PROJECT TITLE: How do ants build responsive nests? From local construction rules to environmental plasticity

Project Science Theme: Evolution and Biodiversity
Project keywords: Collective-behaviour, Self-organisation, Environmental-plasticity, Agent-based-modelling, Machine-learning

Lead Institution: University Bristol
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Project description:

Animal-built structures shape their inhabitants' environment, influencing movement, social organisation and exposure to environmental stress. Yet we still lack a mechanistic understanding of how complex architecture emerges from local behavioural rules, or how those rules are modified by changing environmental conditions. This project will use the black garden ant Lasius niger to determine how individual building decisions scale up to colony-level nest architecture and how environmentally responsive construction emerges, providing a mechanistic basis for predicting behavioural responses to environmental change.

The Doctoral Researcher will exploit a new high-throughput platform being developed in Bristol combining high-resolution video, AI-based behavioural classification and 3D scanning of growing nests. Using machine-learning approaches, they will extract interpretable behavioural rules linking soil-pellet collection, transport and deposition to the surrounding physical and social environment. These empirically-derived rules will then be implemented in agent-based models to identify the minimal mechanisms required to reproduce observed architectures.

The Doctoral Researcher will investigate how environmental conditions modify these construction rules, using temperature as an initial focus, with scope to extend the research to humidity, soil properties or other environmental variables depending on project outcomes and the Doctoral Researcher's interests. Laboratory experiments may be complemented by field studies on natural colonies, allowing the Doctoral Researcher to shape both the ecological questions and the balance between experimental, analytical and modelling approaches.

The project provides integrated training across partner institutions: experimental behavioural ecology, automated behavioural analysis and 3D imaging at Bristol; ant thermal ecology, microclimate measurement and field ecology at Cardiff; statistical machine learning and rule calibration at Exeter; scalable deployment of AI-based computer vision at ZSL; and stochastic and agent-based modelling at Bath. Research visits between institutions will enable the Doctoral

Researcher to connect empirical data collection, behavioural inference and predictive modelling while developing ownership of the project's scientific direction and analytical framework.

Collaborative Partner:

ZSL/ Institute of Zoology ZSL/Institute of Zoology will contribute in kind through three elements of its established Collaborative Partner commitment. (1) Dr Robin Freeman will provide project co-supervision and specialist expertise in computer vision, AI workflows and scalable analysis of large-volume behavioural video, with access to ZSL's Conservation AI Lab, including high-performance/GPU computing, and opportunities for research visits. (3) ZSL contributes speakers and representatives to DLTP Doctoral Researcher meetings, providing wider exposure to careers and developments in conservation science. (4) ZSL contributes staff expertise, facilities and computational resources to DLTP training activities and workshops. For this project, the Doctoral Researcher will additionally benefit from access to ZSL's wider network of conservation scientists, practitioners and collaborative programmes.

Useful recruitment links:

For information relating to the research project please contact the lead Supervisor via: nathalie.stroeymeyt@bristol.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/

The application deadline is Thursday 7 January 2027 at 2359 GMT