

Sexual selection and local adaptation to the environment

Supervisors:

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Hosting Institution: University of Exeter

Project description: The role of sexual selection in adaptation to the environment is poorly understood. A particular focus of current theory is that, contrary to the traditional view, sexual selection may actually accelerate adaptation. If males that are well adapted to the environment are more attractive to females, then genes that contribute to his adaptation will proliferate both through natural and sexual selection. The student will test this key hypothesis through an interdisciplinary combination of evolutionary ecological, and biophysical experiments to provide insights into the fundamental question of why sexual reproduction is so prevalent.

The student will use field crickets (*Gryllus campestris*) as a model system¹ to test the hypothesis that male acoustic signals (a prominent display trait of crickets and numerous other animals) provide females with information about well adapted to their local environment those particular males are. The major inter-disciplinary leap of this project will be the combination of Evolutionary Ecology (Tregenza and Bridle) and Bionanoscience (Robert). We have pilot data showing that diet influences male condition, such that males fed a high quality diet resemble males that are well adapted to the environment (and hence able to secure resources). The student will begin with laboratory studies using manipulations of diet and quantification of song traits. They will then determine whether females prefer males that are in good condition using standard playback response protocols. Direct measurements of the mechanical responses of the ears of female crickets² will be used to examine the extent to which females can differentiate among males and individual differences in female sensitivity to male calls, allowing us to examine variation in receivers as well as in signallers.

The student will collect crickets from sites we have identified in Northern Spain from >1000m (cold climate) and <200m (warm) areas and carry out reciprocal transplants to enclosures in both types of site. The relative attractiveness of offspring from adults transplanted within their native climate zone will be compared with those transplanted between zones. This will allow a test of the prediction that local adaptation to climate means that females will prefer songs from males that are well adapted to the environment in which they have been raised. Physical measurements of the responses of female ears to sounds will allow us to examine genetic and environmental sources of variation in the mechanical responses of female ears to sound.

Rodríguez-Muñoz, R. Bretman, A. Slate, J. Walling, C.A. Tregenza, T. 2010 Natural and sexual selection in a wild insect population. *Science* **328**, 1269-1272.

Zapata, F.M. Jonsson, B.T. Brown, K.A.R. Postles, M.C. Robert, D. 2012 Convergent evolution between mammalian and insect audition. *Science* **338**, 968-971.

Training opportunities: This project crosses the disciplines of laboratory and field based evolutionary and behavioural ecology. We will provide the student with full training in laboratory and field based evolutionary ecology and in the bionanoscience techniques used to directly measure

the physical responses of receiver mechanisms. Additionally we will offer training open to all students within the DTP in the following areas:

- a) Design and execution of laboratory behavioural studies of insects (Based at the CEC, Penryn, Exeter), we have resources for this aspect for up to 4 students, larger numbers will require us to access additional Constant Temperature room space.
- b) Design and execution of acoustic and laser measurements of song production and hearing response. Training will be extended to other students in DTP as appropriate (Robert, Bristol)
- c) Studying invertebrates in the wild – field based training on collecting and studying terrestrial invertebrates. This will require resources to cover the travel and accommodation expenses of participating students for a week (Bridle, Bristol and Tregenza, Exeter – course run in N. Spain)
- d) Acoustic analysis of animal signals – this will be a remote learning course enabling students to take it from anywhere within the DTP. (Tregenza, Exeter).