Master's thesis (+IRT3) projects available in the *Speciation Behaviour* Group

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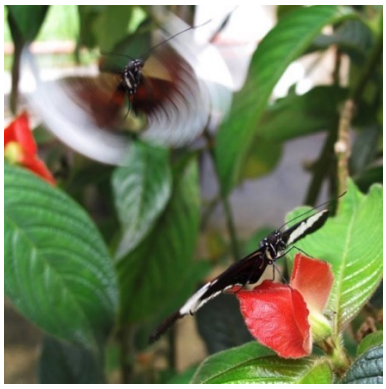
Project 1. Using *CRISPR* to test the role of *Regucalcin* in *Heliconius* mate choice



A key challenge in evolutionary biology is to link genetic variation to adaptive phenotypes. Although we have made considerable progress for morphological adaptations, we still know little about the genetics of behaviours in natural populations. The genes for warning pattern variation in *Heliconius* are now well characterised. We recently identified candidate genes for shifts in mate preference behaviours, including a pair of *Regucalcin* genes. We are now attempting to functionally test these genes using *CRISPR/Cas9*. The student will learn to design and conduct *CRISPR* experiments (IRT3), before testing whether knockouts influence behaviour (thesis). This could be coupled with immunocytochemistry to study which neuronal populations might mediate the behavioral shift.

Project 2. Larval adaptations contributing to reproductive isolation in *Heliconius* butterflies

Students of adaptation and speciation have studied *Heliconius* butterflies for over 150 years. However, most of this work has focused on the mimetic warning patterns of the adults, and other life stages have largely been ignored. In this project the student will investigate larval adaptations to different environments, that potentially contribute to reproductive isolation. The student will examine pupal site choice and desiccation resistance (IRT3), before designing experiments to test the relevance of these phenotypes in the wild, and potentially their genetic basis (thesis).

Project 3. Evolutionary genetics of visual adaptation in *Heliconius* butterflies

Efficient visual perception depends on a match between an animal's visual system and the available light. For diurnal species, the local light conditions can vary greatly (e.g. forest vs. an open savanna). Previous work has compared the eye morphology of *Heliconius* species occurring in different micro-habitats (open vs. dense forest) and reported species-specific differences in eye morphology. The starting point for this project will be to examine the eye morphology of additional *Heliconius* populations (IRT3). The student could then use existing crosses and genomic data to identify their genetic basis, or behavioural assays to determine their significance (thesis).

n.b. These projects *could* involve work in the tropics. The lab will cover any travel costs.

Relevant papers from the lab:

Hausmann AE ***et al.*** (2021) *Light environment influences mating behaviours during the early stages of divergence in tropical butterflies*. **Proc B.** 288: 20210157

Montgomery SH *et al.* (2021) *Neural divergence and hybrid disruption between ecologically isolated Heliconius butterflies.* **PNAS** 118

Rossi M *et al.* (2020) *Visual mate preference evolution during butterfly speciation is linked to neural processing genes*. **Nature Communications** 11, 4763

Merrill RM *et. al.* (2015) *The diversification of Heliconius butterflies: what have we learned in 150 years?* **JEB** 28 (8), 1417-1438