Mechanisms underlying the coral larval settlement

Supervisory team:

Lead supervisors: Dr Elizabeth Williams (University of Exeter), Dr Vengamanaidu Modepalli (Marine Biological Association)

Dr Katherine Helliwell (University of Exeter), Dr Glen Wheeler (Marine Biological Association), Dr John Bishop (Marine Biological Association)

Collaborators: Dr Roberto Feuda (University of Leicester)

Host institution: University of Exeter, Marine Biological Association (MBA)

Submit applications for this project to University of Exeter

Project description:

Global environmental changes threaten coral reefs. Coral larval settlement is vital for the sustenance of the coral reef ecosystem and is considered key to the recovery of reef communities following environmental stress or anthropogenic disturbances. Like most marine benthic invertebrates, the corals develop into adults via a ciliated larval stage that forms part of the zooplankton. Understanding how the coral larvae respond to environmental cues is key to understanding larval metamorphosis and settlement, especially in changing climatic conditions. Several studies in numerous reef-building coral larvae have revealed an array of abiotic and biotic factors that drive the larval settlement. During the settlement, the larva exhibits a searching behaviour to identify a suitable substrate, and the process is facilitated through a complex larval sensory system. In many species of ciliated larvae, the apical organ, a larval sensory structure composed of nervous system components, aids in environmental signal perception. Given the specificity of the apical organ to the larval stage, it has been proposed to serve a function in guiding larval swimming behaviour and larval settlement. Despite its apparent ecological significance, the function and molecular fingerprint of the apical organ in coral larvae remain largely unexplored. To this end, we aim to reveal the cell types, transcription factors and neuropeptides associated with the larval sensory system. The study will enlighten the role of the sensory system in larval swimming behaviour, metamorphosis and settlement.

The student will contribute to culturing and maintaining the selected list of coral species and, if necessary, help establishing a new culture organism. For each chosen species, the larvae will be subjected to spatial transcriptomics. The transcriptome data will be analysed to generate a spatial/molecular map of the larval cell types of each species. Using in situ hybridisations (ISH) and immunohistochemistry, the student will validate expression patterns and the distribution of cell types. Finally, bioinformatic analysis and ISH data will be used to reveal the cell types, transcription factors and neuropeptides associated with the larval sensory system. Next, an array of abiotic and biotic factors will be tested on larvae to elucidate the mechanisms governing the coral larval settlement.

The student will gain the following skills throughout their PhD I) Culturing an array of coral species. II) Molecular biology: RNA isolation, PCR, cloning, in situ hybridisations and immunohistochemistry. II) Bioinformatic analysis: RNA-seq and single-cell sequencing analysis. III) Advanced microscopy: confocal, fluorescent and light-sheet microscopy. IV) Larval behaviour experiments with a list of abiotic and biotic factors. V) Experimental design, data analysis, critical thinking, and scientific writing.

Our aim as the SWBio DTP is to support students from a range of backgrounds and circumstances. Where needed, we will work with you to take into consideration reasonable project adaptations (for example to support caring responsibilities, disabilities, other significant personal circumstances) as well as flexible working and part-time study requests, to enable greater access to a PhD. All our supervisors support us with this aim, so please feel comfortable in discussing further with the listed PhD project supervisor to see what is feasible.