SCIENCES & BIOENGINEERING SCIENCES

The Research Section

Ecology and Biodiversity

has the honour to invite you to the public defence of the PhD thesis of

Evelien Deboelpaep

to obtain the degree of Doctor of Sciences

Title of the PhD thesis:

CONNECTIVITY OF MIGRATION LANDSCAPES: FROM SUITABLE WETLAND HABITATS TO SUITABLE NETWORKS FOR MIGRATORY WATERBIRDS

Supervisors:
Prof. dr. Nico Koedam (VUB)
Prof. dr. Bram Vanschoenwinkel (VUB)

The defence will take place on
Monday, October 31, 2022 at 17h in auditorium D.2.01

Members of the jury

Prof. dr. Iris Stiers (VUB, chair)
Prof. dr. Sophie de Buyl (VUB, secretary)
Prof. dr. Dominique Maes (VUB)
Prof. dr. Jean Hugé (VUB)
Prof. dr. Frank Van de Meutter (Institute for Nature and Forest Research (INBO), KU Leuven)
Dr. Hannah Wauchope (University of Cambridge – University of Exeter)

Curriculum vitae

Evelien Deboelpaep obtained her Master of Science in Biology at the VUB in 2014, after which she received an FWO scholarship. Then, she started her PhD research at the VUB in October 2015.
She published 6 papers in peer-reviewed journals (4 as first author), has written popular science articles, and has presented her work at international conferences and at a specialised PhD masterclass on animal migration.
Evelien supervised several bachelor (3) and master (5) theses and assisted in courses, practical sessions, and fieldwork training in Belgium and abroad.

Abstract of the PhD research

Migratory waterbirds – often called sentinels for the state of the environment – rely on high-quality and well-connected wetland stopovers during their seasonal journeys between breeding and wintering areas. Every year, several billions of waterbirds travel between Eurasia and Africa. Despite the flexibility in migration routes and strategies, anthropogenic and climate-induced impacts on wetland habitats have caused widespread declines of waterbird populations. In this respect, the importance of functional connectivity for long-term population persistence is widely recognised, but hardly ever addressed in conservation frameworks. Therefore, we analysed how graph-theoretic connectivity models can be used to evaluate the structure of migratory flyways (bundles of flight routes), and to capture the role of stopovers in facilitating migration. For this, we focused on Eastern Mediterranean bottlenecks, where flight routes are funnelled in proximity of major ecological barriers such as the Mediterranean Sea and Sahara Desert.

In a first part, wetland quality was evaluated, with an emphasis on the energy available for migratory refuelling. Food availability was seven times higher in spring than in autumn in protected wetlands, while differences between wetland sites and habitat types were less pronounced. This information was used to simulate the foraging performance of waders with different body plans and foraging strategies *in silico*. Here, the finer-scale spatial distribution of resources had strong but variable effects on the foraging performance of different wader species. Experimental simulations of flight responses revealed that the effective foraging opportunities of waterbirds can to a great extent be impacted by human disturbance, however.

In a second part, insights on flyway composition (wetland quality) and configuration (position of wetlands) were combined to analyse connectivity of Palearctic-Afrotropical flyways. Clear differences were discovered in the network structure between the four flyways, but a substantial portion of the overall connectivity was supported by unprotected wetlands. Next, to investigate how the inclusion of more realistic constraints on migration altered the presumed importance of stopovers, a novel energy-based connectivity metric was developed (ECON). Including directionality and energetic constraints resulted in a drastically different picture of the relative importance of stopovers. To conclude, we presented a first analysis of the absence of connectivity in current policies, and suggested an approach for including a connectivity criterion for migratory birds based on results from the research.

Insight on the wetland quality and distribution of resources improved our understanding of how stopovers support flyway connectivity for migratory waterbirds. This research also demonstrates the utility of graph-based models for investigating present and future conservation scenarios of migratory flyways.