

Using dissolved carbon dioxide (CO₂) to alter the behavior of round goby

Background

This project aimed to determine whether elevated CO₂ levels in water could be effectively used as a behavioral deterrent to reduce the spread of invasive round goby. Elevated CO₂ concentrations in water may cause avoidance behavior and loss of equilibrium in fish. The research goal of this study was to identify the CO₂ concentrations that resulted in round goby avoidance behavior and loss of equilibrium as a first step to assess its potential effectiveness as a deterrent/barrier.



Round Goby

Round goby (*Neogobius melanostomus*) is a non-native bottom-dwelling fish that was first detected in the Great Lakes in the 1990s. More recently, round goby were verified directly downstream of the Lake Winnebago system in Little Lake Butte des Morts. These aggressive fish can negatively affect native fish populations and disrupt the food chain. Round goby are listed as restricted under ch. NR 40.

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Research Methods

- Scientists from the U.S. Geological Survey and the University of Illinois conducted laboratory experiments to assess how round goby responded to different levels of dissolved CO₂ in the water.
- Round goby were placed in one of two connected tanks. CO₂ was then added to the tank containing the fish to observe fish behavior and determine CO₂ concentrations when fish moved into the adjoining refuge tank (where no CO₂ was added).
- In separate trials, CO₂ was continuously added into a tank until fish were physically immobilized to determine concentrations that resulted in loss of equilibrium.



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Summary of Results

- Round goby exhibited similar behavior responses to CO₂ as were seen in previous studies conducted on non-native Asian carp.
- Round goby voluntarily avoided high-CO₂ waters at a concentration threshold of 99 – 169 mg/L CO₂.
- Round goby involuntarily lost equilibrium at 197 – 280 mg/L CO₂.
- Results indicate that temperature plays a role in the effectiveness of this method. Dissolved CO₂ may be a more effective deterrent at low water temperatures.

Potential applications:

Fish voluntarily avoided CO₂-enriched water before it caused them to lose equilibrium and become unable to right themselves. These results suggest that with further study, it may be possible to use CO₂ as a deterrent for this species in place of a physical barrier. Additional research is needed on potential impacts of increased CO₂ on other non-target species. However, these laboratory experiments can inform future field trials on the use of CO₂ as a method to deter the continued spread of round goby and protect native fisheries and ecosystems.

Related Publications and Resources

Cupp, A.R. et al. 2017. Using dissolved carbon dioxide to alter the behavior of invasive round goby. *Management of Biological Invasions*. 8(4): 567 – 574. doi.org/10.3391/mbi.2017.8.4.12

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