

Optimising water chemistry for rainbow trout in Recirculating Aquaculture Systems (RAS)

Supervisory team:

Main supervisor: Prof Rod Wilson (University of Exeter)

Second supervisor: Dr Alexis Perry (University of Exeter)

Non-academic (CASE) supervisor: Oliver Robinson (British Trout Association Ltd.)

Host institution: University of Exeter (Streatham/St Luke's)

CASE partner: British Trout Association Ltd.

Project description:

Land-based recirculating aquaculture systems (RAS) offer many advantages for aquaculture including greatly reduced freshwater abstraction, enhanced biosecurity and control over the aquatic environment for growing fish, easier management of effluent water and greatly reduced effluent water volume. However, RAS also creates water chemistry conditions that are quite different from the natural environment, and that require management and technological solutions to avoid adverse health and welfare outcomes for the fish. In particular CO₂ is always elevated above atmospheric equilibrium, and RAS managers often increase pH, alkalinity, calcium hardness and salinity beyond levels in natural freshwater environments as part of the RAS water chemistry management strategy. However, no studies have yet established the interactive effects of all these variables on fish, including rainbow trout, or provided evidence-based guidance on what optimal levels might be.

There is already concern about some of these variables (e.g., elevated CO₂) and problems such as nephrocalcinosis (kidney stones). This will be the first study to explore all the potential contributors to this health problem, including water chemistry and diet, as well as their role in more general aspects of fish growth, health and welfare.

This PhD will work closely with our project partners (the British Trout Association and various trout farming companies) to survey water chemistry data and farmer opinion from UK trout farms on what is most relevant to avoiding adverse health outcomes and having the most efficient production. Based on this survey, the proposed PhD project will use physiological approaches and in vivo experimental work with rainbow trout to provide a full exploration of how both water chemistry and diet affect growth, health and welfare (e.g. immune function).

This project provides a further inter-disciplinary component, by addressing a further knowledge gap we have identified in the aquaculture industry; the lack of real-time sensors for continuously monitoring many water chemistry variables in RAS (that are cheap, robust and accurate) to aid day-to-day management of water chemistry and its optimisation for fish growth and health. Expertise in chemistry and environmental sensors at Exeter (Dr. Alexis Perry) within the SWBio consortium (GW4 Water Security Alliance – “Environmental Sensors” working group in particular Dr. Pedro Estrela at Bath University), will help develop innovative solutions to this problem.