

## **Title:** Evaluating habitat quality for threatened migratory shorebirds

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Many migratory shorebird populations are declining worldwide. Substantial effort and resources are being invested in shorebird surveys while relatively little effort is being allocated to monitoring their habitat quality. With mounting concerns of shorebird habitat deterioration, it is of increasing importance to monitor habitat quality effectively. In this study, we aimed to evaluate habitat quality for shorebirds on a regional scale across six tidal flats along an ~100km coastline in tropical Queensland, Australia. We combined results from benthic sampling with prey choice and energy requirements of shorebirds to estimate the habitat quality for the six coastal tidal flat systems, using two different approaches. The simplest approach, which compared the energy requirements and availability without taking prey density into consideration, suggests that our survey areas contained between 1.2 and 2.4 times more food than needed by the current number of birds using the sites. However, habitat quality evaluation also taking prey selection and functional responses into consideration yielded considerably lower habitat suitability and an improved correlation with observed shorebird densities. The later approach, which only comes at a higher computational cost, indicated that many of the studied areas were not profitable to migratory shorebirds, especially for large-sized species that tended to have a negative energy balance in those areas. Our approach also identified profitable areas for shorebirds with relatively higher prey densities located on the upper tidal flats, which are thus available for a longer duration within the tidal cycle. Losing such areas to land claim activities will have a

disproportionally higher negative impact on shorebirds. The approach used in this study could be applied to other important sites for shorebirds to monitor and evaluate habitat quality and facilitate urgent conservation measures when shorebird habitat is deteriorating.

Theme: [Monitoring, Conservation Management]

Preferred option: [Oral Presentation]

# The role of molluscan aquaculture in the conservation of migratory molluscivore shorebirds in East Asian - Australasian Flyway

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## **Abstract**

Human-driven deterioration and loss of intertidal mudflats in the stopover sites, had destroyed more than half of refueling habitats of migratory shorebirds in East Asian - Australasian Flyway (EAAF), which implicated in population declines of many migratory shorebirds. Given that habitat restoration takes a long time, restoring the population of molluscs in the remaining intertidal mudflats is the best way in saving and recovering these molluscivore shorebirds. We sampled 25 intertidal sites spanning 20 latitudinal degrees and 18,400 km of China's coastline from 2015 to 2019, to recognize the current situation of molluscs biodiversity. We also reviewed the proportion and size of molluscs in the diet of shorebirds, to explore the roles of molluscs in the food of non-breeding shorebirds. We found the biodiversity of molluscs was manipulated by human's molluscan aquaculture, where commercial mollusc species which selected for economic benefit had dominated the China's coast, resulting in the homogenization of latitudinal gradients of both alpha diversity and beta diversity of mollusc communities. Since the small and medium molluscs are the main food of most shorebirds in EAAF, the quantity of mollusc harvest during molluscan aquaculture will affect the food availability of shorebirds. We propose that aquacultural practices have exerted strong influences on the biodiversity and amount of mollusc, proper management of molluscan aquaculture, such as reducing the harvest and controlling the reseeded timing, can create more food for stopover shorebirds, which will play an extremely important role in the conservation of shorebirds.

## ***Spartina alterniflora* threatens important shorebird habitat in coastal China**

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China's coastal wetlands are critically important to shorebirds. *Spartina alterniflora* (smooth cordgrass) was intentionally introduced to the Chinese coast in 1979 and expanded rapidly thereafter. Its encroachment has occurred almost entirely on intertidal flats. *S. alterniflora* poses a significant risk to shorebirds because its spread onto intertidal flats renders them unavailable for foraging; it also restricts nearshore and occasionally supratidal roosting habitat. Further loss or degradation of intertidal shorebird habitat from *S. alterniflora* encroachment is likely to compound shorebird population declines, particularly when it occurs at important shorebird sites where intertidal flat extent is declining due to other factors (eg. land reclamation, sea level rise). However, the distribution and intensity of the overlap between *S. alterniflora*, important shorebird habitat and intertidal flat change in China is not yet well studied. We mapped the extent of *S. alterniflora* coverage in 2015 of coastal sites that are used by internationally significant numbers of shorebirds, estimated change in the spatial extent of intertidal flats between 2000 and 2015 at the same set of sites, and investigated where these two threats to shorebird habitat intersect. We found that across all sites, the total area of intertidal flats decreased by 15% between 2000 and 2015; that intertidal flats decreased between 2000 and 2015 at 37 of 52 sites (71%); and that there was direct overlap with *S. alterniflora* in 28 of 52 sites (54%) in 2015 which exceeded 5% of the total area at five sites. Combined pressures from *S. alterniflora* and loss of intertidal habitat were most severe in Jiangsu, Shanghai, Fujian, Zhejiang, Tianjin and Hebei provinces. These results underscore the urgent need to develop a comprehensive control program for *S. alterniflora* in coastal areas of China that are important for shorebirds.

Theme: Conservation Management

Preferred option: Oral Presentation

# Moult schedule and potential food of Spoon-billed Sandpiper *Calidris pygmaea* and Nordmann's Greenshank *Tringa guttifer* at a critical staging site in China's Yellow Sea

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The extent of coastal intertidal wetlands in the Yellow Sea region has declined considerably in the past few decades, resulting in severe population decline of a large number of migratory shorebirds, which rely on tidal flats in this region during non-breeding seasons. However, the functional roles (resting, fuelling and/or moulting) of these tidal flats to shorebirds remain poorly understood. Through regular field surveys between July and November 2015, we investigated the stopover and moult schedules of the Critically Endangered Spoon-billed Sandpiper *Calidris pygmaea* and Endangered Nordmann's Greenshank *Tringa guttifer* on the southern Jiangsu coast, eastern China during southward migration. We also explored the potential prey items

of the two species by collecting benthic samples at their foraging locations. Our results show that a large number of Spoon-billed Sandpiper and Nordmann's Greenshank staged for an extended period of time (66 and 84 days, respectively) in Jiangsu to complete their primary moult. On average, Spoon-billed Sandpipers and Nordmann's Greenshanks started moulting primary feathers on 08 August  $\pm$  4.52 days (SE) and 27 July  $\pm$  1.56 days (SE) respectively, and their moult durations were 72.58  $\pm$  9.08 and 65.09  $\pm$  2.40 days. Our results also indicate that Spoon-billed Sandpipers foraged at locations with high numbers of amphipods, suggesting a potentially important food source for this species. Our work highlights the critical importance of preserving the remaining intertidal wetlands in southern Jiangsu, and sheds light on the important benthic organisms and foraging locations that warrant long-term monitoring and management efforts to safeguard the future of two highly threatened shorebirds.

Theme: Migration Ecology

Preferred option: Oral Presentation

## **Upper tidal flats are disproportionately important for the conservation of migratory shorebirds**

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Migratory animals are crucial for the functioning and integrity of global ecosystems, yet many species are in steep decline as a result of human activities. Understanding how migratory species use different habitats is critical to developing effective conservation strategies. Coastal shorebirds migrating along the East Asian-Australasian Flyway have experienced precipitous declines over the past three decades, primary as a result of rapid and large-scale development of tidal flats along the Yellow Sea that serve as important stopover sites for these birds. However, populations of several species have declined much faster than the rate of loss of the tidal flats. We quantified the habitat requirements and usage patterns of 17 species of migratory shorebirds throughout the tidal cycle at two critical stopover sites in the Yellow Sea Region of China. We found that shorebirds at these stopover sites exhibit substantial interspecific and even site-specific differences in their use of different portions of the tidal flats. Notwithstanding these differences, however, the upper tidal zone was used disproportionately often by most shorebird species relative to its availability during the tidal cycle, as measured by the cumulative foraging times of the birds. Because coastal land reclamation projects in China (and elsewhere) typically start near the high-tide line and proceed outward toward the sea, the upper tidal flats are more prone to development than are the lower tidal flats, which may help to explain why shorebird populations have declined much faster than the overall rate of tidal flat loss in the Yellow Sea. Our work highlights the need to conserve as much of the upper intertidal zone as possible within important stopover sites in order to protect today's diminished populations of migratory shorebirds. Our study also demonstrates the value of understanding the detailed patterns of habitat usage by migratory species throughout their journeys in order to conserve them.

Theme: Non-breeding Ecology

Preferred option: Oral Presentation