

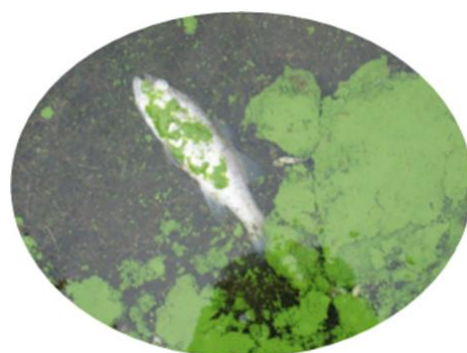


Impact of nitrate exposure on upland bully

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 physical harm to freshwater species, such as fish.



What we don't know

- Are native New Zealand fish species 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

- 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.
 - Under laboratory conditions, fish exposed to elevated nitrate concentrations (11 and $50 \text{ mg L}^{-1} \text{ NO}_3^-$) did not have compromised growth, aerobic scope or performance indicators
 - Heat tolerance (measured as critical thermal maxima, CT_{max}) of fish was unaffected by exposure to nitrate.
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What we did

We sampled upland bullies from 9 streams across a nitrate pollution gradient ($5 - 53 \text{ mgL}^{-1} \text{ NO}_3^-$) in Canterbury and assessed their body condition and organ mass.

We exposed 63 upland bullies to 0 mg/L (control), 11 mg/L and 50 mg/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 and gonads)
- The maximum temperature at which fish first lose the ability to maintain an upright position (i.e. heat tolerance, CT_{max})



Conclusions

- Taken together, 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 $50 \text{ mgL}^{-1} \text{ NO}_3^-$
- The new national bottom line of $11 \text{ mgL}^{-1} \text{ NO}_3^-$ therefore appears to be sufficient to protect upland bully
- 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 supervision from Essie Rodgers at the University of Canterbury, and Nicholas Dunn from the Department of Conservation.

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A scientific paper is being prepared from this research. Please contact Essie (Essie.Rogers@murdoch.edu.au) in the interim

