

Identifying priority shorebird sites for conservation on the east coast of Aceh province, Indonesia

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The extensive coastline of Sumatra, Indonesia, is known to support internationally significant congregations of migratory waterbirds along the East Asian–Australasian Flyway (EAAF), including multiple globally threatened species such as Nordmann’s Greenshank *Tringa guttifer* and Great Knot *Calidris tenuirostris*. Yet, many gaps remain in our knowledge about key shorebird sites on Sumatra’s coastline and the precise conservation status of shorebird species, with Aceh in northern Sumatra being among the most poorly surveyed regions. From October 2019–January 2020, we undertook large-scale exploratory surveys covering the entire eastern (Malacca Straits) coast of Aceh (c.450 km) to determine the occurrence of congregations of migratory shorebirds at potential areas of coastal wetlands identified *a priori*, and to identify priority sites for future conservation action. Our surveys revealed large, previously unknown, congregations of shorebirds, with over 10,000 individuals across 34 species detected. Of these, three species, Lesser Sand Plover *Charadrius mongolus*, Long-toed Stint *Ca. subminuta* and Broad-billed Sandpiper *Ca. falcinellus*, exceeded the 1% threshold of their EAAF population estimates. We also found important populations of several globally threatened waterbirds (e.g. Milky Stork *Mycteria cinerea*) and near threatened species (various shorebirds). Our study provides a new baseline for shorebird monitoring in Aceh province, and we call for stronger conservation action to protect coastal wetlands, particularly the natural and artificial wetlands in Kuala Parek and Ulee Matang.

INTRODUCTION

The eastern coast of Sumatra, Indonesia, is well recognised to be internationally important for staging and wintering migratory shorebirds, and supports many globally threatened species in the East Asian–Australasian Flyway (EAAF) (Verheugt *et al.* 1993, Crossland *et al.* 2006, Iqbal *et al.* 2013, Putra *et al.* 2015, 2019). Since 2009, an increase in the number of surveys and published studies covering coastal wetlands on Sumatra has vastly improved

our understanding of where the most important congregations of shorebirds are, and which ones are of the highest conservation concern (Crossland *et al.* 2009, 2012, Putra *et al.* 2015, 2017). However, major gaps in knowledge remain for the eastern coast of Aceh province (hereafter ‘Aceh’), which has hitherto been little-covered in past (including historical) surveys.

Aceh is located in the northern part of Sumatra, and has an extensive coastline spanning over 400 km along the Strait of Malacca alone (Figure 1). There are extensive areas of natural brackish and

Figure 1. Survey locations (black circles) and key shorebird sites (Kuala Parek and Ulee Matang) along the eastern coast of Aceh province, Sumatra, Indonesia.

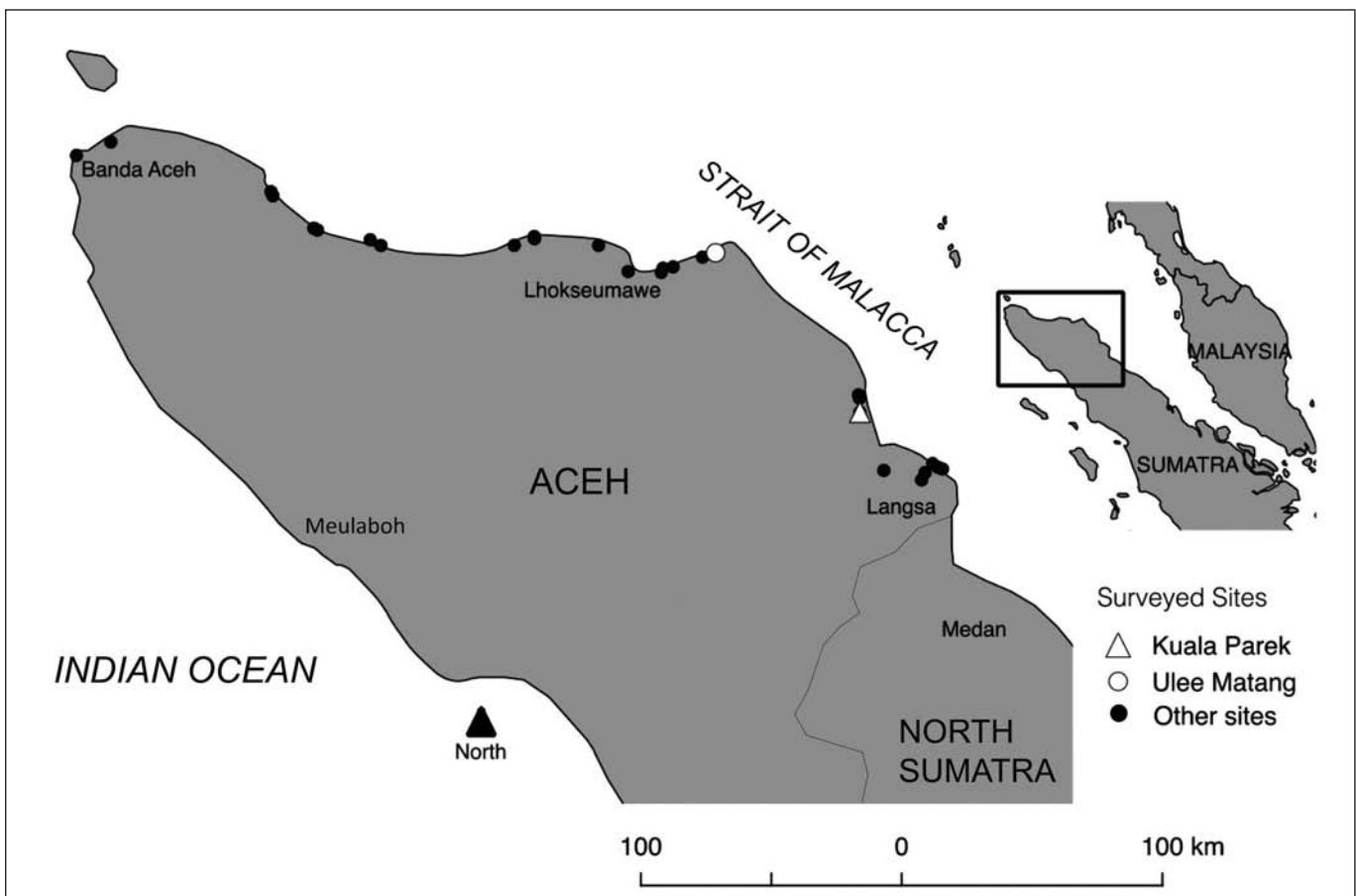


Table 1. A complete list of shorebirds recorded along the eastern coast of Aceh province with numbers counted during our study. Birds recorded by previous authors are listed as: 1 = van Marle & Voous (1988); 2 = Crossland (2000); 3 = Iqbal *et al.* (2010); 4 = Iqbal *et al.* (2013); 5 = Putra *et al.* (2019).

Shorebird species	Total count	Proportion of total count (%)	1% of EAAF population	% EAAF Population	Sources of previous records
Lesser Sand Plover <i>Charadrius mongolus atrifrons</i>	2,970	28.18	1,400	2.1	1, 2, 3, 5
Red-necked Stint <i>Calidris ruficollis</i> NT	2,372	22.50	3,250	0.7	1, 2, 5
Common Redshank <i>Tringa totanus</i>	842	7.99	750	1.1	1, 3, 5
Curlew Sandpiper <i>Calidris ferruginea</i> NT	732	6.94	1,800	0.4	5
Black-winged Stilt <i>Himantopus himantopus</i>	666	6.32	250	2.7	4, 5
Pacific Golden Plover <i>Pluvialis fulva</i>	629	5.97	1,000	0.6	1, 2, 3, 5
Long-toed Stint <i>Calidris subminuta</i>	347	3.29	250	1.4	1, 5
Broad-billed Sandpiper <i>Calidris falcinellus</i>	342	3.24	250	1.4	2, 5
Greater Sand Plover <i>Charadrius leschenaultii</i>	299	2.84	1,100	0.3	1, 2, 3, 5
Marsh Sandpiper <i>Tringa stagnatilis</i>	230	2.18	1,000	0.2	1, 5
Black-tailed Godwit <i>Limosa limosa</i> NT	182	1.73	1,600	0.1	5
Pied Stilt <i>Himantopus leucocephalus</i>	173	1.64	–	–	5
Wood Sandpiper <i>Tringa glareola</i>	160	1.52	1,000	0.2	1
Asian Dowitcher <i>Limnodromus semipalmatus</i> NT	127	1.20	240	0.5	4, 5
Whimbrel <i>Numenius phaeopus</i>	114	1.08	1,000	0.1	1, 4, 5
Terek Sandpiper <i>Xenus cinereus</i> NT	106	1.01	600	0.2	1, 2, 3, 5
Bar-tailed Godwit <i>Limosa lapponica</i>	96	0.91	3,250	0.03	3, 5
Grey Plover <i>Pluvialis squatarola</i>	41	0.39	1,250	0.03	2, 5
Common Sandpiper <i>Actitis hypoleucos</i>	33	0.31	250	0.1	1, 2, 3, 5
Eurasian Curlew <i>Numenius arquata</i> NT	14	0.13	400	0.04	3
Great Knot <i>Calidris tenuirostris</i> EN	12	0.11	3,750	0.0032	First record
Kentish Plover <i>Charadrius alexandrinus</i>	10	0.09	1,100	0.01	4
Little Ringed Plover <i>Charadrius dubius</i>	9	0.09	250	0.04	1, 2, 3, 5
Red-necked Phalarope <i>Phalaropus lobatus</i>	7	0.07	1,000	0.01	5
Grey-headed Lapwing <i>Vanellus cinereus</i>	6	0.06	250	0.02	3
Ruddy Turnstone <i>Arenaria interpres</i>	6	0.06	350	0.02	1, 2, 3, 5
Common Greenshank <i>Tringa nebularia</i>	4	0.04	600	0.01	1, 2, 3, 5
Oriental Pratincole <i>Glareola maldivarum</i>	3	0.03	20,000	0.0002	4
Ruff <i>Calidris pugnax</i>	2	0.02	–	–	4
Sharp-tailed Sandpiper <i>Calidris acuminata</i>	2	0.02	1,600	0.001	First record
Grey-tailed Tattler <i>Tringa brevipes</i> NT	2	0.02	500	0.004	First record
Far Eastern Curlew <i>Numenius madagascariensis</i> EN	1	0.01	380	0.003	First record
Sanderling <i>Calidris alba</i>	1	0.01	220	0.005	5
Little Stint <i>Calidris minuta</i>	1	0.01	–	–	First record
Greater Painted-snipe <i>Rostratula benghalensis</i>	–	–	–	–	1
Malaysian Plover <i>Charadrius peronii</i> NT	–	–	–	–	1, 2
Red-wattled Lapwing <i>Vanellus indicus</i>	–	–	–	–	1
Spoon-billed Sandpiper <i>Calidris pygmaea</i> CR	–	–	–	–	5
Lesser Yellowlegs <i>Tringa flavipes</i>	–	–	–	–	1
Beach Thick-knee <i>Esacus magnirostris</i> NT	–	–	–	–	1
Pintail Snipe <i>Gallinago stenura</i>	–	–	–	–	1
Unidentified snipe <i>Gallinago</i> spp.	–	–	–	–	3

freshwater wetlands along the Aceh coastline, as well as substantial areas of man-made wetlands. This diverse mosaic of wetlands includes mangrove forest, intertidal mudflats, estuaries, fish and shrimp ponds, as well as rice-fields (Crossland 2000, Iqbal *et al.* 2010, Putra *et al.* 2019). The eastern coast of Aceh is mostly lined by mangroves, especially in Aceh Tamiang, Langsa City and East Aceh Regencies. On the western tip of Aceh, there are small and fragmented remnants of mangroves distributed in North Aceh, Pidie, Pidie Jaya and Aceh Besar Regencies. Most major areas of wetlands along the eastern coast of Aceh have been converted to aquaculture (fish and shrimp), agriculture (mostly rice-fields and oil palm plantation) and human settlements (Noor *et al.* 1999, Fathanah *et al.* 2019, Fitri & Iswahyudi 2010) (Figure 1). The remaining areas of wetlands, including artificial wetlands such as fish-ponds, provide a diversity of habitats used as feeding grounds and roosting sites for migratory waterbirds (Burger

1984, Richards 1988, Putra *et al.* 2017) as well as resident species such as the globally threatened Lesser Adjutant *Leptoptilos javanicus* and Milky Stork *Mycteria cinerea* (Verheugt *et al.* 1993).

Between the early 1990s and 2018, only two shorebird-specific surveys were undertaken on the Aceh coast. In the earliest published study, Crossland (2000) found small congregations, totaling 546 individuals across 12 species, at the northern tip of Aceh during surveys between 31 November and 12 December 1995. Iqbal *et al.* (2010) visited eight areas of coastal wetlands from Aceh Tamiang to Aceh Besar and recorded a total of 716 individuals across 13 species. More recently, Putra *et al.* (2019) discovered 9,791 individuals across 24 species in an area of coastal fish ponds in Aceh Utara in November 2018. This large concentration of shorebirds on the Aceh coast was discovered as a result of a real-time, satellite-tagged Spoon-billed Sandpiper *Ca. pygmaea* (Putra *et al.* 2019).

The present study builds upon the work from past field surveys, including inventories conducted by Putra *et al.* (2019), and entailed comprehensive surveys of migratory shorebirds across 29 wetland sites during October and December 2019, and January 2020. We undertook this series of surveys to systematically map and identify key shorebird areas of regional and potentially international significance for migratory species along the EAAF. New sites identified in our study are assessed for their potential either as coastal protected areas, Flyway Network Sites under the East Asian–Australasian Flyway Partnership (EAAFP 2018), or as focal landscapes for future conservation intervention. Second, we compiled our data in conjunction with existing information from the published literature to determine the diversity, population size and status of each shorebird species on the Aceh coastline. Third, we provide an overview of new distributional records, including new records for all of Sumatra. Last, we discuss threats to shorebirds that were observed during our fieldwork, and evaluate the importance of each site surveyed in relation to the EAAFP criteria for wetlands of international importance (EAAFP 2018).

METHODS

Study sites

We surveyed a total of 29 locations covering 127,706 ha, consisting of 19 areas/landscapes of predominantly man-made wetlands (i.e. fish-ponds or shrimp-ponds) and 10 areas of natural wetlands (e.g. sandy beach, mudflats abutting scrub and mangroves). The survey was conducted in three phases between October 2019 and January 2020 (Table 1). We surveyed 18 sites in October 2019, six sites in December 2019 and five sites in January 2020; only Ulee Matang and Kuala Parek were surveyed during all three months since these were identified as key sites in October 2019. Administratively, the 29 surveyed locations fall under seven districts and three small cities spanning a total coastline of 413 km (Figure 1).

Before conducting our field surveys, we collected information on all known localities that may potentially support migratory shorebirds, based on published material, as well as information gleaned from the local birdwatching community and individual experts (e.g. Andrew Crossland). In addition, we used satellite imagery from Google Earth Image (www.earth.google.com) to assess potential areas of mudflats and man-made wetlands. We accessed the sites by car where possible (e.g. presence of access roads in coastal area), and by boat to reach remoter areas that cannot be reached by road. We used a DJI Mavic Pro drone to aerially survey large areas or sites that were difficult to reach on foot or by car from the landward side.

Survey methods

We identified and counted shorebirds using field telescopes and binoculars. Members of the field team scanned areas within a radius of 500 m from the observer's spot at each location visited. If no congregations of shorebirds were seen after 60–90 minutes of survey, we moved on to the next location. Birds were counted individually if numbers were below 50 individuals, but large flocks and groups of birds in flight were block-counted in multiples of 50 or 100, following the guidelines outlined by Bibby *et al.* (2000). Count results were tabulated as the total number of each species observed per site, on each survey day. In addition, we noted the geographic coordinates of each sampling location and compiled a list of threats and the types of habitat present. We also used our data and information from previous studies (van Marle & Voous 1988, Crossland 2000, Iqbal *et al.* 2010, Putra *et al.* 2019) in order to generate a list of the total number of shorebird species that occur in Aceh. We followed Bamford *et al.* (2008) to apply the 1% flyway population criterion to identify sites of international importance and we followed the taxonomy of Gill *et al.* (2020).

RESULTS

Overview

A total of 17,636 waterbirds across 52 species were recorded during our surveys, including 10,541 shorebirds across 34 species (Table 1). The most abundant species recorded during the surveys were Lesser Sand Plover *Charadrius mongolus atrifrons* (2,970 individuals, 27.94 % of the total shorebirds counted), followed by Red-necked Stint *Ca. ruficollis* (22.31%), Common Redshank *Tringa totanus* (7.92%), Curlew Sandpiper *Ca. ferruginea* (6.89%) and Black-winged Stilt *Himantopus himantopus* (6.26%) (Table 1). We recorded three globally threatened species, including Far Eastern Curlew *Numenius madagascariensis* (one individual) (EN), Milky Stork (126 individuals) (EN) and Lesser Adjutant (seven individuals) (VU), in addition to seven Near Threatened species. We recorded three species of shorebirds that exceeded 1% of the estimated EAAF population: Long-toed Stint *Ca. subminuta* and Broad-billed Sandpiper *Ca. falcinellus* at the Ulee Matang fish ponds, and Lesser Sand Plover at the Kuala Parek fish ponds.

Potentially important sites and their significance at the flyway level

We found a total of 6,119 migratory shorebirds of 27 species at the Ulee Matang fish-ponds. This included at least two species that were represented by >1% of their EAAF population total, specifically Long-toed Stint on 8 December 2019 (294 individuals, 1.18%) and Broad-billed Sandpiper on 21 October 2019 (300 individuals, 1.2 %). We found six Near Threatened shorebirds in this area, including Eurasian Curlew *N. arquata* and Asian Dowitcher *Limnodromus semipalmatus*. The maximum total number of shorebirds recorded each month here was 5,548 individuals (October), 4,354 individuals (December) and 1,077 individuals (January) (Figure 2).

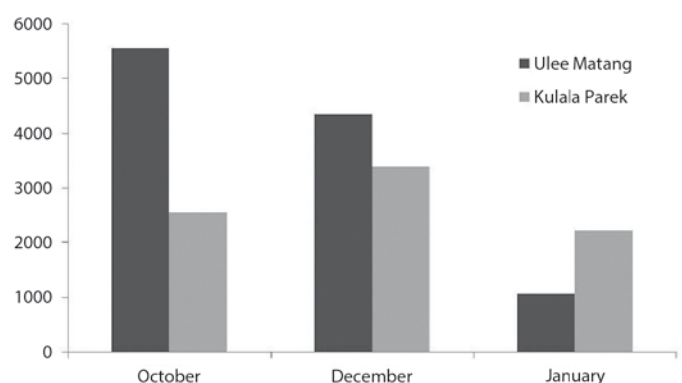
Another site that is potentially important is Kuala Parek. Here, we counted a total 2,888 shorebirds across 24 species: 1,455 individuals of Lesser Sand Plover on 5 December 2019 marginally exceeded 1% of their total EAAF population (1.04%). We counted a total of 2,544 shorebird individuals in October, 3,389 in December and 2,230 in January (Figure 2). Here we recorded four globally Near Threatened and one Endangered shorebird, including Eurasian Curlew, Asian Dowitcher and Far Eastern Curlew.

Important species accounts

Little Stint *Calidris minuta*

A single, adult non-breeding Little Stint was recorded on 21 October 2019 among flocks of sandpipers and plovers in the fish-pond area at Ulee Matang village. Furthermore, on 8 December 2019 and 31 January 2020 we recorded another Little Stint, this time in breeding plumage (Plate 1) at the same site, presumably referring to the same individual. The Little Stint breeds widely across northern Eurasia,

Figure 2. Total numbers of shorebirds counted at Ulee Matang and Kuala Parek fish ponds in October and December 2018, and January 2019.





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Plate 1. Little Stint *Calidris minuta* (left) in its diagnostic breeding plumage: the white chin and throat contrast with the rufous cheeks; a broad white supercilium splits around both sides of the eye; extensive rufous-orange fringes on the wing-coverts and tertials; longer legs; slightly drooped and shorter bill (compared to Red-necked Stint *C. ruficollis* to the right); and overall 'hump-backed' appearance, Ulee Matang village, Aceh province, Sumatra, Indonesia, 8 December 2019.



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Plate 2. Sharp-tailed Sandpiper *Calidris acuminata* (front bird), Ulee Matang, 31 January 2019. The species can be separated from the similar Pectoral Sandpiper *C. melanotos* by its more distinct white supercilium, which was noticeably more conspicuous behind the eye, and a breast patterning that lacks a strong demarcation on the lower breast. Note the size comparison with the Long-toed Stint *C. acuminata* (rear bird).

but primarily winters in Africa and South Asia. In South-East Asia, it is known to occur as a scarce winter visitor or passage migrant, with recent records in Myanmar, Thailand, Malaysia, Singapore and Vietnam (Lee *et al.* 2018) in small numbers, and has reached Australia (Roger & Cox 2015). Eaton *et al.* (2016) considered this species a vagrant to the Greater Sundas, Indonesia, based on a single record from Borneo (Brunei Darussalam) (also Vowles & Vowles 1982), although there are now multiple recent photographic records of the species from Sabah and Sarawak in Malaysian Borneo (J. A. Eaton, pers. comm.), suggesting that the species is overlooked in the region. Our records constitute not only the first record of the species for Aceh, but also for Indonesia. Detailed documentation is now published in Muzika *et al.* (2020).

Sharp-tailed Sandpiper *Calidris acuminata*

Up to three Sharp-tailed Sandpipers were found at the fish-ponds of Ulee Matang, North Aceh, with two on 8 December 2019 and another on 31 January 2020 (Plate 2). On 9 January 2020, we found two Sharp-tailed Sandpipers amongst a large flock of shorebirds (>5,000 birds) at Pantai Jono, Batubara, North Sumatra (CAP pers. obs.). The Sharp-tailed Sandpiper is a generally rare visitor to western Indonesia (MacKinnon & Phillips 1993, Mason 2011, Eaton *et al.* 2016). It can be separated from the similar-looking Pectoral Sandpiper *Ca. melanotos*, which occurs as a very rare vagrant to the region (Lim *et al.* 2020), by its shorter bill (with a stronger base) and a less strongly marked and more weakly delineated area of breast spotting. The Sharp-tailed Sandpiper occurs as a rare passage migrant in Brunei and Sabah, but there are no records from Indonesian Borneo (Mann 2008). Recently, a record was reported from western Indonesia which involved an individual seen at a watermill pond on Bangka, off the south-east coast of Sumatra (Iqbal *et al.* 2014a). Our records from Aceh and North Sumatra constitute the first three records of the species on the main island of Sumatra.

Far Eastern Curlew *Numenius madagascariensis* EN

A single bird was seen at the fish-ponds at Kuala Parek village, East Aceh, on 5 December 2019. Records of the Far Eastern Curlew are mostly in south-east Sumatra (Silvius 1988, Verheught *et al.* 1993, Febrianto *et al.* 2019), although there are several records from the eastern coast of North Sumatra (Crossland *et al.* 2006, Iqbal *et al.* 2010, Putra *et al.* 2015, 2017). Our record at Kuala Parek constitutes the first record of the species for Aceh and, by extension,

the westernmost record for Indonesia (Crossland 2000, Iqbal *et al.* 2010, Putra *et al.* 2019).

Grey-tailed Tattler *Tringa brevipes* NT

Two Grey-tailed Tattlers were recorded at two different sites in the fish-ponds at Kuala Pawon and Jangka village on 26 October 2019. Previously, the Grey-tailed Tattler has been recorded off the Sumatran coast twice on Siberut (Grantham & Kemp 2000), while another record of seven individuals came from Pulau Belitung in February 2014 (Iqbal *et al.* 2014b). The first documented record for the Sumatran mainland was at Pantai Panjang, Bengkulu province, in October and November 2014 (Rahmansyah & Iqbal 2015), followed by three individuals at Pantai Jono, North Sumatra province (Mugan *et al.* 2017). Recently, Iqbal *et al.* (2020) recorded 20 Grey-tailed Tattlers on Enggano Island in March 2020. Our record in Aceh is likely the westernmost record for Sumatra. Given its regular occurrence in adjacent parts of the Malay Peninsula, it is likely to occur in small numbers across Sumatra.

Great Knot *Calidris tenuirostris* EN

On 17 April 2020, 12 individuals were recorded in the fish-ponds of Alue Rangan village (near Kuala Parek village). This is the first record of the species for Aceh and, by extension, the westernmost record for Sumatra (Crossland 2000, Iqbal *et al.* 2010, Putra *et al.* 2019). Surprisingly, the species occurs in large numbers in the mudflats of North Sumatra not far from Aceh: for instance, surveys at several sites can yield 2,000–3,000 individuals in a single area of mudflats (CAP pers. obs.). The Great Knot is widely recorded along the Sumatran east coast, and has been reported from Pantai Cemara (Jambi) and the Banyuasin Delta in South Sumatra (Febrianto *et al.* 2019, Verheught *et al.* 1993).

Milky Stork *Mycteria cinerea* EN

We counted a total of 126 Milky Storks from eight sites, with the highest single count of 97 individuals at the Ulee Matang fish-ponds on 8 December 2019. These counts may constitute as much as 6.5% of the estimated wild world population (BirdLife International 2020). Almost all were adults in non-breeding plumage (Plate 3); we did not observe any morphological signs indicating hybridisation with the closely related Painted Stork *M. leucocephala*. Extensive hybridisation between the species has been documented in Peninsular Malaysia and Singapore as escaped individuals of both species come into close contact (Baveja *et al.*



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Plate 3. A flock of Milky Storks *Mycteria cinerea* using the fish-pond area in Ulee Matang village as a roosting area, 8 December 2019.

2019). Milky × Painted hybrids may eventually reach the Sumatran coastline, potentially threatening the global stronghold of the Milky Stork's wild populations. There have been several historical records of Milky Stork along the northern coast of Aceh (south to Lhokseumawe) between 1970–1985 (van Marle & Voous 1988). Prior to this, there was little to no information on its occurrence in Aceh during the twentieth century (Holmes 1996; also see www.ebird.org and www.gbif.org).

Threats to migratory shorebirds

Mist-nets are widely used to hunt waterbirds in many parts of South-East Asia. In our surveys, we did not find any mist-nets or directly observe hunting activities. In previous surveys by Putra *et al.* (2019), two mist-nets were found at two different locations in the fish-pond area at Ulee Matang village in November 2018. Unstructured interviews (consisting of a list of 6–8 questions) with local people around the survey sites indicated that bird hunting does exist, but did not allow us to estimate its magnitude. We interviewed a total of 32 individuals, none of whom reported any evidence of large-scale shorebird hunting for sale. However, interviewees acknowledged that they occasionally use mist-nets to catch birds for subsistence consumption.

DISCUSSION

Potentially important sites for migratory shorebirds at the flyway level

Our data showed that both Ulee Matang and Kuala Parek are potentially important staging and wintering sites for migratory shorebirds at the flyway level, especially for Lesser Sand Plover, Long-toed Stint and Broad-billed Sandpiper (Plate 4). Ulee Matang is also an important site for both the threatened Milky Stork and Lesser Adjutant. We found more than 5,000 migratory shorebirds at the fish-ponds of Ulee Matang in October, but this count progressively decreased from December to January, suggesting that many were staging and destined for wintering locations elsewhere. On the

other hand, the number of shorebirds at Kuala Parek increased from October to December (maximum count of 3,000 individuals), and then declined from January, showing that it is relatively more important as a wintering site for shorebirds. Other potential sites include fish-pond areas in Cinta Raja and Alue Sentang villages. There are anecdotal records of over a thousand shorebirds (c.1,000–2,000 birds) reported near Langsa City (IH pers. obs.), although we did not find these congregations during our surveys.

We noted that a high count in excess of 2,000 Red-necked Stints on 21 October 2019 at Ulee Matang likely formed the single highest record for the species on Sumatra. Putra *et al.* (2019) counted an average of 677 birds over three days of observations, and there was another record of 174 birds at Krueng Aceh in December 1995 (Crossland 2000). Furthermore, we found a total of 347 Long-toed Stints here (maximum count of 294 on 8 December 2019), likely the highest single count reported from Sumatra. Previously, Putra *et al.* (2019) found an average of 85 Long-toed Stints over three field days. Other globally threatened shorebird species known to occur at the surveyed sites include the Critically Endangered Spoon-billed Sandpiper, which was recorded in November 2018 (Putra *et al.* 2019) but not seen during our 2019 surveys.

Our surveys constituted the first large-scale, comprehensive census of waterbirds on the eastern coast of Aceh, and covered all the districts therein, considering that Iqbal *et al.* (2010) only covered eight locations between Aceh Tamiang to Banda Aceh. We found high shorebird diversity and abundance in areas of artificial fish-ponds, and by far higher numbers than on intertidal mudflats. Areas of man-made wetlands consisting of shrimp and fish-ponds at Ulee Matang and Kuala Parek showed strong potential to be considered as conservation sites of regional importance to shorebirds, given that they support >5,000 and >3,000 individuals, respectively.

Ten intertidal areas that we surveyed yielded an average of no more than 100 shorebirds counted. Shorebirds typically use mudflats for feeding and resting (Burger 1984, Richards 1988, Putra *et al.* 2017), but are also known to use adjacent areas of plantations and marshes to roost (Putra *et al.* 2017). The observed variation in relative abundances of shorebirds across coastal areas



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Plate 4. An extensive fish-pond area at Ulee Matang village provides habitat for foraging and resting migratory shorebirds, 26 October 2019.

in our surveys (compared to sites in the provinces further south) may be a consequence of the substrate type in the wetlands, and the level of disturbance due to human usage. Intertidal flats at our survey sites are generally more sandy than muddy, and are subjected to relatively high levels of human disturbance due to fishing and beach tourism activities (CAP pers. obs.). For instance, we noticed that the coastal substrates from the eastern coast of North Aceh to Aceh Besar Regency are mostly large-grained sand with limited areas of mangrove forests. From Aceh Tamiang to Langsa, and at some sites on the eastern Aceh coastline, mangrove cover appears more extensive, while the coastal substrate appears to be increasingly sandy. This observation seems consistent with other surveyed sites on the north-western tip of Aceh (Crossland 2000). Nevertheless, there are intertidal areas on the Langsa coast that continue to hold healthy stands of mangroves and extensive mudflats, with a potential for shorebird congregations but which we were unable to survey. A decade ago, Iqbal *et al.* (2010) surveyed Pulau Perling and Pusong Langguk near the Langsa coast and found small numbers of shorebirds (c.500 individuals). Further ecological studies on the availability of food resources (e.g. macrozoobenthos) in aquaculture ponds and natural intertidal flats (e.g. Lim & Posa 2014) in both areas are needed to better understand the conditions that attract congregations of shorebirds.

Comparisons with past surveys

Our findings, when combined with older studies such as van Marle & Voous (1988), Crossland (2000), Iqbal *et al.* (2010, 2013) and Putra *et al.* (2019), showed that at least 41 shorebird species have regularly occurred on the eastern coast of Aceh from the 1980s to the present day (Table 1). During our surveys, we recorded five species as first records for Aceh province (Far Eastern Curlew, Great Knot, Sharp-tailed Sandpiper, Grey-tailed Tattler and Little Stint), which demonstrates how poorly surveyed the Aceh coastline is for shorebirds. Furthermore, we recorded eleven species, including Curlew Sandpiper, Black-tailed Godwit *Limosa limosa*, Eurasian Curlew, Sanderling *Ca. alba*, Ruff *Ca. pugnax* and Red-necked Phalarope *Phalaropus lobatus*, as second records for Aceh.

Collectively, our surveys identified a number of shorebird species of conservation concern for future monitoring, notably Asian Dowitcher, Great Knot and Spoon-billed Sandpiper (recorded in 2018 only). In fact, the original goal of these surveys was to locate new wintering individuals of Spoon-billed Sandpiper, a species only first recorded in Indonesia in November 2018 on the basis of a satellite-tracked individual (Putra *et al.* 2019). Although we did not find any, it is likely that the species continues to occur undetected as the sites held large numbers of similar-looking Red-necked Stint and another small waders. Large flocks of small shorebirds need to be carefully checked to identify Spoon-billed Sandpipers among thousands of Red-necked Stints and smaller numbers of Broad-billed Sandpiper.

Threats to shorebird habitat on the Aceh coast

Since the 1970s, the extent of natural mangrove forests has steadily declined in Aceh due to logging, agriculture, human settlement or conversion to aquaculture ponds (Noor *et al.* 1999, Fathanah *et al.* 2019, Fitri & Iswahyudi 2010). Given that most of the areas of fish-ponds surveyed are privately owned, shorebirds that are wintering here remain extremely vulnerable to habitat loss and conversion. Without legal protection, shorebirds may be caught or killed with impunity. On the other hand, no conservation work can be advanced without the consent of local people. It is therefore clear that an immediate priority is to build better awareness of shorebirds, and migratory birds in general, for villagers living in close proximity to some of these sites. In the longer term, the profiles of these locations should be raised so that their global importance is made clear, encouraging local people to conserve the remaining wetlands.

Presently, there is no regulation that limits or regulates shorebird hunting, including through the use of mist-nets, in Indonesia. Neither is there legislation that protects a number of the threatened species that occur on the Aceh coast, such as the Spoon-billed Sandpiper, Great Knot, Black-tailed Godwit, Bar-tailed Godwit *L. lapponica*, Red-necked Stint and Curlew Sandpiper. None of these species are presently included in Indonesia's protected species list (Regulation of the Minister of Environment and Forestry of the Republic of Indonesia, No. P.106/MENLHK/ SETJEN/

KUM.1/12/2018 on protected species of plants and animals). We recommend that these shorebird species be urgently assessed by the relevant authorities (e.g. Indonesian Institute of Sciences) and be considered for inclusion in future updates of the protected species list in view of their unfavourable global conservation status.

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