Monitoring of migratory shorebirds in the Gulf of Mottama Ramsar Site

By

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Executive Summary

With the support of the Mangrove Conservation Fund (MCF), Manfred Hermsem Foundation (MHF) and the Gulf of Mottama Project (GoMP) funded by SDC, the Spoon-billed Sandpiper Task Force and NCS-Myanmar conducted the annual monitoring of the critically endangered Spoon-billed Sandpipers and other migratory shorebirds in the Gulf of Mottama (GoM), Myanmar. Former bird hunters from the Local Conservation Groups (LCGs) joined the survey and guided the survey team to the small wader flocks. They were trained and informed about the survey techniques, biology, and significance of the species in regional, national, and global contexts. The survey recorded a total of approximately 60,000 waders of 53 species in the survey area from 20 to 25 January 2023. The survey recorded 9 critically endangered Spoon-billed Sandpipers (SBS) and estimated to have 16 individuals in total in the GoM, based on the SBS proportion in 198 flock counts of over 32,194 birds which was extrapolated to an estimate of 56,200 birds of small waders in the survey area. These birds were encountered by the team at low tide feeding and widespread across the vast mudflat habitats. Only one flagged Spoon-billed Sandpiper, one flagged Curlew Sandpiper, one flagged Lesser Sand Plover and one flagged Red-necked stint were observed. None could be identified individually. The flagged Spoon-billed Sandpiper was likely marked in S Chukotka (upper left lime flag) while the flagged, Red-necked stint was marked in Kamchatka, Russia (Black over Yellow on the right leg), which might be the same bird recorded over the last two years. One flagged Curlew Sandpiper (Black and Green) which might be tagged in Thailand was also recorded. A flagged Lesser Sand Plover (Black over Green on the right leg) which was also marked in Thailand was also recorded. Of other globally endangered species, 83 individuals of Great Knot and 15 individuals of Nordmann's Greenshank were observed as well as nine globally near-threatened species such as Black-tailed Godwit (2,040 individuals), Bar-tailed Godwit (91 individuals), Eurasian Curlew (1,072 individuals), Asiatic Dowitcher (183 individuals), Red Knot (21 individuals), Red-necked/Little Stint (4,874 individuals), Curlew Sandpiper (2,455 individuals), Black-headed Ibis (144 individuals) and Painted Stork (4 individuals). The most abundant species were the Lesser Sand plover (24,712). Comparing to the previous years` surveys, the number of threatened species sighted were increased in species as Nordmann's Greenshank, Common Pochard, Bar-tailed Godwit, Eurasian Curlew, Asiatic Dowitcher and Black-headed Ibis whereas the number of individuals was declining in species Spoon-billed Sandpiper, Great Knot, Black-tailed Godwit, Red Knot and Painted Stork. The decline in these bird populations could be related to such factors as changes in the intertidal mudflats habitat, availability of food sources and, climate change. The number of critically endangered Spoon-billed Sandpipers sighted by the survey team was only 9 individuals, which is a decline of about 50% compared to the 2022 record. The populations' decline could be due to several reasons especially climate change, habitat changes, hunting and water pollution etc. It is still needed to investigate the resuming hunting pressures and potential habitats in the whole Gulf of Mottama by using remote sensing techniques.

1. Introduction

The Spoon-billed Sandpiper (*Calidris pygmaea)* is facing a high risk of extinction and is considered one of the most endangered species of migratory birds globally. It has been classified into the "Critically Endangered" category on the IUCN Red List (Bird Life International in 2008). This species reproduces in a specific and disjointed region of coastal tundra that spans around 4,500 kilometers in the northeast arctic and subarctic areas of Russia, which includes the Chukotka Autonomous Okrug and northern Kamchatka Kraj (*Zöckler et al., 2010a*). When not breeding, Spoon-billed Sandpipers travel through the southern Russian Far East, Korea, China, and Japan to spend the winter season in countries such as southern China, Thailand, Myanmar, Vietnam, Malaysia, and Bangladesh. Coastal mudflats, which include estuaries, are the primary habitat that they rely on during this non-breeding period (Clark *et al. in 2014 and Zöckler et al.* in 2016).

According to data from 2014, the global population of breeding Spoon-billed Sandpipers was estimated to be between 210 to 228 pairs, while the combined population of all age groups after breeding was estimated to be between 661 to 718 individual birds (Green et al 2021). Based on winter counts and the proportion of flagged birds across the wintering area, the total population has been estimated 330-340 individuals in 2019-2021 (Zöckler et al. 2021)

The largest wintering population of Spoon-billed Sandpipers is currently known to be located in the northern part of the Gulf of Mottama (GoM), which is also referred to as the Bay of Martaban (*Aung et al. 2020*). Based on surveys conducted in the Gulf of Mottama between 2009 and 2016, the wintering population of Spoon-billed Sandpipers was found to have declined significantly, from 224 individuals in 2009 to only 112 individuals in 2020 (Aung et al. 2020).

This year, with generous support from the Mangrove Conservation Fund (MCF), Manfred Hermsem Foundation (MHF), the International Union for the Conservation of Nature (IUCN) through the SDC funded Gulf of Mottama Project (GOMP), the Spoon-billed Sandpiper Task Force and NCS-Myanmar organized an international survey team with 18 well-experienced members including international scientists and surveyors which were accompanied by 40 local people to conduct the annual monitoring of the critically endangered Spoon-billed Sandpipers and migratory shorebirds in the Gulf of Mottama, Myanmar.

2. Methodology

A survey was conducted to investigate the population of Spoon-billed Sandpipers and migratory shorebirds in the Gulf of Mottama (GoM) by using a counting method. The flock-count method is a commonly used method for estimating the total number of birds within a flock, and it involves counting a small portion of the flock and extrapolating that number to estimate the total flock size. The method involves selecting a sample area within the flock and counting all the birds within that area. The total number of birds within the flock is then estimated by multiplying the number of birds within the sample area by the total area of the flock. The researchers visited both the east and west sides of the GoM. Prior to the survey, previous survey results for the same area were reviewed, and the suitability of the habitat was assessed using Landsat 8 and Sentinel II data from USGS. The GoM is an important area for migratory shorebirds, including the Spoon-billed Sandpiper, and is part of

the Irrawaddy coastal region and is also designated as a Ramsar site for protection. The surveyors used spotting scopes and binoculars to record the number of shorebirds during each scan and estimated the total number of shorebirds, particularly during high tide. Each group of observers included surveyors experienced in shorebird identification, and they scanned flocks of resting and foraging small shorebirds using a telescope. A scan involved a search by one observer through a group of small shorebirds, at the end of which the numbers of small shorebirds of each species were recorded, along with the date and time of the record and the location, using GPS. The total proportion of small waders was estimated based on the average number of each species within all submitted flocks across all observers. The total number of Spoon-billed Sandpipers was then extrapolated based on the estimates of the overall flock size of small waders. Additionally, another method which is based on the proportion of flagged birds across all winter survey sites was also used as it could provide another indicator of the overall population size.

2.1 Field Survey

This year the survey team departed from Koe Tae Su village, Bilin township of Mon State in the evening of 20 January 2023. The survey team divided into two teams: One is headed to the west coast and the other one is headed to the east coast, and started the flock counts surveys on 21 January 2023 and proceeded the surveys until 25 January 2023. The survey was conducted between 21 and 25 January 2023, during which all mudflat areas in the Gulf of Mottama (GoM) were visited (Figure1). The survey was timed to cover the highest spring tide because the boats could access all the intertidal mudflats only during the high spring tide period and because shorebirds are likely to be concentrated at spring tides and gather in large flocks. This way we were less likely to miss the large flocks and counted the total number of small shorebirds (Aung *et al.* 2016, 2017, 2018, 2019, 2020, 2021, 2022).

Comparing to the Nanthar Island of Ayerwaddy Delta, Myeik, and Bokepyin mudflats, the Gulf of Mottama is challenging to counting shorebirds at such vast intertidal mudflats. For the Gulf of Mottama, the survey team was transported to as many parts of the study area as possible in shallow-draft fishing boats, which were grounded on the mud in the intertidal zone at low tide to allow observation of birds from the boat and on foot. This way, the observers were able to conduct scan surveys throughout the daylight period of tidal cycles and at a wide range of elevations relative to the high and low watermarks. Following a protocol outlined by Aung *et al.* (2018), the surveyors were separated into many directions based on the anchor points. Surveyors walked across the mudflat during low tide, diverging from the place where the boat was grounded, and viewed birds from the boats, especially when the tide was high.

2.1 Survey Team Members in 2023

An international survey team of 18 surveyors from Russia, China, Hongkong, US, Germany, Thailand and the U.K., and Myanmar assembled in the remote coastal mudflats to conduct shorebird survey in the Gulf of Mottama, the key wintering area of the Spoon-billed Sandpipers and other shorebirds. They were accompanied by an experienced team of Myanmar surveyors of NCS and local fishermen who joined up those kinds of surveys over 10 years ago.

Table 1: List of International Surveyors

Sr. No	Name	Organization
1	Dr. Elena Lappo	RUSSIA/BIRD RUSSIA
2	Nikolai Yakushev	RUSSIA
3	Kar Sin Katherine Leung	Hong Kong
4	Ziyou Yang	CHINA/ SBS IN CHINA
5	Suchart Daengpyon	THAILAND/Bird Conservation Society of Thailand
6	Niyom Thongmuean	THAILAND/Bird Conservation Society of Thailand
7	Hartmut Andretzke	GERMANY
8	Dr.Christoph Zöckler	GERMANY/SBSTF Coordinator Manfred-Hermsen Stiftung
9	Dr. George Andrew Gale	THAILAND/ King Mongkut's University of Technology Thonburi

Table 2: List of Myanmar National Surveyors

Sr. No	Name	Organization
1	Pyae Phyo Aung	Nature Conservation Society
2	Saw Moses	Nature Conservation Society
3	Gideon @ Sa Myo Zaw	Nature Conservation Society
4	Nyan Linn	Nature Conservation Society
5	Shane Thu Lwin	Nature Conservation Society
6	Thura Soe Min Htike	Nature Conservation Society
7	Ye Min Aung	Nature Conservation Society
8	Than Kyaw Moe	Nature Conservation Society
9	Myint Myint Soe	Nature Conservation Society

Table 3: Partner organization that joined our bird surveys in 2023

Sr. No	Name	Affiliation/ Organization
1	Wut Yee Kyaw	Conservation Officer, Helvetas Myanmar
2	Wint Hte	Coastal Resources Programme Officer, IUCN Myanmar
3	Nay Lin Htet	Conservation Focal, Ahlat Village, Paung Tsp
4	Moe Zaw Htet	Conservation Focal, Zee Kone Village, Paung Tsp
5	Naung Naung Tun	Conservation Focal, Gyo Phyu Gone Village, Thaton
6	Kyaw Min Oo	Conservation Focal, Zaik Ka Ye Village, Thaton
7	Myint Swe	Conservation Focal, Zwe Ka Lar Village, Bilin
8	Khin Maung Than	Conservation Focal, Aung Phay Village, Bilin

2.3 Spoon-billed Sandpiper counts

Counting Spoon-billed Sandpipers at any wintering site is challenging because they are rare and usually dispersed within large flocks of other small shorebirds, especially the similarly colored and sized, Red-necked Stint (Calidris ruficollis). In the Upper Gulf of Mottama, complete direct counts of Spoon-billed sandpipers are not possible because of the large numbers of other small shorebirds that must be checked, the large size of the intertidal area, day-to-day variation in the extent and location of foraging habitats exposed at low tide and frequent changes in the location of high tide roosts. Roosts are often on very soft substrates making it impossible to approach them before the birds leave on the falling tide. Therefore, in order to estimate the total number of Spoon-billed Sandpipers the flock-count method (described below) was applied along with exact counts of true observations. However, the accuracy of these estimates may be impacted by factors such as observer bias, weather conditions, and the behavior of the birds being counted. To minimize the chance of double-counting, observations of the time and observers during the day were shared among the team on their return to the camp.

2.4 Flock-counts

Each group of observers included surveyors experienced in shorebird identification, scanned flocks of resting and foraging small shorebirds using a telescope. A flock can vary between 30 and 1000 birds. A scan consisted of a search by one observer through a group of small shorebirds, at the end of which the numbers of small shorebirds of each species were recorded, together with the date and time of the record and the location, with a GPS. An individual Spoon-billed Sandpiper was only included in the scan record if it was seen well enough to make sure whether it was a Spoon-billed Sandpiper or not, and the observers were trained spending enough time for observing each bird so that they can do this accurately.

Shorebird species sighted, in addition to Spoon-billed Sandpipers, were mostly *Calidrid* sandpipers (Curlew Sandpiper *Calidris ferruginea*, Broad-billed Sandpiper *Calidris falcinellus* and Red-necked Stint/ Little Stint) and plovers (Greater Sand plover *Charadrius leschenaultii*, Lesser Sandplover *Charadrius mongolus*, Kentish Plover *Charadrius alexandrinus* and Little Ringed Plover *Charadrius dubius*), Ruddy Turnstone *(Arenaria interpres)* and Terek Sandpiper *(Xenus cinereus)*. These species tended to feed and roost in mixed species flocks and were distinguished at a distance on the ground and in flight.

2.5 Analysis

The total proportion of small waders was estimated based on the average number of each species within all submitted flocks across all observers. The total number of small shorebird species was then extrapolated based on the estimates of the overall flock size of small waders. As the latter varies between counters and is likely more inaccurate than the actual flock counts, the total number of SBS and other species varies widely according to the range of overall flock size estimates. In 2021 there was considerable agreement on the size of the flock of small waders among the surveyors. Further analysis was based on the proportion of the flagged birds across all winter survey sites. This could provide another indicator of the overall population size.

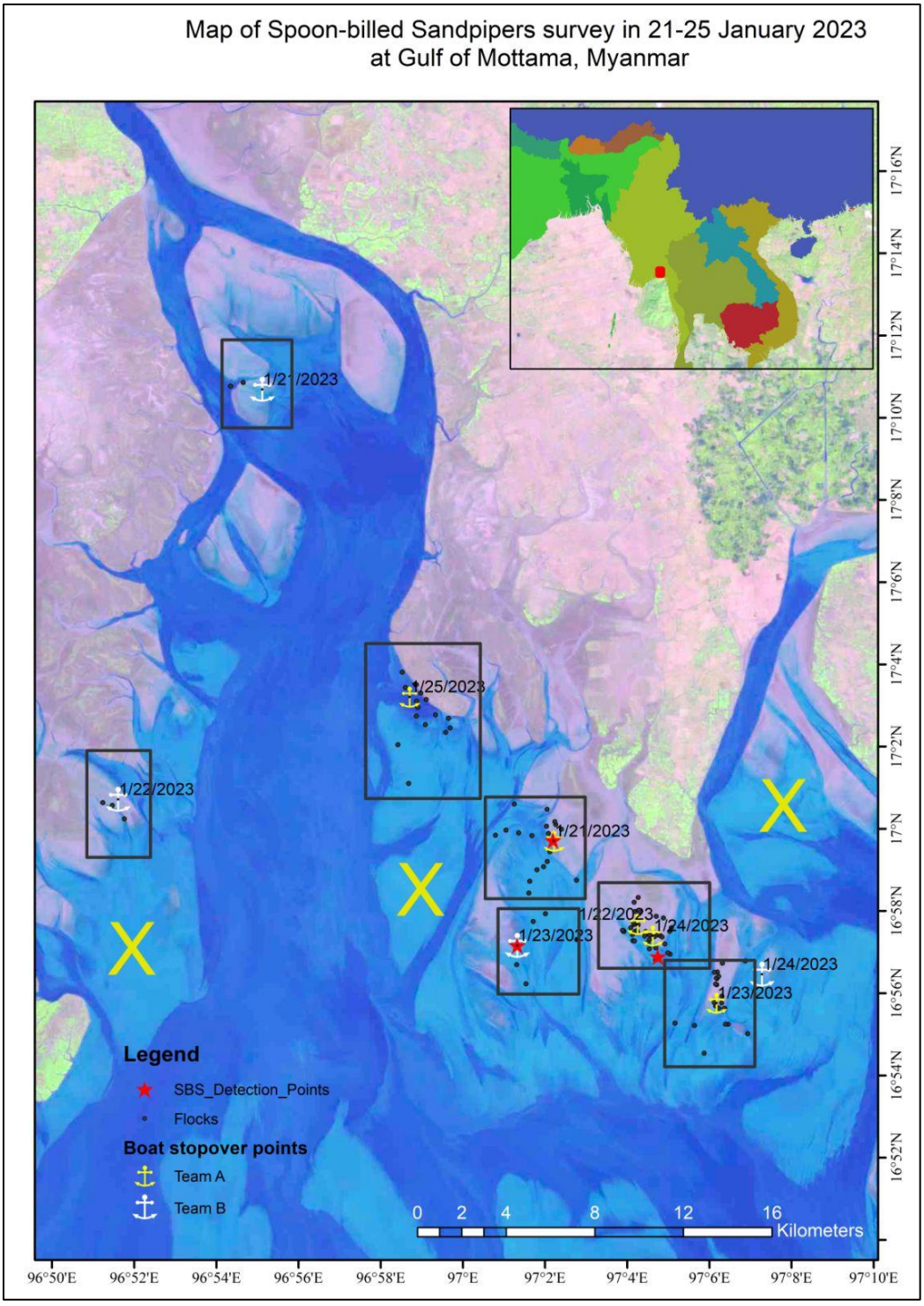


Figure 1: Distribution of Spoon-billed Sandpiper sightings from 20 to 25 January 2023. Yellow and White anchors signs are depicting campsites or boat anchor points from where surveys have been undertaken on foot. Green points represent flock counts sites and red star sites with SBS observations. Black rectangles are coverage survey areas and Yellow cross signs are missed potential mudflats for the survey.

3. Results

Between 20 and 25 January 2023, a total of approximately 60,000 waders of 53 species were recorded in the GoM) (see details in Table A). The estimated number of small waders in the survey areas was around 70,000 including the estimate that we missed some flocks in the large area shown (X) sign (see Figure 1). The number of critically endangered Spoon-billed Sandpipers sighted by the survey team was only 9 individuals, which is a decline of about half compared to the 2022 records of 17 Individuals, depending on the total flock size of small waders. These birds were observed during low tide feeding and were found in different locations across the vast mudflat habitats (see Figure 1).

3.1 Estimation of SBS and other small wader species in the Gulf of Mottama

During the survey period, different observers recorded a total of over 42,194 small waders belonging to eight or nine species (Red-necked Stint and Little Stint were combined as one species group for this estimation) in 198 flocks in the Gulf of Mottama. The average proportion of small waders in these flocks was 0.0003%, as shown in Table 4. Small wader species that occurred in only a few samples were not included in this calculation. Using the proportion generated by the flock count of 0.0003% for 2023, which was significantly lower than the proportions of 0.05, 0.07, and 0.19 recorded in 2022, 2021, and 2020, respectively, we estimated that the total population of Spoon-billed Sandpipers in the Gulf of Mottama in winter 2023 was only 16 individuals out of a total flock of small waders of about 60000.

Table 4: Average flock proportions of small waders in the Gulf of Mottama in January 2023 (n= 198)*, proportional observations for 2019,2020, 2021, 2022, and 2023 (Figures in brackets represent 2021 numbers (Aung et al 2022)

English Name	Scientific Name	Flock count total*	Mean proportion in %				
			2023	2022	2021	2020	2019
Spoon-billed Sandpiper	*Calidris pygmaea*	9	0.0003	0.05	0.07	0.19	0.18
Little /Red necked Stint	*Calidris ruficollis/minuta*	4874	0.1514	11.85	15.59	18.06	22.37
Curlew Sandpiper	*Calidris ferruginea*	2455	0.0763	7.74	17.75	16.32	6.55
Broad-billed Sandpiper	*Calidris falcinellus*	2417	0.0751	2.38	5.30	7.66	5.32
Kentish Plover	*Charadrius alexandrinus*	3778	0.1174	6.87	18.41	12.53	31.41
Lesser Sand Plover	*Charadrius mongolus*	18113	0.5626	70.78	42.00	44.17	32.20

Greater Sand Plover	*Charadrius leschenaultii*	538	0.0167	0.25	2.77	0.69	1.63
Little Ringed Plover	*Charadrius dubius*	10	0.0003	0.07	2.83	0.39	0.34
Total of all flocks		**32194 (34,914)**					
Total of SBS calculated in flock @between 56,200~70000		**9(17)**					

Additionally, the estimated number of Spoon-billed Sandpipers (SBS) observed and estimated in the Gulf of Mottama (GoM) over a period of 15 years, from 2009 to 2023 as shown in Figure 2. The observed numbers refer to the actual number of SBS recorded during the surveys, while the estimated numbers refer to the population size estimated using statistical models based on survey data. Table 4 shows that in 2023, only 9 SBS were observed during the survey, which is a significant decrease from the 17 bserved in 2022 and also the lowest number of SBS recorded in the Gulf of Mottama since 2009. The estimated number of SBS in 2023 ranges between 16 and 25 based on the small wader number maximum estimated 85000 including missing some flocks, which is much lower than the previous year's estimate of 42. The highest number of observed SBS in the survey period was in 2015 with 143 individuals, while the highest estimated number was in 2009 with 240 individuals (see Figure 2).

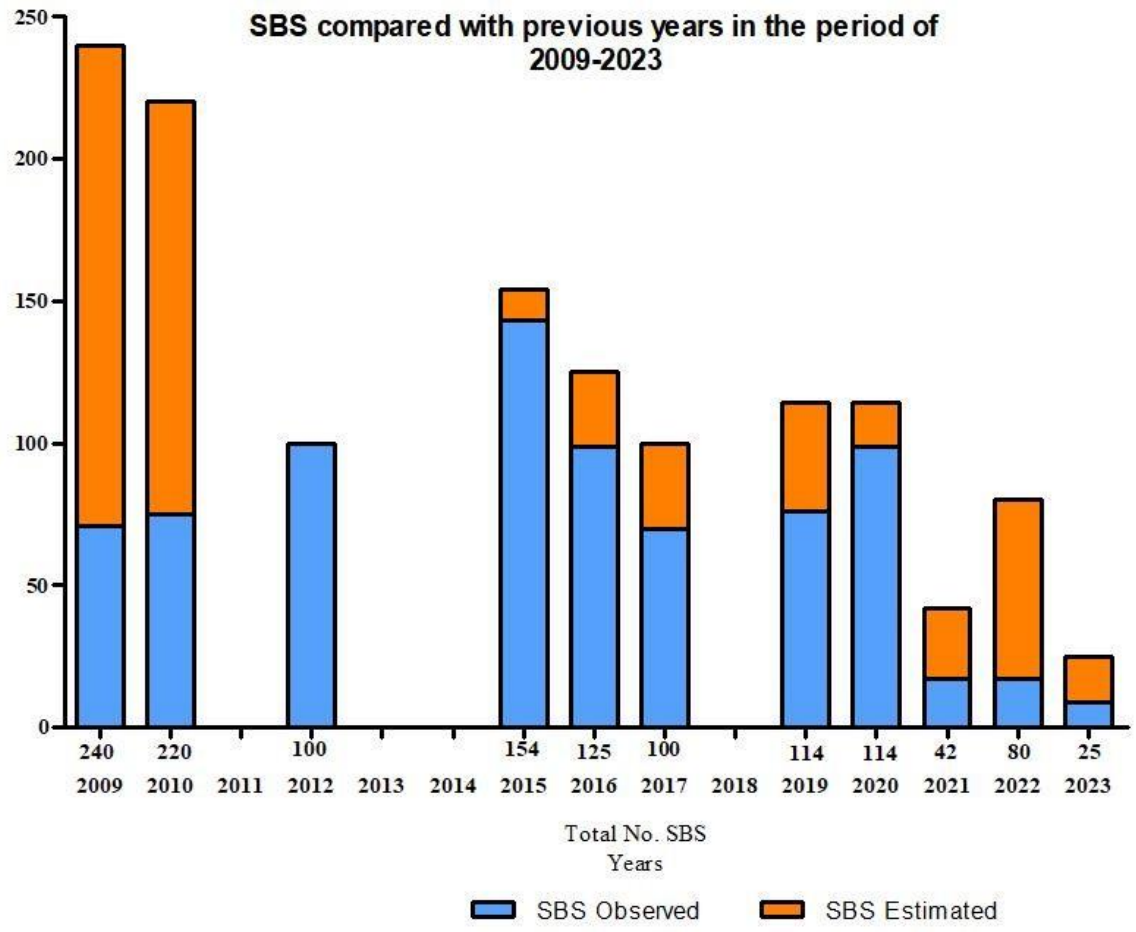


Figure 2: Spoon-billed Sandpiper population estimates in the Gulf of Mottama from 2009-2023, blue reflects the actual observed number, and orange the additional estimated number based on flock counts.

Table 5: Summary results of the key common shorebird species during the 2023 mid-winter count period in the Gulf of Mottama in comparison with 2010, 2019, 2020, 2021, 2022 and 2023 (Zöckler et al. 2014, Aung et al 2019, 2020, 2021, 2022), increasing species with bold fond, declining in Italic, not much change in regular.

Species	**Scientific name**	2023	2022	2021	2020	2019	2018
Lesser Sand Plover	*Charadrius mongolicus*	*13472*	24,712	6,340	14,508	16,385	18,032
Red-necked/Little Stint	*Calidris ruficollis/minuta*	4373	4,138	3,884	4,760	7,690	6,353
Curlew Sandpiper	*Calidris ferruginea*	2247	2,703	2,235	4,512	3,003	6,762
Kentish Plover	*Charadrius alexandrinus*	**3705**	2,399	7,107	3,727	10,997	8,131

Pallas' Gull	*Larus ichthyaetus*	**645**	149	2,988	2,835	84	2,473
Whiskered/White-winged tern	*Chlidonias hybrida /leucoptera*	1100	1127	5,925	2,435	8,088	10,345
Black-tailed Godwit	*Limosa limosa*	1651	3,723	14,392	2,310	5,625	3,405
Broad-billed Sandpiper	*Calidris falcinellus*	**2179**	831	856	2,138	1,909	4,000
Common Redshank	*Tringa totanus*	3739	1,648	5,378	1,331	809	4,617

Also, 18 raptors (birds of prey) of 4 species were recorded during the survey. But the globally threatened Spotted Eagle wasn't observed for the third consecutive year.

3.2 Red-listed Species

One critically endangered species (CR), two endangered (EN), one vulnerable (VU), and nine globally near-threatened (NT) species have been recorded (see Table 5). The red-listed species included the globally critically endangered Spoon-billed Sandpiper (CR), which is more discussed in detail as well as the globally endangered Great Knot (EN), Nordmann's Greenshank (EN). This winter, the Red Knot has been recorded again while the species has not been recorded in the last winter. It was known from the 2008-2012 period when on average 20-40 birds were observed (Zöckler et al. 2014). However, the feeding habitat is not ideal for this species mainly feeding on small bivalves. Black-headed Ibis increased considerably because the survey area is suitable for this species or due to the high number of surveyors. A number of other threatened species were increasing this year, including Nordmann's Greenshank, near-threatened Bar-tailed Godwit, Eurasian Curlew, Asiatic Dowitcher and Red Knot (See Table 6).

Table 6: Globally threatened species recorded in the 2023 survey period in the Gulf of Mottama compared to 2022, 2021, 2020 and 2019. *For Spoon-billed Sandpiper a separate more extensive analysis is below. Species with bold fonts were increasing and in italic style decreasing.

Common Name	Scientific name	IUCN Status	2023	2022	2021	2020	2019
Spoon-billed Sandpiper*	*Calidris pygmaea*	CR	*16*	80	42	114	112
Great Knot	*Calidris tenuirostris*	EN	*83*	165	84	32	153
Nordmann's GGGGGGGGreenshank	*Tringa guttifer*	EN	**15**	8	-	-	-
Common pochard	*Aythya ferina*	VU	**16**	-	-	-	-
Black-tailed Godwit	*Limos limosa*	NT	*2040*	3,723	14,392	5,625	2310
Bar-tailed Godwit	*Limosa lapponica*	NT	**91**	3	24	4	21
Eurasian Curlew	*Numenius arquata*	NT	**1072**	313	1,264	597	280
Asiatic Dowitcher	*Limnodromus*	NT	**183**	-	2	-	49

Red Knot	*Calidris canutus*	NT	*21*	-	478	-	-
Red-necked Stint/Little Stint	Calidris ruficollis/minuta	NT	4,874	4,238	3,884	7,690	4760
Curlew Sandpiper	*Calidris ferruginea*	NT	2455	2703	2235	3003	4512
Black-headed Ibis	*Threskiornis melanocephalus*	NT	**144**	12	13	32	-
Painted Stork	*Mycteria leucocephala*	NT	*4*	13	55	1	-

3.3 Flagged birds

In total only one flagged Spoon-billed Sandpiper was recorded; it was Lime (flagged in Russia). One flagged stint as recorded during the surveys; one was blue on Black over Yellow on right leg (flagged in Kamchatka, Russia). One flagged Curlew Sandpiper (Black and Green) which might be tagged in Thailand was also recorded. A flagged Lesser Sand Plover (Black over Green on right leg) which was also marked in Thailand was also recorded. All flags were not photographed, and it was not possible to read the marked combination.

4. Discussion

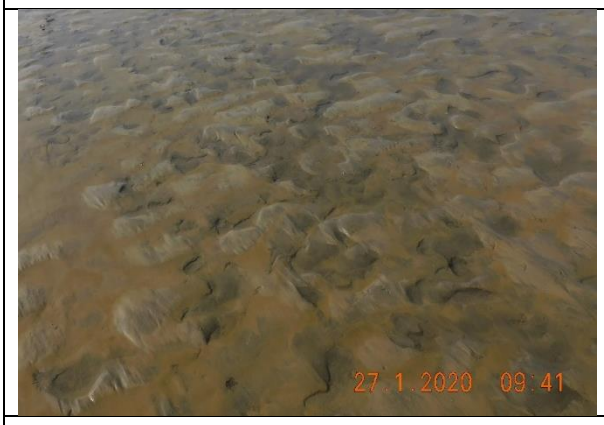
This year we could locate only 9 individuals of the Spoon-billed Sandpipers in GoM during 20 to 25 January 2023.We could not visit some of the potential areas during the survey period due to the logistic constraint and the difficulty to boat anchoring near the main channel during the spring tide. And there also is still a slight some possibility of overlapping in the numbers since many surveyors worked together in the same areas and flock counts were often close between the team.According to the continuous survey from 2019 to 2023 in this region, particularly in the north-eastern Gulf of Mottoma, the Spoon-billed Sandpiper wintering population continued to decline from114 in 2019 and 2020, 42 in 2021, and 80 in 2022, to only 16-25 in 2023. The site level decline was happened at the rate of 50% between 2009 and 2016, 30% between 2021 and 2022, and about 80% between 2022 and 2023. Even though we cannot be totally sure about the exact numbers, we could assume a strong decline in its population. A study conducted in Bangladesh found that the Spoon-billed Sandpiper population experienced a similarly significant decline over the years and reported an exponential decline of 9.5% per year between 2012/2013 to 2017/2018, followed by a much steeper decline of 49.1% per year from 2018/2019 to 2020/2021(*Chowdhury et al. 2022*).

It was particularly difficult to estimate the total number of small waders in the Gulf of Mottama for which we could only account for 60,000. Local people also reported fewer small wader flocks than in previous years, but Figure 1 showed that there are still a large extent of potentially suitable habitats that were not covered by the survey. We assumed that only a smaller proportion of the area might be suitable habitats and added another 10,000- 25,000 additional small waders to the estimate, which would increase the estimated number of SBS to 25 but as this was very speculative, we cannot provide any exact figures

for this winter season. Spoon-billed Sandpiper observation in other wintering sites in Myanmar, we observed (5) including (2) flag birds in Nanthar Island, only (1) in Ayarwaddy Delta, and did not observe at Tanintharyi coastal for this year. Similarly, the numbers of SBS in Nanthar Island and Bangladesh, and Southern China and Vietnam were also declining. We concluded that the overall Spoon-billed Sandpiper population across the flyway level is significantly decreasing to less than 330-340 individuals estimated in 2021 season (Zöckler et al. 2021).These findings indicate an alarming rate of SBS population decline and suggest that conservation efforts are urgently needed to prevent further declines in this endangered bird species.The decline could be due to several reasons in GoM including perhaps climate change, avalibity of food sources, resuming hunting pressure, changes in the intertidal mudflat areas and water pollution etc. More intensive surveys on wintering population in the GoM should be conducted to know the real situation. Increasing temperatures near the equator could be a reason because some migratory birds stay at the stopover sites for the whole winter. The invisible water pollution could be another reason why its impact is increasing like mercury contaminant and other wastes from the upstream and estuary, and it is needed to study the pollution level in the Gulf of Mottama including microplastic issues that will lead to future mitigation and biosafety reasons not only for biodiversity but also for human well-being. According to the local fishers' information, bird hunting is resuming in some coastal areas in the Gulf of Mottama, and an urgent need to eradicate and investigate the root causes. Moreover, need to consider the alternative livelihoods for new hunters if necessary to provide and increase the patrol effort at the coastal site and village/ town markets for bird selling activities. However, the decline is also happening in other wintering grounds.

In the Gulf of Mottama, a total of 53 waterbird species was recorded between 21 to 25 January 2023. The estimated number of small waders was about 55,000~85,000 in the survey areas. This year, the number of identified small numbers decreased compared to the previous years, and only 9 individuals of the Spoon-billed Sandpipers were detected which is only half of those in 2022. Similarly, the total number of individuals of other wader species was also lower. The number of Lesser Sand Plovers decreased by over 40% from 24,712 in 2022 to 13,472 in 2023, etc. Kentish Plover, Pallas' Gull, Broad-billed Sandpiper, and Common Redshank were found to be increased compared to the records in 2022. Other estimated waterfowl numbers such as Whiskered/White-winged Tern numbers are increased up to 45,000. Also, other globally threatened species such as Bar-tailed Godwit, Eurasian Curlew, and particularly Asiatic Dowitcher number are increased possibly due to that fact that the former habitat was likely to change to a muddy habitat (Aung et al 2021) and see different substrate in Figure 3. Our counts in this year could be duplicated because many surveyors were working together in the same place and most of our flock counts were close.

This year the survey was conducted in the west coast and also particularly more in the east coast (Bilin and Thaton) areas. According to the previous survey results in Thaton where the habitat is more muddy places, the maximum observation of Spoon-billed Sandpipers was approximately 6 individuals (Aung et al 2017). The surveyors observed that not much food (like small crabs) do not come out from the mudflat after the receding tide until another high tide period during the survey days which was unlike in previous years. Food availability depends on the dynamic movement of sediment and tide conditions, and pollution would be another major impact on the food sources, but it is beyond our scope of the survey. However, we are not aware of what food is eaten by Spoon-billed Sandpipers in the core area Upper Gulf of Mottama (Aung et al 2021), and the site is still an outstanding largest wintering site.

	
Sand	Mud
	
Mixed Sand-Mud	Sand (with thin layer of mud on top)
	
Hard Sand	Mud-covered sparsely Grassland

Deep Mud

Soft Sand

Figure 3: Different substrate types identified by visual inspection.

6. Recommendations

- To conduct the survey in both Spring and Neap tide at the same area to ensure two cycles of spring tides included and survey a full cycle. To stay longer in the field and have 1-2 days short break in between spring and neat tides and it would be helpful to know the distribution pattern of shorebirds. Need more logistic arrangement and team members.
- To re-visit the sites where Spoon-billed Sandpipers were recorded in Yangon region and southern Gulf of Mottama, due to the dynamic movement of mudflat and food availability.
- To use the proper hi-tech drones for searching hide tide roosting sites with the special permission of the Department of Aviation Authority of Myanmar because over the decade of the survey efforts in the Gulf of Mottama, we didn't know exactly the high tide roosting places where we could easily estimate the numbers of shorebirds including the Spoon-billed Sandpipers.
- To investigate the potential mudflat, hydrology, and dynamic situation by using remote sensing techniques for the long-term monitoring approaches of the shorebird conservation.
- To conduct further assessments on potential threats including resuming hunting pressures, water pollution, climate change consequences, food availability, etc.
- To continue CEPA for delivering the current population trends and threat levels to different stakeholders (community, private sectors, fishery, government) through global events such as World Wetlands Day, World Migratory Bird Day, Biodiversity Day, local media, newspaper, and mobile education team although education and awareness activities have been conducted over the past 10 years.
- To keep the momentum of LCG participation for long-term conservation efforts as the LCG members are very active to learn the shorebird watching and that is a very positive sign. To provide bird-watching equipment (binoculars, spotting scopes, and more intensive training) to the LCG. To communicate with the Forest Department / Department of Fishery by the LCG for law enforcement within the Ramsar Site through facilitation and support of GoMP.

Table A. Daily counts of birds per species during bird surveys from 20 to 25 January 2023 in Gulf of Mottama, Myanmar

	location	Name of Survey Area		Team A	Team B	Team A	Team B	Team A	Team B	Team A	Team B	Team(A+B)
No	Date		IUCN Status	21-Jan-23		22-Jan-23		23-Jan-23		24-Jan-23		25-Jan-23
	Aproximate centre of survey - Latitude	*17.03173*		16.995000	17.178062	16.961248	17.011908	16.92932	16.95266	16.95664	16.940991	17.05344
	Aproximate centre of survey - Longitude	*97.02844*		97.037000	96.91866	97.070969	96.860138	97.10296	97.02209	97.07705	97.121369	96.97843
	Day			1		2		3		4		5
	Common Name	*Scientific Name*										
1	Pintail Snipe	*Gallinago stenura*	LC									
2	Common Snipe	*Gallinago gallinago*	LC									
3	Black-tailed Godwit	*Limosa limosa*	NT	785		667	384	71	1	42	4	86
4	Bar-tailed Godwit	*Limosa lapponica*	NT	35		7		3		15		31
5	Whimbrel	*Numenius phaeopus*	LC	6		104	7	14		27		151
6	Eurasian Curlew	*Numenius arquata*	NT	303	34	328	64	51	8	228	1	55
7	Ruff	*Calidris pugnax*	LC	1				2				
8	Terek Sandpiper	*Xenus cinereus*	LC	11		169		41	8	139	4	0
9	Common Sandpiper	*Actitis hypoleucos*	LC	8								3
10	Ruddy Turnstone	*Arenaria interpres*	LC	1		8		27		19		
11	Asiatic Dowitcher	*Limnodromus semipalmatus*	NT	86		82		0		2		13
12	Spotted Redshank	*Tringa erythropus*	LC	8		6		0		3		3
13	Nordman's Greenshank	*Tringa guttifer*	EN	1		2		0		11		1
14	Common Redshank	*Tringa totanus*	LC	2487	13	1028	205	19	4	123	5	82
15	Marsh Sandpiper	*Tringa stagnatilis*	LC	10	1	3	3			3		1

	location	Name of Survey Area		Team A	Team B	Team A	Team B	Team A	Team B	Team A	Team B	Team(A+B)
No	**Date**		**IUCN Status**	**21-Jan-23**		**22-Jan-23**		**23-Jan-23**		**24-Jan-23**		**25-Jan-23**
	Aproximate centre of survey - Latitude	***17.03173***		**16.995000**	**17.178062**	**16.961248**	**17.011908**	**16.92932**	**16.95266**	**16.95664**	**16.940991**	**17.05344**
	Aproximate centre of survey - Longitude	***97.02844***		**97.037000**	**96.91866**	**97.070969**	**96.860138**	**97.10296**	**97.02209**	**97.07705**	**97.121369**	**96.97843**
	Day			**1**		**2**		**3**		**4**		**5**
16	Common Greenshank	*Tringa nebularia*	LC	16	11	61	3	16		21		17
17	Sanderling	*Calidris alba*	LC			3		6		7		
18	Spoon-billed Sandpiper[1]	*Calidris pygmeus*	CR	2		4		1	1	1		
19	Little Stint/Red necked Stint	*Calidris minuta*	LC	975	55	1962	59	262	387	1117		57
20	Great Knot	*Calidris tenuirostris*	EN	23		20		28		5	7	
21	Red Knot	*Calidris canutus*	NT			5		9		7		
22	Curlew Sandpiper	*Calidris ferruginea*	NT	992		785	36	112	152	351	20	7
23	Broad-billed Sandpiper	*Calidris falcinellus*	LC	760	3	568	190	369	30	475	15	7
24	Small Pratincole	*Glareola lactea*	LC									
25	Common Ringed Plover	*Charadrius hiaticula*	LC	20								
26	Little Ringed Plover	*Charadrius dubius*	LC			7		1		2		
27	Kentish Plover	*Charadrius alexandrinus*	LC	804	4	989	28	475	8	1327	33	110
28	Lesser Sand Plover	*Charadrius mongolus*	LC	1733	333	6196	2206	1271	1420	4097	682	175
29	Greater Sand Plover	*Charadrius leschenaultii*	LC	37		132	2	156	200	11		
30	Pacific Golden Plover	*Pluvialis fulva*	LC	55		35		2		3		

	location	Name of Survey Area		Team A	Team B	Team A	Team B	Team A	Team B	Team A	Team B	Team(A+B)
No	**Date**		**IUCN Status**	**21-Jan-23**		**22-Jan-23**		**23-Jan-23**		**24-Jan-23**		**25-Jan-23**
	Aproximate centre of survey - Latitude	***17.03173***		**16.995000**	**17.178062**	**16.961248**	**17.011908**	**16.92932**	**16.95266**	**16.95664**	**16.940991**	**17.05344**
	Aproximate centre of survey - Longitude	***97.02844***		**97.037000**	**96.91866**	**97.070969**	**96.860138**	**97.10296**	**97.02209**	**97.07705**	**97.121369**	**96.97843**
	Day			**1**		**2**		**3**		**4**		**5**
31	Grey Plover	*Pluvialis squatarola*	LC	69		152	4	5	2	84		5
32	Dunlin	*Calidris alpina*		1	4	6		2		1		
	Total Waders			9229		13329		2943		8121		804
	Estimated total small waders (includes unidentify spp)			16000		10000		5000		25000		200
1	Common Shelduck	*Tadorna tadorna*	LC	1								
2	Eurasian wigeon	*Mareca penelope*	LC	16								
	Total Wildfowl			**16**		**0**		**0**				
1	Black-headed Gull	*Larus ridibundus*	LC	10		22		1		1		
2	Pallas's Gull	*Larus ichthyaetus*	LC	15	3	152		370	4	93	26	15
3	Brown-headed Gull	*Larus brunnicephalus*	LC	70	72	75		107	5	318		22
4	Gull-billed Tern	*Gelochelidon nilotica*	LC	165	3	34	1	44		41	1	
5	Caspian Tern	*Hydroprogne caspia*	LC	23	2	4	11	7		17		17
6	Little Tern	*Sterna albifrons*	LC	24	7	50		17		44		12
7	Whiskered Tern	*Chlidonias hybrida*	LC	100	58	232			1	250	27	160
8	White-winged Tern	*Chlidonias leucopterus*	LC	15	29	4	167		8	293		46
9	Whiskered/White-winged Tern					25000				80000		

	location	Name of Survey Area		Team A	Team B	Team A	Team B	Team A	Team B	Team A	Team B	Team(A+B)
No	**Date**		**IUCN Status**	**21-Jan-23**		**22-Jan-23**		**23-Jan-23**		**24-Jan-23**		**25-Jan-23**
	Aproximate centre of survey - Latitude	***17.03173***		**16.995000**	**17.178062**	**16.961248**	**17.011908**	**16.92932**	**16.95266**	**16.95664**	**16.940991**	**17.05344**
	Aproximate centre of survey - Longitude	***97.02844***		**97.037000**	**96.91866**	**97.070969**	**96.860138**	**97.10296**	**97.02209**	**97.07705**	**97.121369**	**96.97843**
	Day			**1**		**2**		**3**		**4**		**5**
10	Lesser Black-backed Gull	*Larus fuscus*		53		1		1				
11	Lesser crested tern									1		
	Total Gulls and Terns			**475**		**25574**		**547**		**81057**		**272**
1	Little Egret	*Egretta garzetta*	LC	26	8	62		3		66		38
2	Grey Heron	*Ardea cinerea*	LC	47		168		6	1	102	1	25
3	Great White Egret	*Ardea alba*	LC	115		244		8	1	467	1	60
4	Intermediate Egret	*Ardea intermedia*	LC							4		1
5	Pond Heron spp.	*Ardeola sp*	LC	4								
6	Black-headed Ibis	*Threskiornis melanocephalus*	NT	7		86	5			46		
7	Painted Stork	*Mycteria leucocephala*	NT			3	1					
8	Little Commonrant									1		
	Total other dependent waterbirds			**199**		**563**		**17**		686		124
1	Peregrine Falcon	*Falco peregrinus*	LC	1		1				1		1
2	Osprey	*Pandion haliaetus*	LC	1								
3	Black Kite	*Milvus migrans*	LC	1						4		3
4	Eastern Marsh Harrier	*Circus spilonotus*	LC	4						2		7
5	Pied Harrier	*Circus melanoleucos*	LC	2								1

	location	Name of Survey Area		Team A	Team B	Team A	Team B	Team A	Team B	Team A	Team B	Team(A+B)
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	Day			1		2		3		4		5
6	Short-toed Snake Eagle											5
	Total raptors			9		1		0		7		17
	Total wetland dependant species			9928		39467		3507		89871		1217

Appendix: Photos section

Survey team members, Local Conservation Groups members, and boat crews (Gulf of Mottama)

	
Discussion for the potential survey site before heading to Mottama	Survey boat at the channel near Ko Tae Su village

	
Watching shorebirds from the boat during the receding tide of the evening	Surveyors waiting the receding tide to cross the channel
	
Heading in different directions for shorebirds survey	Crossing the channel
	
Lecture talks to LCG members for basic watching	Practical to use spotting scopes by LCG members

	
Practical bird-watching training	Summary of the bird-watching training activities at night
	
Survey boats at the receding tide	Surveyors preparing for bird counting
	
A flock of Godwit	A flock of Plover

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