Antibiotic exposure impacts on skin microbiomes and disease resilience in fish in aquaculture

Supervisory team:
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Host institution: University of Exeter (Streatham)
CASE partner: Centre for Environment, Fisheries and Aquaculture Science (Cefas)

Project description:
Microbiomes (the microbes associated with a host) are a fundamental component of human and animal health. Stressors that induce shifts in microbial communities have been associated with increased disease and infection in humans, but almost nothing is known in this regard for fish. Aquaculture supplies approximately 8% of global animal food proteins and is vital for food security in Low Income, Food Deficit Countries but is hampered by disease with huge annual losses (exceeding >$6bn). Attempts to combat these diseases in aquaculture include the liberal use of antibiotics (at levels estimated in the hundreds of thousands on tonnes globally) but these antibiotics may also induce shifts in microbial communities that populate external facing (and gut) surfaces in fish and provide important barriers to disease infection.

This studentship will harness the latest DNA sequencing technologies and in partnership with key stakeholders including Centre for the Environment, Fisheries, and Aquaculture Sciences, and the global organisation WorldFish, work to help understand how antibiotics affect skin and gill surface microorganism assemblages of tilapia (the second largest farmed fish species in the world; 6.7 million tonnes) and the implications of these changes for disease resistance.

The student will first characterise skin and gill microbiomes in disease free tilapia from farm sites in Bangladesh through samples collected in a major disease surveillance project lead by one of the partners (WorldFish). They will then undertake a series of laboratory studies at Exeter, Cardiff and Cefas partner laboratories to investigate how exposure to antibiotics used in tilapia farming re-shapes the microbiome compared to non-exposed communities and whether these shifts in the microbiome alter susceptibility to infection to some of the key disease-causing organisms in tilapia culture. An additional, and important component of this work will study whether presence of natural viruses that bacteria can mitigate antibiotic-driven microbiome shifts due to competing fitness costs of phage and antibiotic resistance. The student will acquire outstanding multidisciplinary training, developing skills in a wide range of cutting edge molecular, ecotoxicology, disease biology, bioinformatics and statistical methods. They will be supported through a highly experienced and well-resourced team and including major stakeholder engagement. They will also be integrated into the newly established centre for Sustainable Aquaculture Futures at Exeter with further support and network benefits.