A SAMPLE OF FISH COMMUNITIES IN BEAVER PONDS OF NORTHERN MINNESOTA

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***Abstract*—The North American beaver *Castor canadensis* is an ecosystem engineer and a keystone species to the environment. Beaver inhabit ponds and construct dams to build ponds that provide habitat for certain fish. Little information is provided on the species of fish that live in beaver ponds. The objective of this study is to sample the fish communities in beaver ponds while comparing the effectiveness of two styles of minnow traps. Twelve beaver ponds were selected in the Bemidji area to be sampled. The quantity and species caught in each style of trap were recorded to compare effectiveness of each trap and a sample of the fish community. A total of 15,453 fish were caught, seven different species and possible hybrids. Between the two trap types used, there appeared to be a significantly higher catch in the clover leaf trap type.**

I. Introduction

The North American beaver *Castor canadensis* is a relatively common and abundant semi aquatic mammal across most of the United States and especially Minnesota. Beaver are ecosystem engineers and their impact on the landscape has been known to increase species richness (Rosell et al. 2005). Bodies of water in which beaver inhabit are crucial for a wide variety of both terrestrial and aquatic systems. Fish communities rely on beaver heavily for their role in controlling water levels. In open water created by beaver in unconnected peatland by stopping water from draining, it was found fish colonize the pond quickly (Ray et al. 2004). Little research and sampling have been done on what species of fish live in beaver ponds. Beaver pond fish communities hold a spot in the ecosystem and show further importance of the presence of beaver.

Beaver ponds have a wide range of variance of size, hydrology, and depths that may influence fish communities. Factors in beaver ponds such as low oxygen, low water levels, and the changes of water temperatures across the year may also be limiting to fish (Collen and Gibson 2001). While some ponds may be void of fish inhabitants, others may have abundant fish life with little information about species present. (Williamm and Magnuson 1982) suggest bodies of water with low oxygen during times of winter, such as beaver ponds, consist of species of small bodied fishes.

Northern Minnesota presents a great opportunity to sample the different complexities of beaver ponds through the abundant flowages, ponds and small streams in the area. None of the ponds have shown documentation on the species of fish that are present, leaving fish populations relatively unknown in the ponds inhabiting fish. The objective of this study was to sample the fish communities in ponds that were or are currently inhabited by beaver.

II. Methods

Beaver ponds were chosen from a criteria system to determine which ponds would be sampled. The first of the criteria was that the pond had to contain beaver sign such as a recently active beaver lodge. The pond also had to be less than 10 acres in area of open water and could not contain a name in accordance with MNDNR (2024). Lastly the pond could not have visible water flowing through the system at the time samples were taken and could not be a part of a river system. Using this criterion, a total of 12 ponds were selected and sampled.

Ponds were sampled 8 October 2024 through 1 November 2024. A total of six minnow traps were set on each pond. Of the six traps, three were clover leaf style and the other three were cylinder style traps. Clover leaf and cylinder traps were placed interchanging along the bank with at least 20 ft between the traps. The minnow traps were baited with a handful of dog food and placed in water deep enough to completely submerge the traps.

Traps were checked and removed the following day they were set. The fish in the traps were removed, species and the quantity of fish were recorded. Fish in the *Chrosomus* genus that were caught and could not be accurately identified in the field was represented as *Chrosomus* sp. in the data. The data recorded from the different styles of traps will be compared to determine

the effectiveness of the styles of traps along with a sample of the fish community.

The data that was recorded was broken up into four different methods to analyze the catch. A pie chart was created to show the total number of species compared to the total number of fish caught. To show differences in style of trap, a bar graph was created to show the number and species that was caught in each style of trap. To supplement the comparison in style of trap, an NMDS plot was created to show the differences in the trap types in regard to the number of fish and species caught in each. To plot differences of fish communities between the ponds, another NMDS plot was created.

III. Results

A total of 15,453 fish were caught during sampling with six different species recorded. The six species included central mud minnows *Umbra limi*, brook sticklebacks *Culaea inconstans*, northern redbelly dace *Chrosomus eos*, finescale dace *Chrosomus neogaeus*, brassy minnows *Hybognathus hankinsoni*, fathead minnows *Pimephales promelas* and unidentified fish in the genus *Chrosomus* (Figure 1).

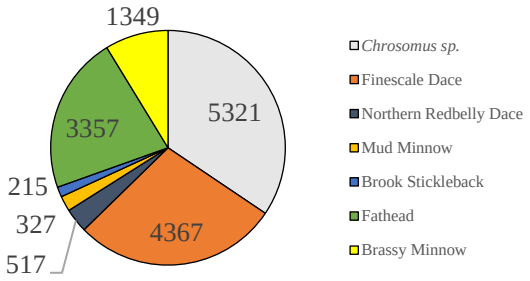

Fig. 1. Northern Minnesota ponds containing recent beaver inhabitance were sampled in the fall of 2024. The pie chart represents the number of each species caught (7) in comparison to the total number of fish caught (15,453) between clover leaf traps and cylinder traps.

The clover leaf trap type overall caught higher quantities of fish in comparison to the cylinder trap type. All species had a higher catch rate in the clover leaf trap compared to the cylinder trap. Species caught in lower numbers remained to have a higher catch rate in the clover leaf traps (Figure 2). In another analysis of the difference in trap type catch, it also appeared to have a difference in trap catch when taken account for species, total number of fish, and the pond (Figure 3).

Eleven of the twelve ponds that were sampled contained fish. Pond number nine failed to sample any fish. Although most ponds contained a similar species richness, they differed in overall fish density and evenness of species. The fish communities that were sampled appeared to have a difference depending on the pond that they were sampled from (Figure 4).

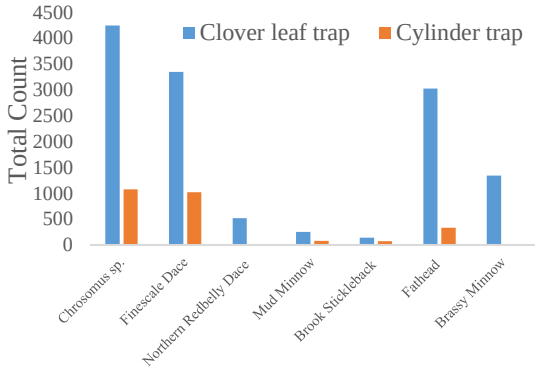

Fig. 2. Northern Minnesota ponds containing recent beaver inhabitance were sampled in the fall of 2024. The bar graph represents the number of each species caught in comparison to the clover leaf trap and cylinder trap.

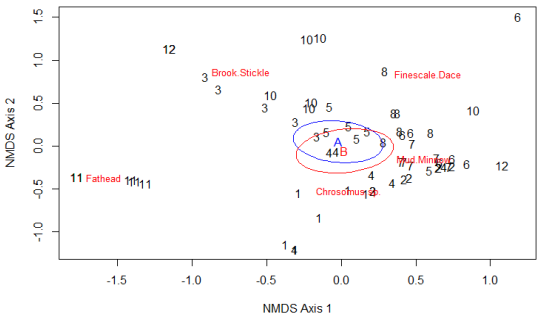

Fig. 3. Northern Minnesota ponds containing recent beaver inhabitance were sampled in the fall of 2024. The NMDS represents the proximity of species and number caught between trap A (clover leaf trap) and trap B (cylinder trap).

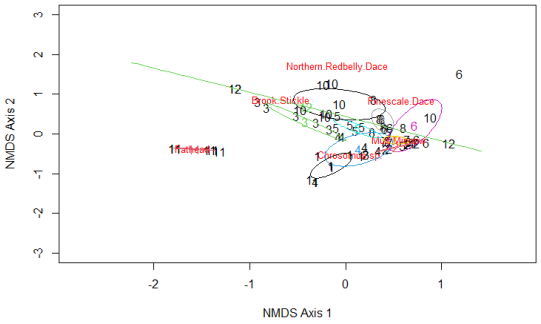

Fig. 4. Northern Minnesota ponds containing recent beaver inhabitance were sampled in the fall of 2024. The NMDS represents the proximity of fish communities among the twelve ponds excluding pond nine due to lack of catch.

IV. Discussion

A large portion of the fish caught consisted of finescale dace *Chrosomus neogaeus* and Northern Redbelly Dace *Chrosomus eos* and were often present in the same pond that was sampled. Past literature has demonstrated that the finescale dace and northern

redbelly dace hybridize to create a *C. neogaeus* x *C. eos* with intermediate characteristics and can happen frequently (New 1962). It was originally thought the hybrid populations were only female and males were never recorded. In a study done on two populations of hybrids, it was found the reason for an all-female population was because a form of asexual reproduction and can happen with only *C. eos* or *C. neogaus* present (Goddard et al. 1998). Although in a recent study, evidence of male hybrids and backcrossing with the parental species were found and changed the original thinking on the hybrids (Schultz 2025). The ecology of the hybrids, *C. eos*, and *C. neogaeus* is complex and identifying a hybrid from either parental species is difficult. Although a *C. neogaeus* x *C. eos* hybrid has never been recorded in Minnesota, it is plausible to occur given both species are present and seemly abundant. It is also possible during this study hybrids were present and were either misidentified or simply identified as a *Chrosomus* species. Further research could be done to either confirm or deny the presence of hybrids in Minnesota.

The presence of fish seemed to be abundant throughout the ponds that were sampled. The communities sampled consisted entirely of small bodied fishes. The beaver ponds that were sampled were relatively small, shallow and all most likely experienced periods of hypoxia. Small bodied fish such as the cyprinids and mudminnows use less oxygen than larger fish and make the small bodied fish more suitable to the small ponds with less oxygen (Klinger et al. 1982). Another possibility that would explain the small body size of fish caught is the connectivity of the waterbodies that were sampled. In shallow systems with an outlet or inlet, species of fish can travel to areas of higher oxygen (Magnuson et al. 1985). The ponds chosen for the study were relatively closed systems that would not allow larger fish to escape the winter hypoxia. Beaver ponds that do connect with larger bodies of water may have varying fish communities and possible seasonal changes in the community.

To further build a map of the fish communities in beaver ponds at a larger scale, more geographic regions should be sampled. Regions with differing substrate types, elevations, or even beaver densities may result in differing fish communities. Areas with much lower beaver densities and less natural ponds containing beavers in different geographic locations would most likely contain different species compared to Northern Minnesota. In the Ohio river basin, areas of differing glacial activities have resulted in predictable fish communities (Jacquemin and Pyron 2011). Areas of differing past glacial events may play a role in the communities that can be found in the beaver ponds. Glaciers may limit the distribution of many species and create a predictable map of fish assemblages. It may be difficult to construct a consistent map that would cover a whole geographic area. Small systems such as beaver ponds hold more variability and less stability than many of the other large lakes and rivers (Jackson et al. 2001). Further sampling of a large area and different geographic zones of beaver ponds could be done to determine a better picture of fish communities that is more broad than northern Minnesota.

REFERENCES

[1] Collen, P. and R.J. Gibson. 2001. The general ecology of beavers (*Castor* spp.), as related to their influence on stream ecosystems and riparian habitats, and the subsequent effects on fish – a review. Reviews in Fish Biology and Fisheries 10:439–461.

[2] Goddard, KA., O. Megwinoff, L.L. Wessner and F. Giaimo. 1998. Confirmation of gynogenesis in *Phoxinus eos-neogaeus* (Pisces: Cyprinidae). Journal of Heredity 89:151–157.

[3] Jackson, D.A., P.R. Peres-Neto, and J.D. Olden. 2001. What controls who is where in freshwater fish communities the roles of biotic, abiotic, and spatial factors. Canadian Journal of Fisheries and Aquatic Sciences 58:157-170.

[4] Jacquemin, S.J. and M. Pyron. 2011. Impacts of past glaciation events on contemporary fish assemblages of the Ohio River basin. Journal of Biogeography 38:982–991.

[5] Klinger, S.A., J.J Magnuson, and G.W. Gallepp. 1982. Survival mechanisms of the central mudminnow (*Umbra limi*), fathead minnow (*Pimephales promelas*) and brook stickleback (*Culaea inconstans*) for low oxygen in winter. Environmental Biology of Fishes **7**:113–120.

[6] Magnuson, J.J., A.L. Beckel, K. Mills, and S. Brandt. 1985. Surviving winter hypoxia: behavioral adaptations of fishes in a northern Wisconsin winterkill lake. Environmental Biology of Fishes 14:241–250.

[7] MNDNR (Minnesota Department of Natural Resources). 2024. Lakee Finder. Accessed 1 October 2024. https://www.dnr.state.mn.us/lakefind/index.html

[8] New, J.G. 1962. Hybridization between two cyprinids, *Chrosomus eos* and *Chrosomus neogaeus*. Copeia 1962:147–152.

[9] Ray, H.L., A.M. Ray, and A.J. Rebertus. 2004. Rapid establishment of fish in isolated peatland beaver ponds. Wetlands 24:399–405.

[10] Rosell, F., O. Bozser, P. Collen, and H. Parker. 2005. Ecological impact of beavers *Castor fiber* and *Castor canadensis* and their ability to modify ecosystems. Mammal Review 35:248–276.

[11] Schultz, B. 2025. Disentangling the hybridization dynamics between *Chrosomus eos*, the northern redbelly dace, and *Chrosomus neogaeus*, the finescale dace. Doctoral dissertation, University of Guelph.

[12] Williamm, T. and J.J Magnuson. 1982. Patterns in the species composition and richness of fish assemblages in northern Wisconsin Lakes. Ecology 63:1149–1166.