Determining impacts of exposure to environmentally relevant chemicals on tissue repair in fish

Supervisory team:
Main supervisor: Dr David Gurevich (University of Bath)
Second supervisor: Prof Charles Tyler (University of Exeter)
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Collaborators: Prof Andrew Johnson (UK Centre for Ecology and Hydrology)

Host institution: University of Bath

Project description:
Background: The rivers of the UK and especially England are some of the most exposed to wastewater treated works (WWTW) effluents in Europe. As a consequence, resident fish are routinely exposed to an increasingly wide range of chemicals which can evade treatment processes, including various metals, organic compounds, pharmaceuticals (e.g. endocrine disruptors) and other chemicals (e.g. PFOAs). Reported impacts of these contaminant exposures on aquatic wildlife range from the feminisation of fish populations to increased infection risk. However, interactions between contaminant chemicals and other stressors on animal health, such as tissue damage, remain poorly understood. Fish in natural environments are subject to frequent and wide-ranging physical insults that result in skin lesions and tissue damage, such as infections, external parasites, spawning events and predator attacks. This proposal aims to ascertain how exposure to, and the mechanisms through which, chemical mixtures in WWTW exposure impair fish healing.

Methodology: In this project, the student will first identify what contaminants in WWTW accumulate in fish tissues, using cutting-edge chromatography and mass spectrometry methods complemented with histopathological analyses, assessing how these findings relate to tissue effects (liver/skin/muscle) of fish (roach, Rutilus rutilus, collected by the Johnson lab at UKCEH) that have been exposed to known levels of wastewater contamination. To identify the specific chemicals and combinations that are most biologically potent, the student will screen exposure conditions (WWTW effluent) and body tissues using chemical fractionation processes, identifying the chemicals using analytical chemistry approaches developed in the Kasprzyk-Hordern lab. To establish the impact of these chemical exposures on wound healing, the student will use state-of-the-art confocal microscopy of live zebrafish (a cyprinid fish with many biological features similar to the roach), utilising a variety of fluorescent reporter lines marking key components of the repair response (immune cells, skin, oxidative stress reporters) available in the Gurevich/Tyler labs. These studies could include acute and chronic chemical exposures in individual fish and for effects over multiple generations, together with CRISPR genetic manipulation to interrogate mechanisms underlying healing impairment.
Personal development: This interdisciplinary PhD project will provide the student with a wealth of training and expertise in cutting-edge analytical chemistry, ecotoxicology, environmental biology, cell and molecular biology. They will be supported by well-equipped laboratories across the partnering labs including supervisors with extensive track records in PhD training and development. The student will be encouraged to communicate their research through publishing articles and presenting at national and international conferences.

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.