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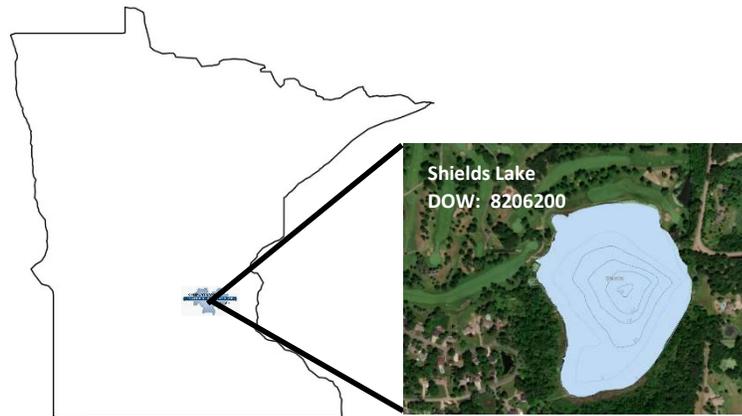
**SHIELDS LAKE:  
2022 CARP REMOVAL AND POPULATION  
UPDATES PROJECT REPORT  
FOR COMFORT LAKE FOREST LAKE WATERSHED DISTRICT**



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**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 past a small open water wetland and 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 for non-motorized boats 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 2018 the CLFLWD commissioned a carp biomass and aging study and in September – October 2019 the watershed district pursued an in-lake Aluminum Sulfate (Alum) Treatment to work towards this nutrient reduction goal.

An elevated biomass of carp can contribute to internal loading and has the potential to reverse the effects of an alum treatment due to their propensity to root around in the lake bottom while feeding. Even in a deep lake, this sediment disturbance can settle into the zone that has been treated and lessen the lifespan of an alum treatment. Because the outlet and inlet of Shields Lake has a barrier to carp immigration, it is likely that removing a portion of the population will provide long-lasting benefits to the lake. It has been accepted by scientists that a level of 100 kg/ha of carp biomass has a minimal impact on water quality and has been set as the goal biomass in Shields Lake.

**History of carp management in Shields Lake:**

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. Carp management began in 2018 with a catch per unit effort (CPUE) estimate of population that was conducted by Carp Solutions (CS). The 2018 study also included the collection of common carp to use in aging the population to guide management decisions.

Results of this initial population estimate indicated that approximately 1,000 individual carp or 529.8 kg/ha resided in Shields Lake. Using this data, it was estimated by WSB scientists that 650 -1770 individual carp reside in Shields Lake and that between 510 and 1600 carp would need to be removed from to reach a carp biomass goal of less than 100 kg/ha. The aging study collected 45 carp to be analyzed and found that the majority of these fish were born, aka recruited to the system, between 1997 and 2007. CS reported that a significant recruitment event had not occurred since approximately 2007.

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. Because electrofishing was employed, time and catch rate were also collected to run an updated CPUE estimate of population that concluded approximately  $411.2 \pm 110$  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  $373.6 \pm 100$  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	$411.2 \pm 110$	$746 \pm 200$
9/28/2019	Gill & Electro	43	22.1	$389.2 \pm 104$	$706 \pm 189$
9/30/2019	Gill & Electro	18	9.3	$379.9 \pm 102$	$689 \pm 184$
10/18/2019	Electrofishing	10	6.3	$373.6 \pm 100$	$678 \pm 181$

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.

As a surrogate for carp aging data, WSB plotted the lengths of carp captured in 2019. This plot suggested that carp were not present in Shields Lake under 20 inches, indicating that no recent recruitment had occurred.

A baiting trial was conducted in the early spring of 2020. CLFLWD Staff placed cracked corn in a bait bag near the fishing pier and checked it daily. There was no bait consumed during this time. As carp removal methods were explored and a contract was developed it was decided not to pursue box netting or other baiting and capture techniques.

In 2020, a carp removal project was initiated that would target the stream reach between Shields Lake and Forest Lake in the Springtime. Anecdotal evidence suggested that carp move into a wetland area approximately 500 feet downstream in the springtime to spawn. This wetland was targeted by erecting a barrier on the downstream side of the wetland while allowing movement through a gate on the upstream side of the wetland. The barrier and gate were monitored with remote cameras daily and the site checked periodically. This method did not prove effective as no carp were observed to be migrating in this springtime period.

In 2022, WSB was again contracted to remove carp from Shields Lake and at the same time update the CPUE population estimate. The method for removal was to continue electrofishing after the CPUE survey was complete on each date and remove any carp that were captured. This method was chosen because of out of all the methods that were tried a boat electrofishing effort was shown to be more effective than others. The purpose of this report is to both report on the 2022 removal and CPUE population estimate but also to take a closer look at the population reported in past years. These items are described below.

It should be noted that a CPUE estimate give managers a snapshot into the carp population and is used by WSB scientists to report if the population is low, moderate, high to very high and is not given as an exact estimate. In the case of Shields Lake, the trend of the CPUE survey over the 5-year period of surveillance and the observations made about the lake overall fishery, vegetation and side-scan sonar surveys are taken into consideration when suggesting the current status of carp biomass in the lake. The current status of the carp biomass is described in the results and discussion section of this report.

**2022 Carp Removal and Population Update:**

Shields Lake was visited on June 21, October 14 and October 20, 2022. The purpose of these visits was to conduct a catch per unit effort estimate of population and to remove carp that were captured during and after the surveys were complete. Catch rates for common carp were lower than in previous years and resulting CPUE averaged throughout all of the visits in 2022 suggest that  $39.9 \pm 26.3$  kg/ha reside in Shields Lake (table 2).

Date	Method	# Ind. Carp Captured	2022 CPUE Biomass Estimate (kg/ha)
6/21/2022	CPUE Survey	2	$104.8 \pm 68$
10/14/2022	CPUE Survey	1	$11.2 \pm 10.7$
10/20/2022	CPUE Survey	0	$3.6 \pm 0$
2022	CPUE Estimate	n/a	$39.9 \pm 26.3$

Table 2: Summary of 2022 carp CPUE survey. Three transects were traversed on each date that were timed from 10 to 15 minutes and covered the entire shoreline.

Carp were removed that were captured during the survey and additional time was spent after the surveys were complete to capture carp in the Shields Lake basin. In 2022 a total of 7 carp were captured and removed totaling a biomass removal rate of 3.62 kg/ha (table 3). Carp that were captured were concentrated around a downed tree on the eastern shoreline. This is the location where most fish have been captured in previous year surveys and removal events. As discussed in previous reports, this occurrence of carp aggregation resulting in a higher catch rate, could inflate a CPUE biomass update. That consideration is discussed in the following section.

Date	Method	# Ind. Carp Removed	Biomass Removed (kg/ha)
6/21/2022	Electrofishing	6	3.57
10/14/2022	Electrofishing	1	0.05
10/20/2022	Electrofishing	0	0.0
<b>2022</b>	Biomass Removed	7	3.62

Table3: Summary of 2022 carp removed during and after CPUE surveys were complete.

### Results and Discussion:

Total biomass removed from shields lake between 2018 and 2022 was 66.3 kg/ha (table 4). These carp have been removed using a variety of methods with the most effective method being boat electrofishing. The options for removal have been limited due to a variety of factors. Baiting and removal using box-netting was not executed due to flocculent bottom substrate and carp not showing signs of being attracted to a baited site. Stream trapping proved to be ineffective as carp did not migrate towards the open water wetland area in 2020. Seine netting was not pursued due to the potential for sediment disturbance after alum treatment in 2019. Gill netting captured some carp in 2019 but was not as cost effective as boat electrofishing.

Year*	# Ind. Carp Removed	Biomass Removed (kg/ha)	Biomass estimate (kg/ha)
2018	45	25.0	529.8 ± 265
2019	71	37.7	373.6 ± 100
2020	0	0	n/a
2022	7	3.62	39.9 ± 26.3
<b>Total</b>	123	66.3	314.4 ± 204

Table 4: Summary of total carp biomass removed from Shields Lake in 2018-2022. This number represents actual carp biomass removed. 2018 survey was completed by CS and range calculated by WSB based on that data and 2019-2022 project work was completed by WSB.

There has been some variation in carp biomass estimates using a CPUE method of estimation. A more thorough discussion of electrofishing CPUE in relation to the size of Shields Lake and the distribution of carp captured during the surveys may help to describe this variation. Studies have shown that electrofishing CPUE has a tendency to overestimate low densities and underestimate high densities of common carp (Bajer, 2012). This could be the case in Shields Lake as the estimate has trended down over the five years of surveys. Studies have also indicated that a small basin is likely to experience an overestimation using this method. In the case of Shields Lake, this could be especially true since the majority of the carp were captured in just one area of the lake in all survey years.

It is likely that the carp biomass in Shields Lake near the threshold that is known to be damaging. The biomass estimate is  $314.4 \pm 204$  kg/ha and uses the CPUE estimate data from all survey years (2018, 2019, and 2022). The estimated biomass has dropped in each survey year (table 4) with the most recent estimate suggests a biomass range of 13.6-66.2 kg/ha remains in Shields Lake. As described above, there are factors that suggest the original biomass estimate was much higher than the actual biomass in Shields Lake. Because of these factors and because the estimate is trending downwards it is recommended to use the lower end of the range to manage carp in Shields Lake. This concludes that the biomass in Shields Lake is close to 110 kg/ha in 2022.

<b>Date</b>	<b>Method</b>	<b>*Biomass Estimate (kg/ha)</b>	<b># Ind. Carp Remaining</b>	<b>**Biomass to manage at in Shields Lake (kg/ha)</b>	<b>Threshold to where carp are damaging (kg/ha)</b>
<b>2022</b>	CPUE Estimates	$314.4 \pm 204$	$1658 \pm 1077$	110	100

*Table 5: Carp CPUE estimate. \*Reported using average 2018, 2019, and 2022 survey data. \*\*Management is recommended at lower end of this range.*

The size structure in Shields Lake since 2018 has not shown recruitment of young fish until the 2022 survey. In 2022 carp were sampled that were ~9 inches in length (figure 2). Although these fish were not aged, it is clear they are younger than fish sampled in the past and are possibly 1-2 years old.

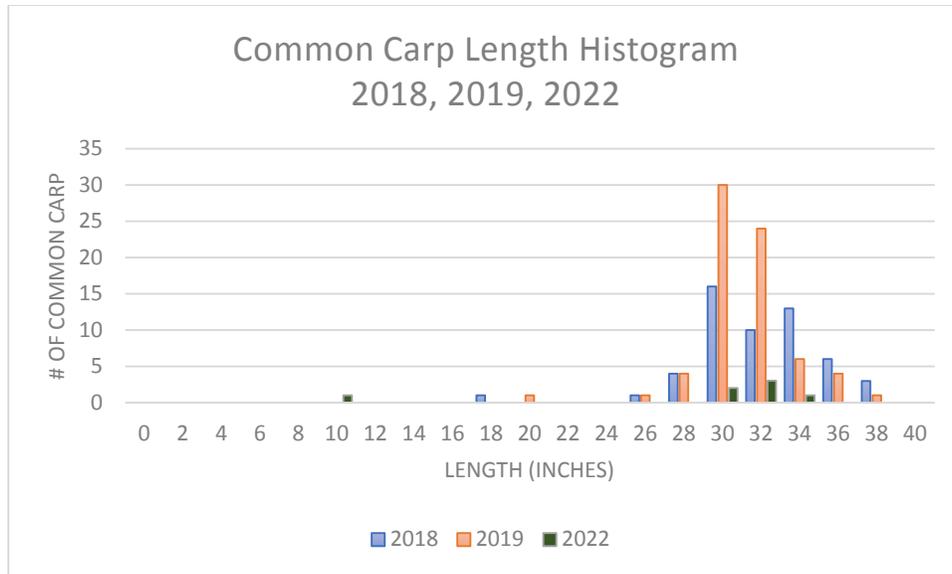


Figure 2: Length histogram of carp captured in Shields Lake in 2018, 2019, and 2022.

This finding of smaller carp in Shields Lake should prompt managers to monitor the population periodically to determine if an increase in biomass occurs. This monitoring could be done with boat electrofishing CPUE surveys and would be strengthened with the use of a fall trap netting survey. Adult population would be monitored with CPUE while a recruitment event (carp age-0) may be captured in a trap netting survey. It is unknown what has prompted a suspected recruitment event of carp between 2019 and 2022. A study has shown that there is a potential that a year where zooplankton abundance is especially strong that carp can recruit, even in basins where a bluegill population is healthy (Lechelt, 2016). This may be the case for Shields Lake in this period.

Curlyleaf pondweed and coontail are the only two recorded plant species in Shields Lake. In recent years, curlyleaf has been treated in the springtime and has been effective at suppressing its growth (McComas, 2021). Coontail is the dominant species in the summertime growing period and was found at 33% of the sampled sites throughout the lake and is found at depths less than 5 feet. If carp biomass remains low and water clarity continues to improve, it would be expected that plant growth would increase.

A total of seven (7) species of fish were observed in the 2022 CPUE surveys conducted by WSB (Attachment C). These species included bluegill, northern pike, largemouth bass, crappie, pumpkinseed, white sucker, and bullhead. This assemblage of species is one that will help to suppress carp recruitment. The presence and relative abundance of bluegill sunfish is especially important as they are known to predate on carp eggs and larvae. Predator species such as northern pike and largemouth bass can help to suppress the recruitment of young carp fry and fingerlings by predation on this age class. The aeration unit that is maintained through the winter is likely helping to maintain this population.

**Literature Cited:**

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