

Experimental evolution of gut commensals and their impact on host metabolism in a zebrafish model

Project ID: 3683

Supervisory team

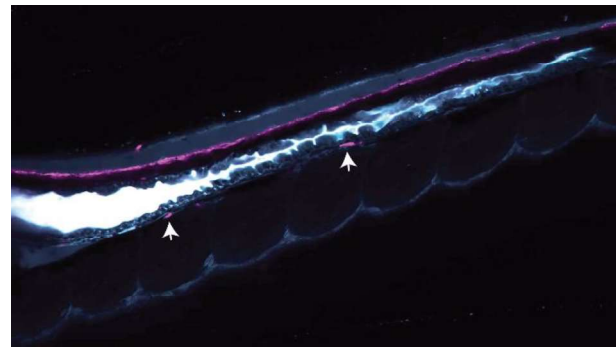
Main supervisor: Prof Edan Foley (University of Bath)

Second supervisor: Dr Meaghan Castledine (University of Exeter)

Other supervisors: Prof Tiffany Taylor (University of Bath)

Host institution: University of Bath

Project description: The gut microbiome shapes host health, yet we understand surprisingly little about how bacteria evolve in the gut, and how that evolution feeds back on their animal hosts. This project asks how an evolving community of bacteria adapt to changes in the host diet, and how does these bacteria affect host metabolism? To answer this question, the student will develop a tractable microbe-host model using zebrafish, a powerful vertebrate system for studying host-microbe interactions.



Larvae can be reared in a microbe-free environment and then colonised with defined bacteria, allowing us to control the microbial community with precision. As larvae have translucent bodies, we can readily visualise host-microbe interactions and metabolism in live animals. For this project, we will focus on *Aeromonas*, a well-characterised member of the zebrafish gut community and build outwards in stages: first characterising how single species affect metabolism in the host, then assembling defined communities to ask how interbacterial species interactions change the picture. The student will evolve *Aeromonas* under contrasting dietary regimes, both in isolation and within a community, then test how the evolved bacteria alter host metabolism when they recolonise the fish. We have already shown that *Aeromonas* evolved to use egg yolk emulsion as a sole carbon source changes how larvae process dietary fat, which we can visualise directly using fluorescent lipid reporters and confocal microscopy. From here, the student will explore how community context shapes the evolutionary paths bacteria take, and whether adapting alongside competitors leads to different outcomes for the host. Beyond the fundamental science, the project has potential real-world application, through understanding how diet reshapes the microbes we carry and what that means for host metabolism. It offers a broad and unusual training portfolio spanning microbiology, experimental evolution, gnotobiotic zebrafish husbandry, live imaging and metabolic assays. The project will benefit from expertise in host-microbe interactions and the zebrafish gut model (Foley, Bath), experimental evolution of bacteria (Taylor, Bath) and microbial ecology of communities (Castledine, Exeter). The student will be based in the Foley lab within the Life Sciences Department at the University of Bath, with opportunities to work in the Castledine lab at the Environment and Sustainability Institute at the Cornwall (Penryn) campus of the University of Exeter. It will suit a curious biology graduate keen to work at the interface of evolution, microbiology, ecology, microbiomics and animal biology, and to help build a new model system from the ground up.

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.