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Can slowing the rate of water temperature decline be utilized to reduce the impacts of cold water pollution from dam releases on fish physiology and performance?

Monique A. Parisi, Craig E. Franklin, Rebecca L. Cramp
School of Biological Sciences, The University of Queensland, Brisbane, Australia

Abstract:

Cold water pollution (CWP) is caused by releases of unseasonably cold water from large, thermally stratified dams. Rapid and prolonged decreases in water temperature can have depressive effects on the metabolism, growth and swimming performance of fish. However, it is unknown if reducing the rate of temperature decrease could mitigate these negative effects by allowing thermal acclimation/acclimatization to occur. This study investigated the rate of temperature decrease as a potential CWP mitigation strategy in juvenile Murray cod *Maccullochella peelii*. *M. peelii* were exposed to a gradual, intermediate or rapid temperature decrease from 24 to 14 °C. Energetic costs, locomotor performance, growth and survival were measured to determine if the initial thermal regime affected the thermal acclimation capacity of *M. peelii*. Cold exposure had significant acute and lasting depressive effects regardless of the rate of temperature decrease, although *M. peelii* showed varying degrees of thermal compensation in swimming performance and metabolism after 8 weeks of exposure to low temperatures. The short-term effects of CWP-like reductions in temperature are significant, but over time *M. peelii* can offset some of the depressive effects of CWP through thermal plasticity. This study highlights the importance of understanding physiological responses of fish to inform management and conservation. We conclude that rate of water temperature decline cannot be used to mitigate the sublethal effects of CWP on juvenile *M. peelii* but may still be useful for managing the negative effects in other native Australian fish species.

Keywords: conservation physiology, metabolic rate, phenotypic plasticity, swimming performance, thermal pollution