Understanding phenotypic plasticity and genetic adaptation in a range-expanding species: lessons from physiology and modelling.

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Background: Global climate change often results in poleward range expansions. A new and promising model species for rapid range expansion is the orb-weaving spider *Argiope bruennichi*, which moved from the Mediterranean region into continental climates as far as Scandinavia and Finland in less than 100 years. Consequently, its current distribution spans different climates and environments. The rapid northward expansion of *A. bruennichi* was probably facilitated by admixture of formerly isolated lineages through global warming, resulting in an introgression of Asian alleles into the central European genepool (*Mol. Ecol. 22: 2232*). To understand the range expansion dynamics, and subsequent adaptation of these spiders in novel environments, we use common garden experiments to compare populations of *A. bruennichi* from the range expanding front of the distribution (Baltic countries) with those of the original range in the Mediterranean.

We have developed state-of-the-art genomic resources for the species (bioRxiv: doi.org/10.1101/2020.05.21.103564), as well as detailed population genomic data, which we use to detect adaptation at the sequence level. Common garden physiological experiments at the phenotypic level point to both genetic adaptation and plasticity as important factors contributing to cold tolerance and overwintering success. Gene expression studies and metabolomic data will provide the connecting link between genomic and phenotypic evidence for adaptation. Our work contributes to the overall aim of the RTG by pinpointing the mechanisms driving success in species that colonise, and subsequently adapt to, new habitats.

Goals of the project: We will investigate variation between populations from the northern range limit (Estonia) and the core of the range (Southern France). In this project, we aim to assess the degree of phenotypic plasticity and genetic adaptation underlying the variability in traits related to temperature tolerance, specifically in adaptation to colder winters. The methodology will include field collection of spiders, with overwintering of offspring in a common garden design followed by physiological measurements, including gene and metabolite expression. We will work closely with Henrik Krehenwinkel (Uni Trier) and an interdisciplinary collaboration network at our university to generate and analyse the expression data. Analysis will be aided by the use of our high quality genome assembly. We will use these fitness-relevant data to parameterize various models with the aim of predicting population persistence and distribution of *A. bruennichi* in the future.

Required skills:

- Strong background in evolutionary biology and molecular biology
- Interest in environmental physiology
- Knowledge of statistics (preferably in R)
- Interest in species distribution modelling
- Excellent knowledge of English (speaking and writing)
- Very good organizational skills
- Strong ability to work cooperatively in a team

This project is one of 12 within the consortium **RESPONSE**, supported by the German Science Foundation (DFG). For detailed information on **our project B5** and other projects see here:
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For detailed information on how to apply, please visit our RESPONSE homepage
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