BioMove Project P05 (IZW Berlin), 2nd PhD student cohort

Supervising team: Christian Voigt, Jana Eccard, Niels Blaum

Equalizing and stabilizing mechanisms in regulating the co-existence of aerial-hawking bat species in agricultural landscape

0. Brief expected profile of PhD student

Background in behavioral ecology, particularly in the area of spatial behavior of animals
MSc in ecology, animal behavior, or related fields
Experience in conducting field work, preferably with bats
Knowledge in genetic techniques such as DNA-barcoding or next generation sequencing
Excellent statistic skills, possibly modeling experience
Fluent in English (both speaking and writing)
Driver license

1. Short Abstract

Animals adjust their foraging movements according to the presence or absence of conspecific or heterospecific competitors, yet it is poorly understood what the criteria are for animals to seek, tolerate or avoid potential food competitors. Using high resolution spatial tracking of bats in combination with meta-barcoding of fecal samples to determine their diet, we aim at understanding the principles that rule the three dimensional movements of bats in an agricultural landscape, with the ultimate goal to understand which factors influence the coexistence of species and how and to what extent top consumers such as bats affect local insect abundances/ assemblages.

2. Background and previous work

Overall, we aim at understanding the patterns of biodiversity that are driven by movements. Specifically, we focus on bat movements based on underlying principles and rules (Voigt et al. 2017). In collaboration with other members of the RTG Biomove, we have established a joint study site, the AgroScapeLabs, north of Berlin. Our previous work has shown that noctule bats prefer certain habitats when foraging in agricultural landscapes (Roeleke et al. 2016). At our study site, the abundance of species varies strongly between seasons, with peak activities of bats (both regional and migrants) in late summer and autumn (Heim et al. 2016). Local activity of bats varies across species and depends largely on landscape features, such as edge structures, ponds and the intensity of farmland practice (Heim et al. 2017a, 2017b). A highly mobile species capable of powered flight, bats may lift their body into the three dimensional space of the troposphere, several hundred meters above ground. Altitudinal flights of bats are guided by landscape topography and may reach up to several hundred m above ground (Roeleke et al. 2017). The use of the lower boundaries of the troposphere varies with the lunar cycle, probably in response to prey availability, which might have cascading effects on local insect populations. Based on playback experiments, we already showed that local foraging activities of bats depend on the presence of competing species, which could potentially act as stabilizing mechanisms, supporting the co-existence of species with local bat communities. Species-specific travel distances and small scale spatial separation may present an equalizing factor that allows highly mobile species to respond dynamically to local resources and competitors.

3. Objectives/Aims

- Do bats forage spatially in a disassortative way in response to competing conspecifics and heterospecifics, and do bats adjust their prey choice accordingly?
- Does the presence of bats down regulate local insect populations and limit ecosystem services mediated by insects, e.g. pollination?
- Is it possible to model the co-existence of bats using a virtual bat community influenced by species-specific motion capacities and interactions?

4. Outline work program

We would like to use high-resolution spatial tracking of bats with the Atlas-System (Weiser et al. 2015) to understand how bats respond to other bats. We will achieve this by simultaneous tracking of several individuals of different species, which will allow us to quantify the spatial distance of competing bats when foraging in the same habitat. The Atlas system is a high-throughput VHF system that automatically triangulates the position of tagged animals based on signal delay at several receiving antenna stations. Encoded VHF signals allow the simultaneous tracking of several animals at high temporal and spatial resolution. Further, based on mist netting in a randomized grid design, we will collect feces from captured bats and identify consumed insect species based on meta-barcoding with Next Generation Sequencing. This work will be done in collaboration with BeGenDiv, a local consortium spezialized on NGS technologies (www.begendiv.de).

Using experimental plots, we will assess if the simulated presence of bats will change the local diversity of insect prey and their ecosystem services, such as pollination and herbivory. We will use playbacks to simulate the presence of predator bats and study how this affects the abundance of insects and their pollination services and herbivory disservices for plant communities.

We will use an individual-based modeling approach in competitive virtual bat communities to study which movement related traits promote the co-existence of bats in landscape of varying heterogeneity and complexity.

5. Linkage to 'BioMove' hypotheses, objectives and concepts

The PhD student of the 2nd cohort will build on the joint knowledge of the first generation and specifically on the work of the previous PhD student working with bats. Our focus will be on the competitor interactions, targeting the identification of equalizing and stabilizing mechanisms that might support local diversity of bats and prey insects. Yet, we will more strongly work on indirect trophic interactions using cutting edge technologies, such as meta-barcoding and high-throughput automated radio-tracking.

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Weiser, A. W., Orchan, Y., Nathan, R., Charter, M., Weiss, A. J., & Toledo, S. (2016, April). Characterizing the accuracy of a self-synchronized reverse-GPS wildlife localization system. In Proceedings of the 15th International Conference on Information Processing in Sensor Networks (p. 1). IEEE Press.