Investigating the molecular and environmental mechanisms regulating larval metamorphosis in the starlet sea anemone Nematostella vectensis.

Project ID: 3737

Supervisory team

Main supervisor: Dr Elizabeth Williams (University of Exeter)
Second supervisor: Dr Vengamanaidu Modepalli (University of Bristol)
Other supervisors: Dr Jordi Solana (University of Exeter), Dr. Josh Prince (Dstl)

Host institution: University of Exeter



Project description: Many marine invertebrates, including sponges, corals, anemones, worms, molluscs, and echinoderms, develop into adults via a ciliated larval stage that forms part of the zooplankton. These microscopic free-swimming larvae must navigate successfully from the plankton down to the sea floor below, where they will undergo metamorphosis into their juvenile form and recruit to seabed communities. This larval settlement process is vital for the sustenance of different marine ecosystems, including coral reefs, oyster reefs, seagrass and macroalgae beds, and is considered critical to the recovery of marine communities following environmental stress or anthropogenic disturbances.During settlement, larvae rely on their sensory systems to search and identify a suitable substrate on the seabed. In many species of ciliated larvae, the apical organ, a multicellular sensory structure in the head, is thought to aid 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 settlement. Despite its apparent ecological significance, the function and molecular signalling of the apical organ in larvae remain largely unexplored. Using the established marine invertebrate laboratory model, the starlet sea anemone, Nematostella vectensis, this project aims to reveal the environmental cues and signalling networks of the larval apical sensory organ that are important to the coordination of larval settlement and metamorphosis. You will use behavioural and metamorphosis assays in combination with knockdown or knockout of target genes to identify specific external environmental cues for metamorphosis and assign functions to apical organ-specific cells and genes. In situ hybridization and immunohistochemistry approaches will be used to characterize the genes expressed in different sensory apical cells of larvae. By improving our understanding of the function of the sensory apical organ in a cnidarian, we can move closer to understanding how environmental change will influence the critical larval settlement process and the maintenance of marine communities.The student will gain the

following skills throughout their PhD:I) Marine invertebrate husbandry and larval cultureII) Molecular biology: RNA isolation, PCR, cloning, in situ hybridisations and immunohistochemistry, microinjection, gene knockdown/functional geneticsII) Bioinformatic analysis: RNA-seq and single-cell sequencing analysisIII) Advanced microscopy: confocal, fluorescent and light-sheet microscopy, behavioural and morphological assaysIV) Experimental design, data analysis, critical thinking, scientific writing and presentation.

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.