Adaptive evolution of stress coping style in guppies

Supervisory team:
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Host institution: University of Exeter (Penryn)

Project description:

Context: Stress responses allow animals to maintain homeostasis, health and fitness when challenged by adverse environmental conditions. Although we know a lot about some of the specific pathways involved, we know less about how they operate together. For instance, when challenged by an acute threat in the environment – perhaps a predator - neuroendocrine pathways trigger both behavioural (e.g. fight or flight behaviours) and longer-term hormonal responses (e.g. increases in circulating cortisol). Although these pathways need to be coordinated to maintain fitness, different trait combinations may be optimal depending on the challenges faced. This idea leads to the prediction that behavioural and endocrine components of stress response should co-evolve, a hypothesis that can be tested by looking at the genetic basis of phenotypic differentiation among populations experiencing different stress environments.

Specific background: This project will explore evolution across populations of the Trinidadian guppy that have evolved under very different predation - and so stress - regimes. It will be primarily lab-based, focusing on 12 colonies of fish currently housed in the Penryn aquatic facility that are derived wild parents collected in 2017. From previous work we know that individuals within a population differ in stress response 'coping style' and that that genetic differences among individuals are an important source of behavioural and physiological variation. This variation sets the stage for evolution by natural selection to proceed and generate adaptive phenotypic divergence among populations.

Aims: Using a combination of behavioural and breeding experiments, endocrinology and genetic analyses (including both quantitative genetic and genomic approaches) the project will test 4 hypotheses:

1) That populations show genetic divergence in behaviours and endocrine traits

2) That behaviour and endocrine function have co-evolved

3) That divergence is adaptive and cannot be explained by neutral population genetic processes alone (drift, contemporary gene flow) 4) That predation regime is a specific driver of adaptive divergence in stress response.

These objectives are firmly rooted in evolutionary biology and the successful applicant will have a strong interest in genetics. Training in skills needed for quantitative and population genetics/genomic analyses will be provided. However, the project also contains a large behavioural component and thus a strong interest in this area, coupled to a desire to work with animals, is also essential.