

## **M.L. 2021 Minnesota Aquatic Invasive Species Research Center Subproject Abstract**

For the Period Ending June 30, 2025

**SUBPROJECT TITLE:** MAISRC Subproject 45: Carp Remediation - Climate Change, Ecological and Economic Benefits

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**COLLEGE/DEPARTMENT/DIVISION:** Large Lakes Observatory and Minnesota Sea Grant

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**FUNDING SOURCE:** Environment and Natural Resources Trust Fund (ENRTF)

**LEGAL CITATION:** M.L. 2021, First Special Session, Chp. 6, Art. 6, Sec. 2, Subd. 06e

**SUBPROJECT BUDGET AMOUNT:** \$262,907

**AMOUNT SPENT:** \$261,723

**AMOUNT REMAINING:** \$1,184

### **Sound bite of Project Outcomes and Results**

Common carp are a damaging invasive species in lakes throughout Minnesota. By comparing lakes with and without carp over two years, we found that carp change lake sediments by decreasing organic matter quality, reducing carbon burial, and altering methane production. These results give insights into how carp impact Minnesota lakes.

### **Overall Subproject Outcome and Results**

Common carp are one of the most damaging aquatic invasive species both in Minnesota and worldwide. Carp degrade water quality by uprooting aquatic vegetation, increasing turbidity, promoting eutrophication, and reducing native fish diversity. In Minnesota, carp have dominated fish communities across the state, incurred vast economic costs, and have prompted extensive control and removal efforts. Lakes provide critical ecosystem services, including recreation, drinking water supply, and regulation of nutrient and carbon cycles. They act as both sources of atmospheric carbon dioxide (CO<sub>2</sub>) and methane (CH<sub>4</sub>), and as sinks through the storage of organic carbon in sediments. While invasive carp have been shown to alter nutrient levels and biodiversity in lakes, their effects on lake carbon cycling remain poorly understood. In this study, we assessed how carp invasion alters carbon cycling in Minnesota lakes. Over two years, we measured CO<sub>2</sub> and CH<sub>4</sub> emissions, water quality, sediment characteristics, and carbon burial in 10 carp-infested lakes and 8 carp-free lakes. Surprisingly, lakes with invasive carp exhibited lower CH<sub>4</sub> emissions despite higher levels of eutrophication, challenging the prevailing assumption that methane emissions increase with nutrient enrichment and productivity. Additionally, carp-invaded lakes had reduced sediment nutrient content and organic matter, which were associated with the lower greenhouse gas emissions. These findings show that invasive carp significantly alter lake ecosystem processes. By disturbing the sediment environment, carp reduce greenhouse gas emissions but also diminish the potential for long-term carbon storage in sediments, shifting the carbon and nutrient balance of the ecosystem.

### **Subproject Results Use and Dissemination**

We have shared both the goals and results of this research with various interest groups throughout the project. In the fall of 2024 we gave multiple presentations of our research findings, including a talk given to scientists and managers at the AIS Research and Management Showcase in September, as well as a presentation to a team of administrators for the National Oceanic and Atmospheric Administration for the MN Sea Grant in October. This spring (March 2025), we presented a research talk at the Association for the Sciences of Limnology and Oceanography (ASLO) conference, to convey our findings to aquatic research scientists and managers. Currently we are publishing our results in scientific manuscripts, and we are working to develop an infographic to share a summary of our findings with the public. Resources completed after the project completion date (e.g. factsheets, infographics) will be posted on the MAISRC website: <https://maisrc.umn.edu/research/45>

#### *Peer-Reviewed Publications*

- Rabaey, J. S., Bajer, P. G., Huser, B. J., & Downing, J. A. (In Review). Invasive species can alter aquatic greenhouse gas emissions. *Limnology and Oceanography Letters*.
- Rabaey, J. S., Huser, B. J., & Downing, J. A. (In Review). Invasion of Common Carp (*Cyprinus carpio*) Reduces Sediment Quality and Increases Eutrophication in Shallow Lakes. *Water Resources Research*.

#### *Presentations*

- Carp Remediation: Climate Change, Ecological and Economic Benefits. Association for the Sciences of Limnology and Oceanography (ASLO) Conference, John Downing (Presenter), Joseph Rabaey. March 28, 2025.