Deciphering Host/Pathogen Interactions to Improve Disease Resistance in a Changing Climate

Project ID: 3560

Supervisory team

Main supervisor: Dr Sarah Salisbury (University of Exeter)
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Host institution: University of Exeter (Streatham)

CASE partner: Centre for Environment, Fisheries and Aquaculture Science (Cefas)

Project description: Proliferative kidney disease (PKD), caused by the myxozoan parasite Tetracapsuloides bryosalmonae, is a major threat to farmed and wild salmonids, causing severe kidney inflammation and mortality rates of up to 100%. Disease severity increases with temperature, making PKD an escalating threat to sustainable aquaculture under climate change. PKD pathology varies markedly within and among salmonid species, yet the mechanisms that determine susceptibility and resilience remain poorly understood.This interdisciplinary PhD will uncover the molecular, cellular and physiological mechanisms underlying variation in PKD pathology. By integrating existing and newly generated transcriptomic datasets, including bulk RNA-seq, single-cell RNA-seq and spatial transcriptomics, the project will characterise host and pathogen responses during infection and identify the cellular pathways driving disease progression. A particular focus will be understanding why some individuals develop severe pathology while others exhibit greater resistance or tolerance, and why disease outcomes differ between species such as rainbow trout (Oncorhynchus mykiss) and brown trout (Salmo trutta). The project will examine how immune cells respond to, and are manipulated by, the parasite, and reciprocally how the parasite responds within different host species.A complementary physiological component will investigate how these molecular changes affect kidney function and whole-animal health, including impacts on ion transport, osmoregulation and blood physiology. The project will also explore links between PKD and nephrocalcinosis, a condition characterised by calcium deposition within the kidney that is now regarded as one of the highest-priority health and welfare challenges in trout and salmon aquaculture. Using Cefas' extensive archive of historical histology slides alongside contemporary datasets and novel translational technologies developed at Exeter, the student will quantify nephrocalcinosis and parasite abundance to determine how infection, inflammation and calcification interact to influence fish health. There will also be opportunities to investigate how environmental variables, including temperature, oxygen, CO_2, hardness, salinity, as well as diet ingredients, shape both PKD pathology and nephrocalcinosis.The project aims to identify molecular pathways and physiological processes that could be leveraged to improve salmonid resilience to PKD through selective breeding or the application of therapeutics. Supported by an interdisciplinary supervisory team from Exeter and Cefas, and embedded within the Sustainable Aquaculture Futures (SAF) partnership, the student will be immersed in a unique government-academia collaboration and receive training in bioinformatics, transcriptomics, molecular laboratory techniques, histology, imaging and physiology. The project offers considerable scope to develop novel research directions while building highly transferable skills sought across the aquaculture, environmental and bioscience sectors. Continued on next page……..

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.