Navigating fragmented tropical landscapes; understanding how forest fragmentation affects bird behaviour (Ref IAP2-18-187)

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In partnership with Durham University, Department of Biosciences

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Key Words
1. Tropical forest
2. Agricultural landscapes
3. Animal tracking
4. Bird communities
5. Movement ecology

Overview

Over the last century much of the tropical forest biome has been converted from continuous tracts of undisturbed forest to complex human-modified landscapes composed of degraded primary forest fragments, secondary forest, pasture and agricultural land\textsuperscript{1,2}. In contrast, <10\% of the tropical forest biome is protected within strict reserves\textsuperscript{3}. Consequently, the long-term conservation of tropical forest biodiversity is increasingly dependent on whether fragmented, human-modified landscapes can support viable populations of forest species\textsuperscript{2,4} and the extent to which landscape dynamics alter species behaviour and interactions\textsuperscript{5,6}.

Previous studies of birds in fragmented forest landscapes describe the presence and abundance of species but fail to explain why we see certain species persisting in fragments while others are only found in continuous forest\textsuperscript{7}. The answer likely lies in how animals use their spatial environment and their capacity to move among forest fragments to meet dietary, roosting and reproduction needs, while avoiding predation\textsuperscript{8}. Currently, we know little about how birds disperse in undisturbed habitats let alone how movement patterns shift with habitat fragmentation. We predict that species life-history and morphological traits will interact with landscape composition to determine dispersal among forest fragments\textsuperscript{9}. For example, animal species with large dispersal distances may be less affected by fragmentation than poorly dispersed species with small home ranges.

Fig1: Forest fragments in the Cerro Cama landscape.

In this project we will work in well-characterised landscapes in central Panama, where we will tag birds with state-of-the-art radio tracking devices capable of recording their movements within and between forest fragments. These devices represent the latest in animal movement monitoring technology and will provide us with
unprecedented detail on individual bird movements. We will integrate these novel data with existing knowledge of the landscape, and bird functional and life-history trait data to:
1. Describe how the movement patterns of birds (from a subset of species) shift from forested to fragmented landscapes.
2. Understand how movement patterns are mediated by landscape structure and species traits.
3. Quantify the functional connectivity of human-modified landscapes for birds, and identify how this shapes species composition of individual forest fragments.

Methodology

Study landscapes: We propose to study tag and track individuals from a subset of bird species in two landscapes in central Panama that present contrasting forest cover and disturbance regimes; Barro Colorado Nature Monument (BCNM) and Cerro Cama (CC). BCNM is a forested landscape composed of contiguous patches of PF and older secondary forest (SF >35 years) with no on-going disturbance; CC is an active agricultural landscape with high levels of spatial and temporal disturbance.

Animal tracking: We will use existing bird survey data from the study sites to select a subset of bird species that represent functionally distinct groups of species (including canopy and understory frugivores, and understory insectivores), and species that exhibit distinct responses to fragmentation. We will capture individuals in both the forested and fragmented landscape and fit them with GPS loggers to monitor movement patterns.

Data integration: Spatially explicit movement data will be integrated with landscape composition data, existing bird census data from the two landscapes, and morphological trait data collected from museum specimens at the Smithsonian Tropical Research Institute, Panama. In combination these data sets will allow us to describe how the functionally distinct bird species move across forested and fragmented landscapes.

Collaborators: This project is in collaboration with Dr Martin Wikelski (Max Planck Institute for Ornithology - MPIO, Germany) and Dr Rachel Page (Smithsonian Tropical Research Institute, Panama). Dr Wikelski will provide training and technology to enable monitoring of bird movements, and the student will visit MPIO early in the project to complete training. Dr Page will provide logistical support and supervision during fieldwork in Panama.

Timeline

This is a 3.5 year PhD studentship with an anticipated start in October 2019:
Year 1: Literature review. Training at MPIO & fieldwork in Panama. Thesis chapter 1.
Year 2: Continuation of fieldwork in Panama. Training in analysis of spatial data. Thesis chapter 2 and manuscript submission.
Year 4 (6 months only): Final write-up and thesis submission.

Training & Skills

The PhD training will have three main components:
1) Fieldwork and experimental design. Training in the required field skills (e.g. bird identification, mist netting and tagging), and sampling design.
2) Numeracy, data analysis, ecological modeling & informatics. These skills will be gained through interaction with supervisors and targeted training courses within the IAPETUS consortium (e.g. Programming and Analysis of Environmental Data in R, GIS & Remote Sensing for Environmental Managers).
3) Complementary training in transferable skills. Training in core scientific skills (data management, analysis, presentations, paper writing).

References & Further Reading

Further Information

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