# Abstract

Environmental seasonality, and associated fluctuation in resource abundance, affects organisms throughout their life cycles. Periods of resource scarcity can be avoided by seasonal migration, strategy common in animals, including birds. However, the long journeys of migratory birds separate the stages of their annual cycles in space and time, and present them with a variety of challenges. Environmental conditions that migrants experience may have local effects, or may carry over across seasons, and have delayed impacts on individuals and populations. To better understand the interactions between migratory animals and their environment, we integrated individual tracking, environmental measures, and population data within a full annual cycle perspective. We contributed to the understanding that environmental conditions can affect migratory populations both en route and during stationary non-breeding periods, and that their effects can be observed on a continental scale. We also showed, across species and migratory flyways, that stages of the annual cycle are tightly linked during migration, but that these links weaken during prolonged non-breeding stationarity, with implications for individual success and future prospects under ongoing environmental change. To enhance the ability to trace animal movements, we also developed a stable sulfur isotopic map for sub-Saharan Africa, revealing a longitudinal gradient across this biodiversity-rich region with promising applications in wildlife conservation and ecological studies. Overall, large-scale tracking datasets integrated with data on long-term population changes can provide valuable insights into environment–animal interactions, serve as a reference for studies of their temporal dynamics, and can guide targeted conservation efforts.