. We argue that most of these birds must have perished, because sea-wall closure at Saemangeum coincided with (1) declines in numbers of non-breeding Great Knots reaching Australia in the austral summer; and, (2) declines in apparent annual survival of adult Great Knots colour-marked in north-western Australia (demonstrated by mark-recapture studies). There has been some subsequent recovery in numbers of Great Knot in north-western Australia, but this appears to have been driven by fortuitous high breeding success in several consecutive years; annual adult survival has not returned to its previous levels, and population recovery has not occurred in southern Australia. Our study supports several indicating that tidal flat reclamation projects are responsible for serious ongoing declines in many species of migratory shorebird.

CONSERVING SHOREBIRD ROOST SITES IN A HUMAN DOMINATED LANDSCAPE: AN ECOLOGICAL AND ECONOMIC PERSPECTIVE FROM THAILAND

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The coastal fringe of the Inner Gulf of Thailand, between the shoreline and seaward expanding urbanization, has been heavily used for salt production and aquaculture. Whilst saltpans have long been recognized for their value to shorebirds, little is known about how the birds actually use this anthropogenic habitat and, more importantly, whether the increased rates of conversion of saltpans to aquaculture pose a serious threat to the birds. To address these issues, we undertook over 200 surveys of shorebird diversity and abundance in saltpans and aquaculture ponds. We also recorded behavior and foraging success in saltpans, aquaculture, natural mangrove clearings and

intertidal mudflats. In addition, we administered questionnaires to landowners to elucidate the economic incentives behind conversion of saltpans to aquaculture. Our results indicated that aquaculture is indeed bad for some shorebirds, but not all. Bigger shorebirds, together with other waterbirds, held the largest proportion of the birds found using aquaculture ponds (90%). Conversely, saltpans were dominated by medium-sized shorebirds (56%). Smaller shorebirds spent 87% of their time in saltpans feeding, while medium-sized shorebirds spent around 53% (compared to 11% in aquaculture). Bigger shorebirds spent similar amounts of time feeding in saltpans and aquaculture (49% and 44%, respectively), but their roosting time almost doubled in saltpans. Our analyses of socioeconomic data indicate that median yearly net benefits of saltpans and aquaculture were similar, although greater variability was observed in aquaculture. Aquaculture demanded greater chemical and biological inputs whilst saltpans were more labor intensive. There are important differences in the distribution of benefits among land uses, and we discuss some of the policy options available to conservationists, including ways in which aquaculture can be managed to minimize its negative impacts on shorebird populations.

SHOREBIRD HABITAT MANAGEMENT AT THE WESTERN TREATMENT PLANT, VICTORIA: THE CHALLENGES AND OPPORTUNITIES OF MANAGING A LARGE SHOREBIRD SITE WITH MULTIPLE VALUES

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The Western Treatment Plant (WTP) is a large – 10,500 ha – coastal sewage treatment facility outside Melbourne, Victoria. With around 190 wetlands, including 181 constructed ponds, the Plant is well known as an important site for waterfowl and shorebirds and was included as a major component of the Port Phillip Ramsar Site in 1982. But the site is unusually complex in that it supports numerous other biodiversity values associated with coastal wetlands, coastal saltmarsh or temperate grasslands such as the Critically Endangered Orange-bellied Parrot and Spiny Rice-flower, the Endangered Growling Grass Frog, Australasian Bittern and Australian Painted Snipe, and the Vulnerable Striped Legless Lizard. In addition, the site has public health infrastructure of critical importance, servicing almost 10% of Australia's population, and significant agricultural and resource recovery assets. For many years certain constructed ponds have been managed to provide high tide foraging/roosting habitat for migratory shorebirds through water level manipulation and vegetation management. Managing ponds for migratory shorebirds while simultaneously maintaining summer habitat for endangered species of frog, waterfowl and cryptic marsh birds can be challenging. Extended drought, occasional floods and sewage treatment operational requirements have all complicated shorebird habitat management at times. But the extensive WTP has also provided unique opportunities to manage shorebird habitat on a large scale. Initiatives have included trialing multiple, 'trickle' discharges of effluent to nourish intertidal mudflats at reduced volumes and concentration of effluent, and returning ~12 ha of sewage treatment ponds to tidally inundated coastal saltmarsh. Close monitoring of shorebird populations and intertidal invertebrate prey resources by the Arthur Rylah Institute and GHD Pty Ltd has enabled regular evaluation of our management and led to significant improvements over time.

LESSONS LEARNED FROM 50 YEARS OF WETLAND HABITAT REMEDIATION AND MANAGEMENT FOR WATERBIRDS

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Wetlands as habitat for waterbirds are facing increasing pressure from human impact, whether directly as a result of development or indirectly through degradation or increasing disturbance. To halt or reverse this trend it is necessary to restore or manage what is left, or in extreme cases to rebuild wetlands from scratch, to provide the functions that have been lost. We will be showing some examples of attempts to restore, construct and manage wetland habitats over the past 50 years and some of the reasons for successes and failures of these case study sites. It goes without saying that it is essential to have an understanding of habitat needs of wildlife occupying a wetland and to prioritise wetland species in order of importance to the wetland managers. However, the lack of these basics is probably the result of most failures. There are few specialist environmental engineers, and in their absence it is essential that engineers recognise the limitations of computer modelling and work closely with experienced wetland biologists. Although huge machines have taken over from the shovel and wheelbarrow, the basic principles of wetland design haven't changed, and neither has the need for ongoing commitment to manage wetlands effectively in the long term. Many shorebirds have become dependent on constructed wetlands as

natural systems have been lost. It therefore stands to reason that these artificial systems need to be retained and managed as much as any other wetland of similar carrying capacity.

GREY-TAILED TATTLERS – A FRESH LOOK AT A COMMON SHOREBIRD

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The presence of a small population of Grey-tailed Tattlers in Port Stephens on the central coast of New South Wales is providing opportunities to carefully observe the behaviour of this common, but much under-studied species. Typically, 100–120 birds are present in Port Stephens in the austral summer; 10–15 non-breeding birds in winter. The authors have been monitoring the population since 2012, conducting extended observations during periods of foraging and roosting. In May 2014 the program was extended to include observations at some well-known Japanese staging areas. Also, contact was established with local Japanese shorebird surveyors who agreed to an exchange of information. Certain behavioural aspects among both the Port Stephens study population and migrating Grey-tailed Tattlers staging in Japan appear to differ from previously published reports. The differences observed in both groups will be discussed, including previously unreported agonistic episodes and two instances suggestive of pair-bonding.

SHOREBIRDS 2020: SEVEN YEARS ON AND COUNTING

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The *Shorebirds 2020* program commenced in 2007 to reinvigorate the volunteer-driven national shorebird population monitoring program started by the Australasian Wader Studies Group (AWSG) in 1981. Subsequent to the recent discontinuation of external funding, the program is managed and supported wholly by BirdLife Australia and the AWSG. The agenda set for the program under the previous Caring for our Country (CFOC) funding scenarios has had to be adjusted to the new funding situation, however the program continues to collect shorebird population count data through its 1400-strong volunteer network at 320 shorebird areas around Australia forming a nationwide network of increasingly important shorebird sites. The continued development and implementation of a practical model for community-based shorebird monitoring is imperative in identifying shorebird population trends around the country. While overall objectives of the *Shorebirds 2020* program remain essentially unchanged, the program has been subject to some adjustments following the cessation of significant external funding. These adjustments are ultimately aimed at maintaining effective and timely identification of shorebird population trends and the provision of this information to guide best-practice management and conservation outcomes for shorebirds and their habitats in Australia. This presentation provides an update on the Shorebirds 2020 program, an overview of the last three population reports prepared for the journal *Stilt* (in preparation), as well as a brief outline of recent preliminary analyses of the national dataset on shorebird population trends in Australia, which continue to show population decline in a number of resident and migratory shorebird species.

STATUS AND CONSERVATION OF MIGRATORY SHOREBIRDS IN TASMANIA

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Tasmania is the southernmost destination for migratory shorebirds (waders) in Australia using the East Asian-Australasian Flyway (EAAF), which extends from Siberia and Alaska to Australia and New Zealand. Approximately 30 species of migratory shorebirds in Tasmania have been monitored during ongoing summer and winter months since the early 1960s. The counts are coordinated and undertaken at fixed sites used by the birds to roost (rest) during high tides. At least seven sites in Tasmania meet the criteria for international significance, based on the numbers of shorebirds present during the year. Analyses of these data indicate decreases in the numbers present in Tasmania for most species at the major roosts around the state. Numbers of Eastern Curlew, the largest migratory shorebird in the EAAF, have decreased by approximately 75%, while numbers of Curlew Sandpipers, one of the smaller migratory species have decreased by more than 95%. In addition, the species diversity at roosts around Tasmania is decreasing. The observed decreases in Tasmania are also being observed elsewhere in Australia, but the Tasmanian data have typically been of greater magnitude and earlier than elsewhere, suggesting Tasmania is serving as an early warning indicator for migratory shorebirds in Australia and the EAAF.

STATUS AND CONSERVATION OF RESIDENT SHOREBIRDS IN TASMANIA

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Extensive surveys of beach-nesting shorebirds (for example Hooded Plovers and Pied Oystercatchers) on sandy beaches around Tasmania have been undertaken over the past decade. These surveys have mapped more than 4,000 nest sites and breeding territories on more than 250 beaches in Tasmania. Early surveys in the 1980s provide baseline data for comparison with contemporary data. Analyses of breeding population data of resident shorebirds in Tasmania suggest decreases for Hooded and Red-capped Plovers around the state, with substantial losses in the southeast and east. Human activities such as 4WDs, dogs and horses disturb nesting birds and result in breeding failure by them. Breeding by shorebirds inside National Parks and other reserves does not afford greater protection, as population decreases inside reserves are similar to those outside reserves. The surveys have enabled estimates of state-wide populations, and the break-down by Natural Resource Management (NRM) regions and by coastal Councils. Conservation efforts directed towards resident species could also contribute to an improvement in the conservation status of migratory shorebirds, given the extensive overlap of habitat use. Sea-level rises and concurrent habitat loss will exacerbate existing threats to coastal shorebirds.

SHARING THE MARGINS: POPULATIONS AND CONSERVATION STATUS OF NEW ZEALAND SHOREBIRDS

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Twenty-seven taxa of Charadriiformes breed in New Zealand and offshore islands (excluding the Kermadecs). Of these 20 are endemic. Under current threat rankings, seven taxa are classified as Nationally Critical, one Nationally Endangered, seven Nationally Vulnerable, and four At Risk: Declining. Only one taxa is classed as Recovering while two are Not Threatened. A further five taxa, confined to offshore islands, are classified as Naturally Uncommon. Up to 15 species of Arctic migrants occur annually in New Zealand, three of them in internationally important numbers. Two of these, Bar-tailed Godwit and Red Knot, were recently reclassified as being native to New Zealand and given a threat ranking, one as Nationally Vulnerable and one as Declining. Population trends for the third taxa, Ruddy Turnstone, indicate it should be reclassified as Nationally Vulnerable as well. A review of the population and conservation status for each taxa is given. Habitat loss or degradation is a common thread, but the most potent threat for NZ breeding shorebirds comes from introduced mammalian predators. For migratory species, habitat loss in East Asia appears the primary driver of population declines.

OBSERVATIONS ON WADERS IN RUDONG AND LIANYUNGANG, JIANGSU, CHINA

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Rudong and Lianyungang, both in Jiangsu Province, west coast of Southern Yellow Sea, have intertidal flats important for many shorebird and waterbird species, including some threatened species. Lianyungang is at the northern end of Jiangsu coastline, and supports large numbers of threatened or noteworthy birds, including Asian Dowitcher, Red Knot, Curlew Sandpiper, Sharp-tailed Sandpiper and Far Eastern Oystercatcher. Rudong is near the southern end of Jiangsu coastline, and supports almost the whole world's population of Spoon-billed Sandpiper and Nordmann's Greenshank, and large numbers of Far Eastern Oystercatcher and other species. The southernmost population of Saunders's Gull breeds here. Both sites are monitored regularly by China Coastal Waterbird Census (once a month). Rudong is also frequently monitored especially for Spoon-billed Sandpiper in spring and autumn in recent years. Spoon-billed Sandpiper and Nordmann's Greenshank finish their flight feather moult in autumn in Rudong, but the role of these sites for Spoon-billed Sandpiper as either a stopover or a staging site in spring is not very clear yet. Here we will share some of our counts, observations on moulting, and resightings of colour-marked birds, especially from Australia, that connects the two parts of the East Asian-Australasian Flyway.

STILT - INSTRUCTIONS TO AUTHORS

Stilt is the journal of the Australasian Wader Studies Group and publishes material on all aspects of waders (shorebirds) of the East Asian-Australasian Flyway and nearby parts of the Pacific region. Authors should send their manuscript by email to the editor at editor@awsg.org.au. Authors are strongly encouraged to consult these instructions in conjunction with the most recent issue of *Stilt* when preparing their manuscripts. Authors are asked to carefully check the final typescript for errors and inconsistencies in order to minimise delays in publication. Authors are also encouraged to seek collegial advice on writing style and English before submitting manuscripts.

Material sent to *Stilt* is assumed to be original and must not have been submitted for publication elsewhere. All authors listed must agree to the publication of the material. Please refer to the *Stilt* Publication Ethics and Malpractice Statement for further information in relation to co-authorship and similar matters. The Publication Ethics statement is available at www.awsg.org.au/stilt.

Suitable material submitted before **1st February** or **1st August** will normally be published in the next issue of *Stilt* in April or October, respectively. Late submissions may be accepted at the editor's discretion.

Submissions should be presented in a Microsoft Word version compatible with Word 2003. All contributions, including table and figure captions and references, should be in 11 pt Times New Roman font. Tables should be in 10 pt Times New Roman. Please refer to the most recent version of *Stilt* for table styles. If photographs or grayscale images are to be included, please submit images in one of the following formats: jpg, jpeg, tiff, gif, bmp, pdf, pcx or eps. Figures, photos or other graphics exceeding 2 MB in size should be forwarded as separate files, clearly labelled to enable cross-referencing. Please ensure that photographs are of highest possible quality. Poor quality images will not be accepted.

Stilt publishes research papers, short communications, reports, book reviews, conference abstracts (usually only from the Australasian Shorebird Conference), notifications of AWSG committee matters and state-wide wader group reports. Research papers and short communications are peer-reviewed and authors are welcome to suggest one or more suitable reviewers. Other material will usually be edited only, although reports may receive one or more reviews at the editor's discretion.

RESEARCH PAPERS

Research papers should document the outcome of original research from wader scientific studies and monitoring of waders. Please note at present, *Stilt* does not publish keywords. Research papers should contain the following sections:

TITLE - in bold, capitalised type.

AUTHORS NAME AND ADDRESS - JOHN SMITH[1], STEPHEN BROWN[2] AND MAX WELL[3]

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RUNNING TITLE - a short version of the title of approximately 50 characters.

ABSTRACT - This will summarise the main findings of the study, preferably in fewer than 200 words.

INTRODUCTION - This should be a short section of about half a journal page to "set the scene" and explain to the reader why the study was important. It should end with a clear definition of the aims of the study.

METHODS - This will describe the methods used in the study in sufficient detail to enable the work to be repeated

RESULTS - The key findings of the study are provided here. Where feasible, data should be presented in figures and/or tables.

DISCUSSION - This section explains the significance of the major results obtained, their relevance to other work, and implications for future research.

ACKNOWLEDGEMENTS - In this section the author(s) should thank others who have contributed to the work. If applicable, ethics committee approvals and funding sources should be detailed.

REFERENCES - This section gives details of all the literature cited in the paper. References should be in alphabetic and chronological order with multi-authored references after single author citations by the same author. Examples of the required format follow:

Single author papers: **Smith, F.T.H.** 1964. Wader observations in southern Victoria, 1962-1963. *Australian Bird Watcher* 2: 70-84.

Multi-authored papers: **Dann, P., R.H. Loyn & P. Bingham**. 1994. Ten years of water bird counts in Westernport Victoria 1973-83. II. Waders, gulls and terns. *Australian Bird Watcher* 15:351-67.

Books: **Kershaw, K.A.** 1964. Quantitative and dynamic ecology. Edward Arnold, London.

Reports: **Noor, Y.R**. 1994. A status overview of shore birds in Indonesia. Pp. 178-88. *In:* Wells, D.R. & T. Mundur. (Eds.) Conservation of migratory water birds and their wetland habitats in the East Asian-Australia Flyway. Asian Wetland Bureau, Malaysia.

Online material: **Dutson G., Garnett S. & Gole C.** 2009. Australia's Important Bird Areas: Key sites for bird conservation. Birds Australia (RAOU) Conservation Statement Number 15. Available at http://www.birdlife.org.au/document/OTHPUB-IBA-supp.pdf (accessed 10 August 2012).

TABLES - There should be no lines in the table except at the top and bottom of the table and below the column headings. All tables should be prepared using the word processing table function and included after the Reference section. Please do not produce tables created as lists using tab stops.

FIGURES - Figures should be placed after Tables. All maps should have a border, distance scale, reference latitude and longitude and/or inset map to enable readers unfamiliar with the area to locate the site in an atlas. Google Maps and Google Earth images will be accepted but are discouraged as they reproduce poorly in print. Line figures are preferred. At their minimum, Google Earth images should retain the Google trademark device and year of image publication.

APPENDICES - Appendices should supplement but not repeat material elsewhere (i.e. in tables and figures). Appendices should be accompanied by a self-explanatory caption. Formatting should follow that for other manuscript components. At this time, *Stilt* does not have the capacity to accommodate Supplmentary Material Online.

SHORT COMMUNICATIONS

These will present material, insufficient for a research paper, on any matters relating to the flyway and the shorebirds in it. They are not usually subdivided like research papers and do not require an abstract. Generally, short communications should be word documents less than 6 pages 1.5-spaced including all tables, figures and photographs.

REPORTS

Reports are intended to provide updates on wader group activities, regular monitoring and related topics. Reports will not usually be subject to peer-review, although the editor and editorial board reserve the right to send reports out for review if they feel another opinion on content is required. Reports should be written in the same style as research papers with the exception that an abstract is not required. Results and Discussion may be combined into a single section "RESULTS AND DISCUSSION". All other formatting should follow that described under Research Papers.

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The terms "summer" and "winter" should be avoided, if possible. Instead, it is recommended that authors use the terminology "breeding" and "non-breeding". If this is not possible, a clear explanation of the month(s) referred to are necessary. East Asian-Australasian Flyway (**not** East-Asian Australasian Flyway) should be spelt out in full on first mention and then subsequently written as EAAF. Subsequent mention of the EAAF as the flyway should be title case, as in, Flyway. Directions should be lower case and hyphenated, as in "north-west" not "North West". Coordinates should be listed in degrees and minutes, usually with the northing (or southing) first followed by the easting, as in Bagan Serdang (3^{o}42' N, 98 ^{o}50'E)

OTHER MATTERS

In general, nomenclature of Australian birds should follow **Christidis, L. & W. Boles.** 2008. Systematics and Taxonomy of Australian Birds. CSIRO Publishing, Australia. The first reference to a species in the text should have the scientific name in *italics* after the common name. Where alternative nomenclature is used, the appropriate reference(s) should be clearly cited.

For all manuscripts, first level headings should be **BOLD and UPPERCASE**, second level headings should be **Bold and lower case** and further subheadings in *italics.*

All measurements should be in metric units (e.g. mm, km, °C etc) and rates should be recorded as, for example, d^{-1} rather than /day or per day. Authors are encouraged to examine previous recent issues of *Stilt* for examples of the presentation of different types of material. The editor is happy to advise on issues that cannot be so resolved.

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The closing dates for submission of material are **1 February and 1 August** for the April and October editions respectively.

Extensions to these dates must be discussed with the Editor. Contributors of research papers and notes are encouraged to submit well in advance of these dates to allow time for refereeing. Other contributors are reminded that they will probably have some comments to consider, and possibly incorporate, at some time after submission. It would be appreciated if this could be done promptly

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