

Nitrate exposure does not compromise growth, metabolism or heat tolerance in upland bully (*Gobiomorphus breviceps*)



What we know

- Intensive agricultural activities in New Zealand and worldwide have resulted in large quantities of nitrate (NO_3^-) leaching into and contaminating freshwater streams and rivers.
- Nitrate pollution can cause eutrophication which can kill freshwater species.
- Nitrate pollution can also cause direct physiological harm to freshwater species, such as fish.

What we don't know

- Are native New Zealand fish species also affected by nitrate pollution?
- Is the NZ National Policy Statement for Freshwater Management 2020 national bottom line of $11 \text{ mg L}^{-1} \text{NO}_3^-$ sufficient to protect native fish?
- Are fish exposed to elevated nitrate more susceptible to other threats, like heatwaves?

What we found

1. Living in nitrate-polluted streams appeared to have no effect on upland bully body condition suggesting that living in nitrate-contaminated habitats is not energetically expensive for this species.
2. Under laboratory conditions, fish exposed to elevated nitrate concentrations (11 and $50 \text{ mgL}^{-1} \text{NO}_3^-$) did not have compromised growth, aerobic scope or performance indicators
3. Heat tolerance (measured as critical thermal maxima, CT_{max}) of fish was unaffected by exposure to nitrate.

How we did it

We sampled upland bullies (*Gobiomorphus breviceps*) from 9 streams across a nitrate pollution gradient (5-53 mgL⁻¹ NO₃⁻) in Canterbury and assessed their body condition and organ mass.



We exposed 63 fish in the laboratory to 0 (control), 11 and 50mg/L of nitrate (21 fish/treatment).

We then measured:

- Standard and maximum metabolic rates (oxygen consumption) to determine aerobic scope
- Growth rates and body condition
- Organ weights (heart, liver, spleen, gonads)
- The maximum temperature at which fish lose the ability to maintain an upright position (i.e., heat tolerance, CT_{max})



Conclusions and future directions

- The new national bottom line of 11 mgL⁻¹ NO₃⁻ appears to be sufficient to protect upland bully as the results of this thesis suggest that upland bully can maintain growth, performance, and heat tolerance when faced with nitrate pollution, up to concentrations as high as 50 mgL⁻¹ NO₃⁻
- We recommend future studies investigate the effects of nitrate pollution on potentially more sensitive species such as Canterbury Galaxiids

Research conducted by MSc student Charlie Barker, with Dr Essie Rodgers from the University of Canterbury and Nicholas Dunn from the Department of Conservation. Big thanks to all field and laboratory assistants. We also appreciate support from Brian Mason Scientific and Technical Trust. Photos taken by Charlie Barker. A scientific paper is being prepared from the work but contact Essie (Essie.Rodgers@murdoch.edu.au) in the interim.



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