Beaver Dam Impacts on Water Quality, Trout Populations, and Biodiversity: Challenges and Early Evidence

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INTRODUCTION

Beavers as Ecosystem Engineers

North American beavers (*Castor canadensis*) are well-known for building dams. Their impoundments and activity can[1]

- Moderate impacts of flooding and drought
- Increase groundwater recharge and hydrologic connectivity
- Increase habitat complexity, availability, and biodiversity
- Facilitate nutrient cycling and mitigate non-point source pollutants
- Regulate sediment transport and reduce downstream erosion

These beaver-driven ecosystem-wide impacts can be leveraged to restore wetland and stream communities and maintain ecosystems that are more resilient to climate change and extreme weather events.

Beavers and Trout

In much of the Great Lakes Region, beavers are seen by fisheries managers and anglers as nuisances that negatively impact trout populations and the fishing experience. Beaver management policies are driven by or directly linked to trout management goals.

> "Objective 3.2. Maintain free-flowing conditions on select cold water stream systems… through removal of beaver and beaver dams."
>
> WDNR 2015-2025 Beaver Management Plan[2]

Half of the perennial stream mileage in a county can be designated for beaver removal, and more than half may be selected subject to review.[2]

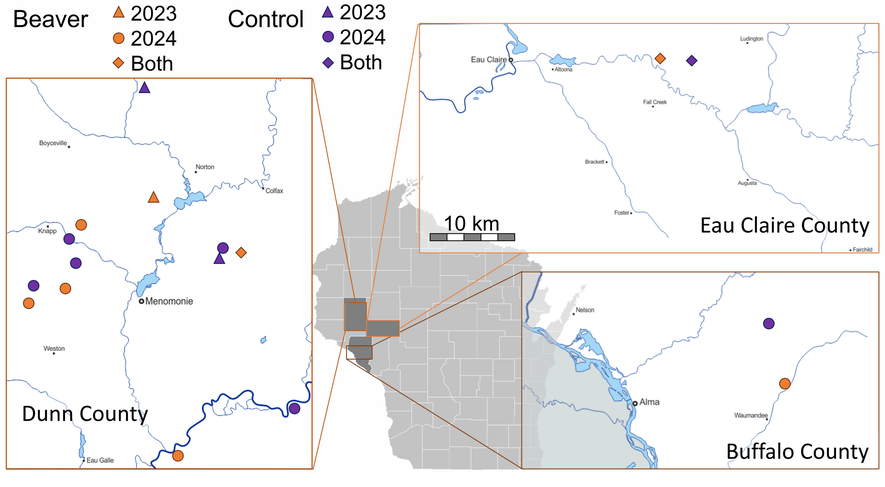
Despite the perceptions and policies, reliable data on the relationship between beavers and trout are not available for the region.[3]

Study Objectives

Evaluate effects of beaver impoundments on western Wisconsin trout streams.

- Water Quality
- Biodiversity
- Trout

STUDY SITES



PRELIMINARY METHODS AND FINDINGS

Water Quality

We collected water samples at each control site and immediately downstream of the dam at impounded sites. Analyses for nutrients and sediment were completed by the UW-Stevens Point Water Lab. We measured water temperature 10 cm below the surface and just above the substrate.

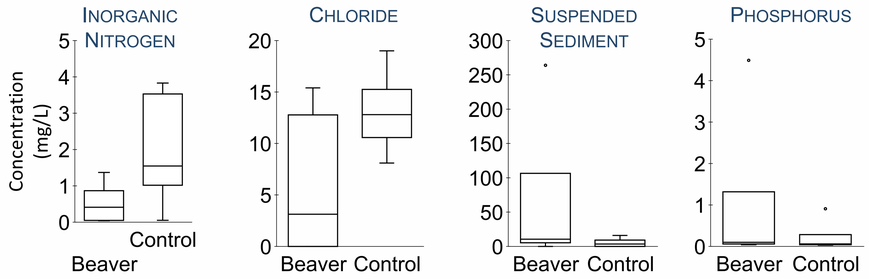
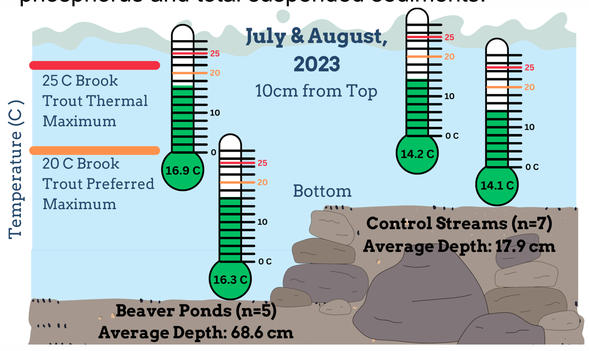


Figure 1. Select water quality variables at 3 beaver and 3 control sites in 2023.

Beaver sites appeared to have lower total inorganic nitrogen and lower but higher total phosphorus and total suspended sediments.



Water was warmer in beaver ponds than in control streams (Fig. 2). However, it was still well below critical thresholds for native brook trout (*Salvelinus fontinalis*).[4] Moreover, the area was in drought conditions during sampling, with air temperatures of 34-35°C.[5]

Figure 2. Mean water temperatures at 3 beaver and 3 control sites in 2023.

Biodiversity

We captured 10-minute audio recordings at visits in July and August and identified birds to species using the Merlin app as needed.[6] We excluded sightings without sound to maintain comparable sampling effort across sites.

Avian species richness and abundance were higher at beaver sites than at control sites during our brief observation periods (Fig. 3). Most species observed at control streams were also seen at beaver streams, but the reverse was not true.

Figure 3. Avian diversity and abundance at 3 beaver and 3 control sites in 2023.

Trout

Beaver ponds were 2-7.8 acres in area with highly uneven bottoms, making electrofishing difficult, unreliable, and potentially unsafe.

DISCUSSION AND FUTURE WORK

We will be sampling 7 pairs of sites during summer 2024, including 5 new pairs (see map at lower left). We lost one pair of 2023 sites when the beaver dam was removed, and one 2023 control stream was replaced due to new beaver activity on the original control stream.

Water Quality

Preliminary findings for nitrogen were consistent with previous research, but suspended sediments and phosphorus were not.[1] The reduced chloride is potentially important, given the widespread use of road salt and brine in the area.

Warmer water in beaver ponds is often used as an explanation of why they harm trout, but even during warm drought conditions, ponds remained well below what would be detrimental to trout.

Additional sampling of targeted metrics (see right) will provide sufficient sample sizes to conduct statistical analyses.

- Nutrients
  - Nitrates and nitrites
  - Ammonium
  - Total phosphorus
- Others
  - Conductivity (chloride)
  - Turbidity (suspended sediment)
  - Temperature

Biodiversity

Preliminary avian observations support the claim that beaver wetlands provide opportunities for a greater diversity of species. In the 2024 field season, we will deploy passive acoustic monitors to capture more comprehensive samples of avian diversity, as well as identify bat species using the riparian flyways. These will be supplemented by camera traps to document non-vocalizing species.

Additionally, we may have undergraduate researchers conduct plant surveys that will allow us to compare plant biodiversity.

Trout

To circumvent the difficulty of directly sampling trout in beaver ponds, we will collect eDNA at our study sites. Samples will be passively collected on submerged filters and later analyzed via real-time PCR to detect (and potentially quantify) trout presence. Sampling from stream reaches outside a beaver complex should allow us to assess whether trout DNA found in the impoundment primarily originates from trout upstream or from trout using the beaver pond itself.

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