

## 2023 Pleasant Lake System Carp Management Report

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### **Summary**

This report covers Carp Solutions' work to manage the common carp population in Pleasant Lake in North Oaks, MN, as well as its connected water bodies in 2023. Backpack electrofishing and some new technology was employed to remove 384 carp migrating up from Pleasant Lake at the barrier in between Deep and Wilkinson Lakes. Of these carp, ten had PIT tags implanted by Carp Solutions during boat electrofishing surveys, nine from 2019 and one from 2022. In October, five carp were captured in Pleasant Lake and implanted with radio tags for future tracking in the system. Using the mark-recapture method and the catch per unit effort from the boat electrofishing, it is possible to estimate the carp population and biomass density. Using the mark-recapture method with a very small sample size, the estimated carp population in Pleasant Lake is 1,539 (90% CI: 276-2,802) with an estimated biomass density of 46.7 kilograms/hectare (90% CI: 8.4-85.1 kg/ha). From the catch per unit effort of the boat electrofishing, the carp population is estimated to be 1,959 (90% CI: 1,574-2,345) with a biomass density of 56.0 kg/ha (90% CI: 47.3-64.6 kg/ha). Although these estimates are fairly imprecise due to smaller sample sizes, the carp population does seem to be below the biomass density management threshold of 100 kg/ha. In order to further reduce the carp population with maximal efficiency, some technological improvements were tested during and after the spring removals. We recommend continuing spring removals with these technologies and periodic boat electrofishing surveys of the carp population in Pleasant Lake.

### **Methods and Results**

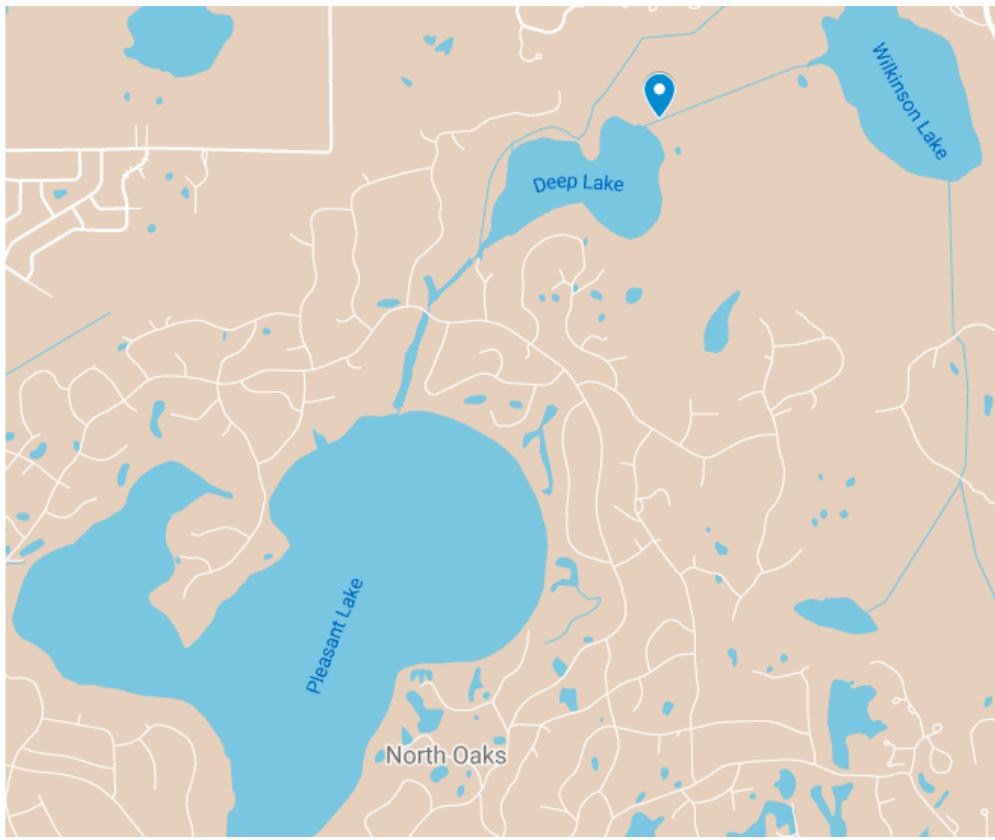
#### **Background**

In 2019, Carp Solutions conducted boat electrofishing surveys on Pleasant Lake to estimate the carp biomass density and implant PIT tags into the captured carp in order to track their suspected migration through Deep Lake towards Wilkinson Lake. A total of 78 carp were

captured, implanted with PIT tags, and released. The data from these surveys indicated that there was a carp biomass density of 273 kg/ha, well above the management threshold of 100 kg/ha. In the springs of 2020 and 2021, a PIT antenna was installed in the connecting channel between Deep and Wilkinson Lakes to track the spring migration of carp. In 2020, 71% of the carp tagged in Pleasant Lake in 2019 were detected at this antenna. The following year, 53% of the tagged carp were detected. This indicated that a majority of the carp in Pleasant Lake migrated up towards Wilkinson Lake. Based on this data, a removal of this migration of carp from Pleasant Lake through Deep Lake into Wilkinson Lake was recommended. In the spring of 2022, a barrier was constructed at the PIT antenna site from the previous two years (Figure 1) and 670 carp were removed from this channel, along with an additional 250-300 that died of hypoxia in the section below the permanent barrier at the outlet of Wilkinson Lake. The exact number of these carp is unknown, with the estimate being based off of the 246 dead carp that were counted. It is possible that this number is much higher. A follow up summer boat electrofishing survey was conducted, finding a substantially reduced biomass density of 48.9 kg/ha. Based on this success, it was decided to conduct removals in the Deep Lake channel again in the spring of 2023.

### **Preparation for removal**

Work on the Deep Lake removal site began on April 14th for the 2023 spring removal season. On this date the barrier was closed in anticipation of the annual spring migration of common carp. A Passive Integrated Transponder (PIT) tag antenna system was also installed on the same day in order to help indicate when a removal should be conducted at the site. On April 19th the barrier was further reinforced to fix damage from the previous winter. A power supply issue was also addressed with the PIT system, as well as installation of a remote access camera in order to further assist with the timing of removal efforts. In an attempt to increase the efficiency of removals, a box net at the base of the barrier was tested. This box net was installed on April 21st, although the net was left on shore to avoid unnecessary bycatch. The net was stretched briefly on May 9th. However, it was pulled to the side later that day after aggregations of fish tangled in the net and made it unusable. Due to the failure of the box net a second barrier wall was installed on May 12th in order to contain fish during removal events.



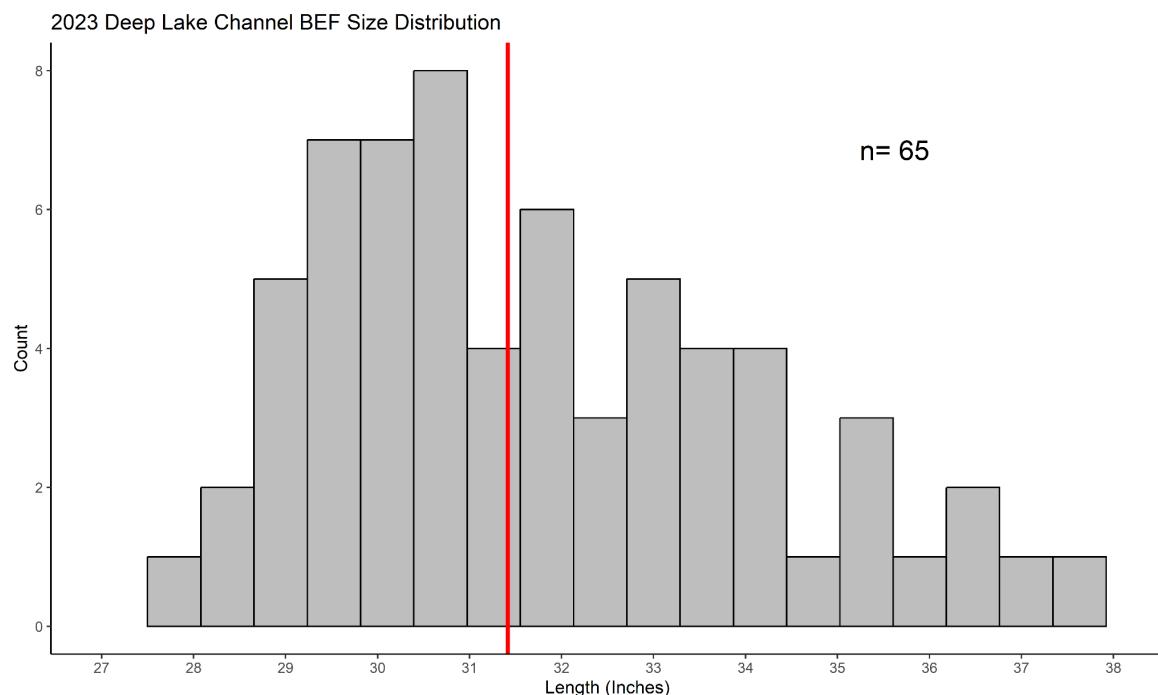
**Figure 1:** The location of the barrier wall in respect to the Wilkinson Lake/Deep Lake channel.

## Removals

Starting on May 9th, a large number of fish were observed trying to migrate upstream and were stopped at the barrier on the remote camera. There were also multiple carp detected by the PIT system at the time, initiating a removal on May 10th. During the removal, a large number of fish previously observed on the camera were found to be native bigmouth buffalo along with a very small number of common carp also present. The removal effort resulted in the capture of five carp, none of which were PIT tagged. The trap was reset for a subsequent removal and, with assistance from VLAWMO and the North Oaks Company, the site was prepared for the usage of Carp Solution's telehandler to increase the efficiency of removals.

After the first removal, there was an immediate peak of PIT tagged carp being detected at the PIT antenna. This peak only lasted two days, but was followed by a steady buildup of daily detections starting on May 15th. In addition to the PIT antenna, a large number of fish were seen on the remote camera. A removal was carried out on May 19th and a total of 379 carp were captured, including ten marked with PIT tags. The telehandler greatly increased the efficiency of the removal compared to similar scale removals at this site in 2022. To further increase efficiency, a remotely operated gate was installed at the downstream barrier wall so that carp could be trapped on short notice without the need for staff to be onsite. Unfortunately, no aggregations of carp were observed on camera after the construction of this wall. Additionally, only one PIT tagged carp was detected at the PIT antenna following the removal on May 19th. Thus, no more removals were conducted at the site for the remainder of the season.

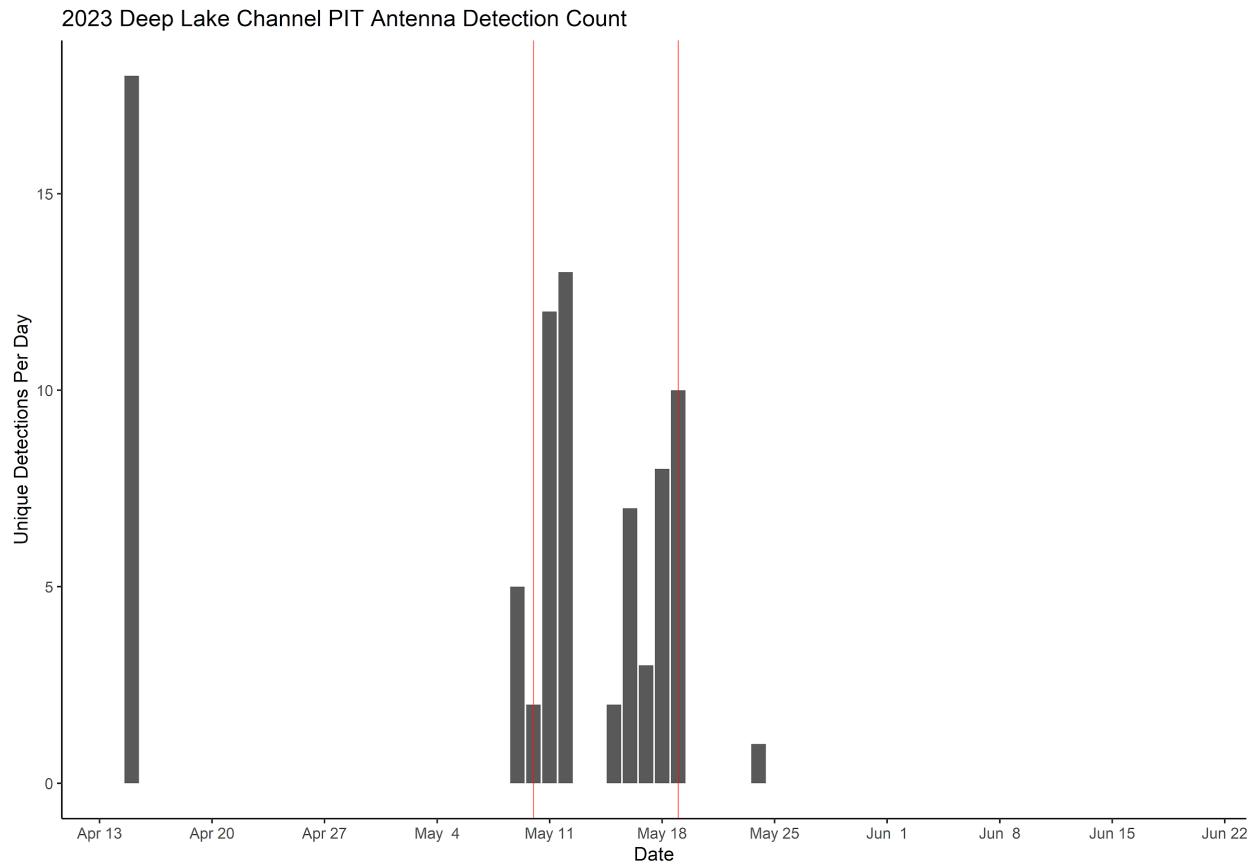
In total, 384 carp were removed in the spring of 2023. A subset of 65 of these captured carp were measured for length, which can be seen in Figure 2. The average length was 31.8 inches with an estimated average weight of 18.3 lbs. Among the captured carp, ten PIT tags were detected, all of which were captured on the second removal day. The ten recaptured carp out of 384 captured carp equates to a recapture rate of 2.6% or one out of 38 migrating carp being tagged. Of the ten recaptured carp, nine were originally tagged in 2019, and the remaining one was tagged in 2022. By comparing the length when the carp were tagged and when they were recaptured, the carp growth rate can be estimated. On average, these carp grew 0.22 inches per year (spread of 0.05-0.79 inches per year) since their initial mark and capture.



**Figure 2:** A histogram of the size distribution of carp (n=65). The red line indicates median length.

### PIT antenna

The PIT antenna below the barrier was operated between April 14th-June 20th. During this period, 26 PIT tagged carp were detected, mostly in three distinct periods (Figure 3). Of these 26, 23 were originally tagged in 2019, and three were originally tagged in 2022. The three carp tagged in 2022 represent 42.8% of the seven carp tagged in that year. Of the 26 tagged carp detected at the antenna, ten (38.5%) were captured and removed. Based on the percentage of tagged carp among the captured carp (2.6%) and the number of carp detected (26), approximately 1,000 carp participated in the attempted spring migration towards Wilkinson Lake, of which 384 were removed and an estimated 616 carp survived to return to Pleasant Lake.



**Figure 3:** Number of tagged carp detected per day below the barrier when the PIT antenna was installed. The red lines indicate removal days.

### Radio tagging

In order to continue monitoring the seasonal movement of carp in the Pleasant Lake system, boat electrofishing was used to capture carp that were implanted with radio tags on October 24th-25th. As a result of these efforts, five adult carp were collected, implanted with radio tags and released. The average size of carp sampled was 32.8 inches long (Table 1). It took two days to collect the five carp (12 transects total). The catch rate was quite low, with an average catch per unit effort (CPUE) 1.05 carp/hr. The low water temperature of 12.5°C and 12°C during the surveys may have contributed to this low catch rate. The carp were concentrated along the shore of the northeast and east side of the lake. Radio tagging surgeries were performed by Dr. Przemek Bajer. The list of radio frequencies and lengths of the tagged carp are shown below in Table 2.

**Table 1:** Data from the boat electrofishing to capture carp for radio tag implantation in late October 2023.

Date	Transects	Carp caught	Time shocking (min)	CPUE	Average Length (inches)	Population Estimate	Biomass Density Estimate (kg/ha)
10/24/2023	6	3	144	1.25	32.5	2,193	61.4
10/25/2023	6	2	142	0.85	33.1	1,725	50.9
Average	6.0	2.5	143.0	1.05	32.8	1,959	56.0
Total	12	5	286				
SE				0.20	0.31	234	5.3
Lower 90%				0.7	32.2	1,574	47.3
Upper 90%				1.4	33.3	2,345	64.6

**Table 2:** Data for the 5 carp implanted with radio tags in late October 2023.

Date	Inches	Radio frequency
10/24/2023	33.0	149.332
10/24/2023	29.5	148.771
10/24/2023	35.0	148.621
10/25/2023	35.7	149.212
10/25/2023	30.6	148.891

## Discussion

Spring removal of carp from the Pleasant Lake system resumed successfully in 2023 when a total of 384 individuals, weighing approximately 7,030 lbs, were removed. From the PIT antenna data, these 384 individuals were estimated to represent 38.5% of the spring spawning run. As in 2022, the carp were very large, with an average weight of 18.3 lbs. As before, it appears that the carp aggregate at the barrier in between Deep and Wilkinson Lakes for relatively limited periods of time. This aggregation has proven easy to capture, with a total of 1,054 carp weighing an estimated 19,602 lbs being actively removed in 2022-2023. In 2022, an additional 250-300 carp were estimated to have died of hypoxia in the pond below the permanent physical barrier at the outlet of Wilkinson Lake, adding an additional biomass of between 4,700-5,500 lbs removed from the population in the Pleasant Lake system. So, this location has been a productive location to remove spring migrations of carp.

Because of small sample sizes, updated population estimates are somewhat imprecise, but show a significant decline since 2019. The current carp population can be estimated with two methods, using the mark-recapture method, and from the two boat electrofishing surveys in the fall. Using the mark-recapture estimate on the carp marked in the summer of 2022 and

recaptured in the spring of 2023, the estimated carp population in Pleasant Lake is 1,539 (90% CI: 276-2,802). The estimated biomass density is 46.7 kg/ha (90% CI: 8.4-85.1 kg/ha). The confidence interval on these estimates is so large because of the small number of carp tagged (seven) and recaptured (one). Another method for estimating the carp population uses the data from the boat electrofishing surveys following the methods from Bajer and Sorenson 2012. From this, the carp population is estimated to be 1,959 (90% CI: 1,574-2,345) with a biomass density of 56.0 kg/ha (90% CI: 47.3-64.6 kg/ha). The confidence intervals on these estimates are similarly high due to the small number of carp (five) captured during them. Interestingly, the carp were larger than usual in this survey, with an average length of 32.8 inches compared to 31.8 inches in May 2023, 29.3 inches in the summer of 2022, and 31.7 inches in May of 2022. This larger length contributes to a relatively higher biomass density compared to population size when compared to other estimates. Although the difference is not statistically significant, these estimates are lower than that from 2022. In 2022, the carp population was estimated at 2,339 (90% CI: 1,579-3,100) with a biomass density of 48.9 kg/ha (90% CI: 44.7-53.1). This change between 2022 and 2023 is due to the average CPUE dropping from 1.38 carp/hr in 2022 to 1.05 carp/hr in 2023. All of these estimates are far lower than those from 2019, when the carp population was estimated at 8,834 (90% CI: 3,577-14,091) with a biomass density of 230 kg/ha (90% CI: 93-367 kg/ha). The average CPUE in 2022 (1.38 carp/hr) and 2023 (1.05 carp/hr) has fallen significantly since 2019, when it was 9.58 carp/hr. Thus, it appears that removing carp migrating from Pleasant Lake towards Wilkinson Lake has been a very effective method of reducing the carp population in Pleasant Lake.

Removal efficiency has increased with the introduction of new technology as well as the refinement of old technology. The PIT systems and remote cameras continue to be an invaluable asset for monitoring the formation, timing, and size of carp aggregations at barriers. For the removals themselves, we implemented some newly developed equipment to trap the carp within the barriers by adapting our remote trigger system. After the removals, we installed and tested a gate with a door at the downstream barrier. This door was able to be remotely closed, eliminating the need for someone to travel to the site and manually close the gate, potentially dispersing the carp in the process. Although we have continued to use backpack electrofishing units and dip nets to capture the carp, we improved the efficiency of handling the carp after capture through the use of a small telehandler. Carp are counted, scanned for PIT tags, a random subset is measured for length, and they are placed into brailer bags in tubs on the streambank with minimal manual movement. Once placed in the bags, the carp can be maneuvered completely in bulk into the euthanasia tubs and then the dump trailer by the telehandler. From there, they can be transported to and dumped at the burial site with the push of a button. This increase of mechanization ensures that carp can be removed with less labor needed per carp. Overall, the technological improvements increase our ability to capture and remove the aggregations of the large numbers of abnormally large carp in this system.

## **Management Recommendations**

Based on our data from the 2023 season, we recommend the continuation of carp removals in the Pleasant Lake system. With the new barrier constructed at the outlet of Deep Lake, we are hoping to block and remove a larger percentage of the migrating carp population in the system. We hypothesize that the carp will be more motivated to aggregate at this barrier

for longer periods of time since they cannot aggregate in Deep Lake as with the old barrier. At this new barrier, we plan to continue improving removal efficiency with technological advancements. As soon as the ice melts around the new barrier, we will install all of the pipes and reinforce the shore sides of the barrier with sandbags. At this same time, we plan to install a PIT antenna and remote camera inside of this barrier to monitor carp aggregations remotely. We will use the gate that can be closed remotely so that carp aggregations can be trapped quickly before they dissipate. To improve the removal efficiency, we will again use the large boats and telehandler to handle the carp in bulk, decreasing the amount of labor needed per carp. With this technology employed at the new site, we hope to increase the percentage of migrating carp removed and speed up the decrease of the carp population in Pleasant Lake.

As carp removals continue in the Pleasant Lake system, it is important to continue to survey the carp population in the lake. We recommend a set of boat electrofishing surveys every two-three years to monitor the progress of the removals by periodically estimating the carp population, ensure that there is no carp recruitment occurring, and implanting more PIT and possibly radio tags for tracking seasonal movements of the carp in the system. As in 2019 and 2022, we recommend three separate days of boat electrofishing surveys during July-September to accomplish this.

## **Citations**

Bajer, P. G., & Sorensen, P. W. (2012). Using boat electrofishing to estimate the abundance of invasive common carp in small Midwestern lakes. *North American Journal of Fisheries Management*, 32(5), 817-822.

Bajer, P.G., Beck, M.W., Cross, T.K., Koch, J.D., Bartodziej, W.M. and Sorensen, P.W., 2016. Biological invasion by a benthivorous fish reduced the cover and species richness of aquatic plants in most lakes of a large North American ecoregion. *Global Change Biology*, 22(12), pp.3937-3947.