The impact of copper on a native fish

Copper (Cu) is a harmful contaminant in freshwater systems, the concentration of which is being increased by human activity. The impact of elevated copper on fish, particularly during the larval development stage, is not well understood. This work identified the eye organ of a native fish, *Mogurnda adspersa*, as being particularly sensitive to increased Cu concentrations.

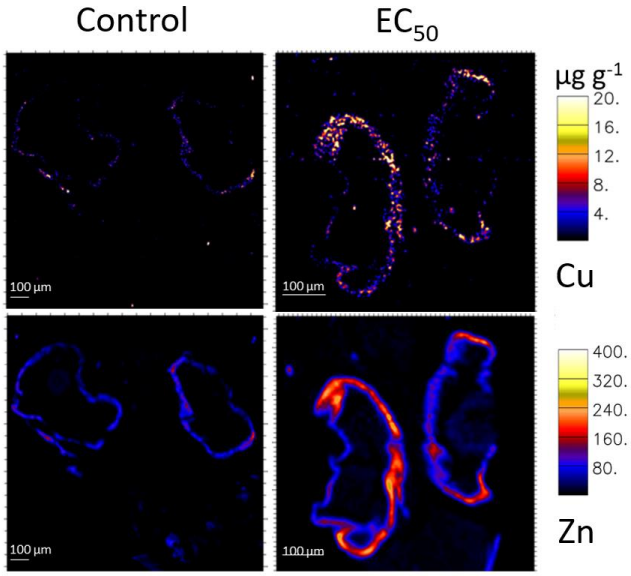
The Research & Outcomes

Using a suite of analytical techniques, the impact of increased concentrations of Cu was determined for the sacfry larval stage of the southern Purple Spotted Gudgeon (*Mogurnda adspersa)*, an endangered native fish found in the Murray-Darling basin and coastal northern NSW and Queensland.

The study included performing ecotoxicity tests to determine EC_{10} and EC_{50} levels of Cu. Treatment groups of Control, EC_{10} and EC_{50} were then assessed for amino acid profiles, metal distribution using proton-induced X-ray emission (PIXE) imaging and organic functional group composition using synchrotron-FTIR at the **IRM beamline**.

PIXE imaging revealed Cu accumulated in the eye organ tissue, with increased Cu concentrations also altering the distribution of Zn, S, P, and K. In particular, Zn was also found to increase accumulation in eye tissue and co-locate with Cu.

Synchrotron-FTIR analysis indicated major changes were happening within the eye tissue in the presence of increased Cu. A change in protein secondary structure and a decrease in the proportion of molecular retinal point towards the degradation of rhodopsin, a fundamental protein for vision. Vision is particularly important as, along with the inner ear, it is used to orientate the fish to keep it upright and swimming normally.



PIXE imaging of Purple Spotted Gudgeon eye tissue from a Control animal (no added Cu) and an animal exposed to high concentrations of Cu (EC_{50}). The top row shows the accumulation of Cu while the bottom row shows the distribution of Zn.

Benefits & Impacts

Understanding the sublethal effects of environmental contaminants is important for informing guidelines and regulations.

Determining sublethal effects in early life stages such as sacfry and larval forms is particularly important as the consequences for development and growth, reproduction and overall survival can be much greater.

References

Shakya *et al.* (under review) Aquatic Toxicology

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