MINNESOTA AQUATIC INVASIVE SPECIES RESEARCH CENTER
UNIVERSITY OF MINNESOTA

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Minnesota Carp Management Effectiveness Assessment

A statewide evaluation of carp management as a lake restoration strategy.

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DEPARTMENT OF NATURAL RESOURCES
MINNEHAHA CREEK WATERSHED DISTRICT
QUALITY OF WATER, QUALITY OF LIFE
MINNESOTA POLLUTION CONTROL AGENCY

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2. Minnehaha Creek Watershed District

Need for a Statewide Assessment

Researchers and lake managers often consider common carp to be a driver of poor ecological conditions in Minnesota lakes, citing their negative impact on water clarity and aquatic plants. As a result, managers throughout the state have implemented carp management programs over the past decade to improve lake conditions. However, in practice, these programs have produced varied results, suggesting the effectiveness of carp management is inconsistent across lake systems.

The Minnehaha Creek Watershed District (MCWD) experienced this variability when it conducted carp management from 2014-2023, as part of a regional restoration program. Although this program successfully reduced carp biomass, it did not result in consistent water quality and aquatic plant improvements. In 2023, MCWD began discussions with the Minnesota Department of Natural Resources (MNDNR) and the Minnesota Pollution Control Agency (MPCA) that highlighted the need to better understand the factors impacting the effectiveness of carp management.

While individual program evaluations exist, no statewide assessment has been conducted to inform where and when carp management can be an effective restoration strategy.

To guide future implementation, the MNDNR, MPCA, and MCWD partnered with the Minnesota Aquatic Invasive Species Research Center (MAISRC) to compile the first statewide carp management dataset.

Project Goal

Set data-driven guidance for future management efforts.

Project Team

Funded by MCWD, and in partnership with the MNDNR and the MPCA, this work was conducted by University of Minnesota researchers and MCWD staff. The work was done in collaboration with MNDNR and MPCA staff.

Project Team Members	
Staff Members	**Organization**
Jake Walsh and Daniel Larkin	University of Minnesota
Jill Sweet and Brian Beck	Minnehaha Creek Watershed District
Brian Nerbonne	Department of Natural Resources
Jeff Strom, Amy Timm, and Allison Gamble	Pollution Control Agency

Project Background and Overview

Invasive common carp are known to disturb lake sediments and dislodge aquatic plants, which can negatively affect a lake's water quality and ecology. Water resource managers rely on a conceptual model that assumes the ways in which carp affect water quality and aquatic plants, both directly and indirectly.

Assumed Direct Effects

When carp disturb sediment, they dislodge vegetation, reduce water clarity, and release buried pollutants.

Assumed Indirect Effects

Reduced water clarity can negatively affect plants, and increasing pollutant concentrations can fuel algal growth.

Because of these assumed relationships, carp management is often viewed as an effective tool to improve water or plant quality. However, it is important to test these assumptions by analyzing pre- and post-management data in diverse lakes.

Past analyses of lake responses to carp management demonstrate the benefits of carp removal are variable; successfully reducing carp biomass does not always result in meaningful water quality or aquatic plant improvements.

To test this model and study the variability in observed lake responses, the project team identified three research questions.

Research Questions

1. How variable are lake responses to carp management?

2. What drives the variability in lake responses to carp management?

3. What are the important ecological relationships in carp-managed lakes?

Photo Credit: Dave Hansen, Minnesota Aquatic Invasive Species Research Center

Data Collection and Analysis

The project team compiled a dataset of available statewide carp management, water quality, and aquatic plant data to evaluate lake responses to carp management. The dataset spanned both pre- and post-management time periods, which allowed the project team to quantify lake responses to management and test the industry's underlying assumptions regarding ecological relationships in carp-managed lakes.

The project team collected data from 90 lakes with carp removals. Many of these carp-managed lakes lacked data for some of the study's response variables, and only 15 had pre- and post-management data for all response variables (Figure 1).

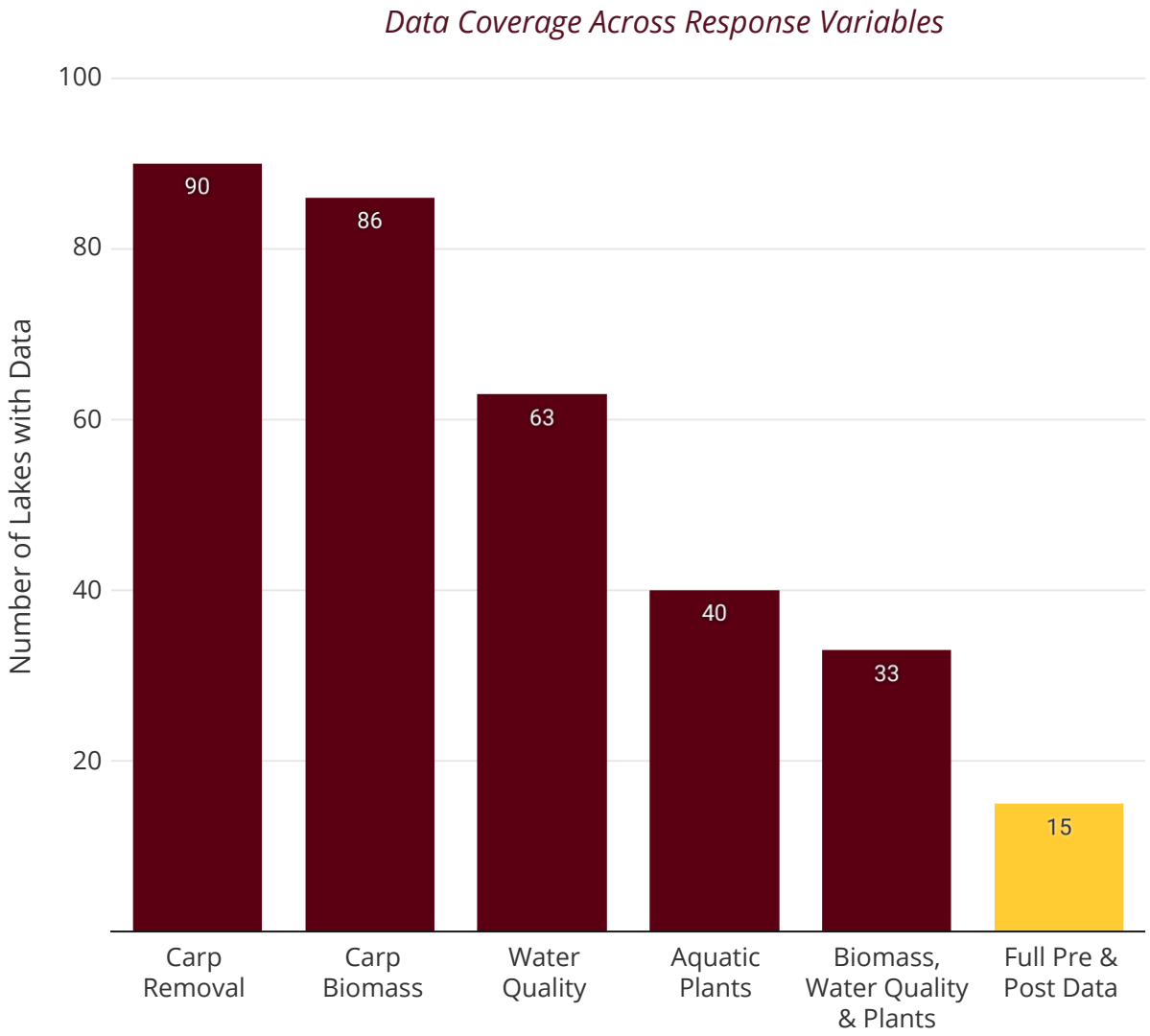

Figure 1. The dataset included 90 carp-managed lakes, 86 of which had carp biomass data. Out of the 90 study lakes, 63 had water quality data, 40 had aquatic plant data, and 33 had data for carp biomass, water quality, and aquatic plants. However, only 15 lakes had pre- and post-management data for all three variables.

Carp Data

The project team worked with local management organizations to collect carp population estimate and removal data. Collected data points included average carp length and weight, biomass density estimates, and survey and removal methods.

(top left) A box net removal on Benton Lake from October 8, 2017, Credit: Carver County Water Management Organization. (top right) Boat electrofishing is conducted in 2023, Credit: Riley Purgatory Bluff Creek Watershed District. (bottom) An electric guidance system directs carp into a fenced in area, where they are aggregated and then removed, Credit: Rice Creek Watershed District.

Water Quality Data

The MPCA provided water quality data, which included Total Phosphorus, chlorophyll-a, and Secchi disk depth.

These variables were averaged over the open water season (May - September) and compared to State standards.

Aquatic Plant Data

Data from MAISRC's "PI Charter app" database were used to estimate plant occurrence and calculate quality.

These data are a collection of point-intercept (PI) surveys from managers, contractors, citizens, and researchers.

Effectiveness Assessment Findings

Overall, the results demonstrated that carp management can produce marginally positive water quality outcomes and variable plant responses. The results also highlighted the importance of pre- and post-management monitoring to further support understanding.

Managers Should Expect Limited and Variable Lake Responses

- **Water quality improvements were marginal and variable.** On average, lakes saw a Total Phosphorus (TP) reduction of 22 µg/L following carp removal. Shallow lakes typically exhibited larger reductions than deep lakes.

- **Seasonal differences were common.** Carp had a stronger effect on water quality in the early season, while internal nutrient cycling may have a greater impact on late season (July – September) water quality.

- **Aquatic plant responses were mixed.** On average, plant diversity increased, but carp removal did not result in consistent improvements to overall coverage.

These findings suggest the benefits of carp management are most meaningful in shallow systems already near the State phosphorus standard.

Invest in Monitoring to Evaluate Projects and Support Understanding

- **Monitoring before, during, and after management is essential.** Of the 90 lakes with carp removals in this study, only 15 had pre- and post-management data for all response variables.

- **Continuing to collect and analyze data will remain critical.** Further analysis with a more robust dataset will enhance guidance for lake management and restoration strategies.

Lake Management Interpretations

Defining Successful Carp Management

For lake managers, successful carp management is not solely defined by a large reduction in a lake's carp biomass. Successful lake restoration through carp management is defined by the changes in a lake's water and/or aquatic plant quality, following carp biomass reductions.

This study's results showcase carp management is not a stand-alone solution for lake restoration and should be part of an integrated management approach.

Integrated Strategies Create Lasting Improvements

The most successful management projects were often accompanied by other restoration strategies, such as watershed nutrient reduction, internal load management, and plant management.

Accordingly, managers should consider a lake's historical and existing conditions to determine whether carp removal will meaningfully improve water quality and aquatic plants (Figure 2).

Lasting restoration relies on strategic, data-informed prioritization of multiple management strategies.

External pollutant loading is typically the underlying driver of poor lake conditions, and until it is addressed, in-lake treatment will have limited, short-term benefits.

As such, carp management and other in-lake strategies should be considered once a lake's underlying issues have been treated, to maximize and sustain long-term improvements.

Anticipated Impact of Average TP Reduction

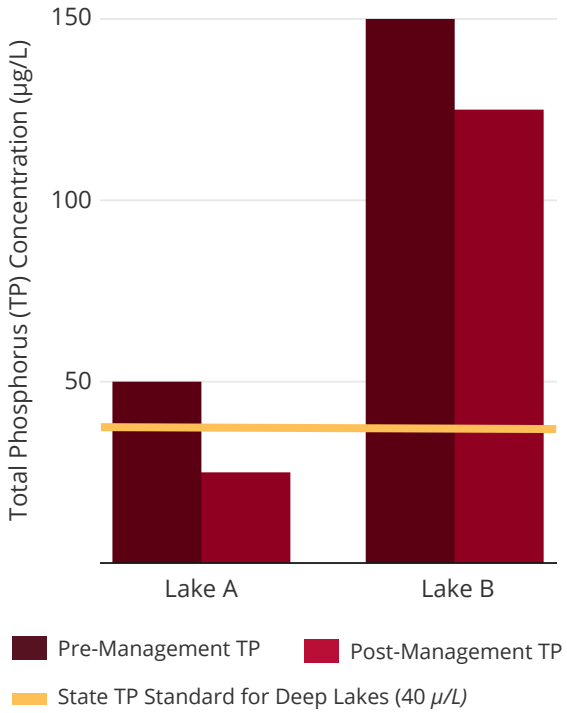

Figure 2. The study's results found an average reduction in Total Phosphorus concentration was 22 µg/L. This reduction is less impactful for lakes starting well above 80 µg/L, which will likely require additional nutrient reduction strategies.

Resources to Learn More

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