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**SHIELDS LAKE:
2019 CARP REMOVAL PROJECT REPORT**
FOR COMFORT LAKE FOREST LAKE WATERSHED DISTRICT



MARY NEWMAN
WSB
178 East 9th Street, Saint Paul, MN

Introduction:

Shields Lake is a 28.6 acre lake in the Comfort Lake Forest Lake Watershed District, Washington County Minnesota (Figure 1). This lake is connected to Forest Lake by an unnamed stream that outflows north into Forest Lake's middle bay. One inlet to the lake is a drainage ditch on the south side of the basin. Shields Lake provides fishing and recreational opportunities with a rustic boat launch and fishing pier located within Shields Lake Park in the NW corner of the lake.

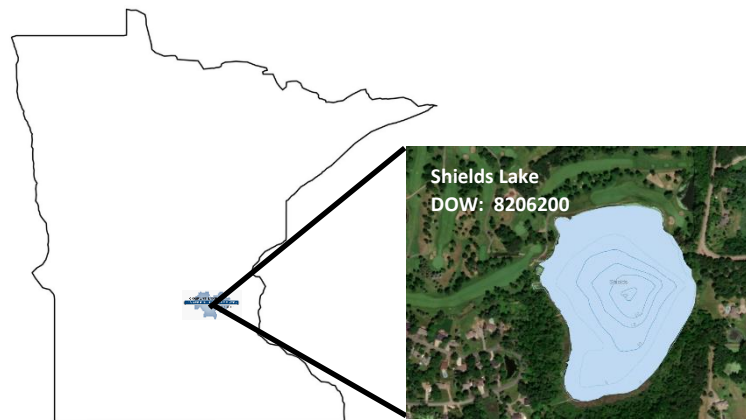


Figure 1: Shields Lake is within the Comfort Lake Forest Lake Watershed District and is located approximately 1.7 miles SE of Forest Lake. Maximum depth is 27 feet and area is approximately 28.6 acres in size.

In 2006, Shields Lake was placed on the MPCA list of impaired waters due to high levels of nutrients/eutrophication and biological indicators impairing aquatic recreation. According to the TMDL Implementation Plan for the CLFLWD, Shields Lake needs an 83% reduction of internal nutrient loading to meet water quality standards. In September – October 2019 the watershed district pursued an in-lake Aluminum Sulfate (Alum) Treatment to work towards this nutrient reduction goal.

The watershed district aimed to increase the effectiveness and longevity of water quality improvement projects in Shields Lake by removing a portion of the Common Carp population because of the contribution Common carp have to internal nutrient loading due to their feeding habits and excretion of waste. In the case where Alum is being applied in lake, an elevated biomass of carp has the potential to reverse the effects of the treatment due to their propensity to root around in the lake bottom while feeding. Because the lake has a barrier to carp movement at any inlet or outlet to the lake, it is likely that removing a portion of the population will provide long-lasting benefits to the lake.

In 2018, the CLFLWD had a biomass survey completed that estimated the population of carp to be between 650 -1770 individuals or 529.8 kg/ha. It was estimated by WSB scientists that between 510 and 1600 carp would need to be removed from Shields Lake to reach a carp biomass goal of less than 100 kg/ha. In the fall of 2019, the CLFLWD hired WSB and contracted commercial fishing crews to attempt carp removal from the system. With three visits to the lake, removal techniques were employed

including boat electrofishing and gill netting. This is a summary of the work completed and recommendations for removing additional biomass in the future.

Approach:

Shields lake is a relatively small but deep (~25 feet) basin with a flocculant substrate. These factors alone were enough to choose to forgo seine netting in the basin where a large net would be deployed and pulled across the lake to capture any fish within the nettable water. Because of the shape of the basin, pulling a net would result in space under the net exposed for fish to escape. Additionally, flocculant substrate would cause difficulty pulling a net without “mudding-in”, meaning the net would catch sediment to slow or stop the advancement of the net. Instead it was decided to pursue commercial gill netting and boat electrofishing with permitting through WSB’s MN DNR Fisheries Research Permit.

In addition to removing carp, it was decided with consultation with watershed district staff that an attempt to strengthen the estimate of carp population and biomass in the lake. This would be done by keeping track of time and number of carp captured in multiple transects throughout the lake and applying the same CPUE model used in the 2018 estimation. This activity was completed over the course of two visits to the lake with WSB’s electrofishing boat. This estimation is used in calculating carp removal rates and remaining biomass in 2019. Carp captured in these surveys were removed from the lake to work towards reaching biomass reduction goals.

Gill netting was pursued on September 28 and again on September 30, 2019 using 2,500 feet of netting with 7 inch or greater stretch. Gill nets were set by commercial fishermen and checked every hour to reduce stress on other fish species that were captured incidentally. Nets were set in various configurations after each check throughout the center of the lake and out from the shoreline of Shields Lake.

At the time of gill nets being set and checked, one WSB scientist and an employee from the CLFLWD conducted boat electrofishing. One member of the crew drove the boat in a zig-zag fashion around the perimeter of the lake while the other member netted any visible carp that floated to the surface in response to electrofishing activity. Care was taken to traverse the entire lakeshore to conduct a timed CPUE survey while other areas of the lake were especially targeted to pursue removal of carp biomass. Areas of the lake that produced the most carp was along the eastern shoreline near downed trees that created habitat for carp and other fish species.

Results:

Carp biomass estimates were strengthened in 2019 by completing a boat electrofishing CPUE on September 30 and October 18, 2019. Catch rates on these dates were used to calculate a biomass on the day of capture and these numbers were back-calculated to approximate the biomass at the beginning of the project period. CPUE estimates in 2019 were slightly lower than 2018 numbers suggested although they remained well above the threshold of 100 kg/ha. At the beginning of the project period, it is estimated that there was approximately 411.2 ± 110 kg/ha of carp biomass in Shields Lake.

In the 2019 project period, a total of 71 common carp were removed from Shields Lake weighing on average 6.7 kilograms (14.8 lbs). This equates to a total biomass removal of 456 kg (1,006 lbs) or 37.8 kg/ha leaving the remaining carp biomass estimate in Shields Lake to be 373.6 ± 100 kg/ha (Table 1).

Date	Method	# Ind. Carp Removed	Weight Removed (kg/ha)	2019 Biomass* (kg/ha)	# Ind. Carp Remaining
Fall 2019	CPUE	n/a	n/a	411.2 ± 110	746 ± 200
9/28/2019	Gill & Electro	43	22.1	389.2 ± 104	706 ± 189
9/30/2019	Gill & Electro	18	9.3	379.9 ± 102	689 ± 184
10/18/2019	Electrofishing	10	6.3	373.6 ± 100	678 ± 181

Table 1: Summary of carp removal efforts in 2019. *2019 CPUE biomass was calculated by WSB scientists using catch rates from electrofishing data collected on September, 30 and October 18, 2019 and back-calculated to capture carp removal rates throughout this project period.

Gill netting that was conducted by JR Commercial Fishing in the Fall of 2019 and captured and removed a total of 19 Common Carp and incidentally captured one Large Mouth Bass that was released back to the basin in good condition. Boat electrofishing captured and removed the remaining 55 individual Carp. All captured carp (71) were removed from the system and taken by the commercial fishermen to properly dispose of.

Conclusion & Recommendations:

In the Fall of 2019, biomass reduction was not enough to reach the goal biomass of 100 kg/ha that has been established by scientists to be the threshold to where carp are no longer damaging to the nutrient loading in a system. At an average weight of 6.7 kg (14.8 lbs), it is estimated that between and 364 and 630 individual carp still need to be removed from Shields Lake to meet a goal biomass of 100 kg/ha or below (Table 2).

Date	2019 Biomass (kg/ha)	# Ind. Carp Remaining
November 2019	373.6 ± 100	678 ± 181
Projected Goal Biomass	100 kg/ha	181 ± 49

Table 2: Current Common Carp biomass after 2019 removal efforts using gill netting and boat electrofishing. Approximately 364 to 630 carp still need to be removed from the system to reach biomass reduction goals.

The size structure of carp in Shield Lake coupled with the aging data collected in 2018 suggest that very little recruitment in this basin occurs (Figure 2). This means that a reduction in carp biomass has the potential to have long-lasting benefits and removal of carp biomass would have to be infrequent once the biomass reduction goal has been met. This theory is strengthened with the observation of bluegill sunfish who are known to predate upon carp eggs and larvae and Largemouth Bass who are known to predate upon carp fry.

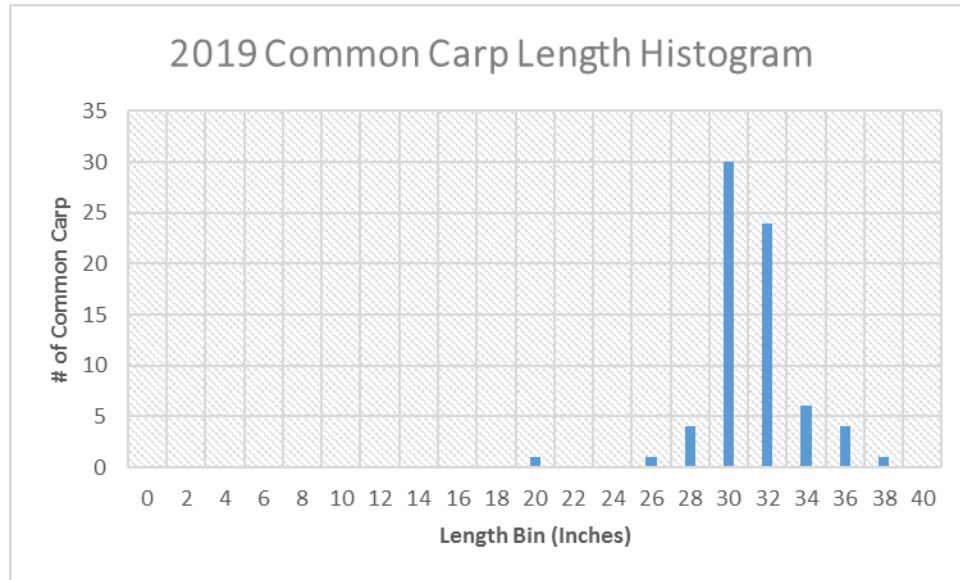


Figure 2: Shields Lake Common Carp length histogram. Zero (0) Carp were sampled between zero and 19 inches, indicating that recruitment has not occurred in recent years.

Efforts are ongoing by CLFLWD to reduce the excess level of nutrients to Shields Lake, including the alum treatment that was applied to the lake in Fall 2019. It is recommended that further carp biomass be reduced to lower the stress on the system caused by the feeding habits and excretion rates of this invasive fish species. To reduce the impact of removal efforts in lake operations should be limited as to not disturb the bottom sediments that are now bound by the alum treatment. Alternative options include exploiting carps propensity to move into shallow connected basins in the springtime by setting traps and implementing other removal strategies in outlet stream.

On October 18, CLFLWD and WSB staff did a reconnaissance of this stream reach to determine the feasibility of removal here and consultation between district staff and a long-term employee of the adjoining golf course confirms movement of carp into the outlet stream in the springtime. WSB would be pleased to present a proposal to complete additional biomass removal in the Spring of 2019 using the information gathered throughout the Fall 2019 project period.