Explaining the global bird migration system from first principles using a process-based model

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Abstract

Nearly one in five bird species has separate breeding and overwintering distributions, and the regular migrations of these species cause a significant seasonal rearrangement of avian communities across the world. Birds exhibit an impressive global migration system composed of hundreds of migrating species with very different traits, some migrating short distances while others undertaking extraordinary journeys across continents. In this study, we mapped for the first time the global macroecological patterns associated with bird migration, and found that despite the great biological and ecological diversity in migratory birds, strong spatial patterns emerge when all species are pooled together. We then developed a spatially-explicit process-based model rooted in physiological ecology, modelling the energy use of species throughout the year, which successfully explains the patterns associated with the global bird migration system (e.g. richness in migrants, contribution of migrants to local avian assemblages, frequency distribution of migration distances). In contrast to correlative models, this mechanistic model based on key ecological processes can be a great tool for prediction, in particular for the impact of global changes on bird migration and to retrace the evolution of bird migration since the Last Glacial Maximum, which I will discuss in my talk.

Keywords: bird migration, mechanistic model, macroecology

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