

PROJECT TITLE: (In)visible interactions: insect webs in human-modified tropical forests

DTP Research Theme(s): Dynamic Earth, Living World, Changing Planet

Lead Institution: University of Bristol

Lead Supervisor: Dr Filipe M. França – University of Bristol, School of Biological Sciences

Co-Supervisor: Professor Afried Vogler – Natural History Museum/Imperial College London

Co-Supervisor: Dr Polyanna C. Bispo – The University of Manchester, Department of Geography

Co-Supervisor: Professor Jane Memmott – University of Bristol, School of Biological Sciences

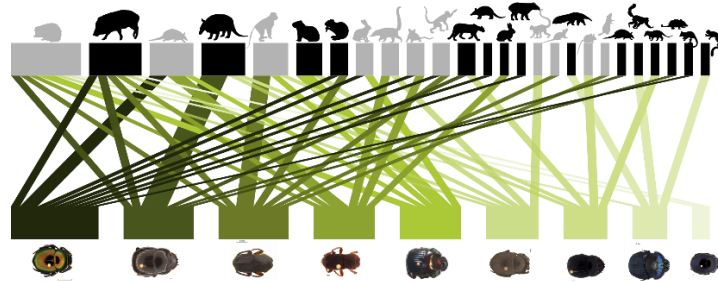
Co-Supervisor: Dr Christoph Gruetter – University of Bristol, School of Biological Sciences

Project Enquiries: filipe.machadofranca@bristol.ac.uk

Project keywords: Tropical forests, Molecular Ecology, Insect interaction webs, Remote Sensing



Amazonian landscape with a mix of pristine and human-modified forests. Credits: Flávio Forner



Dung beetle-mammal interactions from undisturbed forests in Amazonia (Santarém, Pará, Brazil). Beetle iDNA was metabarcoded for the most abundant species and mammals were ID at species (black) and higher levels (grey).

Project Background

Challenge. Insects make up the majority of known animal species and play pivotal roles in ecosystem functioning through (in)visible interactions with other biodiversity groups. Tropical forests are global hotspots of insect diversity and have vital importance for achieving international conservation goals but face multiple human-induced threats. Environmental disturbances alter ecosystem function by filtering out species with specific traits, triggering cascading effects on species interaction webs. However, empirical evidence from tropical forests is scarce, especially for insect pollination and detritivore interactions, hampering our capacity to inform effective conservation efforts in the region.

Proposed solution. Your PhD journey will take you to the Brazilian Amazonia to reveal how environmental changes influence tropical bee-plant and dung beetle-mammal networks. To achieve this, your research will encompass multiple scales and combine cutting-edge molecular techniques (microscale) like ingested DNA (iDNA) and environmental DNA (eDNA) with insect traits and landscape ecology metrics (macroscale).

Project Aims and Methods

Aim: The project's initial goal is to explore how forest degradation and traits influence tropical insect interaction networks. This objective is flexible, depending on the student's interests and prior skills.

Approach. Dung beetles and Meliponini stingless bees are highly responsive to environmental change and contribute significantly to ecosystem function. These insects will be collected in three Amazonian regions that represent the diverse socio-environmental contexts found across the tropics. Each region will have twelve landscapes, each with a forest site where insects will be surveyed with dung-baited pitfall traps (beetles) and suspended carrion traps (bees).

Mammal-beetle and plant-bee networks will be built by metabarcoding iDNA from dung beetle gut contents and eDNA from pollen in bees. You will receive training in high-throughput sequencing and bioinformatics to produce the first comprehensive overview of tropical insect interaction networks. Insect traits (e.g. body size, wing length) will be measured for each species. Field-based and satellite-derived landscape metrics will serve as explanatory variables to assess the influence of environmental change on insect communities and network quantitative descriptors. These descriptors reflect ecosystem functioning and stability. Through this approach, you will adopt an innovative and valuable framework to inform effective strategies for conserving tropical forest biodiversity.

Candidate requirements

We are a diverse supervisory team with representatives across career stages, genders, nationalities and educational backgrounds. We value a diverse research environment and both welcome and encourage student applications from under-represented groups in academia. High enthusiasm and passion for the natural world are as welcome as having previous experience in molecular techniques, species interaction approaches, remote sensing, and/or fieldwork skills. You don't need to have all these and we will offer you training opportunities for those disciplines during your PhD journey.

Project partners

This PhD project offers an exciting opportunity to collaborate with other postgrads from the NERC GW4+ DTP, as well as within five research groups from three institutions (Natural History Museum, University of Bristol and University of Manchester). NERC GW4+ DTP will provide you with many opportunities for skill development, including statistical analysis, bioinformatics, outreach communication and writing. We also care for your well-being and offer regular workshops on emotional resilience and mindful techniques.

Training

Before embarking on your tropical expedition, you will receive training on remote sensing at the University of Manchester to identify the best landscapes for your research and first aid to ensure safety during fieldwork. While in the field, you will undergo training in insect identification and trait measurements. Upon your return, you will be trained in metabarcoding and bioinformatics. Once your data is ready, we will also train you in stats and network data analysis.

Background reading and references

Bush et al. (2017) *Nature Ecology and Evolution*: Connecting Earth observation to high-throughput biodiversity data. <https://doi.org/10.1038/s41559-017-0176>

Memmott et al. (2007) *Ecology Letters*: Global warming and the disruption of plant–pollinator interactions. <https://doi.org/10.1111/j.1461-0248.2007.01061.x>

Bispo et al. (2020) *Remote Sensing*: Woody Aboveground Biomass Mapping of the Brazilian Savanna with a Multi-Sensor and Machine Learning Approach. <https://doi.org/10.3390/rs12172685>

Peng et al. (2021) *Ecological Entomology*: Foragers of the stingless bee *Plebeia droryana* inform nestmates about the direction, but not the distance to food sources. <https://doi.org/10.1111/een.12937>

França et al. (2020) *Philosophical Transactions of the Royal Society B*: Climatic and local stressor interactions threaten tropical forests and coral reefs. <https://doi.org/10.1098/rstb.2019.0116>

Useful links

<http://www.bristol.ac.uk/biology/courses/postgraduate/>

<https://www.nhm.ac.uk/our-science/departments-and-staff/life-sciences.html>

<https://www.seed.manchester.ac.uk/research/>

<https://www.nercgw4plus.ac.uk/>

Bristol NERC GW4+ DTP Prospectus:

<https://www.bristol.ac.uk/study/postgraduate/research/great-western-four-doctoral-training-partnership-nerc/>

How to apply to the University of Bristol:

<http://www.bristol.ac.uk/study/postgraduate/apply/>

Please note: If you wish to apply for more than one project please contact the Bristol NERC GW4+ DTP Administrator to find out the process for doing this.

The application deadline is Tuesday 9 January 2024 at 2359 GMT. Interviews will take place from 26 February to 8 March 2024.

For more information about the NERC GW4+ Doctoral Training Partnership please visit

<https://www.nercgw4plus.ac.uk>.

General Enquiries: Bristol NERC GW4+ DTP Administrator

Email: bristol-nercgw4plusdtp-admin@bristol.ac.uk