Exploratory surveys to clarify the status of the Far Eastern Curlew on the Sarawak coastline in Borneo, Malaysia

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EXPLORATORY SURVEYS TO CLARIFY THE STATUS OF THE FAR EASTERN CURLEW ON THE SARAWAK COASTLINE IN BORNEO, MALAYSIA

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Table of Contents

Introduction

Among the nine major flyways in the world, the East Asian-Australasian Flyway (EAAF) is one of the largest and most threatened flyways. It spans over 84 million square km and more than 20 countries from the Russian Arctic to the most southern part of Australia and New Zealand and also covering East Asia, Southeast Asia, and eastern India (Parish 1987, Conklin *et al.* 2014). Over 50 million migratory waterbirds utilize the flyway during their annual migration. Malaysia contains multiple stopovers and wintering sites for shorebirds that migrate through the EAAF, with some of the most important found in Sarawak. Located on the island of Borneo, the rugged coastline of Sarawak stretches 1,035 km and provides a variety of coastal habitats ranging from intertidal mudflats and sandflats to mangrove forests and rocky outcrops offshore (Shabdin, 2014). This coastline supports more than 30 migratory waterbird species including several globally threatened species such as Chinese Egret, Great Knot, Bar-tailed Godwit, Asian Dowitcher, Far Eastern Curlew and, as discovered recently, Spoon-billed Sandpiper (Orenstein *et al.* 2010, Bakewell *et al.* 2017, Teepol *et al.* 2023).

One of the key species highlighted across previous work done on migratory waterbirds in Sarawak is the endangered Far Eastern Curlew *Numenius madagascariensis*. Far Eastern Curlew breeds in eastern Russia between the Nizhnyaya Tunguska river east and Verkhoyarsk mountains up to Kamchatka, Primorye and north-eastern Mongolia (del Hoyo *et al.* 1996). The Yellow Sea region is an important stopover site for their migration and three quarters of the population is estimated to winter in Australia (BirdLife International, 2023). Non-breeding locations of the remaining population are much less well known, but were previously documented to include China, Indonesia, Papua New Guinea and New Zealand (del Hoyo *et al.* 1996). In response to its endangered and declining status, the *International Single Species Action Plan for the Conservation of Far Eastern Curlew* (Single Species Action Plan) was adopted by the CMS Conference of the Parties at its 12th meeting in Manila, 2017. The Far Eastern Curlew is also listed on CMS Appendix I and II. As a result of the aforementioned knowledge gaps regarding the non-breeding population outside of Australia, there are multiple priority actions included in the Single Species Action Plan that relate to improved understanding and conservation of the species at non-breeding sites outside Australia.

The Waterbird Surveys of The Sarawak Coast (WSSC) (2010-2012) was a pioneer report on shorebird surveys in Sarawak and the first state-wide survey conducted for the entire coast of Sarawak. The surveys conducted from the WSSC concluded that the west coast of Sarawak is

very important for migratory shorebirds highlighting important sites according to species (Bakewell *et al.* 2017). Previous surveys on Sarawak coastline have illustrated its importance for Far Eastern Curlew as staging and wintering habitat (Mizutani *et al.* 2006, Bakewell *et al.* 2017, Teepol *et al.* 2020). A significant number of Far Eastern Curlew was first documented in 1986 at Pulau Patok (Howes *et al.* 1986a, Edwards *et al.* 1986) indicating the importance of the coastline to this species. Subsequently, 350 individuals were recorded in 2006 at the Sejingkat Ash Pond and 77 individuals were observed during the same survey at Kabong (Mizutani *et al.* 2006), leading to further study of this species in Sarawak. Subsequent monitoring has shown that Far Eastern Curlew numbers in Pulau Bruit declined rapidly between 1986 and 2011, while numbers at the Sejingkat Ash Pond and at Kabong were relatively consistent between 2006 and 2019 at around 450 and 114 individuals, respectively (Mizutani *et al.* 2006, Teepol *et al*. 2020). Numbers of Far Eastern Curlew at Buntal Bay showed an increase between 2006 to 2019 from 23 to 600 individuals (Mizutani *et al.* 2006, Teepol *et al*. 2020).

Awareness about the need for enhanced conservation of migratory shorebirds has been growing around the world and in Malaysia, specifically in recent years. Historically, there were a few early works done on migratory shorebirds surveys and research in Sarawak (Edwards *et al.* 1986, Howes & NPWO 1986a, Howes & NPWO 1986b, Edwards & Polshek 1987, Parish 1987) which documented the migratory waterbird species found throughout the state. Data on migratory waterbirds were collected by citizen scientists of our local non-governmental organisation (NGO), Malaysian Nature Society Kuching Branch (MNSKB) for many years. With the support of Sarawak Forestry Corporation and Wetlands International together with volunteers from MNSKB, the Annual Waterbird Census (AWC) has been conducted since 2006. These long-term data are crucial in policy making and highlighting the importance of Bako Buntal Bay Important Bird and Biodiversity Area (IBA) for migratory shorebirds in the state and within the region (Mizutani *et al.* 2006, Bakewell *et al.* 2017, Teepol *et al.* 2020).

The purpose of this project was to clarify the status of the Far Eastern Curlew on the Malaysian Borneo coastline (Sarawak) and to implement priority actions identified in the Single Species Action Plan. Specifically, implementing project activities have assisted delivery on the following objectives in the plan:

- Objective 1: Protect all important habitats for Far Eastern Curlew across its range
- Action 1.1.1 Important non-breeding areas are identified
- Result 1.1 All important staging and non-breeding sites along the EAAF are adequately protected and, where possible, managed

In addition, the results of the study will generate data which can inform other objectives, results and actions of the action plan as follows:

- Objective 2: Establish a climate change response plan for Far Eastern Curlew; Result 2.1 The impacts of climate change on Far Eastern Curlew are buffered
- Action 2.1.3 Validate predictions of population response to climate change against measured data
- Action 2.1.4 Identify potential shifts in nesting and non-breeding distribution and ensure adequate coverage of these areas in protected areas;
- Objective 6: To monitor the population dynamics of Far Eastern Curlew in the EAAF to detect population responses to management implemented under this Single Species Action Plan
- Result 6.1 Demographic data are available to allow assessment of the response of Far Eastern Curlew to anthropogenic impacts throughout the EAAF
- Action 6.1.2 Monitor numbers of birds at a statistically robust sample of staging and nonbreeding sites and undertake analysis of data to improve the accuracy of the global population estimate
- Objective 7: Assess the risk and impact of disturbance on Far Eastern Curlew
- Result 7.1 The effect of disturbance on Far Eastern Curlew has been quantified
- 7.1.2 Quantify the level of disturbance in key staging and non-breeding sites and assess the likely impact on the population.

Aim of the project

The aim of this project was to improve knowledge of the conservation status and distribution of the Far Eastern Curlew on the Sarawak Malaysian Borneo coastline. Specifically, the project:

(i) supported re-surveying and re-assessment of potentially important sites in Sarawak Malaysian Borneo for Far Eastern Curlew that have not been visited since comprehensive surveys were conducted in 2010-2011, and

(ii) clarified the conservation status, local distribution, non-breeding phenology and movements of Far Eastern Curlew in the Bako Buntal Bay Important Bird and Biodiversity Area (IBA) and other important wetlands in Sarawak.

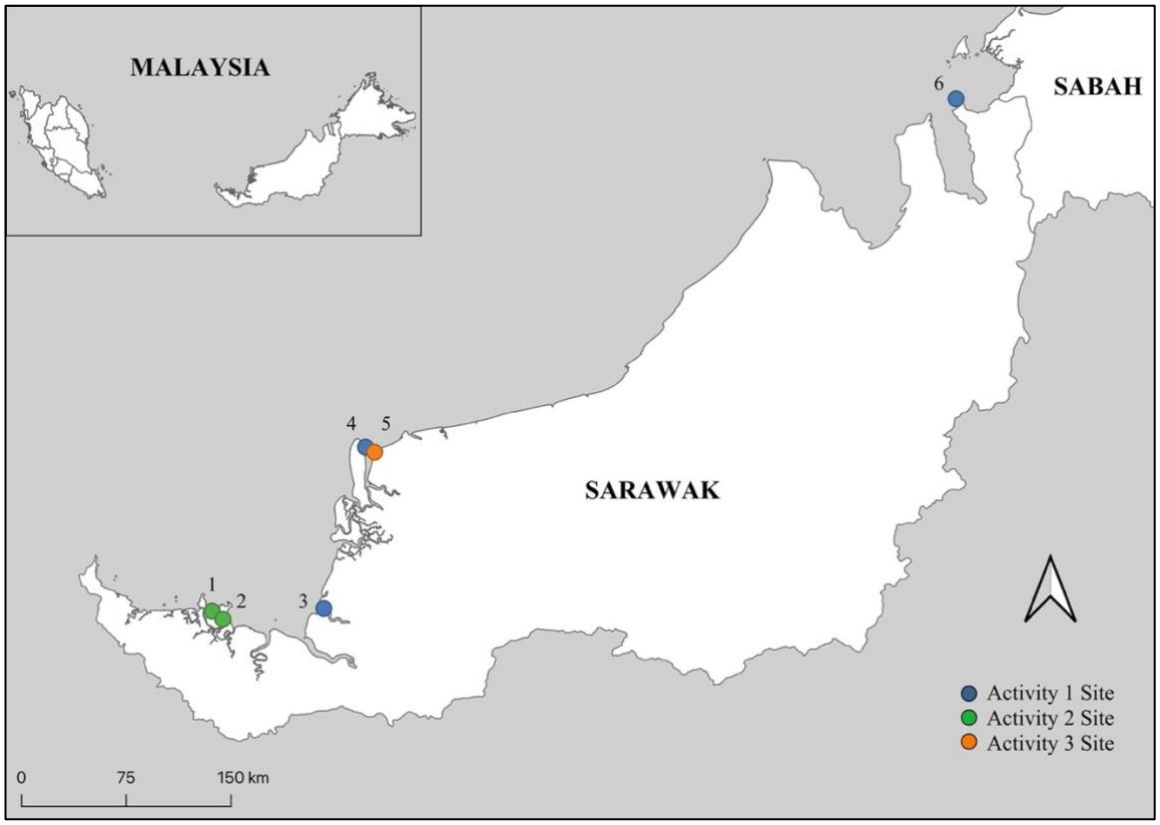
Methodology

The study was broken into three major activities:

1. Re-survey and re-assess potentially important wetland sites for Far Eastern Curlew along the coastline of Sarawak, Malaysian Borneo identified from previous survey work.
2. Conduct counts and observations of Far Eastern Curlews in the Buntal Bay and Sejingkat Ash Pond.
3. Undertake exploratory field surveys to sites with potential sight records of Far Eastern Curlew to identify new sites of importance to the species.

Site information and activity overview

The sites studied were mainly coastal tidal flats located on western Sarawak and one site in eastern Sarawak (Map 1).



Map 1. Site location of each activity.

The sites are numbered as (1) Buntal Bay, (2) Sejingkat Ash Pond, (3) Batang Maro, (4) Pulau Patok, (5) Maro Sandbar and (6) Trusan Sundar.

The substrate of each of the six sites was documented based on basic observations and field work experience (Table 1).

Table 1. Substrate description for each roosting site.

Roosting Site	Substrate description
Sejingkat Ash Pond	Hardened ash with wet ash constantly being pumped with overgrown vegetation on the banks
Buntal Bay	Soft firm sediments on the upper region of intertidal flats and soft muddy sediment near the water channel. Dead mangrove vegetation observed at the inundated part of sandbar and fringed mangrove forest can be observed further from the intertidal zone.
Pulau Bruit-Patok (Pulau Patok)	Soft muddy sediment with overgrown vegetation.
Matu (Matu Sandbar)	Soft firm sediments with fine sand at the highest and middle part of the sandbar
Kabong (Batang Maro)	Soft firm sediments on the upper region of intertidal flats and soft muddy sediment near the water channel
Trusan Sundar	Soft firm sediments on the upper region of intertidal flats with fine sand at the highest and middle part of the sandbar and soft mud near the water channel

Activity 1 focused on surveying and re-assessing potentially important wetland sites for Far Eastern Curlew along the coasts of Sarawak, identified through previous surveys. The three sites selected were Batang Maro, Pulau Patok and Trusan Sundar where historical records indicated substantial numbers of Far Eastern Curlew had been observed. For these sites, each site was visited twice between December 2022 and April 2023 (Table 2).

Table 2. Timeline of Activity 1.

Date	Area	Site
1st Count		
16-20 December 2022	Pulau Bruit	Pulau Patok
5-8 January 2023	Lawas	Trusan Sundar
12-15 January 2023	Maludam	Batang Maro
2nd Count		
18-21 February 2023	Pulau Bruit	Pulau Patok
11-14 February 2023	Lawas	Trusan Sundar
3-6 April 2023	Maludam	Batang Maro

The second visit to Batang Maro was planned to be conducted at the end of February but due to monsoon season and inclement weather, the second count was postponed to early April 2023.

Surveys were conducted by approaching the local boatmen in each site to obtain information on potential sightings of Far Eastern Curlews and sites which were suitable for counts. For all three sites, the team used a small powered boat during the flooding tide to access the survey sites. The main counts were conducted for Far Eastern Curlew and Eurasian Curlew *Numenius arquata* but counts of other species were done opportunistically. Identification of the curlews were done to species level. Of the *Numenius* sp. present throughout the project, Whimbrel (*Numenius phaeopus*) could easily be identified with its prominent head stripes and its smaller size in comparison to the Far Eastern Curlew and Eurasian Curlew. In flight, Far Eastern Curlew could be easily distinguished from the Eurasian Curlew with their uniformly dark brown rump and fine dark barred underwing. When perching, Far Eastern Curlew looked darker and browner in comparison with their heavily barred upperparts in contrast to the overall pale appearance of Eurasian Curlew.

Activity 2 focused on counts and observations of Far Eastern Curlews in Buntal Bay and Sejingkat Ash Pond, which are located within the Bako Buntal Bay (IBA) and the first and only site in Malaysia included in the East Asian-Australasian Flyway Partnership (EAAFP) Flyway

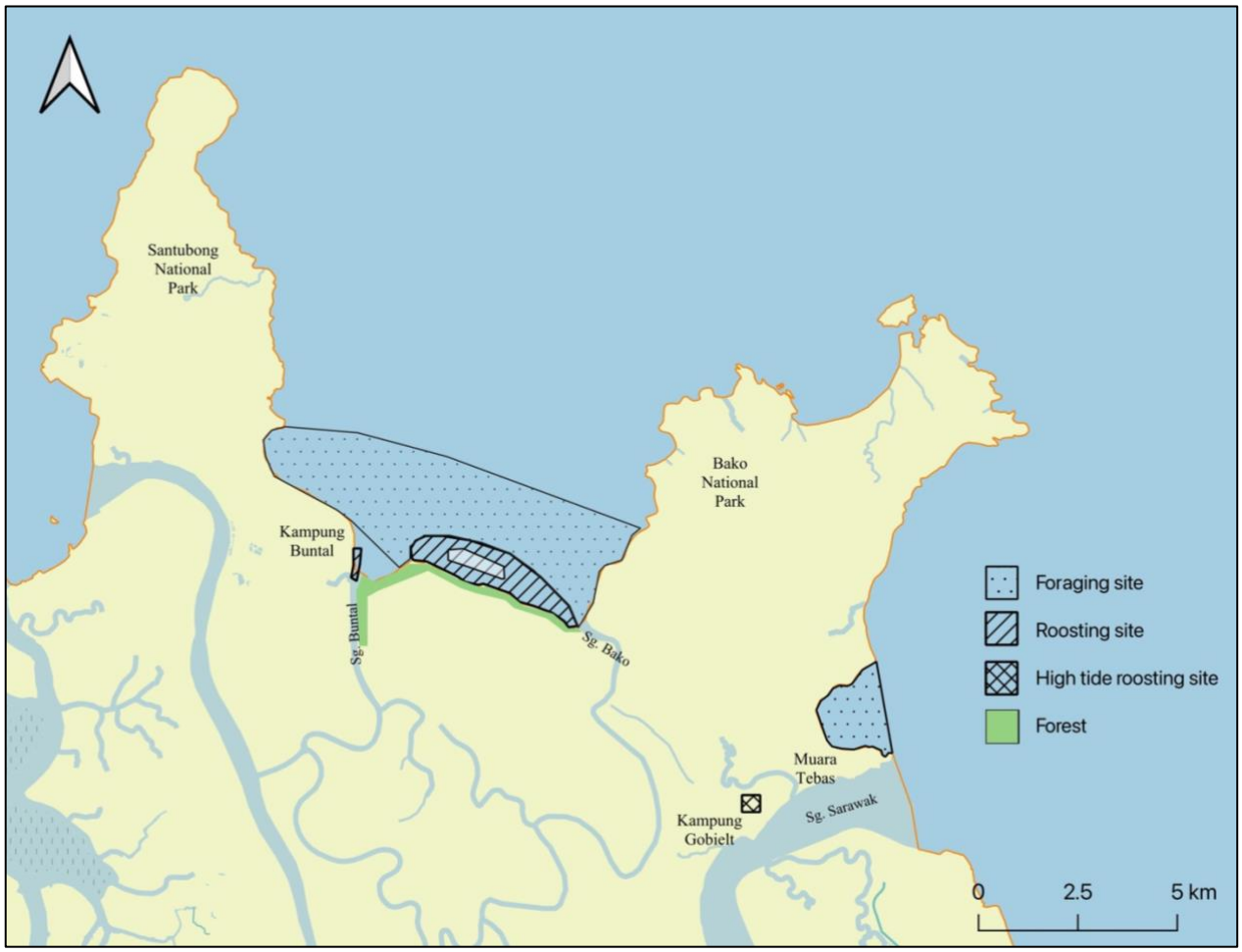
Site Network. These two sites are considered well surveyed for migratory waterbirds as compared to other sites in Sarawak because the Annual Waterbird Census (AWC) has been carried out at these sites since the 1980s (Howes & NPWO, 1980a,b), and several peer-reviewed studies and reports also cover these sites (Edwards & Polshek 1987, Mizutani *et al.* 2006, Bakewell *et al.* 2016, Teepol *et al.* 2020).

Roosting counts were conducted at both sites in Buntal Bay during neap tides (4.0 – 4.5m) and at Sejingkat Ash Pond during spring tides (4.5 – 5.0m) as the Buntal Bay sandbar was mostly inundated and Far Eastern Curlews did not roost here during spring tides. All surveys for Sejingkat Ash Pond were conducted during the morning tide. We conducted surveys at least twice each month from November 2022 to March 2023 at both sites (Table 3). As there were previous sightings of tagged birds utilizing both sites for roosting, counts for each sites were considered independent, except for one survey day (2 April 2023) where the counts were coordinated at the same time at both sites to understand the utilization of roost site by Far Eastern Curlew at both sites at the same time.

Table 3. Survey dates for Activity 2 from November 2022 to March 2023.

Site	Date	Time/Tide
	November	
Buntal Bay	5 November 2022/ Saturday	2.42PM (4.2m)
Sejingkat Ash Pond	11 November 2022/ Friday	5.13AM (4.7m)
Buntal Bay	21 November 2022/ Monday	2.58PM (4.2m)
Sejingkat Ash Pond	26 November 2022/Saturday	4.51AM (4.8m)
	December	
Buntal Bay	5 December 2022/ Monday	3.07PM (4.5m)
Sejingkat Ash Pond	11 December 2022/ Sunday	5.24AM (4.3m)
Buntal Bay	21 December 2022/ Wednesday	3.14PM (4.5m)
Sejingkat Ash Pond	26 December 2022/ Monday	5.34AM (4.6m)
	January	
Buntal Bay	4 January 2023/ Wednesday	4.00PM (4.3m)
Sejingkat Ash Pond	11 January 2023/ Wednesday	7.00AM (4.4m)
Buntal Bay	19 January 2023/ Wednesday	2.00PM (4.2m)
Sejingkat Ash Pond	25 January 2023/ Wednesday	6.00AM (4.9m)
	February	
Buntal Bay	3 February 2023/ Friday	4.00PM (4.2m)
Sejingkat Ash Pond	9 February 2023/ Thursday	6.00AM (4.6m)
Buntal Bay	17 February 2023/ Friday	2.00PM (4.3m)
Sejingkat Ash Pond	23 February 2023/Thursday	6.00AM (5.0m)
	March	
Buntal Bay	4 March 2023/ Saturday	4.00PM (4.2m)

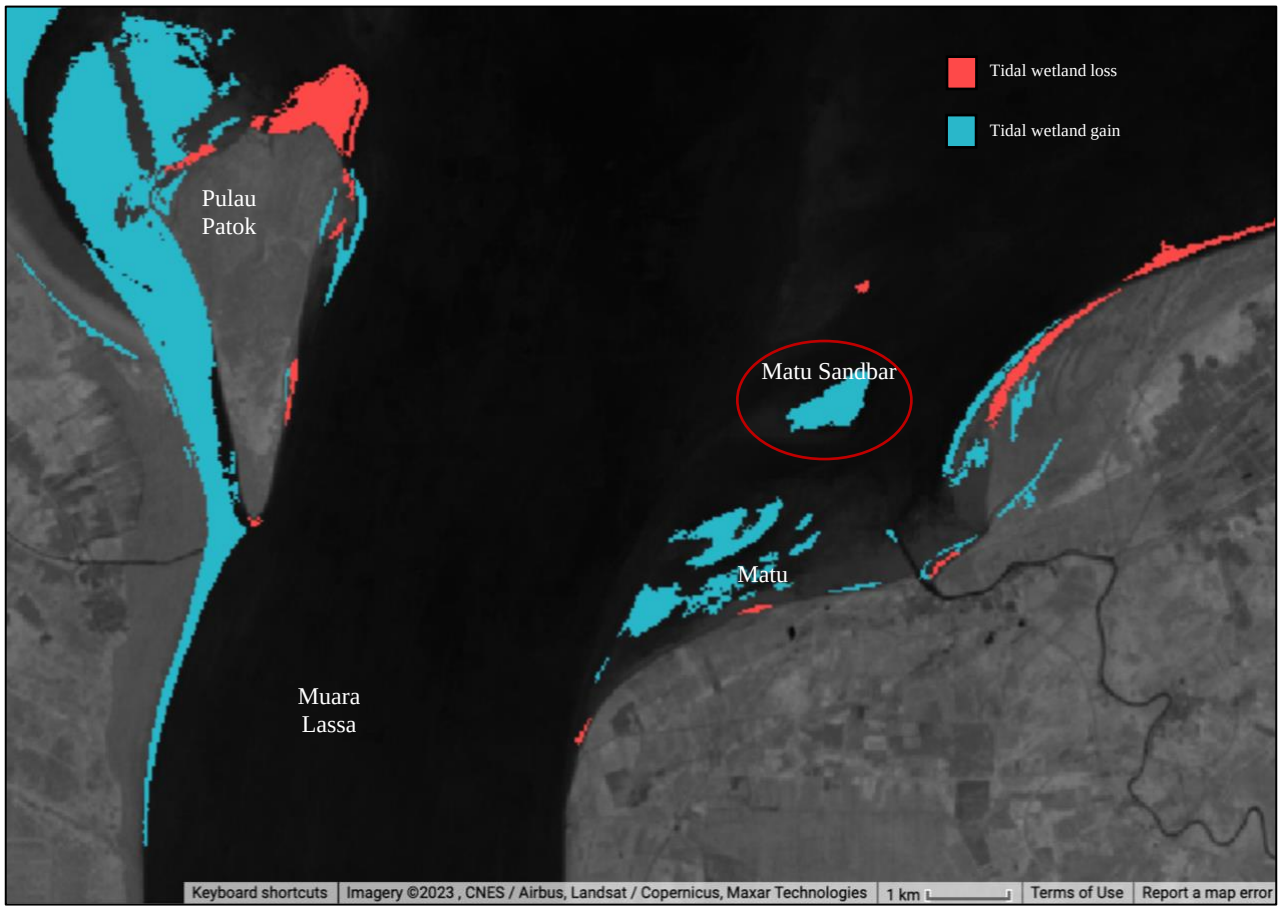
Sejingkat Ash Pond	9 March 2023/ Thursday	6.00AM (4.6m)
Buntal Bay	19 March 2023/ Sunday	3.00PM (4.5m)
Sejingkat Ash Pond	25 March 2023/ Saturday	6.00AM (4.9m)



Map 2. Foraging and roosting sites of Far Eastern Curlew in Buntal Bay and Sejingkat Ash Pond.

Map 2 shows the foraging and roosting sites of Far Eastern Curlew that are known in the Buntal Bay region. The mudflats of Buntal Bay and Rajang delta are known to be among the most important foraging grounds for migratory shorebirds in northern Borneo and Southeast Asia. Besides that, the mudflats of Muara Tebas and Asajaya – Kuala Sadong are also known to serve as foraging grounds for migratory shorebirds. The sandbar in Buntal Bay plays an important role as a roosting site for shorebirds together with the man-made pond, Sejingkat Ash Pond which is located in Kampung Goebilt. The ash ponds belong to the coal powered station of Sarawak Energy Berhad.

An exploratory field survey was conducted for Activity 3 to a site with anecdotal sightings of Far Eastern Curlew. In consultation and discussion with Sarawak Forestry Corporation and local boatmen, the team surveyed for potential a roosting site of Far Eastern Curlew opportunistically while conducting Activity 1. The team managed to find one new roosting site for Far Eastern Curlew at the recently formed Matu Sandbar (Map 3).



Map 3. Exploratory survey at Matu Sandbar (circled in red) with map showing tidal wetland loss and gain at the site between 1999 and 2019 (Murray *et al.* 2022).

Apart from the surveys conducted from November 2022 to March 2023, additional surveys were conducted under Activity 2 in August 2023 (Table 3) where Far Eastern Curlew numbers were documented for two sites (Sejingkat Ash Pond and Buntal Bay).

Table 3. Survey dates for Activity 2 from November 2022 to March 2023.

Site	Date	Time/Tide
Sejingkat Ashpond	05 August 2023/Saturday	7.14AM (5.1m)
Sejingkat Ashpond	06 August 2023/Sunday	7.10AM (4.8m)
Sejingkat Ashpond	07 August 2023/Monday	7.40AM (4.8m)
Buntal Bay	08 August 2023/Tuesday	10.15AM (4.5m)
Buntal Bay	10 August 2023/Thursday	11.00AM (4.0m)

Buntal Bay	11 August 2023/Friday	12.10PM (3.8m)
Buntal Bay	12 August 2023/Saturday	12.12PM (3.6m)
Buntal Bay	13 August 2023/Sunday	1.15PM (3.6m)
Buntal Bay	15 August 2023/Tuesday	3.35PM (4.0m)
Buntal Bay	16 August 2023/Wednesday	4.51PM (4.1m)
Sejingkat Ashpond	17 August 2023/Thursday	6.45AM (4.5m)
Sejingkat Ashpond	18 August 2023/Friday	7.35AM (4.4m)
Sejingkat Ashpond	19 August 2023/Saturday	7.37AM (4.6m)
Buntal Bay	21 August 2023/Monday	9.35AM (4.1m)
Buntal Bay	22 August 2023/Tuesday	10.01AM (3.7m)
Buntal Bay	24 August 2023/Thursday	11.05AM (3.5m)
Buntal Bay	25 August 2023/Friday	10.15AM (4.0m)
Buntal Bay	26 August 2023/Saturday	10.30AM (3.8m)

This survey period coincided with the southern migration of migratory shorebirds. Roosting counts were conducted at high tides during both sites in Buntal Bay (3.5 – 4.5m) and Sejingkat Ash Pond (4.5 – 5.1m) to maximize the opportunity for Far Eastern Curlew observations during August 2023.

Survey methodology

Across all three activities we carried out moving surveys on foot (sites 1,3,5,6), stationary surveys (site 2) and boat-based surveys (sites 3,4,5,6). Observations were carried out using binoculars (10 x 40mm), telescopes (20-60 x 88mm), a digital camera (300mm) and a DSLR camera with telephoto lens (600mm). The counts were carried out with the aid of a mechanical counter where smaller flocks were counted individually and larger flocks of hundreds were estimated in multiples of tens, 50s or 100s. Although the team focused on sightings and identification of Far Eastern Curlew and Eurasian Curlew, identification of other migratory bird species was also undertaken whenever time and tide permitted. We identified birds using relevant field guides (Phillipps & Phillipps 2014, Lee *et al*. 2018). All counts were conducted by a team consisting of at least two experienced surveyors. Habitats, substrate and potential threats were also recorded during the surveys. During surveys we also recorded any sightings of birds with leg flags to help identify migration pathways between Sarawak and other parts of the flyway.

Data compilation

For Buntal Bay and Sejingkat Ash Pond, count results for Far Eastern Curlew and Eurasian Curlew were tabulated as the total number of individuals observed, per site, per survey day

throughout the survey period (November 2022 to March 2023). Data for additional surveys conducted in August 2023 were also tabulated accordingly. For Pulau Patok, Trusan Sundar and Batang Maro, the highest count for Far Eastern Curlew across the two counts was recorded as the maximum number present. All high counts of Far Eastern Curlew were tabulated and compared against all six sites including the Matu Sandbar. Previous data on Far Eastern Curlew numbers were also compiled either through peer-reviewed literature or grey literature (Edwards *et al.* 1986; Mizutani *et al.* 2006; Bakewell *et al.* 2017; Teepol *et al.* 2020) and compared with results from this survey.

We recorded the local population of Far Eastern Curlew and Eurasian Curlew present at Buntal Bay and Sejingkat Ash Pond throughout the survey period (November 2022 to March 2023) using the maximum count of each species from our surveys. Data were compiled using Microsoft Excel and a map of our study site was created using QGIS (QGIS 2020). A map of tidal wetland change between 1999 and 2019 for the newly found roosting site was obtained from Global Intertidal Change (Murray *et al.* 2022) while maps of species distribution for Great Knot and Far Eastern Curlew were sourced from BirdLife International and Lynx Edicions in Birds of the World (Van Gils *et al.* 2020) where we plotted the leg flag sites observed from our surveys on the map. We cross-checked our surveys results against the two IBA criteria: 1) presence of globally threatened species (Criterion A1) and 2) large congregations of more than 1% of global population threshold (Criterion A4) (Donald *et al.* 2019) to assess the importance of each of our survey sites.

Results

Presence of Far Eastern Curlew along the coast of Sarawak

Far Eastern Curlews were present in all six sites surveyed under each activity. The highest counts of Far Eastern Curlews at each site were recorded (Figure 1).

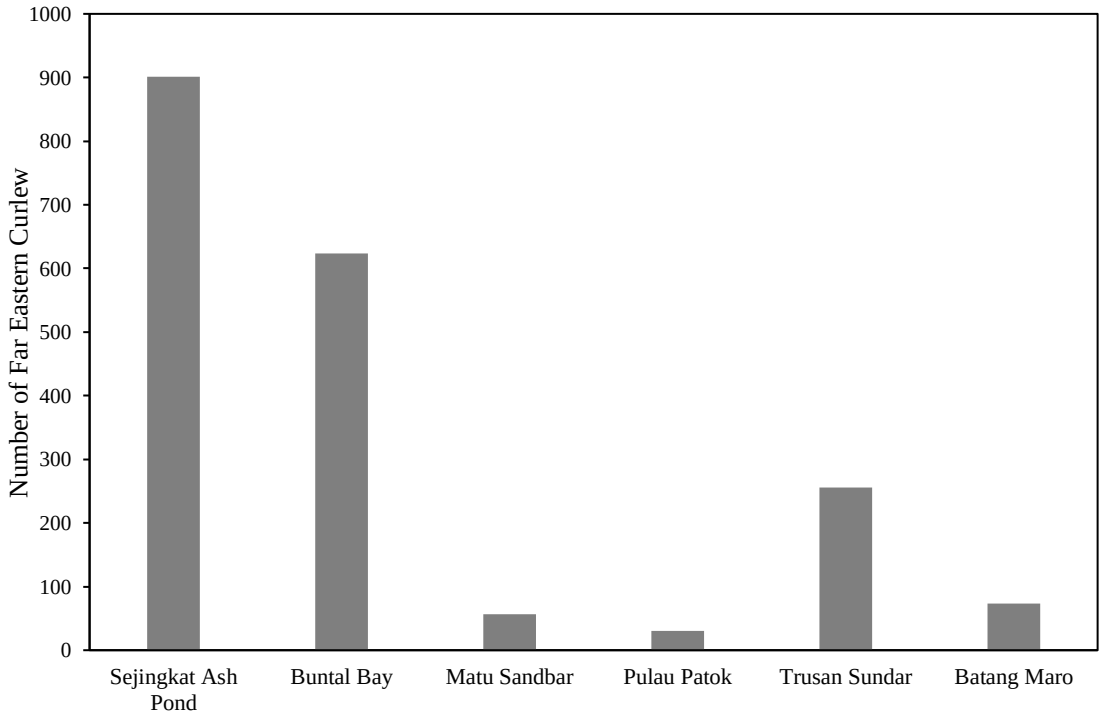


Figure 1. Highest count of Far Eastern Curlew at the six sites surveyed.

Among the six sites, Sejingkat Ash Pond recorded the highest number of Far Eastern Curlew (901), followed by Buntal Bay (623), Trusan Sundar (256), Batang Maro (73), Matu Sandbar (57) and the least count was recorded at Pulau Patok (30). We compiled previous records of Far Eastern Curlews at all six sites to compare counts across time (Table 3).

Table 3. Comparison with previous studies on Far Eastern Curlew counts in Sarawak.

	Edwards et al. (1986)	**Mizutani et al. (2006)**	**Bakewell et al. (2017)**	**Teepol et al. (2020)**	**FEC Survey (2023)**
Sejingkat Ash Pond	N/A	350	790	450	901
Buntal Bay	0	23	8	600	607
Pulau Bruit-Patok (Pulau Patok)	246	26	71	N/A	30
Matu (Matu Sandbar)	0	0	5	N/A	57
Kabong (Batang Maro)	23	77	114	N/A	73
Trusan Sundar	N/A	N/A	89	N/A	256

The highest counts for Far Eastern Curlew for almost all of the studies were from the Sejingkat Ash Pond and generally increased over time with the peak count recorded during our recent survey (901). Counts for Buntal Bay differed greatly and also generally increased over time from a zero count in Edwards *et al.* (1986), 23 individuals in Mizutani *et al.* (2006), 71 in Bakewell *et al.* (2017), 600 in Teepol *et al.* (2020) and a peak count in our recent survey at 607

individuals. The number of Far Eastern Curlew in Pulau Bruit-Patok area showed a rapid localised decline over the years. 246 individuals were recorded in Edwards *et al.* (1986) and only 30 individuals were observed from our recent survey. There were no records of Far Eastern Curlew in Matu during the previous survey except five individuals observed along the coast of Matu (Bakewell *et al.* 2017). The newly formed Matu Sandbar recorded a total of 57 individuals in our study. For Batang Maro which is located within Kabong site, the count increased from 23 individuals (Edwards *et al.* 1986) to highest count of 114 individuals in Bakewell *et al.* (2017). Far Eastern Curlew in Trusan Sundar almost tripled from 89 individuals (Bakewell *et al.* 2017) to 256 individuals in our recent survey.

Counts of Far Eastern Curlew across the non-breeding season at selected sites

The counts from all six sites in Activity 1 were compared in order to observe the changes in number of Far Eastern Curlew between the first and second counts (Figure 2).

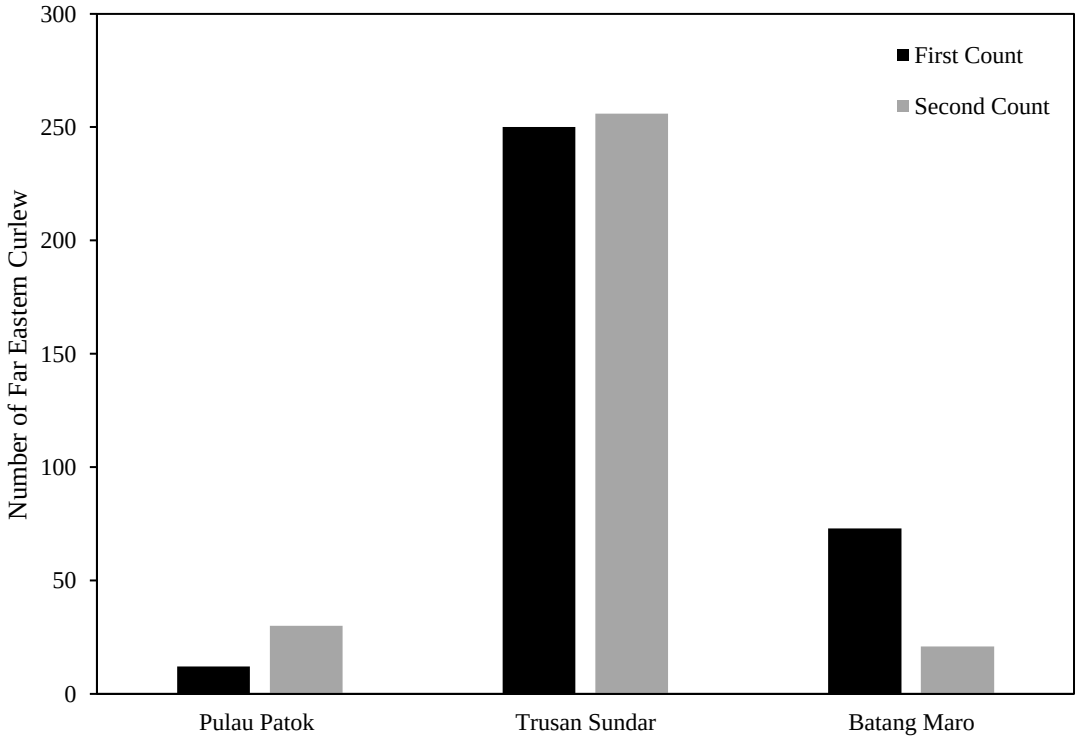


Figure 2. Comparison of Far Eastern Curlew counts at three sites between the first and second counts where counts were conducted during neap high tide periods.

The counts were conducted under similar conditions and tide levels for each site, and similar numbers were recorded. For Pulau Patok, 12 individuals were recorded in December 2022 and 30 individuals were recorded in February 2023. For Trusan Sundar, 250 individuals were recorded in January and 256 in February. For Batang Maro, 73 individuals were sighted in

January but only 21 individuals were recorded in April. The second count for Batang Maro had to be rescheduled from an initial planned survey date in February due to monsoon.

The total number of Far Eastern Curlew and Eurasian Curlew present at Buntal Bay and Sejingkat Ash Pond were recorded from our surveys in Activity 2 throughout the migration and wintering period from November 2022 to April 2023 (Figure 3).

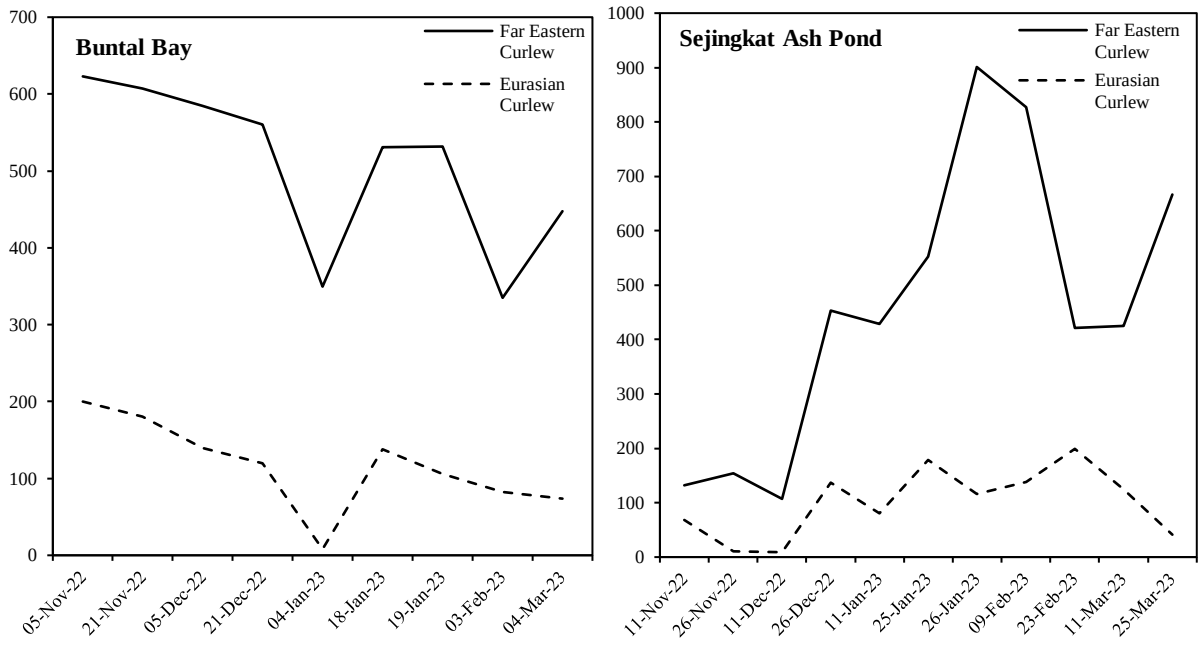


Figure 3. Far Eastern Curlew counts at Buntal Bay and Sejingkat Ash Pond from November 2022 to March 2023.

Weather and tidal conditions were similar across all surveys conducted at both sites, yet there was large variation in Far Eastern Curlew counts between the two sites from November 2022 to March 2023.

The highest single-day counts for Far Eastern Curlew at Buntal Bay was 623 individuals (5 November 2022) and 901 individuals at Sejingkat Ash Pond (26 January 2023). The lowest counts of roosting Far Eastern Curlews throughout this survey period were on 11 December 2022 (107 individuals at Sejingkat) and 3 February 2023 (335 individuals at Buntal Bay). For Buntal Bay, the number of Far Eastern Curlews remained quite consistent with small variations throughout the months (335 – 623 individuals) whereas the number fluctuated greatly in Sejingkat Ash Pond (132 – 901 individuals). Counts of Eurasian Curlew were lower in number than Far Eastern Curlew. Peak counts of Eurasian Curlew were 180 individuals in Buntal Bay

(November 2022) and 199 individuals in Sejingkat Ash Pond (February 2023). The lowest counts for Eurasian Curlew at Buntal Bay and Sejingkat Ash Pond were eight and nine individuals, respectively.

Additional surveys at both Sejingkat Ash Pond and Buntal Bay were conducted throughout August 2023. However, no sightings of Far Eastern Curlew or Eurasian Curlew were observed in Sejingkat Ash Pond. Counts of both curlew species were recorded for Buntal Bay in the month of August (Figure 4).

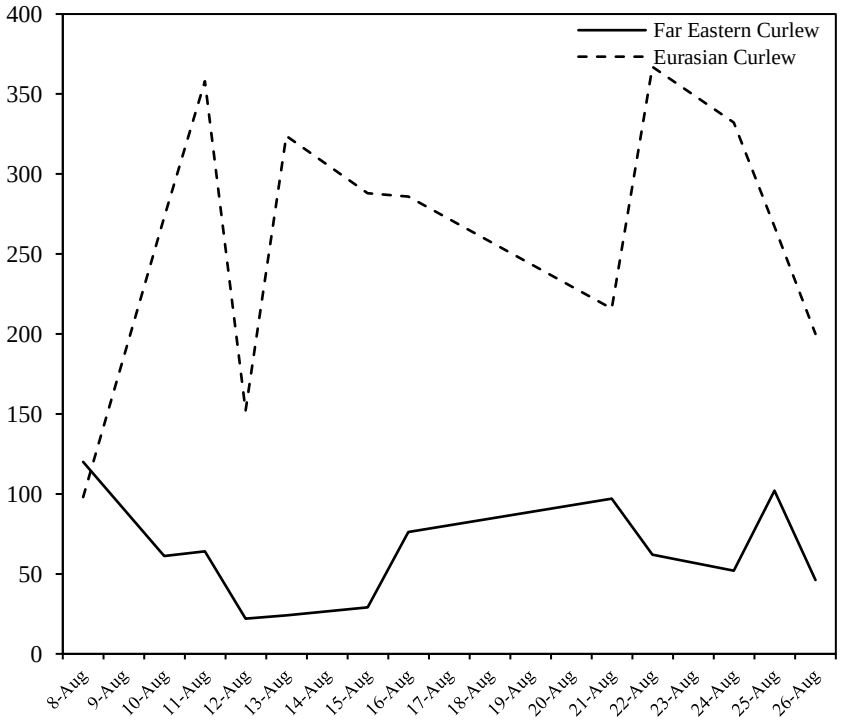


Figure 4. Far Eastern and Eurasian Curlew counts at Buntal Bay in August 2023.

No curlews were observed at Sejingkat Ash Pond throughout August 2023. For Buntal Bay, counts of Eurasian Curlew was more compared to Far Eastern Curlew. For Far Eastern Curlew, the counts ranged between 22 (lowest count) to 120 (highest count) while Eurasian Curlew counts almost quadrupled with the lowest count recorded at 98 and highest at 367. Comparing with the previous counts of Activity 2 (throughout the migration and wintering period from November 2022 to April 2023), the counts in August 2023 showed a higher number of Eurasian Curlew. The highest count for Eurasian Curlew in Buntal Bay was 367 in August 2023 whereas the highest count between November 2022 to April 2023 was 200 individuals.

Reassessment of IBA criteria for selected sites

The IBA programme was formed to determine and provide protection for a group of sites of international significance which are important for the continuity of wild bird populations using a site-based approach (BirdLife International 2006). IBAs have been an important framework in assisting governments and other relevant agencies to focus and identify important sites to be nominated as protected areas (BirdLife International 2014). These sites are identified using four global data-driven criteria (A criteria) which are standardized and used at different levels such as presence of globally threatened species (Criterion A1), range-restricted species (A2), biome-restricted species (A3) and large congregations of more than 1% of global population threshold (A4) (Donald *et al.* 2019).

Based on the Directory of Important Bird Areas in Malaysia: key sites for conservation (Yeap *et al.* 2007), our surveys results are relevant to four IBAs namely, Bako Buntal Bay (MY37), Sadong-Saribas Coast (MY41), Pulau Bruit (MY42) and Brunei Bay (MY55). Our Buntal Bay and Sejingkat Ash Pond survey sites are located within the Bako Buntal Bay IBA; our Batang Maro survey site is located within the Sadong-Saribas Coast IBA; our Pulau Patok and Matu Sandbar sites are included within the Pulau Bruit IBA; and our Trusan Sundar survey site is located within the Brunei Bay IBA. From our counts and observations (Appendix 3), a few additions can be made under the A1 and A4 criteria for these IBAs, Bako Buntal Bay IBA (Table 4), Sadong-Saribas Coast IBA (Table 5), Pulau Bruit IBA (Table 6) and Brunei Bay IBA (Table 7).

Table 4. Bako Buntal Bay IBA with additions to criteria.

Bako Buntal Bay (MY37) Central coordinate: 1.68, 110.42	Our sites within this IBA: Buntal Bay, Sejingkat Ash Pond
A1. Globally Threatened Species	
Nordmann's Greenshank (EN)	7 (Teepol *et al.* 2020), 10 individuals were recorded in our survey at Buntal Bay.
Spoon-billed Sandpiper (CR)	One individual recorded in 2022 (Teepol *et al.* 2023).
Asian Dowitcher (VU)	1 (Teepol *et al.* 2020), 13 individuals were recorded in our survey at Buntal Bay.
Great Knot (EN)	Often observed throughout the IBA (Bakewell *et al.* 2017, Teepol *et al.* 2020, Teepol *et al.* 2023)
A4. Congregations	

Far Eastern Curlew	Reached more than 1% of population threshold (ca. 1.78% in Buntal Bay). Peak count of 901 individuals in Sejingkat Ash Pond (ca. 2.57%)
Nordmann's Greenshank	Reached 1% of population threshold in Buntal Bay at 10 individuals.

Table 5. Sadong-Saribas Coast IBA with additions to criteria.

Sadong-Saribas Coast (MY41) Central coordinate:1.62, 111.07	Our sites within this IBA: Batang Maro
A1. Globally Threatened Species	
Far Eastern Curlew (EN)	73 individuals were recorded during our survey at Batang Maro.
Great Knot (EN)	4 individuals were recorded during our survey at Batang Maro.

Table 6. Pulau Bruit IBA with additions to criteria.

Pulau Bruit (MY42) Central coordinate: 2.78, 111.32	Our sites within this IBA: Pulau Patok, Matu Sandbar
A1. Globally Threatened Species	
Far Eastern Curlew (EN)	30 and 57 individuals were recorded during our survey at Pulau Patok and Matu Sandbar respectively.
Great Knot (EN)	31 individuals were recorded during our survey at Matu Sandbar.

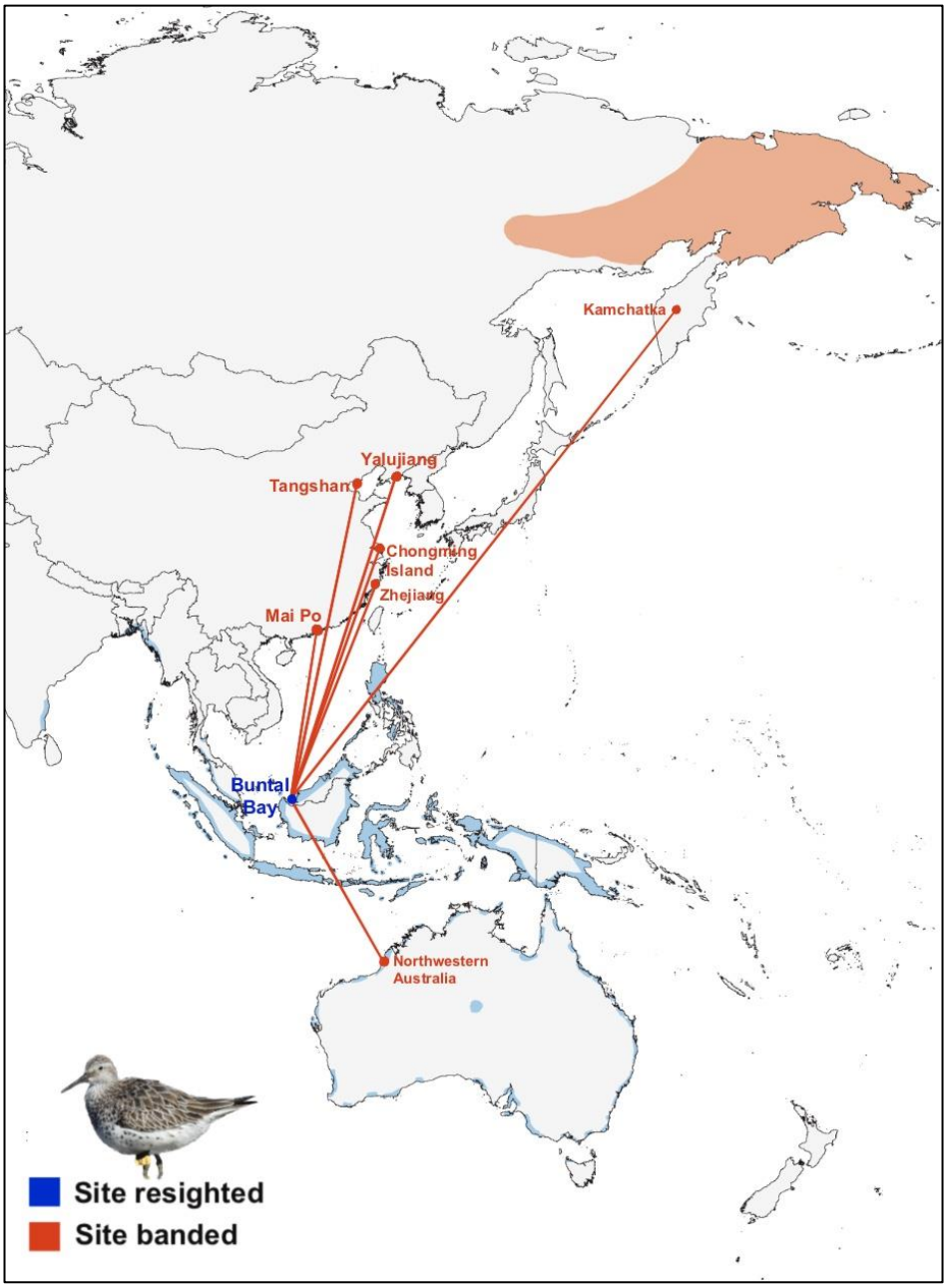
Table 7. Brunei Bay IBA with additions to criteria.

Brunei Bay (MY55) Central coordinate: 4.97, 115.45	Our sites within this IBA: Trusan Sundar
A1. Globally Threatened Species	
Nordmann's Greenshank (EN)	9 individuals were recorded as the highest count during our survey.
Far Eastern Curlew (EN)	256 individuals were recorded during our survey.
Great Knot (EN)	28 individuals were recorded during our survey.

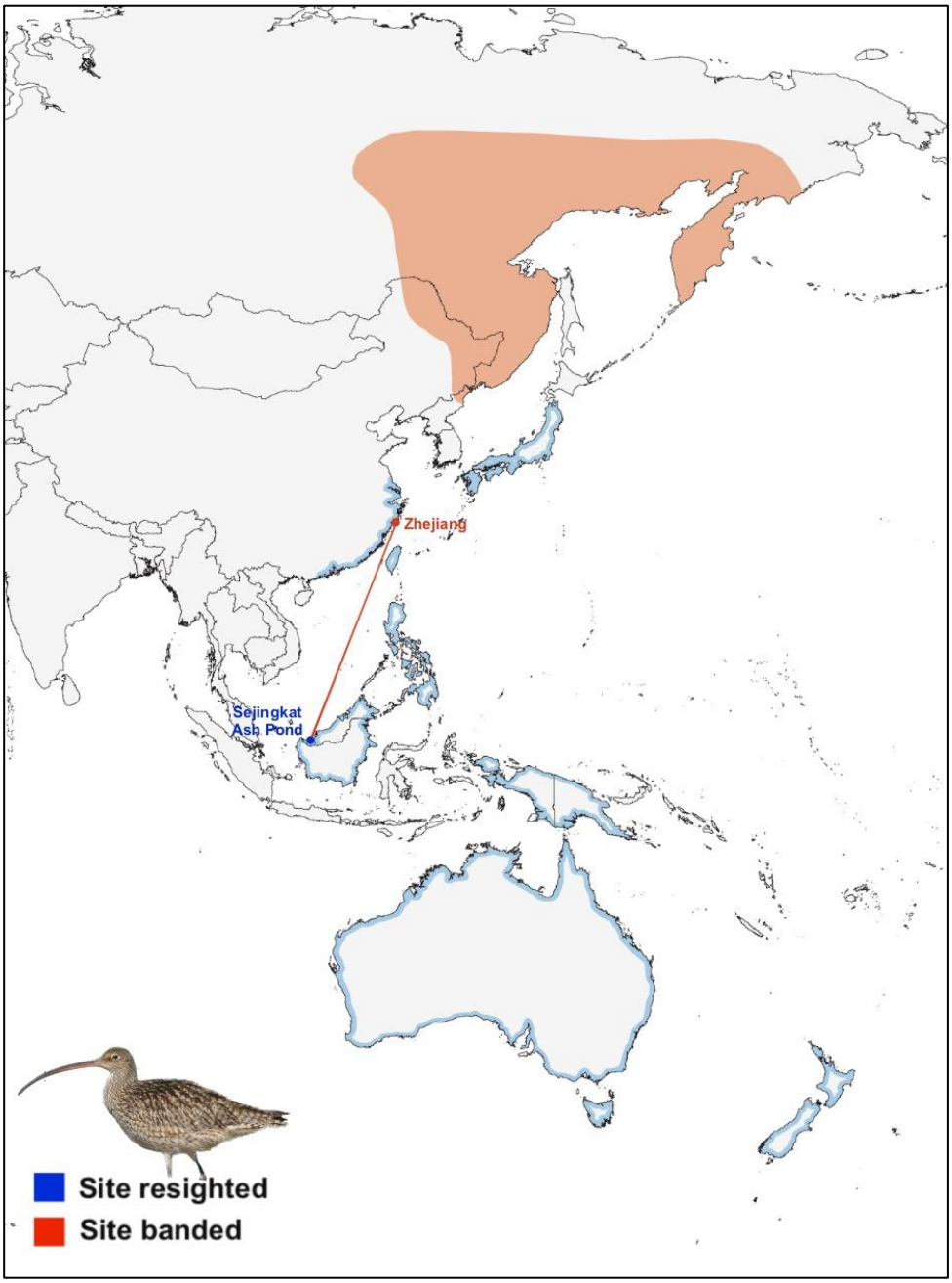
Leg flag resighting

A total of 57 sightings of flagged individuals of eight species (mainly Great Knot) were recorded throughout this study (Appendix 4). Most of the sightings were recorded from Kuching area where 48 sightings of 13 individuals were recorded from Buntal Bay and five

sightings of three individuals were observed in Sejingkat Ash Pond. For Trusan Sundar, two sightings of two species were recorded while one sighting was recorded in both Matu Sandbar and Batang Maro. Most of the sightings involved flagged and banded birds from Kamchatka, Russia (n=17), Mai Po, Hong Kong (n=17), Yalujiang, China (n=9), Chongming Island, China (n=4), Zhejiang, China (n=4), Jiangsu, China (n=3), North Western Australia (n=2) and Bohai Bay, Tangshan, China (n=1). We visualized the movement of two species, Great Knot and Far Eastern Curlew from where the individuals were banded and the site we resighted the individuals on their respective species distribution maps (Map 3,4).



Map 3. Great Knots with leg flags resighted at Buntal Bay (BirdLife International/Lynx Edicions).



Map 4. Far Eastern Curlew with leg flag resighted at Sejingkat Ash Pond (BirdLife International/Lynx Edicions).

Discussion

Far Eastern Curlew distribution along the Sarawak coast

Our surveys substantiate that the coastline of Sarawak is definitely an important stopover and wintering site for Far Eastern Curlew in the region. Previously, three sites in Sarawak namely Kuala Samarahan – Kuala Sadong, Sejingkat Ash Pond and Pulau Bruit were listed as sites of international importance for Far Eastern Curlew (Conklin *et al.* 2014) where one satellite

tracked Far Eastern Curlew which winters in Moreton Bay was reported to stopover at Pulau Bruit site for a few days (Morrick *et al.* 2021). Although the number of Far Eastern Curlew in Pulau Bruit has been declining, our study also shows that Sejingkat Ash Pond remains one of the most important wintering sites for Far Eastern Curlew in Sarawak, with peak numbers recorded during our surveys. This man-made artificial pond harbours more than 1% of the EAAF population of the species (*ca.* 2.57%) followed by Buntal Bay (*ca.* 1.78%). Both sites are crucial for the wintering population of Far Eastern Curlew where Sejingkat is important solely as a high tide roost site whereas Buntal Bay serves as both feeding and roost site. Although the remaining sites did not reach the 1% threshold, the presence of the species was confirmed at all the sites. Previous data showed that the western coast of Sarawak is the most important site for Far Eastern Curlew in the state. However, our surveys conducted in Trusan Sundar provides a different perspective with a significant number of Far Eastern Curlew recorded which is important as it potentially provides new information relevant to shorebird distribution and movement. Through this project we were able to resurvey Batang Maro which is located within the Kuala Samarahan – Kuala Sadong area. This coastline especially Batang Maro site, used to be listed as a potentially important high tide roosting site for Far Eastern Curlew (Bakewell *et al.* 2017), but the area only recorded a small population of Far Eastern Curlew. There are some additional sites (e.g. Kuala Samarahan – Kuala Sadong) that were previously listed as important sites for Far Eastern Curlew which we were unable to visit in the timeframe and could be priorities for future surveys.

From all the six sites surveyed, Sejingkat Ash Pond and Trusan Sundar showed an increase in Far Eastern Curlew numbers. An increase in the local population of this species could indicate changes to local coastal wetlands occurring either naturally or due to human activities. Alternatively, loss of previous roosting sites in the region could contribute to localised increases at other remaining sites.

The maximum counts of Far Eastern Curlew during the southward migration period was 154 and 623 at Sejingkat Ash Pond and Buntal Bay respectively. During the wintering period, the maximum counts for Far Eastern Curlew was 901 at Sejingkat Ash Pond and 585 at Buntal Bay. During the northward migration, the maximum counts were 666 for Sejingkat Ash Pond and 448 for Buntal Bay. The additional surveys in August 2023 recorded 120 individuals in Buntal Bay. Further conclusion can only be done with more focused counts for Far Eastern

Curlew and exploring tracking studies to draw conclusions on the temporal and spatial distribution of this species in Sarawak.

Non-breeding phenology and use of roosting sites in Buntal Bay and Sejingkat Ash Pond.

The movement of shorebirds between feeding and roosting sites is driven by the variation of spring and neap tide heights (Colwell 2010). Neap tides allow shorebirds to continue to forage or roost on upper tidal sandbars, while spring tides cause shorebirds to move from their main coastal feeding grounds (which become inundated) to a neighbouring high tide roost (Rogers *et al.* 2006, Rosa *et al.* 2006, Colwell 2010).

Artificial habitats are known to provide crucial roosting sites for shorebirds in the EAAF (Jackson *et al.* 2020) and the counts of Far Eastern Curlew at Sejingkat Ash Pond confirms the importance of this artificial site for the species in Sarawak. From our coordinated surveys conducted in Buntal Bay and Sejingkat Ash Pond (2 April 2023), the number of Far Eastern Curlews observed were 79 and 351 individuals respectively. The survey was conducted during neap tide (4.4 m). Initially the team planned to conduct coordinated surveys during both neap and spring tides but due to the weather and other safety concerns, the team only managed to count during neap tide. At Sejingkat Ash Pond, the curlews can be seen flying in from different directions – most likely from the other feeding sites, Selabat Mudflats and Asajaya to Sadong area. Curlews at Buntal Bay were likely individuals feeding at the mudflats of Buntal and Bako side (Appendix 5).

During neap tides, the surface of the sandbar at Buntal Bay is still exposed although most of the sandbar is inundated with water forcing the smaller shorebird species to fly off to a nearby high tide roosting site (i.e. the sea rock wall near the village's jetty (Map 3)). The medium and large-sized species either roost on trees (i.e. Terek Sandpiper, Common Redshank) or on the upper section of the sandbar (Knots, Godwits, Nordmann's Greenshanks). The Far Eastern Curlew and Eurasian Curlew prefer to roost on the sandbar even with water reaching up to their tibia. This could suggest that they only move to alternative high tide roost sites such as the Sejingkat Ash Pond when the sandbar is fully inundated. Other species which can be found with these two curlew species are the Nordmann's Greenshank, Grey Plover, Bar-tailed and Black-tailed Godwit as well as the Asian Dowitcher. During the start of ebbing tide, curlews will start to forage in the water and once the mud layers are exposed, they will search for prey by spreading out on the mudflats. This also shows that the upper tidal flats are important

roosting and foraging habitat for shorebirds in order to achieve their daily energy requirement (Mu & Wilcove, 2020).

Our observations provided important insights into detailed site use at the Sejingkat Ash Pond, where we recorded by far the highest counts of Far Eastern Curlew in the region. During the first high tide of the day, which usually occurs between 5.00 to 6.00 a.m., the mixed flock of waders at Sejingkat Ash Pond can be observed roosting in the pond, which led us to suspect that the site is mainly used as an overnight roosting site. Out of the three ponds, only one pond is currently active with wet ash constantly being pumped into the pond which is preferred by the birds. The small overgrown pond at the back of the active pond harbours about a hundred Common Greenshanks and a few Red-necked Stints. Our observations showed that the curlews preferred to be near the water source (i.e. puddle of rain or wet ash drainage) but not directly in contact with the source. No foraging behaviour was observed for curlews but smaller sandpipers and stints were often seen pecking on the surface of the substrate. During ebbing tide, the terns and smaller shorebirds would fly off first whereas the curlews and Whimbrels would usually be the last to fly off unless there were disturbances. Collectively, our observations suggest that management actions taken at the site that affect conditions such as water and vegetation levels have important implications for site use by the birds which differs by species. Management resulting in conditions favoured by Far Eastern Curlew could lead to expanded site use in future, while management resulting in less favourable conditions could lead the birds to abandon the site. Indeed, shorebirds did not roost in the pond previously in 2021 to 2022 when the microalgae facility next to the Sejingkat Ash Pond was still under construction.

During spring tides, seawater may not fully inundate the upper margins of the sandbar which then allows the curlews to remain roosting in Buntal Bay. The energy costs to travel between roosts and foraging areas may be a significant factor impacting Far Eastern Curlews in Sarawak since the nearest high tide roost for curlews is the Sejingkat Ash Pond, which is located about 8 km inland from Buntal Bay. The need to constantly fly a significant distance between roosting and feeding sites as well as flying for protection against predators or anthropogenic disturbances would require them to increase their food intake rate to support increased daily energy requirements.

Timing of Far Eastern Curlew arrival during their non-breeding migration is less documented (Minton *et al.* 2011). The first arrival of Far Eastern Curlew in their main non-breeding site,

Australia is usually documented in late July (Minton *et al.* 2011). The exact arrival period for Far Eastern Curlew in Sarawak is not exactly known but the counts in August indicates the presence of this species in Sarawak starting the month of August. The sightings of Far Eastern Curlew in Buntal Bay for August 2023 are most likely the congregation of early curlew arrivals where Buntal Bay is either their stop-over or non-breeding site. However, it is also possible that the curlews might also be juveniles overwintering in Buntal Bay instead. Although Sejingkat Ash Pond harbours the highest count for Far Eastern Curlew in the previous counts, there were no sighting of Far Eastern Curlew here in August 2023. There is a possibility that the tide was not high enough to inundate the intertidal flats along Sarawak coast or that the curlews in Sejingkat Ash Pond and Buntal Bay are of different population utilizing different roosting habitat.

Flyway connections and movements along the Sarawak coast

One Far Eastern Curlew flagged in Zhejiang, China (Black over White on the left tibia and blue flag over a metal ring on the right tibia) was observed on 5 November 2022 in Buntal Bay. An individual with the same flag combination was observed during several surveys at Sejingkat Ash Pond (11 December 2022, 25 January 2023 and 23 February 2023). We suspect this is likely to be the same individual, although there was no code on the flags that could identify it to an individual level.

A Great Knot flagged in Kamchatka, Russia (Black over Yellow) which was identified as 'A2C' was observed roosting at Matu Sandbar on 19 December 2023. The same individual was observed at Buntal Bay on 4 January 2023 and at Sejingkat Ash Pond on 25 January 2023. This is an important source of information as it provides insights into shorebird movements within Bako Buntal Bay and the coast of Sarawak. A single flagged Great Knot individual (Black over Yellow) identified as '62' which has been observed in Buntal Bay during the previous seasons (first observed on 15 September 2021), reported by Irene Dy at Tanza Navotas, Philippines on 17 August 2022. The same individual was sighted at Buntal Bay on 27 August 2022, and observed in a few of our surveys until our last survey in March (21 March 2023), suggesting that birds in Sarawak have migrated through the Philippines. This shows how important sightings of leg flagged birds are to understand their temporal and spatial movement and the re-sightings confirm the role and importance of each staging and wintering site (Dorofeev & Kazansky 2013).

Threats and changes in important habitat along the coast

Although hunting is recognised to be a severe threat to shorebird populations in Southeast Asia (Gallo-Caijiao *et al.* 2020), there was no evidence of hunting of Far Eastern Curlew or other shorebird species at our six survey sites. All species of Charadriiformes in Sarawak are listed as protected species under the Wild Life Protection Ordinance 1997 (WLPO 1997). However, the shorebirds roosting at Sejingkat Ash Pond are susceptible to disturbances caused by stray dogs where the flock may fly off earlier due to their presence. Throughout our surveys at this site, out of the eleven surveys conducted, there were four occasions when the dogs circled the ponds, which either caused the birds to fly off earlier or stay alert throughout their roosting period. Flocks at both Buntal Bay and Sejingkat Ash Pond are likely to depart roost upon raptor attacks (i.e. Peregrine Falcon). Out of nine surveys conducted , we witnessed such attacks on three occasions, but none of the attacks were successful. This could force the birds to expend a lot of energy by staying in flight during high tide. Besides that, there is a considerable amount of plastic pollution along the coast of Sarawak, especially at high tide and the likelihood of shorebirds ingesting plastics is a concern (Flemming *et al.* 2022). During this migration season, the curlews appeared to be roosting back at Sejingkat Ash Pond. Previously this was a concern because the shorebirds did not roost in the pond when the microalgae facility next to the Sejingkat Ash Pond was under construction during the migration period in 2021 to 2022. Initially, we suspected that perhaps during this period the birds might have roosted in the Kuala Samarahan – Kuala Sadong at Batang Maro site.

Drastic changes in the coastal environment can be seen at a few sites, namely, Pulau Patok, Matu Sandbar and Batang Maro. In Pulau Bruit-Patok area, the canal banks between the Northern Pulau Bruit and Pulau Patok used to be far apart with mudbanks fencing the forest fringe of each island (Mizutani *et al.* 2006). During the surveys conducted throughout this project, we found that the mud in the canal is now connecting the islands while previous mudbanks are now overgrown with forest and eroded forest. During low tide, a small number of Far Eastern Curlew were found foraging on the mudflats whereas Common Greenshanks were observed roosting at the western side of Pulau Patok. As a result, both Northern Pulau Bruit and Pulau Patok are no longer suitable high tide roosts for Far Eastern Curlew.

We found a newly formed sandbar off Matu coast, about 7 km from Pulau Patok where Far Eastern Curlew were observed roosting. This provides an alternative roost for curlews which used to roost at Pulau Bruit-Patok site. The coast along Batang Maro has suffered erosion over

the past few years where the sand was mined for road construction where previously the coastline was reported to harbour a significant number of roosting curlews (Mizutani *et al.* 2006). This potentially makes curlews very vulnerable to any changes in the Sejingkat Ash Pond since it appears to be the only major roost site available in the region during the highest tides. In terms of protection status, only Pulau Bruit National Park (part of the Pulau Bruit IBA) is protected where the park is considered a Totally Protected Area (TPA) under the National Parks and Nature Reserves Ordinance 1998. For the remaining sites, there are no protection status at the moment.

Conclusion and recommendations for future work

Even with an increase of groundwork in Sarawak on migratory shorebirds, there is still a lack of information and data for research on migratory shorebirds in Borneo. Notwithstanding the fact that it is one of the least studied sites within the EAAF, our study confirms the importance of sites along Sarawak coast for wintering shorebirds in the region especially for Far Eastern Curlew. Our re-survey of potentially important sites in Sarawak for Far Eastern Curlew is a stepping stone for additional research on migratory shorebirds in Sarawak. Coordinated counts (i.e. counts at multiple sites which clarify relative site use under different tidal conditions) should be done from the start of migration period to the end of wintering period across all important sites, particularly in Buntal Bay which is most accessible and has the highest recorded numbers of curlew in the region. Surveys at all sites with previous records of Far Eastern Curlew should be conducted at least once every two years to continue monitoring the population and habitat of the species along the coast of Sarawak. Studies on leg-flags banding and satellite tracking should be explored in order to understand the local movements and habitat utilisation of shorebirds within the region and the flyway (Chan *et al.* 2019). Tracking studies are still lacking as there are still hundreds of Far Eastern Curlews observed along Sarawak coast without data or information on movement along the flyway and within the island of Borneo itself.

Moving forward, study on habitat utilisation and hands on site management of Sejingkat Ash Pond should be done collaboratively with Sarawak Energy Berhad to establish long-term plans to conserve and manage one of the most important high tide roosting sites for Far Eastern Curlew in the entire flyway. Data on management of artificial roosting sites and movement of shorebirds would be especially important in decision making for policy and protection of sites. Malaysian Nature Society Kuching Branch and Sarawak Forestry Corporation must continue

collaborative efforts on community engagement, public awareness and shorebird research and conservation in Sarawak. As this project can only be completed with the support from the Convention on Migratory Species of Wild Animals (CMS), this is a good opportunity for future collaboration for Sarawak or the rest of the Malaysian counterparts – Peninsular Malaysia and Sabah. This is also an opportune time for Malaysia to explore the potentiality in joining CMS as a party and be further committed to the conservation of migratory species in Malaysia.

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Appendix 1. Activity timeline

Activity	October 2022	November 2022	December 2022	January 2023	February 2023	March 2023	April 2023	May 2023	June 2023	July 2023	August 2023
Activity 1 – Re-survey and reassess the potentially important wetland sites for Far Eastern Curlew along the coasts of Sarawak, Malaysian Borneo											
Activity 2 – Conduct detailed observations of Far Eastern Curlews in the Buntal Bay and Sejingkat Ash Pond											
Activity 3 – Exploratory field surveys to sites with potential sightings of Far Eastern Curlew											
Activity 4 – Data analysis and report writing											

Reports	**Date**
Interim progress and financial reports	31 January 2023
Final progress and financial reports	15 September 2023

Appendix 2. Counts of Far Eastern Curlew at Sejingkat Ash Pond and Buntal Bay under activity 2.

Date	Sejingkat Ash Pond	Date	Buntal Bay
11-Nov-22	132	05-Nov-22	623
26-Nov-22	154	21-Nov-22	607
11-Dec-22	107	05-Dec-22	585
26-Dec-22	453	21-Dec-22	560
11-Jan-23	429	04-Jan-23	350
25-Jan-23	553	18-Jan-23	531
26-Jan-23	901	19-Jan-23	532
09-Feb-23	827	03-Feb-23	335
23-Feb-23	421	04-Mar-23	448
11-Mar-23	425		
25-Mar-23	666		

Appendix 3. Maximum counts of Nordmann's Greenshank, Great Knot and Asian Dowitcher at all six sites surveyed.

Site	Buntal Bay	Sejingkat Ash Pond	Trusan Sundar	Batang Maro	Matu Sandbar	Pulau Patok
Nordmann's Greenshank	10	2	9	1	N/A	N/A
Great Knot	2146	110	42	4	31	N/A
Asian Dowitcher	11	N/A	N/A	N/A	N/A	N/A

Appendix 4. Additional counts of Far Eastern Curlew at Buntal Bay under activity 2 in August 2023.

Date	Far Eastern Curlew	Eurasian Curlew
8-Aug-23	120	98
10-Aug-23	61	273
11-Aug-23	64	358
12-Aug-23	22	152
13-Aug-23	24	324
15-Aug-23	29	288
16-Aug-23	76	286
21-Aug-23	97	216
22-Aug-23	62	367
24-Aug-23	52	332
25-Aug-23	102	267
26-Aug-23	46	200

Appendix 5. List of leg-flagged birds recorded during our surveys.

Species	Date	Site	Leg Flag	Site Banded	Code
Broad-billed Sandpiper	13-Feb-23	Trusan Sundar	Black over Yellow	Kamchatka, Russia	
Far Eastern Curlew	11-Dec-22	Sejingkat Ash Pond	Black over White (Left), Blue flag (Right)	Zhejiang, China	
Far Eastern Curlew	25-Jan-23	Sejingkat Ash Pond	Black over White (Left), Blue flag (Right)	Zhejiang, China	
Far Eastern Curlew	23-Feb-23	Sejingkat Ash Pond	Black over White (Left), Blue flag (Right)	Zhejiang, China	
Great Knot	21-Nov-22	Buntal Bay	White over Yellow	Mai Po, Hong Kong	H0
Great Knot	21-Nov-22	Buntal Bay	Black over Yellow	Kamchatka, Russia	V9
Great Knot	21-Nov-22	Buntal Bay	Black over Yellow	Kamchatka, Russia	AYZ
Great Knot	21-Nov-22	Buntal Bay	Green over Orange	Yalujiang, China	A00
Great Knot	21-Nov-22	Buntal Bay	Green over Orange	Yalujiang, China	HN
Great knot	05-Dec-22	Buntal Bay	White over Yellow	Mai Po, Hong Kong	E8
Great Knot	05-Dec-22	Buntal Bay	Black over Yellow	Kamchatka, Russia	AYZ
Great Knot	05-Dec-22	Buntal Bay	Green over Orange	Yalujiang, China	HN
Great Knot	05-Dec-22	Buntal Bay	White over Yellow	Mai Po, Hong Kong	H0
Great Knot	05-Dec-22	Buntal Bay	Black over Yellow	Kamchatka, Russia	62
Great Knot	21-Dec-22	Buntal Bay	Black over Yellow	Kamchatka, Russia	V9
Great Knot	21-Dec-22	Buntal Bay	Green over Orange	Yalujiang, China	HN
Great Knot	21-Dec-22	Buntal Bay	White over Yellow	Mai Po, Hong Kong	H0
Great Knot	21-Dec-22	Buntal Bay	Black over Yellow	Kamchatka, Russia	62
Great Knot	21-Dec-22	Buntal Bay	Blue Ring, Yellow flag	Bohai Bay, Tangshan, China	B67
Great Knot	21-Dec-22	Buntal Bay	Single Yellow	North Western Australia	
Great Knot	04-Jan-23	Buntal Bay	Black over Yellow	Kamchatka, Russia	V9
Great Knot	04-Jan-23	Buntal Bay	Black over Yellow	Kamchatka, Russia	A2C
Great Knot	19-Jan-23	Buntal Bay	Black over Yellow	Kamchatka, Russia	
Great Knot	19-Jan-23	Buntal Bay	Black over Yellow	Kamchatka, Russia	62
Great Knot	19-Jan-23	Buntal Bay	Black over Yellow	Kamchatka, Russia	AYZ
Great Knot	19-Jan-23	Buntal Bay	White over Yellow	Mai Po, Hong Kong	E8
Great Knot	25-Jan-23	Sejingkat Ash Pond	Black over Yellow	Kamchatka, Russia	A2C
Great Knot	03-Feb-23	Buntal Bay	Black over White	Chongming Island, China	AK2
Great Knot	03-Feb-23	Buntal Bay	Black over White	Chongming Island, China	AU7
Great Knot	03-Feb-23	Buntal Bay	White over Yellow	Mai Po, Hong Kong	E8
Great Knot	03-Feb-23	Buntal Bay	White over Yellow	Mai Po, Hong Kong	H1
Great Knot	03-Feb-23	Buntal Bay	Green over Orange	Yalujiang, China	HN
Great Knot	04-Mar-23	Buntal Bay	Green over Orange	Yalujiang, China	A00
Great Knot	04-Mar-23	Buntal Bay	Black over White	Chongming Island, China	AK2
Great Knot	04-Mar-23	Buntal Bay	Black over Yellow	Kamchatka, Russia	AYZ

Great Knot	04-Mar-23	Buntal Bay	White over Yellow	Mai Po, Hong Kong	E8
Great Knot	04-Mar-23	Buntal Bay	White over Yellow	Mai Po, Hong Kong	H0
Great Knot	04-Mar-23	Buntal Bay	Green over Orange	Yalujiang, China	HN
Great Knot	04-Mar-23	Buntal Bay	Single Yellow	North Western Australia	
Great Knot	04-Mar-23	Buntal Bay	Green over Blue	Jiangsu, China	
Great Knot	20-Mar-23	Buntal Bay	Black over Yellow	Kamchatka, Russia	AYZ
Great Knot	20-Mar-23	Buntal Bay	Green over Orange	Yalujiang, China	HN
Great Knot	20-Mar-23	Buntal Bay	Green over Blue	Jiangsu, China	
Great Knot	21-Mar-23	Buntal Bay	Black over Yellow	Kamchatka, Russia	62
Great Knot	21-Mar-23	Buntal Bay	White over Yellow	Mai Po, Hong Kong	H0
Great Knot	21-Mar-23	Buntal Bay	White over Yellow	Mai Po, Hong Kong	H1
Great Knot	21-Mar-23	Buntal Bay	Green over Orange	Yalujiang, China	HN
Great Knot	19-Dec-22	Matu Sandbar	Black over Yellow	Kamchatka, Russia	A2C
Greater Sand Plover	21-Nov-22	Buntal Bay	White over Yellow	Mai Po, Hong Kong	R0
Greater Sand Plover	19-Jan-23	Buntal Bay	White over Yellow	Mai Po, Hong Kong	R0
Greater Sand Plover	03-Feb-23	Buntal Bay	White over Yellow	Mai Po, Hong Kong	R0
Greater Sand Plover	21-Mar-23	Buntal Bay	White over Yellow	Mai Po, Hong Kong	R0
Lesser Sand Plover	13-Feb-23	Trusan Sundar	Green over Blue	Jiangsu, China	03X
Red-necked Stint	04-Jan-23	Buntal Bay	Black over White	Chongming Island, China	
Terek Sandpiper	05-Apr-23	Batang Maro	Black over White (Left), Blue flag (Right)	Zhejiang, China	
Whimbrel	25-Jan-23	Sejingkat Ash Pond	White over Yellow	Mai Po, Hong Kong	U9
Whimbrel	23-Feb-23	Sejingkat Ash Pond	White over Yellow	Mai Po, Hong Kong	U9

Appendix 6. Map showing potential movements of Far Eastern Curlew from feeding sites to roost sites.

Appendix 7. Photographs taken throughout the entire project.

Photo 1. Curlews roosting at Sejingkat Ash Pond (Credit: Daniel Kong).

Photo 2. Curlews in flight at Buntal Bay (Credit: Daniel Kong).

Photo 3. Far Eastern Curlew roosting at Buntal Bay (Credit: Daniel Kong).

Photo 4. Far Eastern Curlew in flight at Buntal Bay (Credit: Daniel Kong).

Photo 5. Far Eastern Curlew in flight (Credit: Daniel Kong).

Photo 6. Flagged Far Eastern Curlew, Black over White (Left), Blue flag (Right), flagged in Zhejiang, China (Credit: Batrisyia Teepol).

Photo 7. Conducting survey at Trusan Sundar (Credit: Daniel Kong).

Photo 8. Conducting survey at Matu Sandbar (Credit: Daniel Kong).

Photo 9. Surveying the site at Pulau Patok (Credit: Batrisyia Teepol).

Photo 10. Surveying site at Pulau Patok (Credit: Batrisyia Teepol).

Photo 11. Curlews with Bar-tailed Godwit and Terek Sandpiper at Batang Maro (Credit: Batrisyia Teepol).

Photo 12. Mixed Curlews roosting at the back in Trusan Sundar (Credit: Batrisyia Teepol).

Photo 13. Far Eastern Curlew roosting at Buntal Bay (Credit: Batrisyia Teepol).

Photo 14. Far Eastern Curlew preening at Buntal Bay (Credit: Batrisyia Teepol).

Photo 15. Mixed shorebirds roosting at Buntal Bay (Credit: Batrisyia Teepol).

Photo 15. Sejingkat Ash Pond (Credit: Batrisyia Teepol).

Photo 16. Plastic pollution observed when the tide rises (Credit: Batrisyia Teepol).

Photo 17. Curlews roosting at Buntal Bay (Credit: Batrisyia Teepol).

Photo 18. Rare visitors, Red-necked Phalaropes observed at Buntal Bay (Credit: Batrisyia Teepol).

Photo 20. Flagged Great Knot Black over Yellow, flagged in Kamchatka, Russia (Credit: Batrisyia Teepol).

Photo 20. Great Knot flagged in Mai Po, Hong Kong (Credit: Batrisyia Teepol).

Photo 21. Nordmann’s Greenshank at Buntal Bay (Credit: Batrisyia Teepol).

Photo 22. Bar-tailed Godwits at Buntal Bay (Credit: Daniel Kong).

Photo 23. Curlews roosting among other shorebirds at Buntal Bay (Credit: Batrisyia Teepol).