

Memorandum

To: Jessica Vanderwerff Wilson
From: Jordan Wein, WSB
Date: September 16, 2022
Re: Arrowhead Fisheries Survey
Edina, MN
WSB Project No. 018641-000

BACKGROUND

Arrowhead Lake (MN DNR DOW #27004500) located in Edina, MN is a 22-acre lake with an average depth of 4.5 feet with a maximum of approximately 8 feet. Hypoxia (lack of enough oxygen to support living tissues) can occur in winter when ice and snow have prevented reintroduction of dissolved oxygen to the lake. This can result in the observation of fish kills in springtime when ice melts off the lake. In addition, in shallow lakes, hot and dry months in summer can deplete oxygen to the point of summer fish kills. To prevent this, a common management option is to install aeration systems to artificially add dissolved oxygen to the water column. An aeration system with 3 diffusers near the southeast area of the lake were installed in 1994 to attempt to maintain a healthy fishery through conditions that usually result in hypoxia in the lake (winterkill). However, a lack of knowledge of this fishery exists and thus the effect of the aerators is not well known. This system is paid for by the lake association and maintenance is coordinated by the service contractor through the City of Edina.

A standard MN DNR fishery was completed in 1995 and showed a species diversity of black bullhead, green sunfish and fathead minnows using standard trap nets. This diversity seems to suggest regular periods of hypoxia since these species are especially resistant to low levels of dissolved oxygen. MN DNR permitted stocking of 400 bluegill sunfish and 600 largemouth bass (both species susceptible to mortality in hypoxic conditions) occurred in 1994 by lake residents, however no fish from that stock was recaptured indicating low or no survival of stocked species. Since then, in 2016, the lake was stocked with 1000 bluegill fingerlings and 1000 yearlings as well as 430 largemouth bass fingerlings and 90 yearlings. No MN DNR survey has been conducted since then.

This memo describes the use of nets and electrofishing to conduct a standard fisheries survey at Arrowhead Lake in Edina, MN. The results will give a baseline index for catch per unit effort (CPUE) for comparison of subsequent surveys in order to understand population and diversity dynamics as well as presence/absence of invasive species.

ARROWHEAD TRAP NET SURVEYS: SEPTEMBER 2021 AND JUNE 2022

Methods

We used three (3) MN DNR standard double frame fyke trap nets with $\frac{3}{4}$ " mesh and a 60' lead line. In addition, we used three (3) mini fyke trap nets with $\frac{3}{8}$ " mesh and a 30' lead line (seen in Figure 1). This style of trap targets the natural movement patterns of fish along the shorelines during a 24-hour period. Fish swimming along the shore are guided toward funneled throats that allow the fish in but are not able to escape. The contents of each trap were emptied, all fish are identified, and a representative sample was measured for length for comparative purposes.



Figure 1: Example of mini fyke trap net set in a lake.

Results

Both standard trap nets and mini fyke trap nets resulted in the same diversity of species: black bullhead, bluegill sunfish, green sunfish, hybrid sunfish, and largemouth bass as shown in Figure 2. The most abundant species was bluegill sunfish with a CPUE of 18.17 in 2021 and 26 in 2022 and an average size of 5.8 inches and 6.7 inches respectively. Next most abundant was largemouth bass with a CPUE of 2.17 in 2021 and 1.0 in 2022 and an average size of 13.1 inches and 10.1 inches respectively. Black bullhead and green sunfish showed the same abundance with CPUE of 0.17 in 2021 and an average size of 9.8 and 6.2 inches respectively. Green sunfish were not captured in 2022 with trap nets.



Figure 2: Largemouth bass on left and bluegill on right from traps

Table 1: Fall total catch of each species using mini and standard trap nets compared to normal ranges.

September 2021 trap net sampling				
Species	Gear	Total catch	CPUE	Normal range
Black bullhead	Mini trap net	0	0.0	-
Black bullhead	Standard trap net	1	0.2	1.8-26.3
Bluegill sunfish	Mini trap net	88	14.7	-
Bluegill sunfish	Standard trap net	109	18.2	2.8-43.3
Green sunfish	Mini trap net	2	0.3	
Green sunfish	Standard trap net	1	0.2	.2-12.4
Hybrid sunfish	Mini trap net	12	2.0	-
Hybrid sunfish	Standard trap net	0	0.0	NA
Largemouth bass	Mini trap net	6	1.0	-
Largemouth bass	Standard trap net	13	2.2	.1-.8

Table 2: Breakdown of size classes of each species in fall of 2021.

2021 Length of select species sampled					
Length categories	Black bullhead	Bluegill sunfish	Green sunfish	Hybrid sunfish	Largemouth bass
0-5	0	24	0	0	0
6-7	0	121	2	10	1
8-9	0	3	1	2	3
10-11	1	0	0	0	2
12-14	0	0	0	0	3
15-19	0	0	0	0	10

Table 3: Spring total catch of each species using mini and standard trap nets compared to normal ranges.

June 2022 trap net sampling				
Species	Gear	Total catch	CPUE	Normal range
Black bullhead	Mini trap net	1	0.2	-
Black bullhead	Standard trap net	2	0.3	1.8-26.3
Bluegill sunfish	Mini trap net	32	5.3	-
Bluegill sunfish	Standard trap net	156	26.0	2.8-43.3
Green sunfish	Mini trap net	0	0.0	
Green sunfish	Standard trap net	0	0.0	.2-12.4
Hybrid sunfish	Mini trap net	0	0.0	-
Hybrid sunfish	Standard trap net	0	0.0	NA
Largemouth bass	Mini trap net	3	0.5	-
Largemouth bass	Standard trap net	6	1.0	.1-.8

Table 4: Breakdown of size classes of each species in spring 2022.

2022 Length of select species sampled (trap nets and electrofishing)					
Length categories	Black bullhead	Bluegill sunfish	Goldfish	Hybrid sunfish	Largemouth bass
0-5	0	9	0	0	2
6-7	0	160	0	3	1
8-9	0	13	0	0	8
10-11	9	0	0	0	0
12-14	1	0	5	0	6
15-19	0	0	0	0	3

As mentioned above, the MNDNR surveyed Arrowhead Lake in 1995 using similar trap net gear. The comparison of CPUE for species sampled is displayed in Figure 3 below.

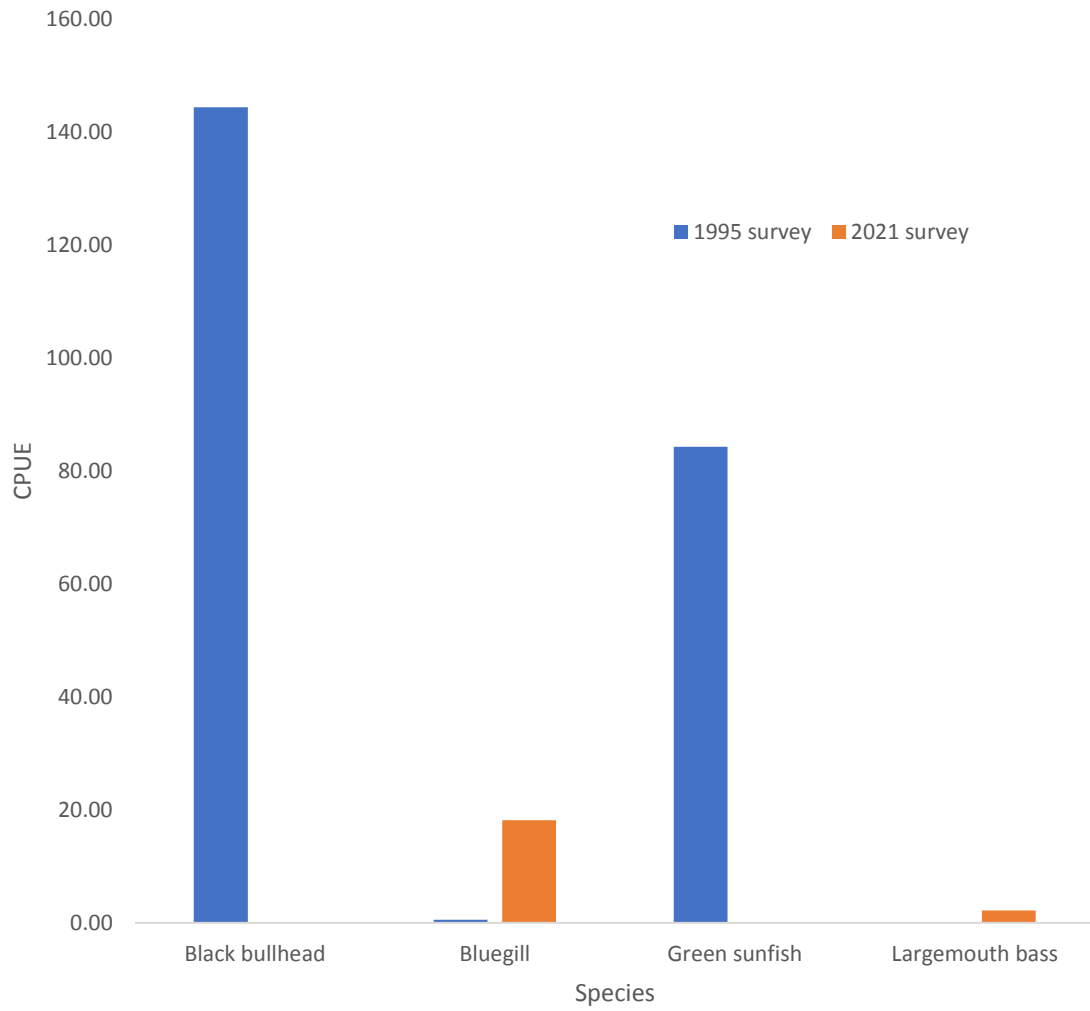


Figure 3: CPUE comparison of MN DNR survey in 1995 and WSB survey in 2021 using standard trap nets.

ARROWHEAD BOAT ELECTROFISHING SURVEYS: AUGUST 2022

Methods

Boom electrofishing consists of a boat with an onboard gasoline generator that supplies power to a dual boom cathode array that hangs off the front of the boat, as shown in **Figure 4** below. A control box run by the navigator adjusts the type of electrical output depending on lake depth, temperature, and conductivity. Generally, the output runs around 18-22 amps and 2,000-3,000 watts. This amount of electricity caused a phenomenon known as electrotaxis, movement toward an electric field, and as the fish entered the strongest area of electricity, they were immobilized and were able to be netted without long term harm. The fish generally returned to normal behavior between a few seconds to a few minutes after removal from the electric field. The zone which immobilized fish was generally about four feet around each boom array and about four feet deep.

Three transects around the lake of 15 minutes were completed. This allowed us to sample all shoreline one time as well as a short portion down the middle of the lake. This prevented us from double-counting fish that had already been captured in earlier transects.



Figure 4: Electrofishing survey on a lake

Results

A total of five species were sampled during the electrofishing survey: black bullhead, bluegill sunfish, hybrid sunfish, largemouth bass, and goldfish. As seen with the trap nets, the most abundant species was bluegill sunfish. A breakdown of species and average lengths is shown below.

Table 5: Breakdown of species sampled during August 2022 electrofishing survey.

	Total caught	Average length (inches)
Black bullhead	7	10.1
Bluegill sunfish	58	7.8
Goldfish	5	13.5
Hybrid sunfish	3	7.2
Largemouth bass	11	9.5



Figure 5: One of the 5 goldfish captured during electrofishing surveys in Arrowhead.



Figure 6: A naturalized/wild form of goldfish captured during electrofishing surveys.

CONCLUSIONS

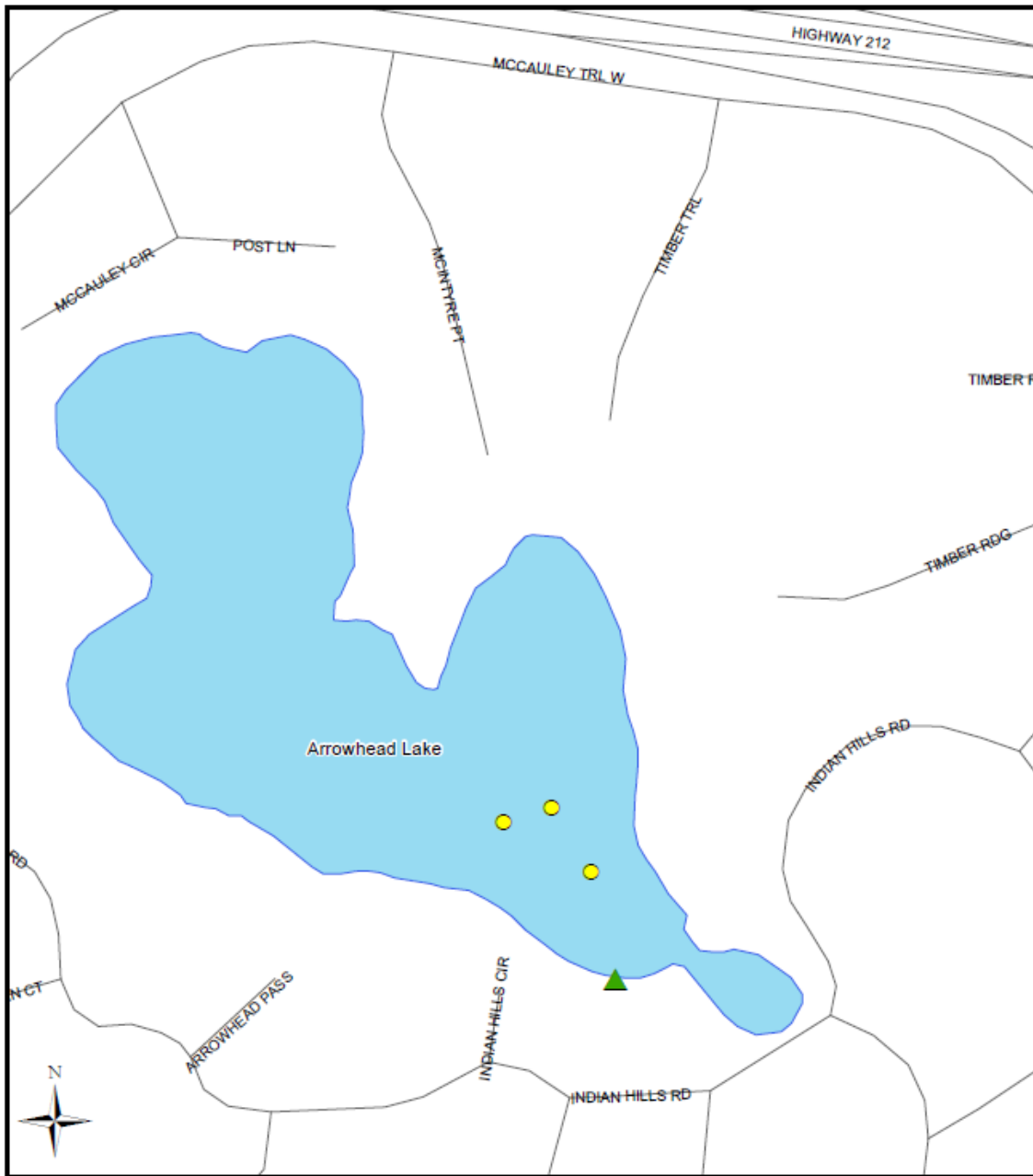
Comparing the MNDNR survey in 1995 and our survey in 2021 (Figure 3) show a stark contrast between the two different surveys. The 1995 survey captured species that are typical in lakes that suffer frequent winter kills due to hypoxia. However, the turnover to species like bluegill and largemouth bass suggests stocking of these species in 2016 was successful and there are normally abundant in Arrowhead Lake.





Average individual size of the largemouth is somewhat small but a few individuals larger. It appears aeration of the lake has successfully prevented winterkill of stocked bluegill sunfish and largemouth bass since 2016 stocking events. This likely means that the average dissolved oxygen does not extensively drop below 2 mg/liter at any time.

Finally, the somewhat surprising and potentially concerning finding was the presence of a small number of large goldfish in the lake. Judging by the number of small number of them captured, and the relative large size, it appears there is currently not an overabundant amount. All were of sexually mature status, though, and could potentially recruit more goldfish if there were a drop in bluegill abundance. Bluegill sunfish are likely the reason for the low goldfish abundance, as they are effective predators of cyprinid fish like goldfish and carp.

If an effort to remove these large goldfish, an accurate population estimate and reduction in the chances of goldfish recruitment could be effectively done with electrofishing surveys since the lake is small.

APPENDIX:



-  Aerator
-  Lake
-  Pump house
-  Streets

0 245 490 Feet



Engineering Department
Last Revision: September 2015

Figure 7: Map of aeration diffusers in Arrowhead Lake