



Systematic Exploration of the South-east Cambodia Coastline to Determine Priority Sites for Migratory Waterbird Conservation

Project Report to the Oriental Bird Club and AEC



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Abbreviations

BCST	Bird Conservation Society of Thailand
CFi	Community fishery
CSR1	Conservation Status Review of the EAAFP, 1 st edition
EAAF	East Asian-Australasian Flyway
EAAFP	East Asian-Australasian Flyway Partnership
IBA	Important Bird and Biodiversity Area
KBA	Key Biodiversity Area
MOE	Ministry of Environment
NBSAP	National Biodiversity Strategies and Action Plan
NESAP	National Environment Strategy and Action Plan
NPASMP	National Protected Area Strategic Management Plan
NLC	NatureLife Cambodia
NT	Near Threatened
RSPB	Royal Society for the Protection of Nature
WPE5	Waterbird Population Estimates 5 th edition.

Executive Summary

The use of the Cambodian coastline by migratory shorebirds in the East Asian-Australasian Flyway is poorly understood. To date, there is only two wetland sites; Koh Kapik, a Ramsar site (Koh Kong Province) and Anlung Pring Protected Landscape, a Flyway Network Site (Kampot Province) currently known to host significant congregations of migratory shorebirds, including threatened species such as the Spotted Greenshank (EN) and Great Knot (VU). There are still considerable gaps in knowledge on the distribution of shorebirds on the Cambodian coastline, especially in south-east (SE) Cambodia where there has been limited survey work historically.

The aim of our project is to improve knowledge on the distribution and status of threatened shorebirds in south-eastern Cambodia, with the long-term objective of identifying new Flyway Network Sites (under the East Asian-Australasian Flyway Partnership), potential Ramsar Sites and Important Bird and Biodiversity Areas (IBA), and is well aligned to the conservation priorities of the national strategies and initiatives such as National Environment Strategy and Action Plan 2016–2023 (NESAP), the National Biodiversity Strategies and Action Plan (NBSAP), the National Protected Area Strategic Management Plan 2017-2031 (NPASMP), as well as the East Asian-Australasian Flyway Partnership and BirdLife International. To this effect, we conducted field surveys on land and by boat along the coastline of Kampot and Kep provinces towards the Cambodia-Vietnam international border from 4-8 February 2023, in collaboration with the provincial Department of Environment in Kampot and Kep. Our field work spanned eight coastal landscapes of salt pans, aquaculture, mangroves and intertidal flats across 50 km of the Cambodian coastline.

We found that the salt pans at Chum Kriel, Kampot were used by significant congregations of waterbirds representing more than 20 species. The salt pans are likely used as a high tide roost and foraging area (for some species), with birds likely dispersing to feed on the intertidal flats off Trapeang Sangkae. Our field work here found moderate congregations of small shorebirds such as Red-necked Stint (NT), Long-toed Stint, Broad-billed Sandpiper, as are Lesser and Greater Sand-plovers, and Kentish Plovers. Marsh Sandpipers were regularly present at the salt pans in small flocks. In Trapeang Sangkae at the estuary of the Tuek Chhu, we found large flocks of shorebirds, with more than 1,200 individuals counted, including Eurasian Curlew (NT), Bar-tailed Godwit (NT), and large congregations of Lesser Sand-plover (>500 individuals, or easily 1.7% of flyway congregations). In Kep province, our surveys showed that the coast of Angkaol to be of potential significance for migratory species. The extensive mangrove, seagrass and mudflat-lined coastline along Angkaol supported nearly 1,000 waterbirds of 20 species. This included Eurasian Curlew, Bar-tailed Godwit, as well as mixed flocks consisting of Red-necked Stint, Broad-billed Sandpiper and sand-plovers (more than 75% of all shorebirds counted). There were also moderate congregations of three terns, Whiskered, Common, and Caspian Tern.

Our project shows that the intertidal mudflats of the Tuek Chhu estuary at Trapeang Sangkae is of flyway-level significance for migratory species in the EAAF and is potentially an EAAFP Flyway Network Site, having met Criterion 2 and Criterion 6 for the Convention on Wetlands of International Importance for at least one species, the Lesser Sand-plover. Our field work showed that the coastal wetlands of SE Cambodia are likely regionally important for shorebird

conservation. An important measure for coastal wetland conservation is designing biodiversity-rich areas as protected areas and enabling human communities to use wetlands in a sustainable manner to ensure the functions and services of the wetland ecosystem are maintained. We recommend continued field work over the winter of 2023-2024 to establish and further study the importance of the coastal wetlands at Trapeang Sangkae, Chum Kriel and Angkaol for long-term management for its migratory species, and wetlands.

1. Project background

1.1. Status of migratory shorebirds in Cambodia

Shorebirds are among the most threatened groups of migratory birds in the East Asian-Australasian Flyway (EAAF). Habitat loss in staging and wintering sites across the flyway, coupled with illegal hunting in many coast parts of East and Southeast Asia, is thought to have driven the rapid declines of many species. The majority of EAAF shorebirds are now globally threatened or near threatened, and the populations of many species continue to decline. Yet, the wintering distribution and staging sites of many species are still inadequately known, especially in Southeast Asia and potentially important areas of wetlands for migratory waterbirds continually get discovered (Chan et al. 2020).

The use of the Cambodian coastline by migratory shorebirds is extremely poorly known, and there are two coastal wetland sites (Koh Kapik Ramsar Site in Koh Kong Province and Anlung Pring Protected Landscape in Kampot Province) known to host significant extent of coastal wetlands and migratory shorebirds, including several threatened species such as Spotted Greenshank *Tringa guttifer* and Great Knot *Calidris tenuirostris*. There are also many extensive areas of muddy and sandy coasts in south-east Cambodia (Kep, Kampot and Preah Sihanouk province) that have never been systematically surveyed, as well as extensive stretches of salt pans very similar to those in Thailand and Vietnam which are known to be utilised by shorebirds.

The coastline of Kampot and Kep provinces span almost 80 km from the west to the Cambodia-Vietnam international border. This complex, and little-surveyed coastline contains a mosaic of natural wetlands such as estuarine mangroves and intertidal mudflat to areas of fishponds and salt pans, and are of clear conservation interest. Two of the largest areas of wetlands can be found at the coast on the mouth of the Tuek Chhu River south of Kampot provincial town where there are extensive areas of sandy shoals, mudflats, mangrove patches, and fishponds, and a mosaic of salt pans, sandy coastline and mangroves east of Kep provincial town.

In 2017-2018, we undertook a series of systematic surveys of the south-west Cambodian coast (Koh Kapik Ramsar Site, Koh Kong Province) to identify congregations of shorebirds with a focus on threatened species. We carried out standardised surveys over a period of five months with international experts from the Bird Conservation Society of Thailand (BCST), BirdLife International, and with technical support from the Royal Society for Protection of Birds (RSPB). Through these surveys, we discovered and identified important congregations of threatened and near threatened species, including some of the highest counts of Chinese Egret *Egretta eulophotes* (c. 20 individuals, reaching 1% of the global population) on the Cambodian coastline, as well as Great Knot *Calidris tenuirostris*, Spotted Greenshank and Malaysian Plover *Charadrius peronii* (a new national record then) (Anon 2018; Taing 2018; Anon 2021). From 2019-2020, we surveyed local people to understand the extent (and impacts) of illegal bird hunting in Koh Kapik (see Yong et al. 2022), whilst building strong relationships with coastal communities and government officers managing the Ramsar Site.

The aim of this project is to improve our knowledge of threatened shorebirds in south-eastern Cambodia, with the objective of identifying new Important Birds and Biodiversity Areas (IBAs) and potential Flyway Network Sites (under the East Asian-Australasian Flyway Partnership) and is well aligned to both the conservation priorities of the Cambodia's national strategy plans including the NESAP, NBSAP and NPASMP, and BirdLife International in the Indochinese region, as well as the East Asian-Australasian Flyway Partnership.

1.2. Key threatened wintering shorebird species in Cambodia

Spotted Greenshank *Tringa guttifer* (Endangered) – A highly threatened shorebird known to occur in Cambodia's coastline as a winter visitor, with counts of nearly 20 individuals (3% of the world population). Small numbers have been documented in our surveys in south-west Cambodia (Koh Kapik Ramsar Site, Koh Kong; Anon 2021), and field work by other teams have identified small wintering congregations on the Vietnamese Mekong delta to the east of our field sites (3-5 individuals, Bao, N.H., Yong, D.L. in litt. 2020). The species' usage of the south-east Cambodian coast is unknown, but the birds likely occur here in muddy coasts, and potentially in salt pans as roosts as they do in Thailand.

Great Knot *Calidris tenuirostris* (Endangered) – A highly threatened shorebird known to occur along Cambodia's coastline as a winter visitor. Small numbers have been documented in our surveys in south-west Cambodia (Koh Kapik Ramsar Site, Koh Kong), and field work by other teams have identified large congregations passing through, or wintering in the Vietnamese Mekong delta (>2,000 individuals, Bao, N.H., Yong, D.L. in litt. 2020). The species' usage of the south-east Cambodian coast is unknown, but the birds likely occur here in muddy coasts, and potentially in salt pans.

Spoon-billed Sandpiper *Calidris pygmaeus* (Critically Endangered) – The most threatened shorebird in the East Asian-Australasian Flyway. The species has been recorded once in south-west Cambodia (Koh Kapik Ramsar Site, Koh Kong) in 2013, the most recent of such records. Surveys have found the species in salt pans in Thailand (Khok Kham, Pak Thale, Khlong Tamru) and adjoining areas of Vietnam (Can Gio, La Gi), and it is highly likely that the species occurs undetected in south-east Cambodia, perhaps mixed with large flocks of plovers and stints foraging in salt pans.

Chinese Egret *Egretta eulophotes* (Vulnerable) – A small number of this species is known to visit the coast of Cambodia annually. Our surveys in 2017-2018 found the largest congregations of the species to date in the country (see Taing 2018), with as many as 20 individuals counted over 5 km of coastline in Koh Kong.

Asian Dowitcher *Limnodramus semipalmatus* (Near Threatened) – A few individuals of this species were detected in our earlier surveys in Koh Kong (Anon 2021). The species is expected to occur in south-east Cambodia, given a similar coastal environment, and that other field projects have found the species in adjacent areas of the Vietnamese Mekong Delta and the Gulf of Thailand. The species is in decline and may be up-listed on the IUCN Red List in coming years.

White-faced Plover *Charadrius dealbatus* (Data Deficient)¹ – A poorly known taxa, formerly thought to be largely a winter visitor to Southeast Asian coasts; identification is confused due to similarity with commoner Kentish Plover. Recent surveys in the Vietnamese Mekong Delta have found a breeding population, and the species likely occurs in Cambodia as a breeder.

1.3. Delivering on project outcomes

The four objectives for our project are:

- To determine how migratory shorebird species use different types of coastal wetlands (e.g., mudflats, sandflats, mangroves, salt pans) on the south-east Cambodian coast
- To identify and assess potential areas of wetlands as Important Bird and Biodiversity Areas (IBAs) for migratory waterbirds
- To determine the conservation measures needed to protect key areas of coastal wetlands for migratory waterbirds on the south-east Cambodian coast, in consultation with local communities.
- To identify potential EAAFP Flyway Network Sites in Cambodia.

Table 1. Project objectives and indicators.

Outcomes	Indicators	Means of verification	Risks
1. To obtain a better understanding of the current and potential importance of the wetlands on the south-east Cambodian coastline to migratory shorebird conservation, and the impact of threats if not addressed. All-important sites will be identified (following both standardised IBA and KBA criteria), and conservation measures proscribed.	(a) Field surveys covering 3 sites completed by end-2020, and covering two survey periods (passage and mid-winter). (b) Data on migratory shorebirds and site characteristics compiled and assessed against KBA and IBA criteria, and relevant datasets (e.g. WPE5).	(i) Project report completed and shared with Oriental Bird Club, and other necessary conservation organisations. (ii) Coastal IBA/KBA for Cambodia updated on relevant databases, including the global KBA database.	Delays in delivery and completion of field work due to coronavirus-related disruptions (high risk) Disruptions due to bad weather (moderate risk)
2. Strengthened science and knowledge base on the distribution of waterbirds, especially EAAF shorebirds, in Cambodia	(a) Data on migratory shorebirds and site characteristics compiled and assessed against KBA and IBA criteria. (b) Data on migratory shorebirds analysed. Key localities for shorebird congregations mapped.	(i) At least one article written and published in a relevant peer-reviewed journal (conservation and ornithology).	Lack of technical support (low risk)

¹ <http://datazone.birdlife.org/species/factsheet/white-faced-plover-charadrius-dealbatus>

<p>3. National and sub-national level government bodies to be made aware of the significance of the south-east Cambodian coast's wetlands for the East Asian-Australasian Flyway, some areas of which may be potentially be identified as EAAF Network sites.</p>	<p>(a) Results of project findings reported to relevant government agencies, particularly the Ministry of Environment.</p> <p>(b) Results of project findings reported to the East Asian-Australasian Flyway Partnership.</p> <p>(c) Results of project published on social media platforms.</p>	<p>(i) Project report compiled and submitted to Ministry of Environment, with clear recommendations for conservation of coastal wetlands.</p> <p>(ii) Social media updates (>5 posts) published on relevant platforms to showcase findings, and profile the work of the Oriental Bird Club.</p>	<p>Delays in delivery and completion of field work due to coronavirus-related disruptions (high risk)</p>
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2. Specific updates on progress made towards the objectives listed in the project proposal

2.1. Study sites

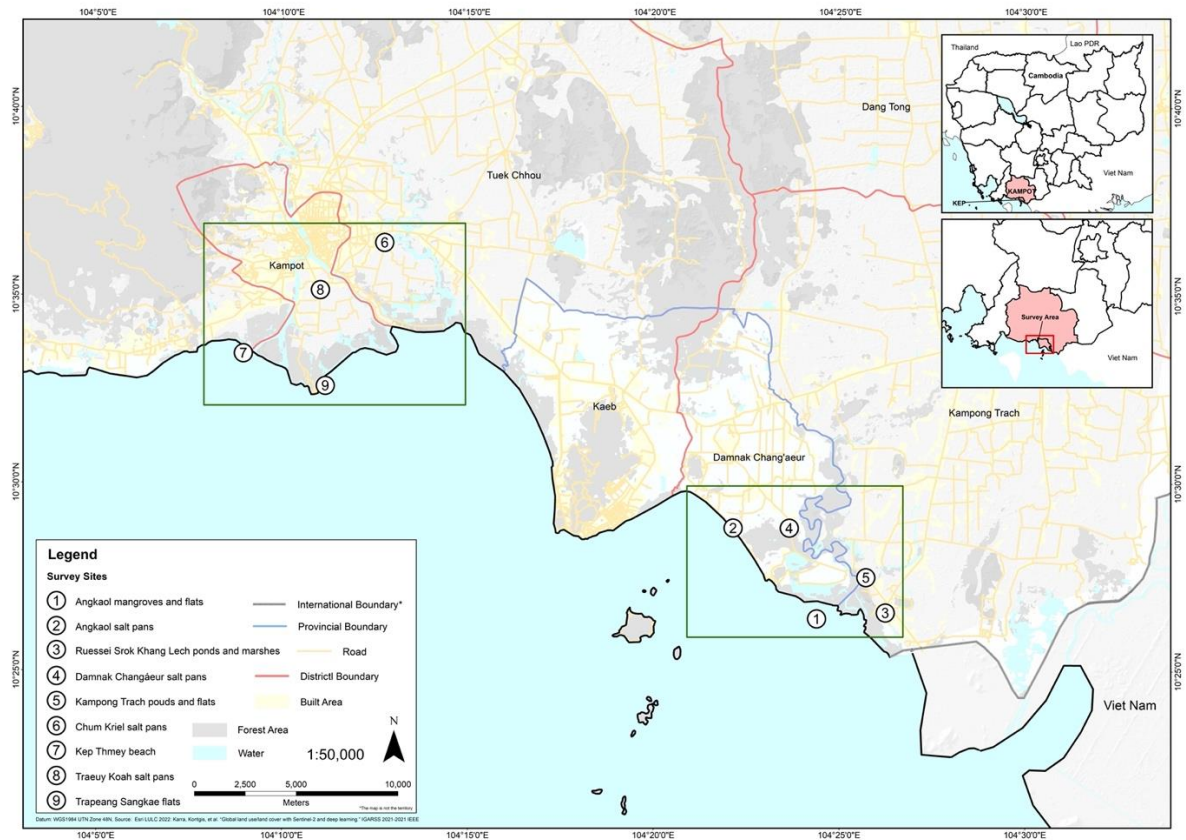
Located in the south-east of Cambodia, near the international border with Vietnam, the coast of Kampot and Kep provinces holds extensive areas of wetlands such as estuarine mangroves, intertidal flats and sand bars, and seagrass beds. The lower reaches and estuary of the Tuek Chhu River has good potential for supporting significant congregations of migratory waterbirds given its diverse mosaics of coastal habitats of mangroves, intertidal flats and man-made wetlands. In addition, there are also large areas of production and inactive salt pans rather similar to those in adjacent parts of Vietnam and Thailand. Existing work from Southeast Asia has shown that salt pans can support diverse communities of shorebirds, especially as high tide roosts and feeding grounds. Our project is the first comprehensive attempt to survey these 'coast-scapes' for migratory waterbirds although we are aware that there are occasional field visits by recreational birdwatchers.

Compared to the coast of Koh Kong province in the west where there have been several field surveys in the past five years (Anon 2018, 2019; Taing 2018), southeast Cambodia's coastal wetlands are relatively unknown. A total of nine different landscapes were identified by the project team for survey, none of which are currently recognised at Important Bird and Biodiversity Areas (IBAs). One site is protected by the local community fishery (CFi) as an eco-tourism site and is known for its rich mangrove forests (Trapeang Sangkae). One site in Kampot province (Chum Kriel salt pans, outskirts of Kampot city) is relatively well-known and was visited by one member of the team several times on recce trips prior to project field work.

Table 2. Details of sites surveyed in the project.

Site name	Approximate coordinates (centroid)	Description of landscape
<i>Kampot Province</i>		
Chum Kriel salt pans	10.60673, 104.21231	Extensive area of production salt pans outside of Kampot town. Some areas of unused ponds and scrubby edges.
Trapeang Sangkae flats	10.543184, 104.18581	Extensive area of intertidal muddy and sand flats at the estuary of the Tuul Chhu. The immediate coastline is fringed by a strip of mangroves. Shallows mostly seagrass beds.
Kampong Trach ponds and flats	10.45833, 104.42855	Open scrubby area and canals, adjacent to mangroves. Landward side is mostly paddy fields.
Ruessei Srok Khang Lech ponds and marshes	10.442688, 104.437273	Mostly modified landscape of fish ponds, production salt pans and strips and patches of brackish marshes and mangrove remnants.
Traeuy Koah salt pans	10.585722, 104.183502	Extensive area of production salt pans on Traeuy Koah, a large estuarine island at the Tuul Chhu river mouth. Also, some agricultural land.
Kep Thmay beach	10.557576, 104.149011	Sandy beaches and a narrow strip of intertidal flats west of a major port development. Some areas were recently reclaimed from the sea.
<i>Kep Province</i>		
Damnak Chang'aeur salt pans	10.48023, 104.39417	Extensive area of production salt pans and strips of mangroves 1-2 km from the coast.
Angkaol salt pans	10.48026, 104.36893	Small area of coastal salt pans, immediately behind the foreshore.
Angkaol mangroves and flats	10.440030, 104.406447	Mangrove lined coastline, with a narrow strip of intertidal mudflats, and shallow waters with seagrass beds.

Map 1. Map of shorebird sites surveyed during the course of our field work.



2.2. Survey methodology

All sites were surveyed on at least one visit over 4-7 February 2023 by three NatureLife and BirdLife staff with extensive field experience. 2-3 recce surveys to a presumably important site (Chum Kriel salt pans, Kampot) were conducted in September 2022 to understand the terrain and conditions of the salt pans. All waterbird species were counted and identified using field spotting telescopes (i.e. Omicron and Swarovski ATX80, magnification 20-60x) and binoculars. Photographs of the coastal landscape were taken for record purposes. To reach difficult-to-access on the coast during the low tide, we used a small, powered boat with a local boatman. For accessible tidal flats and beaches that can be reached from land, we scheduled ourselves to reach the site at least two hours before the lowest tide. Intertidal flats on the coast were limited by limited daylight hours for surveys during very high tides during much of the day, and as a result, most morning surveys were focused at presumed high-tide roosts such as salt pans and mud bunds on the coast.

Upon reaching each site, survey teams would carefully scan the area with telescopes before moving closer to congregations of birds but taking care not to flush birds. Upon the completion of each count, we then proceeded towards the next group of birds until we found no large flocks of birds, or when we cannot advance further. Birds were counted individually, if possible, but large flocks and groups of birds in flight were block-counted in multiples of 50 or 100. Count results were tabulated as the total number of species observed, per site, per survey day and tabulated on the eBird app so that the transects walked can be determined. In addition to

bird surveys, the survey teams also undertook a rapid assessment of the conditions at each site, taking careful notes of potential threats the site may be facing (i.e. the use of mist nets for bird hunting). All counts were conducted by a team consisting of at least two observers, led by Porchhay Taing (PT) and Sen Kethya Sar (SKS), and supported by Samphors Ly (SL), Ding Li Yong (DLY) and two rangers from Kep and Kampot Provincial Department of Environment, respectively.

2.3. Capacity building and consultation with stakeholders

A short online training session on surveying and sampling shorebirds in coastal wetlands was organized on 05 January 2023 by NatureLife, in coordination with BirdLife's Flyways team. The training was provided by invited trainer, Katherine Leung, a well-known technical expert on shorebirds and were attended by all members of the survey team. Katherine explained why it is important to have accurate data on shorebird populations and trends, and compared different methodologies in counting birds. The mark-resighting scan method was then covered in detail, and how it can address limitations using surveys based on raw counts. Formal estimates based on mark-resighting can address limitations in survey efforts across observers and allow proportions of undetected birds to be estimated. Data output and analyses was briefly discussed.

In addition, one online meeting was organized before the survey with the participation from all members of the survey team to discuss and prioritize the survey site base on the google earth imagery and the potential new wintering coastal sites identified in Kampot and Kep through spatial analysis of the Southeast Asian coastline for potential Spoon-billed Sandpiper wintering areas conducted by RSPB through the work of Jenny Weston in 2019. The survey team also communicated and consulted with local communities and rangers in order to plan the survey, prioritize the survey sites, and arrange the logistic. The survey plans was conveyed to the local authorities and community fishery at Trapeang Sangkae to gather their input and site recommendation especially the accessibility and conditions of the sites to be surveyed.

Two rangers from the Kep and Kampot Provincial Department of Environment were provided initial training on waterbird surveys using binoculars and telescopes as well as field guide books during their participation in the survey.

The key findings and a short summary of the field survey have been shared with the Kep and Kampot Provincial Department of Environment through its rangers a short report conveyed o 'telegram' (which widely use as communication tools in government sectors) and the full publication will be shared with wider government and public stakeholders as soon as it becomes available.

2.4. Results

2.4.1. Findings from surveys of Chum Kriel salt pans

The Chum Kriel area just south-west of Kampot town forms an extensive landscape of production salt pans managed under a well-established salt cooperative, dotted with areas of

unused ponds and scrubby edges and margins to salt pans. The site has been irregularly visited by local birdwatchers but never systematically surveyed. Given the size of this area, we (PT, SKS, DLY) surveyed this landscape over four days at different tidal conditions. We found that the salt pans at Chum Kriel are being used by potentially significant but scattered congregations of waterbirds of 25 species.

The salt pans are likely used as a foraging area (and possibly a high tide roost although birds were observed even at low tide). The Chum Kriel salt pans were visited three times from 5 to 8 February. Lesser Sand-plover (subspecies undetermined) and Red-necked Stint were the most abundant species documented here (Table 4). The survey also found moderate congregations of small shorebirds such as Long-toed Stint, Broad-billed Sandpiper, as are Greater Sand-plovers, and Kentish Plovers. Marsh Sandpipers were regularly present at the salt pans in small flocks and there were a few individuals of Common Greenshank. Although no Spoon-billed Sandpiper was observed, it is possible that the species occurred here undetected given its association with several small shorebirds found which are present in large numbers. No species exceeded the 1% EAAF population thresholds here but species richness is the highest of all sites covered.

2.4.2. Findings from surveys of the Tuek Chhu estuary, including Trapeang Sangkae mudflats

The survey team (PT, SKS, DLY) explored two areas of sand bars, seagrass shoal and intertidal flats at low tide at Trapeang Sangkae (Table 3) at the estuary of the Tuek Chhu on 6 February 2023 on boat. This area of intertidal wetlands can only be accessed by boat and is usually exposed at very low tide but is difficult to reach due to shallow shoals and seagrass beds. Here, we found very large flocks of shorebirds, with at least 1,200 individuals counted before sunset. This included Eurasian Curlew, Bar-tailed Godwit, and very large congregations of Lesser Sand-plover (>500 individuals, or 1.7% of EAAF congregations, based on Mundkur & Langendoen 2022), alongside 15 other shorebird species. A small group of Nordmann's Greenshank (c. 4 individuals) was observed here in a mixed flock among redshanks. There were also moderate congregations of Caspian Tern (c. 50 individuals).

2.4.3. Findings from surveys of coastal wetlands in Kampong Trach district

This area comprises open scrub, ponds and tidal canals and adjacent to mangroves not far from the international border with Vietnam. The landward side of the coastline here is dominated by paddy fields. Small numbers of shorebirds were found here, mostly Lesser Sand-plover and Pacific Golden Plover roosting in the high tide back-mangrove scrub. Of interest are two Temminck's Stint, a species rare in Cambodia. Small groups of Marsh and Wood Sandpipers were counted in Ruessei Srok Khak Lech.

2.4.4. Findings from the Angkaol coast in Kep, and surrounding areas of salt pans

The Angkaol coastline in Kep extends to the border with Vietnam in Ha Tien and is largely dominated by a narrow strip of mangroves (> 200 m) and intertidal mudflats. At low tide, large expanses of seagrass beds are exposed here. This coastline can only be accessed by boat

but is difficult to reach due to shallow waters and a dense seagrass bed. The team surveyed this area once at low tide on the 5 February, spending about three hours counting waterbirds on boat, and by wading through the seagrass bed. A total of 11 shorebird species was found, but mostly in small numbers. Notable species include Eurasian Curlew, Bar-tailed Godwit and a small party (c. 20 individuals) of Broad-billed Sandpiper (Table 9).

2.4.5. Findings from Kep Thmay (Prek Noat) beach, Kampot

Prek Noat beach is located 10 km west of Kampot Town and is a newly reclaimed area slated for future port development. The coast is defined by a thin strip of sandy intertidal flats no more than 100 m wide while much of the landscape is scrubby or sandy ground. The Prek Noat coast which is accessible by a dirt track was surveyed over low tide on the 6 February by SKS and DLY. A total of 11 shorebird species were found (see supplementary data), as well as a flock of Caspian Tern and a lone Chinese Egret. This site supported small and scattered congregations of *Charadrius* plovers, including a localised population of Malaysian Plovers, a species rare in Cambodia.

2.4.6. Globally threatened and near threatened species

We were unable to find any Spoon-billed Sandpiper (CR), a key target species for our field work, over the surveys or the pre-survey recce trips. However, we detected small numbers of Nordmann's Greenshank (EN) at Trapeang Sangkae and a single Chinese Egret (VU) at Prek Noat. Near Threatened species detected includes Bar-tailed Godwit, Eurasian Curlew, Red-necked Stint and Curlew Sandpiper, all which occurred in small numbers. We did not find any knots during our surveys, even though the species is known to occur in regular numbers in Koh Kapik (Koh Kong Province).

2.4.7. Threats to shorebirds and gaps in protection

We did not document any shorebird hunting or trapping activities during our field surveys. No mist-nets were observed even though they are known from surveys of other parts of the Cambodian coastline (see Yong et al. 2022).

Table 3. Summary of waterbird species counts at each coastal site surveyed.

Site name	GPS coordinates	Species	Species of interest
Kampot Province			
Chum Kriel salt pans	10.60673, 104.21231	25	Long-toed, Red-necked and Little Stint, Broad-billed Sandpiper, Lesser and Greater Sand-plover, Kentish Plover, Common Greenshank
Trapeang Sangkae flats	10.543184, 104.18581	16	Broad-billed Sandpiper, Red-necked Stint, Lesser and Greater Sand-plover, Caspian Tern, Common Tern, Chinese

			Egret, Eurasian Curlew, Whimbrel, Bar-tailed Godwit
Kampong Trach ponds and flats	10.45833, 104.42855	10	Temminck's Stint, Lesser Sand-plover, Wood Sandpiper
Ruessei Srok Khang Lech ponds and marshes	10.442688, 104.437273	12	Wood Sandpiper
Traeuy Koah salt pans	10.585722, 104.183502	8	-
Kep Thmay (Prek Noat) beach	10.557576, 104.149011	15	Malaysian Plover, White-faced Plover, Chinese Egret, Caspian Tern
<i>Kep Province</i>			
Damnak Chang'aeur salt pans	10.48023, 104.39417	10	Red-necked Stint
Angkaol salt pans	10.48026, 104.36893	10	Lesser, Greater Sand-plover, Red-necked Stint
Angkaol mangroves and flats	10.440030, 104.406447	17	Eurasian Curlew, Common Redshank, Bar-tailed Godwit, Terek Sandpiper, Broad-billed Sandpiper

3. Conclusions

3.1. Key findings

Kampot Province

The salt pans at Chum Kriel, Kampot were found to be used by significant congregations of waterbirds representing over 20 species. The salt pans are likely used as a high tide roost and foraging area, with birds likely dispersing to feed on the intertidal flats off Trapeang Sangkae. Our surveys found moderate congregations of small shorebirds such as Red-necked Stint, Long-toed Stint, Broad-billed Sandpiper, as are Lesser and Greater Sand-plovers, and Kentish Plovers but none exceeded the 1% flyway population threshold in Mundkur & Langendoen (2023). Marsh Sandpipers were regularly present at the salt pans in small flocks. Although no Spoon-billed Sandpiper was observed, it is possible that the species occurred here undetected given its association with several small shorebirds found.

The mangroves, sand bars and intertidal flats (at low tide) at Trapeang Sangkae supported very large flocks of shorebirds, with more than 1,200 individuals counted over a limited sampling period. This included Eurasian Curlew, Bar-tailed Godwit, Nordmann's Greenshank and large congregations of Lesser Sand-plover (>500 individuals, or at least 1.7-3.8% of flyway congregation of *Charadrius mongolus*), alongside 15 shorebird species. There were also good congregations of Caspian Tern, and smaller numbers of Common Tern. The surveys show that the intertidal mudflats of the Tuek Chhu estuary is of flyway-level significance for migratory

species in the EAAF and is potentially an EAAFP Flyway Network Site, having met Criterion 2 (A wetland should be considered internationally important if it supports vulnerable, endangered, or critically endangered species or threatened ecological communities) for Nordmann's Greenshank, and Criterion 6 for the Convention on Wetlands of International Importance for at least one species, Lesser Sand-plover (Criterion 6: A wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of waterbird).

Kep Province

Our surveys showed that the coast of Angkol to be of potential significance for migratory species although no species met the 1% threshold for flyway populations. The extensive mangrove and sea-grass coastline along Angkol supported nearly 1,000 waterbirds from about 20 species. This included Eurasian Curlew, Bar-tailed Godwit, as well as mixed flocks consisting of Red-necked Stint, Broad-billed Sandpiper and sand-plovers (more than 75% of all shorebirds counted). There were also moderate congregations of three terns, Whiskered Tern, Common Tern and Caspian Tern, and large flocks of egrets of three species.

3.2. Conservation recommendations

Our (winter) field surveys of the coastal wetlands of southeast Cambodia revealed at least one site supported populations of a species that exceeded 1% criteria based on EAAFP CSR1, (Trapeang Sangkae). The adjacent salt pan areas of Chum Kriel are possibly ecologically connected to Trapeang Sangkae as a source of high-tide roost (and high-tide foraging habitat). The Angkaol coastline is potentially important for waterbirds although we did not find any species that met international criteria for significance to waterbird species. We did not detect any signs of illegal bird hunting at all sites surveyed.

In line with our past work in Koh Kong, our findings show that the coastal wetlands of SE Cambodia are likely regionally important for shorebird conservation, and should be further evaluated as potential Flyway Network Sites or Ramsar sites. On top of supporting congregations of migratory birds, wetlands on the Cambodian coastline in Kampot also holds some of the largest (and most intact) areas of seagrass beds in the country.

As a follow up to our current surveys, we recommend,

- Further surveys in the winter of 2023-2024 to establish the importance of the Trapeang Sangkae coastline, and surrounding wetlands for migratory shorebirds in the mid-winter and autumn passage period, with the view of scoping the site as a potential EAAFP Flyway Network Site.
- Further exploratory surveys on the coastline along Angkaol to the Vietnam border, given the potential importance of the wetlands here for migratory species.
- Sustained engagement with provincial governments to disseminate findings and identify potential for ecotourism opportunities.
- Dissemination of findings among local communities, especially existing eco-tourism establishments in Kampot Province.

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Supplementary data. Count data of shorebirds

Table S1. Total counts of shorebirds at Chum Kriel salt pans.

Species	Latin	Date of survey				
		4 Feb (am)	5 Feb (am)	6 Feb (am)	6 Feb (pm)	7 Feb (pm)
Shorebirds						
Black-winged Stilt	<i>Himantopus</i>	12	10	5	2	1
Grey Plover	<i>Pluvialis squatarola</i>	12	-	-	-	-
Lesser Sand Plover	<i>Charadrius mongolus</i>	36	21	15	-	-
Greater Sand Plover	<i>Ch. leschenaultia</i>	1	-	-	-	-
Kentish Plover	<i>Ch. Alexandrinus</i>	1	-	30	20	-
Eurasian Curlew	<i>Numenius arquata</i>	1	-	-	1	1
Broad-billed Sandpiper	<i>Calidris falcinellus</i>	20	1	-	-	-
Curlew Sandpiper	<i>C. ferruginea</i>	15	20	4	-	-
Long-toed Stint	<i>C. subminuta</i>	15	5	16	30	-
Red-necked/ Little Stint	<i>C. ruficollis/minuta</i>	30	7	25	40	-
Little Stint	<i>C. minuta</i>	3	-	-	-	-
Sanderling	<i>C. alba</i>	-	-	1	2	-
Common Sandpiper	<i>Tringa hypoleucos</i>	1	1	2	1	1
Common Greenshank	<i>T. nebularia</i>	2	1	7	10	-
Marsh Sandpiper	<i>T. stagnatilis</i>	20	20	22	15	-
Wood Sandpiper	<i>T. glareola</i>	-	2	4	-	-
Other waterbirds						
Caspian Tern	<i>Hydroprogne caspia</i>	1	-	1	-	-
Whiskered Tern	<i>Chlidonias hybrida</i>	1	-	-	-	-
Common Tern	<i>Sterna hirundo</i>	2	-	-	-	-
Great Crested Tern	<i>Thalasseus bergii</i>	2	-	-	-	-
Little Cormorant	<i>Microcarbo niger</i>	10	3	5	2	1
Yellow Bittern	<i>Ixobrychus sinensis</i>	1	-	-	-	-
Cinnamon Bittern	<i>I. cinnamomeus</i>	1	-	-	-	-
Grey Heron	<i>Ardea cinerea</i>	10	-	2	1	-
Great Egret	<i>Egretta alba</i>	6	5	-	-	-
Intermediate Egret	<i>E. intermedia</i>	-	-	4	-	-
Little Egret	<i>E. garzetta</i>	20	5	5	10	-
Pond heron	<i>Ardeola sp.</i>	3	-	8	-	-
Striated Heron	<i>Butorides striatus</i>	1	-	--	-	-

Table S2. Total counts of shorebirds at sites surveyed in Kampot province.

Species	Latin	Site				
		Trapeang Sangkae mudflats	Ruessei Srok Khak Lech marshes	Kampong Trach ponds/flats	Traouey Koah salt pans	
		4 Feb (pm)	5 Feb (am)	5 Feb (pm)	6 Feb (am) (pm)	
Black-winged Stilt	<i>Himantopus himantopus</i>	-	13	-	4	-
Greater Paintedsnipe	<i>Rostratula bengalensis</i>	-	1	-	-	-
Grey Plover	<i>Pluvialis squatarola</i>	30	-	1	-	-
Pacific Golden Plover	<i>P. fulva</i>	-	5	10	-	-
Lesser Sand Plover	<i>Charadrius mongolus</i>	500	-	150	-	-
Greater Sand Plover	<i>Ch. leschenaultia</i>	5	-	2	-	-
Little Ringed Plover	<i>Ch. dubius</i>	-	5	4	-	-
Kentish Plover	<i>Ch. alexandrinus</i>	15	-	-	-	-
Whimbrel	<i>Numenius phaeopus</i>	50	-	-	-	-
Eurasian Curlew ²	<i>N. arquata</i>	10	-	-	-	-
Bar-tailed Godwit ²	<i>Limosa limosa</i>	2	-	-	-	-
Broad-billed Sandpiper	<i>Calidris falcinellus</i>	50	-	-	-	-
Curlew Sandpiper ²	<i>C. ferruginea</i>	20	-	-	-	-
Temminck's Stint	<i>C. temminckii</i>	-	1	1	-	-
Long-toed Stint	<i>C. subminuta</i>	-	6	1	-	-
Red-necked/ Little Stint ²	<i>C. ruficollis/minuta</i>	250	-	5	-	-
Little Stint	<i>C. minuta</i>	1	-	-	-	-
Nordmann's Greenshank ¹	<i>Tringa guttifer</i>	4?	-	-	-	-
Common Sandpiper	<i>T. hypoleucos</i>	-	1	-	3	-
Common Greenshank	<i>T. nebularia</i>	-	2	1	13	-
Marsh Sandpiper	<i>T. stagnatilis</i>	-	6	-	-	-
Wood Sandpiper	<i>T. glareola</i>	-	16	-	-	-

¹Globally threatened, ²Near Threatened

Table S3. Total counts of other waterbirds at sites surveyed in Kampot province.

Species	Latin	Site			
		Trapeang Sangkae mudflats	Ruessei Srok Khak Lech	Kampong Trach ponds/flats	Traouey Koah salt pans
		4 Feb (pm)	5 Feb (am)	5 Feb (pm)	6 Feb (am) (pm)
Little Cormorant	<i>Microcarbo niger</i>	80	7	-	4 -
Caspian Tern	<i>Hydroprocne caspia</i>	50	-	-	- -
Whiskered Tern	<i>Chlidonias hybrida</i>	-	1	-	10 -
Common Tern	<i>Sterna hirundo</i>	-	-	-	- -
Great Crested Tern	<i>Thalasseus bergii</i>	6	-	-	- -
Grey Heron	<i>Ardea cinerea</i>	-	-	-	2 -
Great Egret	<i>Egretta alba</i>	35	6	-	- -
Intermediate Egret	<i>E. intermedia</i>	-	2	-	1 2
Chinese Egret	<i>E. eulophotes</i>	1	-	-	- -
Little Egret	<i>E. garzetta</i>	20	7	1	5 6
Pond heron	<i>Ardeola sp.</i>	1	6	-	- -

Table S4. Total count of shorebirds at Kep Thmat (Prek Tnoat) beach and reclaimed area.

Species	Latin	6 Feb (pm)
Shorebirds		
Grey Plover	<i>Pluvialis squatarola</i>	8
Lesser Sand Plover	<i>Charadrius mongolus</i>	15
Greater Sand Plover	<i>Ch. leschenaultia</i>	5
Malaysian Plover	<i>Ch. peronii</i>	1
Kentish Plover	<i>Ch. alexandrinus</i>	2
White-faced Plover	<i>Ch. dealbatus</i>	1
Eurasian Curlew ²	<i>N. arquata</i>	1
Ruddy Turnstone	<i>Arenaria interpres</i>	3
Red-necked/ Little Stint ²	<i>Calidris ruficollis/minuta</i>	1
Sanderling	<i>C. alba</i>	2
Terek Sandpiper	<i>Xenus cinereus</i>	3
Other waterbirds		
Caspian Tern	<i>Hydroprocne caspia</i>	50
Great Crested Tern	<i>Thalasseus bergii</i>	2
Little Cormorant	<i>Microcarbo niger</i>	6
Chinese Egret	<i>Egretta eulophotes</i>	1

Table S5. Total counts of shorebirds at all sites surveyed in Kep province.

Species	Latin	Sites		
		Damnak Chang'aur salt pans 5 Feb (am)	Angkaol salt pans 5 Feb (pm)	Angkaol mangroves and mudflats 5 Feb (pm)
Black-winged Stilt	<i>Himantopus himantopus</i>	45	1	35
Grey Plover	<i>Pluvialis squatarola</i>	-	-	2
Lesser Sand Plover	<i>Charadrius mongolus</i>	1	155	100
Greater Sand Plover	<i>Ch. leschenaultia</i>	-	16	-
Kentish Plover	<i>Ch. alexandrinus</i>	1	4	-
Whimbrel	<i>Numenius phaeopus</i>	-	-	5
Eurasian Curlew ²	<i>N. arquata</i>	-	-	10
Bar-tailed Godwit ²	<i>Limosa limosa</i>	-	-	2
Broad-billed Sandpiper	<i>Calidris falcinellus</i>	-	-	20
Terek Sandpiper	<i>Xenus cinereus</i>	-	-	2
Red-necked/ Little Stint ²	<i>C. ruficollis/minuta</i>	25	6	-
Common Sandpiper	<i>Tringa hypoleucos</i>	1	-	-
Common Greenshank	<i>T. nebularia</i>	5	-	10
Marsh Sandpiper	<i>T. stagnatilis</i>	23	2	25
Common Redshank	<i>T. totanus</i>	-	-	40

Table S6. Total counts of other waterbirds at all sites surveyed in Kep province.

Species	Latin	Site		
		Damnak Chang'aur salt pans 5 Feb (pm)	Angkaol salt pans 5 Feb (pm)	Angkaol mangroves and mudflats 5 Feb (pm)
Common Moorhen	<i>Gallinula chloropus</i>	2	-	-
White-breasted Waterhen	<i>Amaurornis phoenicurus</i>	-	-	2
Little Cormorant	<i>Microcarbo niger</i>	3	12	150
Caspian Tern	<i>Hydroprocne caspia</i>	-	1	10
Whiskered Tern	<i>Chlidonias hybrida</i>	3	-	20
Great Egret	<i>Egretta alba</i>	2	-	20
Little Egret	<i>E. garzetta</i>	2	1	50

Additional figures and photographs



Figure 1. Chum Kriel salt pans.



Figure 2. Trapeang Sangkae flats



Figure 3. Kampong Trach ponds and abundant salt pans



Figure 4. Angkaol mangroves, seagrass beds and flats at low tide.



Figure 5. Congregations of Caspian Tern in Trapeang Sangkae flats



Figure 6. Flock of shorebirds in Trapeang Sangkae flats



Figure 7. Small congregations of small-bodied shorebirds in salt pans at Chum Kriel, Kampot



Figure 8. Flock of small shorebirds in Angkaol mangroves and flats



Figure 9. Survey in Trapeang Sangkae flats



Figure 10. Scan of the coastal mudflats for shorebirds with telescopes in Angkaol mangroves and flats



Figure 11. Shorebird survey in Angkaol mangroves and flats



Figure 12. Survey team (taken on the boat in Angkaol mangroves and flats)