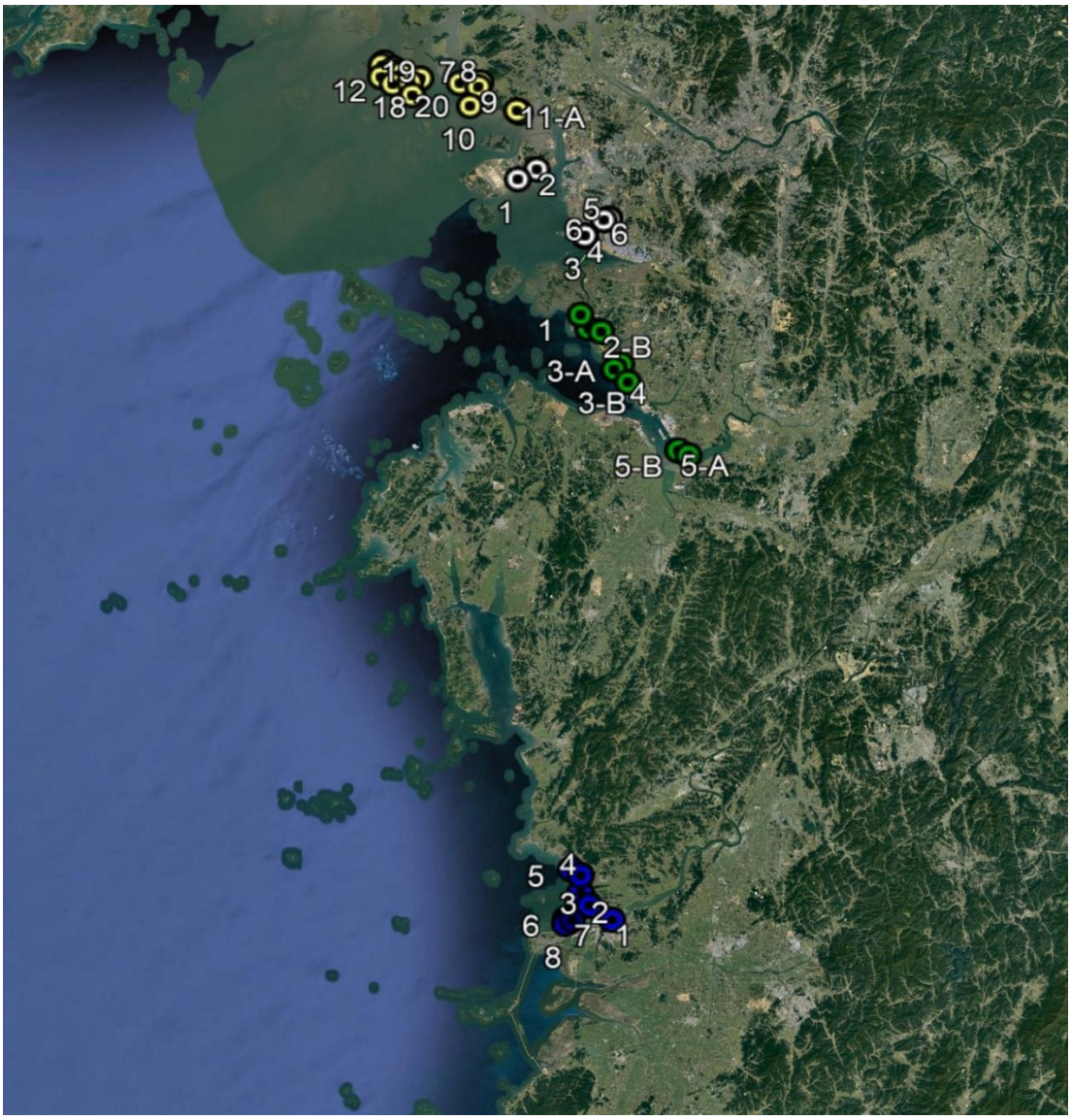
Survey of Far Eastern Curlew *Numenius madagascariensis*: July 21st-25th, 2021



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Report on a survey of Far Eastern Curlew in Incheon, Gyeonggi and Seocheon County, conducted in July 2021 by Birds Korea, “Black-faced Spoonbill and Friends”, Eco-Education Cooperative Moo-Sae-Al, and additional participants.

The survey was coordinated by Birds Korea and the East Asian-Australasian Flyway Partnership (EAAFP) Secretariat; and was funded by the EAAFP Secretariat and the Hwaseong Eco-Foundation as part of the Hwaseong Wetlands Project.

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Executive Summary

- The Far Eastern Curlew *Numenius madagascariensis* is a globally Endangered shorebird with a total population estimated at 32,000 individuals.
- The species is a long-range migrant, with the majority of individuals suspected to migrate *via* the Yellow Sea between breeding grounds in Far Eastern Russia and Australia.
- Multiple information gaps remain on the distribution, abundance and movements (both daily and seasonal) of Far Eastern Curlew in the Yellow Sea Ecoregion as there has been little focused research and no national survey of Far Eastern Curlew in any of the three Yellow Sea nations. Instead, the species has typically been counted more opportunistically during counts of other shorebirds.
- Evidence suggests that the Far Eastern Curlew might peak in number at some Yellow Sea sites earlier than most other shorebird species during both northward and southward migration periods. The highest count of Far Eastern Curlew made during the Hwaseong Wetlands Project between June 2020 and May 2021 was in late July 2020, outside of the main period of most shorebird surveys in the Republic of Korea. This early timing matches well with the start of the arrival of Far Eastern Curlew in Australia for the boreal winter.
- To improve understanding of migration phenology and abundance in the Republic of Korea, a survey of Far Eastern Curlew was conducted between July 21st and 25th 2021 at multiple locations in three main areas known to support the species: coastal Incheon, coastal Gyeonggi Province, and the Geum Estuary.
- A total of 9,642 Far Eastern Curlew were counted, with 3,746 in Incheon, 3,255 along parts of the Gyeonggi mainland coast and 2,641 in the Geum Estuary. This is equivalent to a third of the world population and is higher than previous national estimates of the species for the whole southward migration period.
- Most Far Eastern Curlew seen during the survey were too distant to age or sex, and no juveniles were noted. However, as during previous research in July in the Geum Estuary and in Gyeonggi Province, the majority of individuals belonged to at least two age cohorts: (1) breeding-plumaged adults and (2) immatures (presumably Second or Third Calendar-years), some of which had initiated primary moult.
- Most sites with curlews were surveyed only once during this survey. However, counts were repeated at several sites along the Gyeonggi coast. In contrast to Eurasian Curlew *Numenius arquata*, these counts suggest rapid turnover of Far Eastern Curlew in late July.
- The majority of Far Eastern Curlew were recorded in areas that are either formally protected or are close to the inner border area, and are therefore unlikely to be vulnerable to development pressures in the near-future. However, almost none of the roost sites have any formal protection or any management plan; and ongoing reclamation and associated developments currently threaten roost sites used by at least 2,500 of these individuals.
- In accordance with recommendations in the 2017 Action Plan for the Far Eastern Curlew, more research and collaborative conservation action is required. In addition to increasing research effort in the Republic of Korea, a growth in collaboration between all three Yellow Sea nations will be essential to help close important information gaps on migration phenology, population size and conservation status, greatly supporting conservation actions for the species along the East Asian-Australasian Flyway.

Introduction

As stated in Moores *et al*. (2021), the Far Eastern Curlew *Numenius madagascariensis* is a long-range migratory shorebird, which breeds in northeastern Asia; primarily stages in the Yellow Sea; and winters southward, with > 70% of the population considered to spend the boreal winter in Australia (Conklin *et al*. 2014). The species is endemic to the East Asian-Australasian Flyway and has a declining global population estimated at between 32,000 and 35,000 individuals (Hansen *et al*. 2016; Wetlands International 2021). The rate of decline of the Far Eastern Curlew, estimated primarily through research in Australia, is considered to be between 30-49% and 81% over 30 years (Garnett *et al*. 2011; EAAFP 2017). The species is therefore currently assessed as globally Endangered (BirdLife International 2021); and the 1% population threshold for application of Ramsar Criterion 6 in the identification of internationally important wetlands is 320 individuals (Wetlands International 2021; Ramsar 2021).

BirdLife International (2021), states that the Far Eastern Curlew is "undergoing a very rapid population decline which is suspected to have been primarily driven by habitat loss and deterioration in the Yellow Sea region." In addition to loss of foraging habitat, the loss of undisturbed roosting sites is a growing threat to the species. Far Eastern Curlews are shy. They often initiate flight away from people who are 150m or more away. At high tide, they need undisturbed shallow wetland with an unobstructed 360^{o} view for roosting (e.g., Lilleyman *et al*. 2020, Jackson & Straw 2021).

The Far Eastern Curlew has been the focus of intense research activity in Australia where the species is now assessed as nationally Critically Endangered (e.g., Lilleyman *et al*. 2020). However, there has been relatively little research focused on the species in the Yellow Sea Ecoregion. For example, most counts of Far Eastern Curlew on the Korean Peninsula have been conducted as part of more general shorebird surveys (e.g., Long *et al*. 1988; Moores 1999; Yi 2004; Korea Shorebird Network 2013, 2014, 2015; Moores *et al*. 2016; Reigen *et a*l. 2009, 2016, 2019). During such surveys, there is often insufficient time to separate out Far Eastern Curlews from the similar-looking Eurasian Curlew *Numenius arquata* so that many individual curlews need to be left unidentified.

In addition, most surveys in the ROK have been concentrated in the main shorebird migration periods, i.e., in August and September for southward migration. Research by Moon *et al*. (2013) on Ganghwa Island and at Hwaseong and in Asan Bay (Moores *et al*. 2021), however, found that the peak number of Far Eastern Curlew at their sites during a 12-month period was in late July. If shown to be a regular and widespread phenomenon, this has important implications for understanding the distribution and abundance of the species in Korea, not least because it suggests that previous surveys would have missed the peak of southward migration.

The Far Eastern Curlew is the symbol bird of Hwaseong City. As part of ongoing efforts to conserve this species and the wetlands the species depends on, Hwaseong City launched the Hwaseong Wetlands Project in June 2020. This Project, funded by Hwaseong City through the Hwaseong Eco-Foundation and coordinated by the East Asian-Australasian Flyway Partnership (EAAFP) Secretariat, includes the establishment of a Korean Network for the Far Eastern Curlew. Birds Korea was contracted by the EAAFP Secretariat in 2020 and 2021 to help deliver the goals of the Hwaseong Wetlands Project.

Together with the EAAFP Secretariat, Birds Korea therefore proposed a coordinated survey of Far Eastern Curlew during the spring high tide series in late July 2021, supported by funding through the Project. The aims were to test whether or not the late the July peak recorded in 2020 might be a widespread phenomenon in the ROK; and to improve conservation opportunities for the species, including through building support for a dedicated species network.

Count Sites & Count Methods

Following a review of peer-reviewed and grey literature, three main areas within the Republic of Korea (ROK) were selected for survey of Far Eastern Curlew in late July 2021: parts of coastal Incheon (centred on Ganghwa County, Yeongjong Island and Songdo, all part of the greater Han Estuary); the adjacent Gyeonggi Coast (most especially the Hwaseong Wetlands and Asan Bay); and the Geum Estuary (Figure 1).

Figure 1. The three main count areas on the Yellow Sea coast of the ROK. Image courtesy of Google Earth.

Between July 21st and 25th 2021, counts were conducted by a total of 26 survey participants in these three areas, divided into teams of 1-10 people (Table 1). Participants belonged to several different networks and groups, including Birds Korea, the EAAFP Secretariat, "Black-faced Spoonbill & Friends" (Incheon), Eco-Education Cooperative Moo-Sae-Al (Incheon), and Gyeonggi KFEM (Gyeonggi coast). Each team contained experienced counters with specialist knowledge of their area. Counts of Far Eastern Curlew were made at a total of 34 locations ("count sites" or "sites" 1-34, as referred to throughout this report). Additional sites which did not have any Far Eastern Curlew were also surveyed, and details of these sites were also documented.

Table 1. List of Survey Participants by Count Site

Area	Count Sites	Survey Teams
Incheon	Incheon 1	Kim Hyeong Moon, Oh Hung-Beom, Sim Hyeong-Jin, Kim Jeong-Hi, Kang Yeong-Suk, Jo Hyeun-Ja, Jo Yoon Hee, Kim Bok-Sun, Ham Hyeong-Bok, Oh Ji-Yoon
	Incheon 2	Oh Hung-Beum, Sim Hyeong-Jin, Kim Jeong-Hi, Ham Hyeong-Bok, Oh Ji-Yoon, Ku Yeonah, Choi Mi-Yeong, Vivian Fu
	Incheon 3	Nam Seon-Jeong, Ryu Gi-Chan, Lee Hyeok-Jae, Lee Kwang-Bok
	Incheon 4	Lee Hyeok-Jae, Kang Yeong-Suk, Cho Yoon-Hee, Nam Seon-Jeong, Ryu Gi-Chan, Lee Kwang-Bok
	Incheon 5 & 6	Nam Seon-Jeong, Ryu Gi-Chan
	Incheon 7	Seol Taek-Hyeon
	Incheon 8-11	Park Yeong-Ran
	Incheon 12-21	Yeo Sang-Gyeong, Jeong Yong-Hun
Gyeonggi Coast	Gyeonggi 1-5	Nial Moores, Jung Hanchul
Geum Estuary	Geum 1-8	Ha Jungmoon, O Seungjun

At each count site, in addition to the number of Far Eastern Curlew, the time; coordinates of birds or of point-count positions; notes on weather, including visibility; and expected tide heights and tide times (in Gyeonggi and the Geum Estuary based on http://www.khoa.go.kr) were also recorded.

All counts are useful in improving understanding of local movements and of site use. Because of repeat counts at some sites, a total of 46 counts of Far Eastern Curlew and an additional two counts of curlew sp. were made during the five days. These counts were then reviewed by the author, to identify probable double counts, which were then excluded from any calculation of the total number of Far Eastern Curlew.

1) *Incheon*

Twenty-two people participated in counts at a total of 21 sites (Figure 2), with a few additional locations visited which did not hold any Far Eastern Curlew. Counts were made at seven roosts within 90 minutes either side of high tide through tripod-mounted telescopes. Five of these sites were counted once and two were counted twice. In addition, ten count sites were found through active search from a boat of birds foraging on tidal flats around remote offshore islands at low tide. Two of the 21 count sites (8 and 9) were locations within 6km of main roost areas visited >90 minutes before high tide, so to reduce the risk of double counting these counts were excluded from the total.

Figure 2. Count sites in Incheon. Count site "Incheon 16" is approximately 7 km south of the outer tidal flats of Haeju Bay (DPRK) and 57 km northwest of Count site "Incheon 6", part of the Songdo Ramsar Site (Number 2209). Image courtesy of Google Earth.

2) *Gyeonggi Coast*

Counts were made by two people on all five dates, using tripod-mounted telescopes. Birds in one location (count site 1) were counted foraging at low tide but at all other four main locations, counts were instead concentrated over the high tide period. These counts, subdivided based on an existing count protocol, were repeated on either two or three dates each. Because birds which forage at count points 2-A, 2-B and 4 are known to roost together in the Hwaseong Reclamation Lake at highest high tide (Moores *et al*. 2021), only the highest counts, one each, from count points 1, 3 and 5 are included in the total.

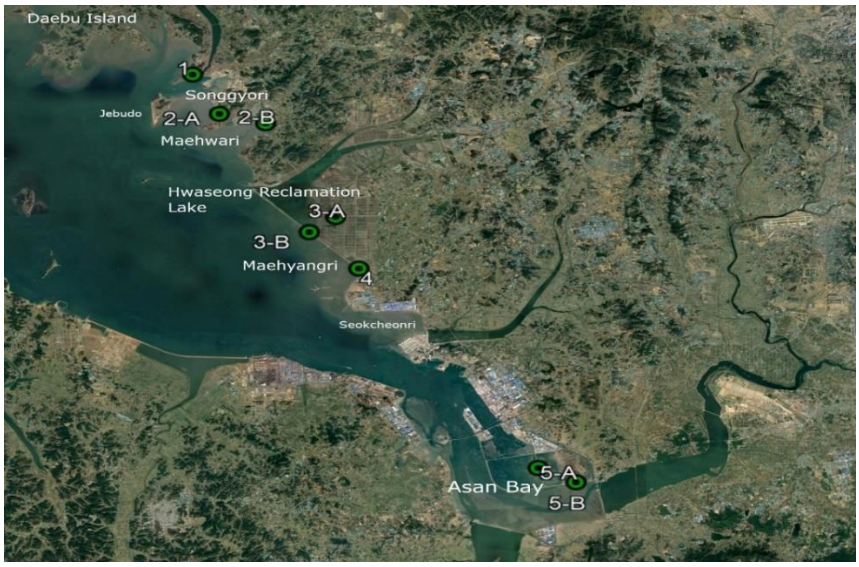

Figure 3. Count sites along the Gyeonggi Coast. Count site "Gyeonggi Coast 1" is approximately 40km northwest of count sites 5-A and 5-B in Asan Bay. Image courtesy of Google Earth.

3) *Geum Estuary*

Two people together counted five roost sites on the mainland within 80 minutes of high tide on the 22nd. On the 23rd, three additional roosts were counted during the incoming tide and over high tide on or close to Yubu Island, with the two counters finding and counting different roosts separately. All roosts were considered to be separate, so all counts are included in the total (Figure 4).

Figure 4. Count sites in the Geum Estuary. Count site "Geum 5" is approximately 14km north-northeast of count site 1, less than 4km downstream of the Geum Barrage. Image Courtesy of Google Earth.

Results

After excluding presumed double counts, the survey between July 21st and 25th found a total of 9,642 Far Eastern Curlew at the 34 count sites. This is approximately 30% of the estimated world population (Table 2).

Table 2. Locations of counts sites and numbers of Far Eastern Curlew used to develop the minimum total recorded between July 21st and 25th 2021.

Location	Number	Date	Roost or Foraging	Coordinates		Number of times counted
Incheon 1	349[1]	25/7	High Tide Roost	37.4613	126.4959	2
Incheon 2	1262[1]	24/7	High Tide Roost	37.4808	126.5403	1
Incheon 4	7	24/7	High Tide Roost	37.3476	126.6538	2
Incheon 6	331	24/7	Neap Tide Roost	37.3821	126.709	1
Incheon 7	50	23/7	Neap Tide Roost	37.653	126.3575	1
Incheon 10	320	23/7	Neap Tide Roost	37.60722	126.3825	1
Incheon 11-A	789	23/7	Neap Tide Roost	37.59806	126.4925	1
Incheon 12	24	24/7	Foraging	37.65111	126.1997	1
Incheon 13	14	24/7	Foraging	37.67472	126.2069	1
Incheon 14	13	24/7	Foraging	37.68222	126.2022	1
Incheon 15	397	24/7	Foraging	37.69417	126.1794	1
Incheon 16	97	24/7	Foraging	37.68833	126.1725	1
Incheon 17	67	24/7	Foraging	37.66528	126.1717	1
Incheon 18	13	24/7	Foraging	37.67111	126.2194	2
Incheon 19	3	24/7	Foraging	37.65417	126.2411	1
Incheon 20	5	24/7	Foraging	37.62861	126.2464	1
Incheon 21	5	25/7	Foraging	37.6625	126.265	1
Gyeonggi 1	65	24/7	Foraging	37.192248	126.64218	1
Gyeonggi 3	2755	24/7	High Tide Roost	37.092048	126.73816	2
Gyeonggi 5-A	246	23/7	High Tide Roost	36.921584	126.87034	2
Gyeonggi 5-B	189	23/7	High Tide Roost	36.91209	126.89454	2
Geum 1	352	22/7	Neap Tide Roost	36.001853	126.71559	1
Geum 2	1281	22/7	Neap Tide Roost	36.029495	126.66462	1
Geum 3	77	22/7	Neap Tide Roost	36.055515	126.64438	1
Geum 4	420	22/7	Neap Tide Roost	36.088844	126.64497	1
Geum 5	77	22/7	Neap Tide Roost	36.100871	126.6227	1
Geum 6	274	23/7	Neap Tide Roost	36.003576	126.61148	1
Geum 8	160	23/7	Neap Tide Roost	35.993612	126.6092	1

[1]As counts were on different dates, it is possible that there was some overlap of birds between these two roosts, which are only 4.3km apart. However, there is also a large road bridge between the two roosts, and other apparently less disturbed potential roost sites have been created by ongoing reclamation 4.7km to the northeast (at: 37.524131°, 126.553860°).

The number of Far Eastern Curlew recorded during this survey is higher than the national estimate of 7,418 for this species during southward migration given by Yi (2004) and is also higher than the number counted each southward migration period in Shorebird Network Korea (2015). Yi's estimate was based on the mean

of seven year of counts made at the nine most important shorebird sites in the ROK which at that time included Saemangeum – an area that before seawall closure in 2006 held substantially more shorebirds than the rest of the ROK combined during southward migration (Moores 1999, Yi 2004). The Shorebird Network Korea (2015) surveyed 35 wetlands, and recorded between 2,386 and 9,191 Far Eastern Curlew each southward migration, a 5-year geometric mean of 5,211 individuals for the period 2010-2014.

1) Incheon

A total of 3,746 Far Eastern Curlew were counted in Incheon during the survey, with birds concentrated in four main areas: two roosts on the southern coast of Yeongjong Island (count sites 1 and 2) which held a combined total of 1,611 individuals, equivalent to 5% of the population; at roost on the southern side of Ganghwa Island (count sites 8-11) which held 1,244 individuals, equivalent to 4% of the population; birds foraging on tidal flats around Boreum Island (count sites 12-18) where 625 individuals were counted, or almost 2% of the population (with the counter reporting that several hundred additional birds were likely missed); and birds foraging on and roosting close to the Gojan tidal flat, part of Songdo Ramsar site which held 338 individuals, equivalent to 1% of the global population.

Several of the tidal flat areas used by foraging Far Eastern Curlew in Incheon appear unlikely to be developed in the near-future, because they are located so close to the inner border of Korea. At closest, the tidal flats around Boreum Island for example are less than 7km from the outer part of the massive Haeju Bay in DPR Korea.

Notably, Haeju Bay is suspected of supporting substantial numbers of the Critically Endangered Spoon-billed Sandpiper *Calidris pygmaea* and other shorebirds including curlews. On May 7th 2019, 200 Far Eastern Curlew were counted at Chongwari (37.81°N 126.05°E) only 17km to the northwest of count point 16 (Reigen *et al*. 2019); and 3,300 Far Eastern Curlew are listed for Ryongmae Island Mudflat, Site 31 in the DPRK Wetlands Inventory (DPRK 2018), at 37.7592°N, 125.8987°E. Ryongmae Island is about 25km to the west-northwest of count point 16.

Figure 5. The inner border area of Korea and the location of Ryongmae Island Mudflat (DPRK Wetlands Inventory Site Number 31: DPRK 2018); Chongwari (Reigen *et al*., 2019); an area for saltpans likely used by roosting shorebirds from Boreum Island; and count sites with Far Eastern Curlew during this survey in Ganghwa County, ROK. Image Courtesy of Google Earth.

Based on the combination of counts made in Haeju Bay, on Google Earth imagery (which shows extensive inaccessible tidal flats in the inner border area) and on the results of this survey, it seems likely that this section of the inner border area of Korea will be even more important for Far Eastern Curlew than currently recognized. It also seems probable that the internationally important concentration of Far Eastern Curlew recorded foraging around Boreum Island in the ROK will need to commute to extensive saltpans at the mouth of Haeju Bay in the DPRK to roost during high spring tides.

Far Eastern Curlew are rather more vulnerable to habitat degradation and disturbance by people at several of the other Incheon count sites. While extensive tidal flats used by foraging birds remain along the south shore of Yeongjong, a former open bay there (count site 2) which has been used as a shorebird roost since at least 1988 (Long *et al*. 1988) is now impounded and surrounded by infrastructure; and areas of old saltpans (including count site 1) are also increasingly vulnerable to development pressures because of rapid urbanization associated with the international airport.

In addition, survey participants also report that Far Eastern Curlew and other shorebirds which forage on the Gojan Tidal Flat, part of the Songdo Ramsar Site at low tide, currently roost in an ongoing reclamation area (count site 4). Incheon City currently has plans to continue construction in this area which will render this roost unusable by shorebirds. The closest alternative roost area for birds which forage on the Gojan Tidal Flat appears to be shallow reclamation impoundments in Sihwa Reclamation Lake, approximately 14km away (Figure 6).

Figure 6. Straight-line distances between the Gojan Tidal Flat in the Songdo Ramsar Site; the current high tide roost site used by Far Eastern Curlew (5.5km) and the next nearest available roost site (13.8km). Image Courtesy of Google Earth.

No research has yet been conducted to assess the potential impacts on Far Eastern Curlew and other shorebirds if they have to increase the flight distance between foraging areas and their roost site from 5km to 14km every high tide. Along the Hwaseong coast, curlews appear to try to avoid commuting more than c.8km regularly, and more than ~11km except during highest high tides (see below).

2) Gyeonggi Coast

A minimum 3,255 Far Eastern Curlew were recorded during the survey, comprised mainly of a single scan count of 2,755 at roost in the Hwaseong Reclamation Lake (~8% of the population), and of two roosts within the main Asan Bay Reclamation Area (a total of 435 individuals, or >1% of the population). Sixty-five were also counted foraging along the outer tidal flats of Daebu Island. Remarkably, the combined number of Far Eastern Curlew counted in late July in 2020 and 2021 in the Hwaseong FNS and in Asan Bay are identical: 3,190 both years.

As in Incheon, the Gyeonggi coast has extensive tidal flats in spite of decades of reclamation projects which have substantially reduced potential foraging and especially roosting areas for Far Eastern Curlew. Reclamation has also led to habitat fragmentation, requiring some birds to fly substantial distances between foraging areas and roost sites.

Research for the Hwaseong Wetlands Project between June 2020 and August 2021 confirmed that Far Eastern Curlew which forage along parts of the Gyeonggi coast use different roost sites dependent on tide heights. Importantly, during high tides above about 8.6m, Far Eastern Curlew which forage on Songgyori and Maehwari tidal flats are forced to roost in the Hwaseong Reclamation Lake, together with birds which forage on the Hwaseong Maehyangri Tidal Flat (Figure 7).

Figure.7. Straight-line distances between foraging and roosting sites of Far Eastern Curlews along the Gyeonggi coast. Movement of birds between Hwaseong Maehyangri (count site 4), Songgyori and Maehwari (count sites 2-A and 2-B) and the Hwaseong Reclamation Lake (count site 3) have been observed regularly during the Hwaseong Wetlands Project. Movement of birds from Daebu Island to Sihwa Reclamation Lake (a distance of only 5.5km) remain suspected only. Image Courtesy of Google Earth.

The upper limit of daily distances flown between roosts and foraging areas has not been measured in the ROK. Tracking of the daily movements of individual Far Eastern Curlew, as in Australia (see e.g., Lilleyman *et al*. 2020) would allow testing of the hypothesis that Far Eastern Curlews appear to be reluctant

to commute more than ~11km even during highest high tide periods in Hwaseong. This is presumably because of the high level of energy expenditure required, especially when the same birds are trying to maximize intake to fuel their long-range migrations.

Evidence in support of this hypothesis includes the small numbers of Far Eastern Curlew seen foraging on the Seokcheonri Tidal Flat (especially on dates with highest high tides); the pre-high tide movements of Far Eastern Curlew from Songgyori to Maehwari on tides up to about 8m; the reluctance of birds to leave Maehwari tidal flat during high tides between about 8.1m and 8.5m, even when birds are forced within 100m of a road (a much shorter distance than their usual disturbance distance of 150-250m); and perhaps the very large difference in the number of birds at roost in the Hwaseong Reclamation Lake on July 24th, when 2,755 Far Eastern Curlew were counted on the morning high tide of 9.12m; and on July 25th, when only 1,669 were counted, even though the tide was higher (9.27m) (Figure 8).

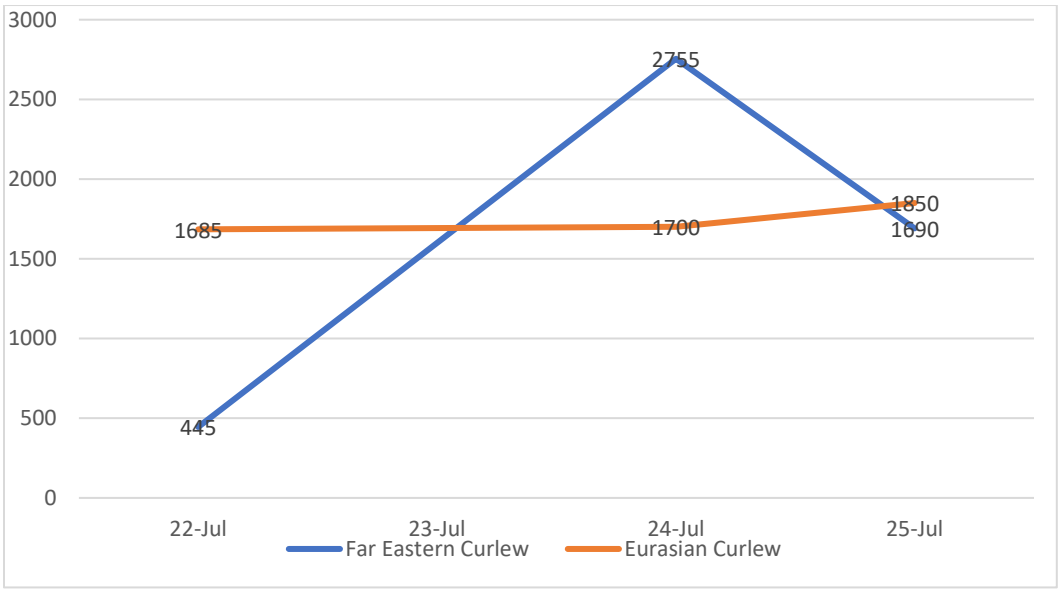

Figure 8. Numbers of Far Eastern Curlew (blue line) and Eurasian Curlew (brown line) counted within the Hwaseong Wetlands FNS on July 22nd, 24th and 25th 2021 (note no count was made on July 23rd). The rapid increase in the number of Far Eastern Curlew between July 22nd and 24th was in large part due to the influx of birds from Songgyori and Maehwari joining birds from Maehyangri to roost in the Hwaseong Reclamation Lake. This rapid increase was followed by a massive reduction in the number counted on 25th. The change in numbers of Eurasian Curlew counted over the same three dates is remarkably different. Many of the Eurasian Curlew were in heavy primary moult and are likely staging for several weeks or months along the Hwaseong coast. Eurasian Curlew forced off tidal flats at Songgyori and Maehwari by the late July spring high tide series apparently relocated to Maehyangri, to avoid the need to commute during each high tide.

In Asan Bay, most shorebirds forage on tidal flats that are within 2-3km of currently secure roost sites within three large reclamation impoundments (see Moores 2021). As these tidal flats are inundated even during neap tides and no other roost sites are available within ~20km, it is reasonable to interpret changes in numbers of curlews between dates in Asan Bay as being the result of immigration into or emigration from the area. Between July 21st and 23rd, the numbers of both Far Eastern Curlew and Eurasian Curlew counted within Asan Bay increased substantially, from 333 to 435 and from 346 to 642 respectively.

During the Hwaseong Wetlands Project in 2020, the earliest juvenile Far Eastern Curlew was recorded on July 21st; and the number of juveniles peaked at 95 individuals in September. The vast majority of individuals were aged as immature (i.e., they were most likely either second or third calendar-years) of which 250+ moulted their primaries. The remainder were likely to have been adults (Moores *et al*. 2021).

During the present survey, although one or two suspected juveniles were seen, the vast majority of Far Eastern Curlew were too distant to age or sex with any level of confidence. One flock in Asan Bay on July 21st containing 92 birds was, however, sufficiently close to check. Of these, 21 showed obvious breeding plumage; and 38 were tentatively identified as female, based on perceptions of bill length. If these observations are correct, then the majority of birds in this flock were immatures, and the majority (but not all) of the breeding plumaged birds were males.

3) Geum Estuary

A minimum 2,641 Far Eastern Curlew were counted in the Geum Estuary, with the largest concentration 1,281 individuals (4% of the population) found at roost on the Songrimri tidal flats (count site 2), a well-known roost, known as "Shellfish Harbour" during the Saemangeum Shorebird Monitoring Program of 2006-2008 (SSMP) (Rogers *et al*. 2006; Moores *et al*. 2008).

During the relatively low high tide of 5.85m on the 22nd, 352 Far Eastern Curlew were considered to remain throughout high tide within the Geum River channel (count site 1); and on the 23rd, a flock of 440 curlews were seen close to Daejuk Island, too far away to identify to species. During previous research for the SSMP and subsequently, Far Eastern Curlew have been observed flying out of the Geum River channel to roost near to Daejuk Island (a straight-line distance of 8km), on tides of ~6m or higher. On 23rd, the first high tide peaked above 7m and the afternoon high tide reached 6.07m (as measured at Janghang). It therefore seems reasonable to assume that some or many of the 440 unidentified curlew observed near to Daejuk on 23rd were the same birds.

Following the closure of the Saemangeum seawall in 2006, Geum Estuary became the most important known shorebird site in the ROK (Moores *et al*. 2008, 2016). As a result, shorebirds have been researched here more extensively than at any other internationally important wetland in the ROK. This research includes a short study of Far Eastern Curlew by Birds Korea between June and August 2017 (Moores & Loghry 2017). Observations from that research relevant to the present survey and conservation of Far Eastern Curlew in the Geum Estuary include:

1. Little evidence on Yubu Island at least of large-scale immigration or emigration of Far Eastern Curlew between June, late July and mid-August. In late June 2017, a total of 2,316 Far Eastern Curlew were counted in the whole Geum Estuary, with 926 along the mainland coast on June 22nd and 1,390 on Yubu Island on June 24th. Subsequently, although there were large day-to-day fluctuations in numbers of shorebirds seen coming to roost on Yubu Island, the number of Far Eastern Curlew counted in July and August perhaps remained similar, with e.g., 1,430 counted on Yubu on August 12th. This trend was obviously different from Eurasian Curlew, which increased from 105 in the whole of the Geum Estuary in late June to >500 on Yubu Island in July; and 1,215 on Yubu Island by mid-August.
2. The regular movement of Far Eastern Curlew between the Geum Estuary, where birds foraged, and the Saemangeum reclamation area, where birds roosted. This behaviour was first noted during the SSMP; was confirmed by simultaneous counts made in 2013; and was suspected in 2017.
3. Between 2% and 5% of Far Eastern Curlew had initiated primary moult by the end of July.

Much of the Seocheon County side of the Geum Estuary is now protected formally both as a Ramsar site and since mid-2021 also as the Seocheon Getbol World Heritage Property. However, the current boundaries of the World Heritage Property do not extend to include some of the shoreline used by roosting Far Eastern Curlew and the Geum River channel used by large numbers of foraging Far Eastern Curlew. These areas are instead included within the buffer zone (Figure 9).

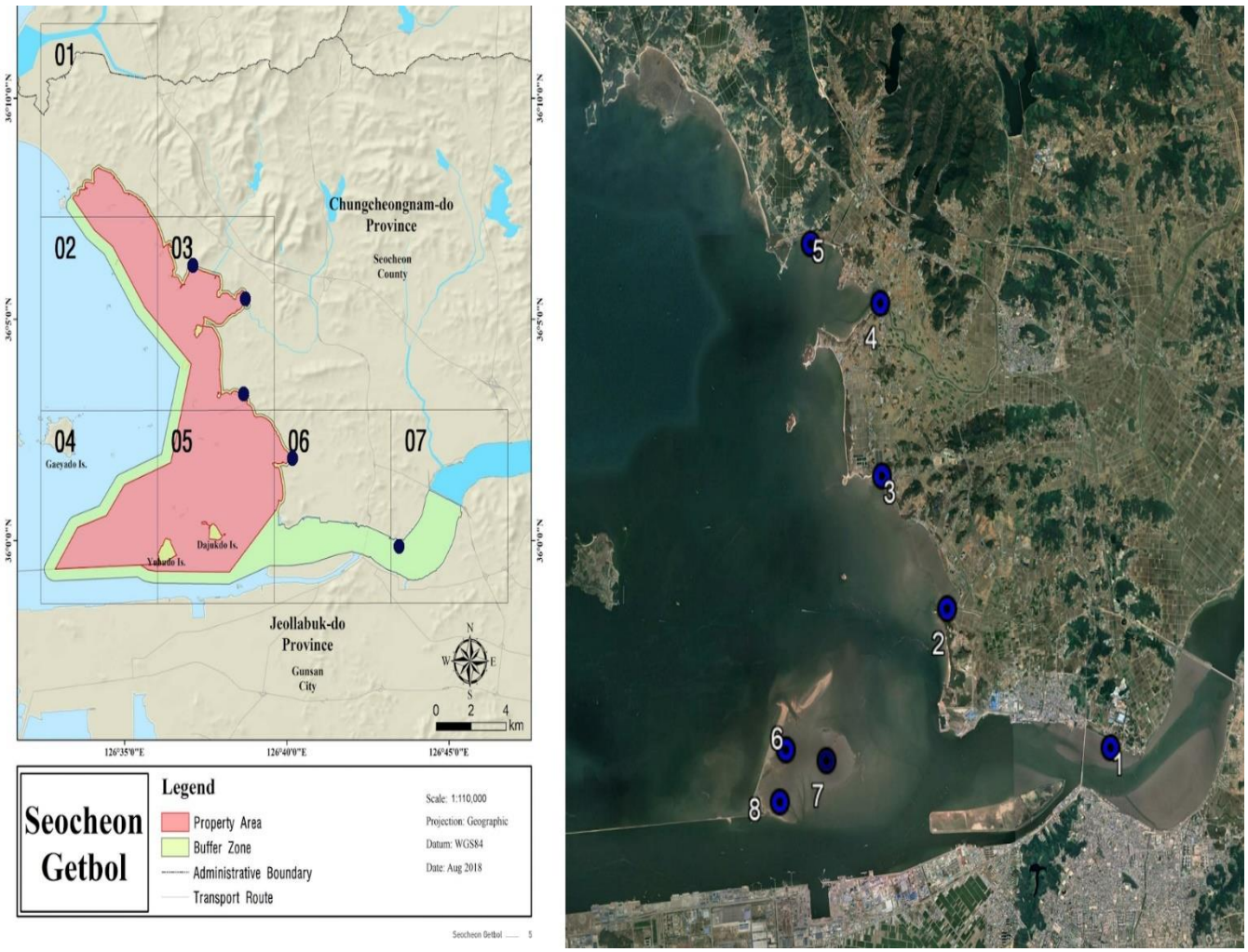

Figure 9. Left: boundaries of Seocheon Getbol World Heritage Property (https://whc.unesco.org/en/list/1591), with mainland count sites added. Right: location of Far Eastern Curlew roost sites counted during this survey within the buffer zone of the World Heritage Property. Images courtesy of World Heritage website and Google Earth.

Discussion & Recommendations

The survey helps to identify 11 discrete areas of tidal flat and / or associated roost sites in the ROK as internationally important for the globally Endangered Far Eastern Curlew: (1) tidal flats around Boreum Island (Incheon count sites 12-18); (2) tidal flats around southern Ganghwa Island (Incheon count sites 8-11); (3) tidal flats and two discrete roost sites in southern Yeongjong Island (Incheon counts sites 1 and 2); (4) tidal flats and the artificial roost site in Songdo (Incheon count sites 4 and 6); (5) tidal flats in Maehwari, Hwaseong (Gyeonggi count site 2-B); (6) the Hwaseong Reclamation Lake, as a roost site (Gyeonggi count site 3); (7) Maehyangri Tidal Flat, Hwaseong (Gyeonggi count site 4); (8) Asan Bay, tidal flat and roost sites within Asan Bay reclamation impoundments (Gyeonggi count sites 5); (9) the Geum River channel tidal flats; (10) the Seocheon County coast, between Songrimri and Jangguri (Geum count sites 2-4); and (11) the tidal flats and saltpans around Yubu Island, Seocheon County (Geum counts sites 6-8).

The survey therefore helps to highlight the importance of tidal flats in the ROK to Far Eastern Curlew, and confirms the need for more research in the ROK focused on Far Eastern Curlew.

Based on arrival dates in Australia, large numbers of Far Eastern Curlew might be expected in the ROK in late July (see Moores *et al*. 2021). However, because some of the count sites included in this survey have not been counted in late July, and the survey included some areas which were not surveyed by the Shorebird Network Korea (e.g., near to the inner border area of Korea) it is not yet possible to confirm whether a late July peak in number is a widespread phenomenon shared by multiple sites or not. However, it is possible to state that the number of Far Eastern Curlew we recorded in a five-day period at the end of July 2021 is higher than the national estimate for the whole southward migration period developed by Yi (2004) and is higher than counts made nationwide by Korea Shorebird Network in years 2010-2014. The Far Eastern Curlew is considered to be in rapid decline along the Flyway; and many important sites for the species in the ROK have either been lost (e.g., Saemangeum) or have been severely degraded since Yi published his estimates. Higher numbers recorded during this survey than in previous surveys would be unexpected, unless previous survey effort was inadequate in some way – either by not finding birds that were present, or by not finding birds because the surveys were outside of the main migration peak time for the species.

In addition, it is also possible to state that, at least along the Hwaseong coast and in Asan Bay, this late July peak appears to be a regular phenomenon. The combined total of Far Eastern Curlew recorded in late July 2020 and again in late July 2021 at these two sites was identical. In addition, counts made along the Hwaseong coast in mid-August 2021 show a similar pattern to the pattern in 2020, with the July peak of 2,755 in 2021 falling to only 1,410 in mid-August.

A workshop is planned in late 2021 to discuss the survey results, and it is intended also to develop a series of recommendations which might help improve conservation opportunities for the species, and help to build a more effective conservation network.

Based on this survey and on research conducted for the Hwaseong Wetlands Project, we consider that it would be very helpful to repeat this survey effort annually, and, if possible, to expand it, so that understanding of the distribution, abundance and movements of Far Eastern Curlew throughout the Yellow Sea Ecoregion can be improved.

Finally, the survey also highlights that while many of the tidal flats used for foraging by Far Eastern Curlew have benefitted from recent improvements in policy, many of the most important roost sites remain unprotected and highly vulnerable to degradation or loss. Urgent measures are required to improve the status of roost sites currently depended upon by this species and other shorebirds in the ROK.

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