PROJECT TITLE: When and how does adaptation prevent extinction due to climate change? Testing for evolutionary change at contracting range margins of European butterflies
DTP Research Theme(s): Living World (also fits within changing planet)

Lead Institution: University of Bristol
Main Supervisor: Dr Jon Bridle, School of Biological Sciences
Co-Supervisor: Dr Robert Wilson, University of Exeter
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High altitude butterfly habitat in the mountains around Madrid
The Dusky Meadow Brown butterfly (Hyponephele lycaon)

Project Background

Profound effects on ecosystems are occurring as climate change causes rapid shifts in species’ distributions in space and time. Many organisms have already contracted their geographical ranges at equatorial margins, and expanded their ranges as their poleward margins become increasingly habitable. However, these responses seem limited by rates of local adaptation. Although most generalist species have shifted their ranges, most specialists remain trapped in increasingly fragmented habitats, apparently because they cannot adapt to conditions at their ecological margins. Defining critical levels of environmental change therefore depends on understanding how easily (and how quickly) adaptive divergence can occur at ecological margins.

Project Aims and Methods

Many butterflies reach their southern range margins in the mountains around Madrid, and have shown uphill contractions associated with climate warming (REF1, 3). Climatic, ecological and morphological data we have collected since 2006 suggest such ecological responses in the Dusky Meadow Brown, which shows synchronous flight periods at different altitudes, and associated size variation, while maintaining populations at low elevations. Such changes suggest evolutionary shifts in thermal niche, and life history of the species.
This studentship will test whether evolutionary responses are driving these distributional changes by:

(i) Conducting butterfly, larval and host plant surveys in central Spain, and comparing their thermal niche and phenology to previous years

(ii) Using population genomic analysis of RAD-sequence data to test for rapid evolution and its relationship to niche shifts in time (since 2006) and in space (across the geographical range).

(iii) Conducting morphological and life history analyses to explore trade-offs associated with shifts in phenology

(iv) Conducting field transplant experiments to test for adaptive divergence in maternal behaviour and larval survival (see REF2) and by testing for variation in larval growth rate at different altitudes.

Candidate

This project would suit a highly-motivated candidate keen to understand the role of evolutionary responses in ecological resilience to climate change, using a combination of ecological analysis, quantitative genetics, and population genomics. JB’s laboratory combines molecular genetics with whole-organism evolutionary research, and is a highly stimulating environment for postgraduates

Training

JB and RW will provide expertise in fieldwork techniques, and will accompany the student for the first summer’s fieldwork. Prof Mark Beaumont will provide expertise in genetic data analysis, in addition to Dr Rita Rasteiro, a Bristol PDRA specialising in the analysis of genomic data. JB has strong collaborations with other UK butterfly ecologists, through his ongoing NERC Highlight Topic Grant to test evolutionary responses in UK butterflies.

RW is an expert in spatial ecological analysis and inferring microclimate variation from larger scale climatic and topographical data. He will also provide training in population ecology and niche modelling.

References / Reading List


Wilson, RJ et al. (2005) Changes to the elevational limits and extent of species ranges associated with climate change. Ecology Letters 8: 1138-1146


Links

School webpage: http://www.bristol.ac.uk/biology/courses/postgraduate/

NERC GW4+ DTP Website: http://nercgw4plus.ac.uk/

Bristol NERC GW4+ DTP Prospectus: http://www.bristol.ac.uk/study/postgraduate/2017/doctoral/phd-great-western-four-dtp/

Application deadline: 23.59 GMT, Sunday 7 January 2018

How to apply to the University of Bristol: http://www.bristol.ac.uk/study/postgraduate/apply/

General Enquiries:

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