THE EFFECTS OF HABITAT CHARACTERISTICS AND LOCATION ON BROOK TROUT SIZE DISTRIBUTION

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***Abstract*—Adfluvial Brook Trout *Salvelinus fontinalis* are known to typically grow larger than riverine Brook Trout. The Kabekona River in Hubbard County, Minnesota exhibits suitable habitat for both fluvial and adfluvial Brook Trout populations. The objective of this study was to analyze the relationships between depth, stream width, canopy cover, water temperature, sediment size, and distance from Kabekona Lake on Brook Trout size distribution in the Kabekona River. Brook Trout (n=35) were angled from the Kabekona River from August 24 to September 26, 2023. Each fish was measured and released, with habitat metrics being recorded at time of release. ArcGIS was used to determine distance from Kabekona Lake for each Brook Trout, and linear regression analysis was used to determine if any of the habitat metrics showed correlation to Brook Trout size. Distance from Kabekona Lake had a significant effect on Brook Trout size (P = 0.03), with larger trout being captured closer to the lake. The trout size also increased as depth increased (P = 0.02). The information from this study could be useful to those seeking to improve stream habitat to enhance the size of Brook Trout.**

I. INTRODUCTION

Clear, cold lakes and ponds, often those that are oligotrophic, represent the optimal lacustrine (lake resident) Brook Trout habitat (Raleigh 1982). Riverine (fluvial) Brook Trout habitat is characterized by silt-free, rocky substrate in rifle–run areas with moderate flow (Raleigh 1982). Brook trout are often characterized with cool, spring fed groundwater (Raleigh 1982). Much of the ideal Brook Trout habitat is exhibited within the Kabekona River system. Adfluvial (spending time in lakes and rivers) and lacustrine Brook Trout are commonly called “coaster” Brook Trout (Becker 1983; Huckins et al. 2008). Coaster Brook Trout tends to grow larger than fluvial Brook Trout (Behnke et al. 2002).

Aside from migratory factors, there are habitat variances that can affect Brook Trout size as well. Brook Trout populations residing in water temperatures between 11 and 16 °C tend to experience optimal growth and survival (Raleigh 1982). Depth can also play a role in Brook Trout size as well. A Wyoming study found that larger Brook Trout were found in low gradients, meandering channels, and deep trench pools (Larschield and Hubert 1992). Large woody debris, boulders, and undercut banks have been described as key cover components for trout (Bjornn and Reiser 1991, Raleigh 1982). Large woody debris is considered excellent cover for Brook Trout. Undercover is any overhanging structure (trees, bushes, debris) above or in the river that trout will reside beneath. This habitat is also a crucial factor to Brook Trout survival. Moreover, pebble count data indicates that small boulders (12.8-25.6 cm) and larger are good sources of cover for Brook Trout as well.

The objective of this study was to analyze the relationships between depth, stream width, canopy cover, water temperature, sediment size, and distance from Kabekona Lake on Brook Trout *Salvelinus fontinalis* size distribution in the Kabekona River. This was done to analyze the effects of different habitats on the size of brook trout to better understand what the ideal habitat consists of to grow and support the largest brook trout possible.

II. METHODS

All Brook Trout captured in this study were caught with standard angling equipment. All fish were caught between 14 August and 26 September 2023. Once captured, each fish was measured with a tape measure in centimeters and released. At the time of release, each habitat metric was recorded. For location, each fish was given a waypoint in the OnX hunting app. This recorded latitude and longitude of the catch location. In the notes of the waypoint, length of the fish and habitat metrics were recorded. Depth was recorded using a tape measure from the bottom of the river to the surface and recorded in meters. Stream width was recorded by taking the distance from one side of the river to the other using a tape measure and recorded in meters. The canopy cover was taken by using a paper towel roll and pointing it at the sky and estimating a percentage of sky that is not obstructed by canopy. Water temperature was obtained using a thermometer and recorded in Celsius. Lastly, sediment size was calculated by walking heal-to-toe in a circle and measuring a pebble from the lake bottom with a tape measure in centimeters at every step. It is important to note that all habitat metrics were recorded where the fish bit the bait.

Once all data was collected, it was transferred to an Excel document. From there, regression analysis was run for depth, stream width, canopy cover, water temperature, and sediment size. A scatter plot was also created within excel for each of the habitat variables.

ArcGIS pro was used to digitize points that corresponded to the waypoints saved in OnX. The cut tool was then used to determine the distance from the lake to each site. Excel was then used to create a figure that represented Brook Trout size as a function of distance from the lake.

III. Results

Habitat metrics were collected from 35 Brook Trout (12.7-29 cm (about 11.42 in) TL). This yielded 35 trout locations. Depth was recorded for each trout location, and it was found that trout size increased as depth increased ($P = 0.02$; Figure 1). Stream width was measured in meters at each location, but despite stream width generally getting wider near the lake, it was not significantly related to trout size ($P = 0.08$; Figure 2). Neither canopy cover ($P = 0.34$; Figure 3) nor water temperature ($P = 0.88$; Figure 4) was significantly related to trout size. Sediment size was recorded via pebble counts at each catch, but it was also not significantly related to trout size ($P = 0.21$; Figure 5). Distance from the lake was also recorded and it was found that trout size decreased as distance from the lake increased ($P = 0.005$; Figure 6).

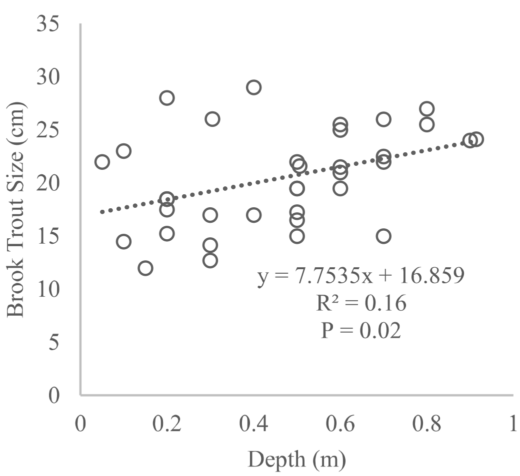

Fig. 1. Depth of catch location plotted against size of Brook Trout *Salvelinus fontinalis* in the Kabekona River. Fish were caught August through September 2023 ($P = 0.016$).

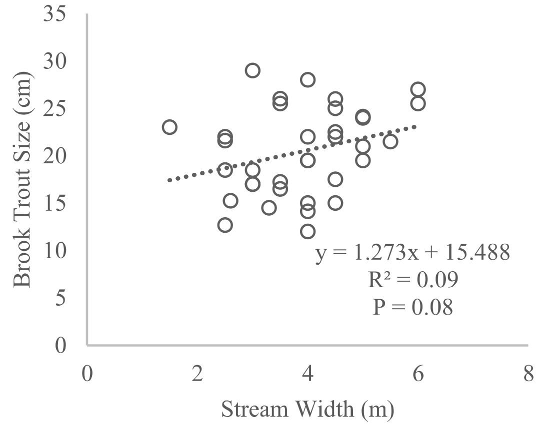

Fig. 2. Stream width plotted against size of Brook Trout *Salvelinus fontinalis* in the Kabekona River. Fish were caught August through September 2023 ($P = 0.08$).

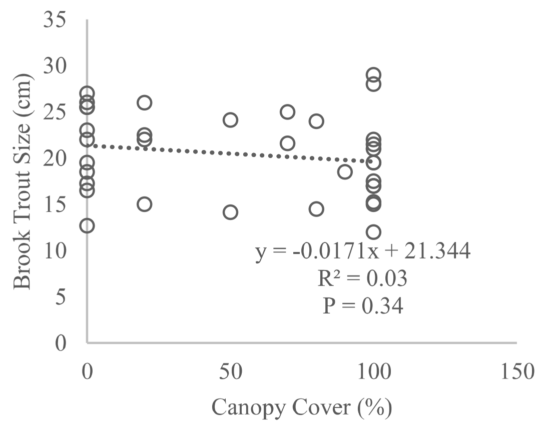

Fig. 3. Canopy cover % plotted against size of Brook Trout *Salvelinus fontinalis* in the Kabekona River. Fish were caught August through September 2023 ($P = 0.34$).

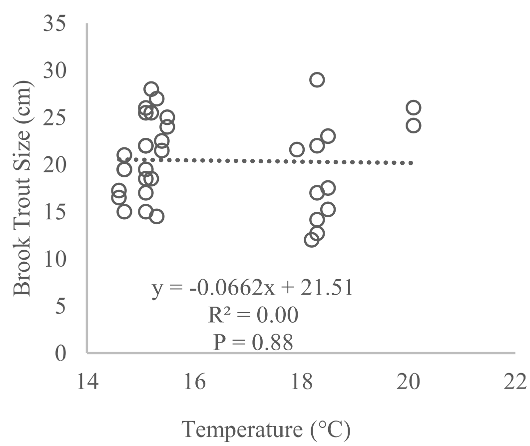

Fig. 4. Water temperature plotted against size of Brook Trout *Salvelinus fontinalis* in the Kabekona River. Fish were caught August through September 2023 ($P = 0.88$).

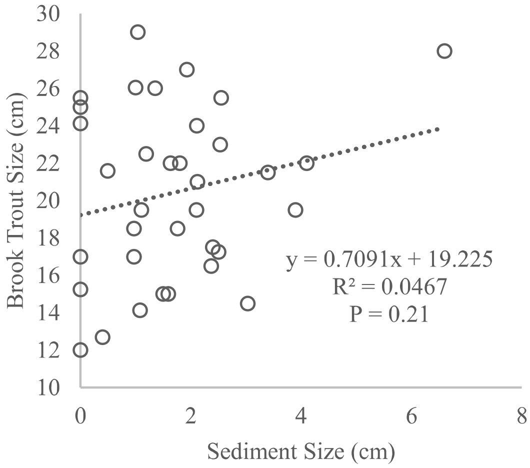

Fig. 5. Sediment size plotted against size of Brook Trout *Salvelinus fontinalis* in the Kabekona River. Fish were caught August through September 2023 ($P = 0.21$).

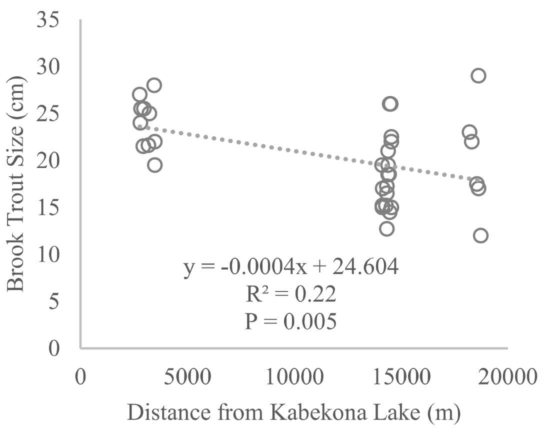

Fig. 6. Distance from Kabekona Lake plotted against size of Brook Trout *Salvelinus fontinalis* in the Kabekona River. Fish were caught August through September 2023 ($P = 0.005$).

IV. Discussion

A key finding of this study showed that larger Brook Trout tended to reside closer to Kabekona Lake. Research from Lake Superior tributaries suggests that the average larger size in adult adfluvial trout is due to a habitat shift, where less energy is required to grow to larger sizes in lake environments (Kusnierz et al. 2009). This would suggest that the trout in this system travel in and out of the river, making them adfluvial. The presence of these fish would explain their larger size.

Another conclusion found in this study was that Brook Trout size increased with depth. This would make sense as larger trout tend to prefer living in deeper pools (Larschield and Hubert 1992). This relationship could also explain why trout are larger closer to the lake, as the river generally gets deeper downstream.

The results of this study suggest that depth and distance from the lake play a role in determining size of Brook Trout. Research suggests that juvenile Brook Trout do not exhibit differences in size, even though heterogenous habitat is present. The larger size in adult fish is often linked to growth in a lake environment (Kusnierz et al. 2009). This could explain why habitat metrics such as stream width, canopy cover, water temperature, and sediment size did not show any statistical significance in Brook Trout size. This study could be further looked into by increasing the sample size, including fish residing in Kabekona Lake.

References

[1] Becker, G.C. 1983. Fishes of Wisconsin. University of Wisconsin Press, Madison, WI.

[2] Behnke, R.J., J.R. Tomelleri, and G. Scott. 2002. Trout and salmon of North America. Free Press, New York, New York.

[3] Bjornn T.C. and D.W. Reiser. 1991. Habitat requirements of salmonids in streams. In Meehan 1991. pp 83-138.

[4] Huckins, C.J., E.A. Baker, K.D. Fausch, and J.B.K. Leonard. 2008. Ecology and life history of coaster brook trout and potential bottlenecks in their rehabilitation. North American Journal of Fisheries Management 28:1321-1342.

[5] Kusnierz, P.C, S.P. Strimmel, and J.B.K. Leonard. 2009. Movement and growth indicators in resident and adfluvial coaster brook trout (*Salvelinus fontinalis*) in the Hurricane River, Lake Superior, Michigan, USA. Journal of Great Lakes Research 35:385-391.

[6] Larscheid, J.G. and W.A. Hubert. 1992. Factors influencing the size structure of brook trout and brown trout in southeastern Wyoming mountain streams. North American Journal of Fisheries Management 12:109-117.

[7] Raleigh, R.F. 1982. Habitat suitability index models: brook trout. U.S. Fish and Wildlife Service FWS/OBS-82/10.24.