Climate change risk assessment for shorebird's stop-over habitats over the western flat-tidal areas in South Korea

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Flat tidal areas located in east coast of China and west coast of Korea around Yellow Sea have been known as main habitats for shorebirds that travel to breeding habitats around Siberia. Those flat tidal areas have received a lot of attentions due to indiscreet removal by human activities, and in addition, concerns of climate change impact on global biodiversity have been increased. Even though political efforts to reduce human threat on those coastal areas have been fortunately increased, threats by climate change factors such as sea level rise and temperature increase are quite uncertain, leading it difficult to plan strategic adaptation actions to conserve the habitats.

In this study, we extracted key risks of climate change for coastal wetland ecosystem through literature reviews and collecting expertise opinions. The key risks are 1) species unable to track changing climate space, 2) habitat disturbance by sea level rise, and 3) food-web mismatch. Then, we developed a quantitative assessing method for each risk within expectations of data availabilities. Considering climate change impact on shorebird, the assessments of the three key risks focused on the western flat-tidal areas in South Korea as their key stop-over habitats and invertebrates there as their main food source. The methods include searching for hazardous climate change factors related to each risk, inspecting current status of exposed species and habitats to the hazards, and diagnosing possible consequences under future climate prediction. The results showed that the risk for invertebrate species to lose their climate space due to temperature increase is very low but that related to sea level rise may affect food source over the flat-tidal areas due to significant habitat reduction. Fortunately, the hot spots for the visiting shorebirds in South Korea does not seem to match the vulnerable areas to sea level rise, but the impact is still uncertain due to the severe lack of data availability.

Theme: climate change
Preferred Option: Oral Presentation

Climatic fingerprints on breeding dynamics and nest failure of plovers across the globe

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Environmental variables, such as temperature and precipitation, are known to affect bird prey abundance and hence influence their breeding phenology. Studies in the past have addressed the potential effects of global increase in temperatures due to climate change on the breeding phenology of birds over large time scales. But within season effects of global warming and climate change, due to extreme stochastic events have not been studied till date. To identify the impact of such events, we first need to explore the associations between local climatic conditions and the breeding dynamics of the birds. For this, we used an ecological model system of plovers (family Charadriidae) as focal organisms, and collated data from 26 populations of plovers belonging to 12 different species across the globe. We compared the breeding characteristics across latitudes and using generalised linear mixed modelling, tested two main hypotheses regarding the effects of temperature and precipitation on breeding season progression and nest failure of these birds. The number of nests initiated per week was correlated with the average temperature of the previous two weeks in a non-linear fashion: at optimum temperature, the number of nests being initiated is the highest, on either side of which it decreases. Probability of nest failure showed the most significant correlation with average temperature and cumulative precipitation over three days prior to the fate date. It was lowest at an optimum range of temperature but increases on either side of the optimum. Whereas, it increased linearly with increase in precipitation. This shows that stochastic environmental events might cause a drastic decrease in the number of successfully breeding plovers in a given season due to effects on two key stages: breeding decisions and egg development. Thus, within-year patterns allow the prediction of long-term changes in nesting dynamics of ground-nesting birds such as plovers.

Theme: Breeding Ecology

Preferred option: Oral Presentation

Migration timing in a changing world: insights from New Zealand-wintering Bar-tailed Godwits

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Long-distance migrants are often assumed to be unable to respond to environmental change due to their timing being under strict endogenous control. Here we provide insights from the migrations of Bar-tailed Godwits *Limosa lapponica* that winter in New Zealand and make a single major stopover in East Asia on northward migration. Our studies over the past decade show that individual timing reflects both geography on the breeding grounds (northern versus southern Alaska, presumably via endogenous control mechanisms) and also latitude in New Zealand (presumably in response to local photoperiod). This response to photoperiod may generate population-level schedules across the entire non-breeding range. The length of stay of birds in Asia tracked in 2008–2009 point to a complex pattern of individual timing, in which southern breeders arrived over a long period but departed quite synchronously, whereas northern breeders arrived synchronously but departed over a long time. Length of stay therefore declined with arrival date for southern breeders (early arrivers stayed longer), but more northerly breeders extended their length of stay to generate individual schedules that matched the pattern of thaw in Alaska. This clear and obvious relationship had largely disappeared in birds tracked in 2013–2014, as late-migrating birds advanced their departure dates from New Zealand (a trend that has continued), yet they departed no earlier from Asia for Alaska. It appears as if conditions in the late 2000s enabled godwits to migrate in a 'leisurely' manner with strong endogenous control of timing, but changing conditions have disrupted this system and birds are adjusting their migration schedules, probably as a response to deteriorating food supplies in the Yellow Sea. Godwits therefore illustrate both the well-regulated control of migration timing we might expect in a stable ecological system, but also the capacity to adjust migration timing in response to past experience.

Theme: Migration Ecology,

Preferred option: Oral Presentation

Kivi-Kuaka: migratory shorebirds as potential sentinels for tropical storms and tsunamis in the Pacific

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Among natural disasters, tropical storms and tsunamis can have dramatic consequences for human populations and infrastructures. Current climate change, associated with sea-level rise and increased storm intensity, is expected to exacerbate these impacts in the Pacific, especially for low elevation islands. After successive recent intense tsunamis, authorities have developed early warning systems to inform people of impending disasters. However, despite continuous advances in predictive modelling methods and technologies, such systems can be further improved.

Birds are indeed particularly sensitive to infrasounds and vibrations and show adaptive specific behaviours when facing hurricanes. Tracking their movements in adverse climatic conditions or after intense earthquakes could reveal their utility to complement existing early warning systems. For example, survivors of the 2004 tsunami in Aceh, Indonesia, reported flights of birds leaving the coast long before the arrival of the tsunami.

In this project, we propose to equip hundreds of shorebirds wintering across the central Pacific, in order to detect some potential behavioural responses to intense earthquakes or incoming tropical storms. We will use tags developed within the ICARUS initiative, with four model species: bar-tailed godwit, bristle-thighed curlew, wandering tattler and Pacific golden plover.

Tags will collect meteorological data at high altitudes and in remote areas, that would not be available to climatologists; otherwise, that will inform meteorologically. Tracking data will also be very valuable to help to preserve shorebirds along the Asian-Pacific flyway.

Climate Change Vulnerability in Migratory Shorebirds

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The world's climate is changing rapidly, but the rate and extent of change are highly spatially variable. Migratory species visit a range of different regions and might be differentially impacted by climate change in different parts of their life cycle. This study analysed climate vulnerability in 24 migratory shorebird species that visit the Arctic to breed, and then migrate to more southerly latitudes during the non-breeding season, exposing them to a range of different climate change dynamics. Climate vulnerability was assessed separately within their breeding, passage and non-breeding ranges. The Natureserve Climate Change Vulnerability Index was utilised because it accounts for all aspects that influence the climate change vulnerability of a species, these being exposure, sensitivity and adaptive capacity. The direct exposure was examined under two global General Circulation models, GFDL-ESM4 and CNRM-ESM2-1. The remaining aspects are incorporated by a list of vulnerability factors, which were scored for each species based on the literature. This study found that the mean climate change vulnerability of shorebirds in their breeding habitat was three-fold that of their passage and non-breeding habitats, under GFDL-ESM4. It appears that passage and non-breeding vulnerabilities are somewhat correlated. Interspecific variation was high, and the data suggests that several of the most climate vulnerable species are not currently recognised as globally threatened. The major threats identified in this assessment suggest that the IUCN Red List status of some species might need to be re-evaluated, and that climate change mitigation be the primary focus of conservation efforts in the Arctic.

Theme: Conservation Management

Preferred option: Oral Presentation