Proposal Details

"Non-genetic" sources of phenotypic variation: transgenerational plasticity, bet hedging and epigenetic mechanisms in marine stickleback

Presentation Type

Invited Speaker

Abstract Text

Ocean climates are changing rapidly and marine organisms must either acclimate or adapt to survive. Identifying how organisms cope with ocean warming, increasing temperature variability and extreme events like marine heatwaves is important for predicting consequences for populations, and ultimately, biodiversity. Using a series of experiments simulating changing ocean temperature scenarios, we investigated the influence of directional warming (+1.5°C and +4°C) and increased temperature variability on marine stickleback (Gasterosteus aculeatus) phenotypic variation. The roles of within-generation (WGP) and transgenerational plasticity (TGP), bet hedging and epigenetic mechanisms in adaptive potential were assessed. We consistently found that exposure to +4°C had detrimental effects on offspring growth compared to ambient conditions. Yet, offspring of mothers acclimated to +4°C reached larger sizes at +4°C via TGP in response to predictable environmental cues of future environments, with optimised gene expression inherited from mothers underlying transgenerational benefits. When parents and offspring were exposed to +1.5°C, transgenerational effects on embryo hatching success were observed. Comparing transcriptomes of parents (eggs/sperm) and embryos across development, we showed that massive changes to the epigenetic landscape occurred at +1.5°C in the blastula stage, potentially reflecting a key “window of opportunity” for adaptive epigenetic responses to near-future climate change. Exposing parents to fluctuating environments (predictably variable or stochastic), however, led to maternal bet hedging strategies (diversified and conservative, respectively) to cope with future

environment uncertainty. Yet, when parents were exposed to natural (ambient) or increased temperature variation, we did not detect evidence for bet hedging of offspring size, but global DNA methylation increased with increasing variability, suggesting a possible link between methylation and plasticity. Taken together, our studies show that marine stickleback employ multiple adaptive strategies both within and across generations to cope with rapidly changing ocean conditions.

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