2022 Minnetonka Bays Carp Management Report
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Lake Minnetonka Conservation District

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Summary

In the summer of 2022, Carp Solutions performed three boat electrofishing surveys to estimate the population and biomass density of common carp in the northwest bays of Lake Minnetonka. Two electrofishing transects were conducted per bay per day between 9/15/22 - 9/22/22, which yielded a total of 226 captured carp. Of these collected carp, 166 were measured, tagged with a Passive Integrated Transponder (PIT) tag, marked with a left pelvic fin clip, and released. The remainder of captured carp were measured and released. The population estimates as well as the biomass density estimates for all three bays are both well above the 100 kg/ha threshold suggested by Bajer et al. (2016). Further management is recommended to assess removal options and potential spawning migrations.

Methods and Results

Three bays in Lake Minnetonka were surveyed for carp using boat electrofishing during the summer and fall of 2022. Three days of electrofishing with two one hour transects (20 minute electrofishing time) transects per bay, per day, were conducted on Jennings Bay, West Arm Bay, and Harrison's Bay. The surveys were conducted between 9/15-9/22. On 9/21, only one transect was completed due to unforeseen conditions, and the survey was finished the following day. Carp were collected from the lake with dip nets and placed into a livewell during the transect. The first twenty carp of each day were measured, tagged with a Passive Integrated Transponder (PIT) tag, and had their left pelvic fin clipped to easily visually identify them in the future. The remaining carp were measured and scanned for PIT tags. All captured carp were then released.

These efforts resulted in the capture of 83 carp in Jennings Bay, with an average length of 25.6 inches. Here, the average CPUE (catch per unit effort) was 40.8 carp per hour of electrofishing. The estimated population for this bay is 22,900 (90% CI: 10,162-35,562) with a biomass density estimate of 692 (90% CI: 320-1064) kg/ha. The 94 carp caught in West Arm had an average length of 27.0 inches. The average CPUE in this bay was 46.8 carp per hour,

with a population estimate of 46,500 (90% CI: 27,831 - 65,075) and a biomass density estimate of 916 (90% CI: 545-1,287) kg/ha. The 49 carp caught in Harrison's Bay had an average length of 25.8 inches. The average CPUE was 24.5 carp per hour. The estimated population for Harrison's Bay is 10,300 (90% CI: 6,252-14,342) with a biomass density estimate of 437 (90% CI: 303-571) kg/ha. The length distributions of the carp in the different bays are displayed in Figure 1. As shown by Table 4, a total of 166 carp were PIT tagged, and 60 carp were measured and released without being PIT tagged, for a total of 226 captured carp.

Table 1: Data from the three boat electrofishing surveys for Jennings Bay. CPUE stands for catch per unit effort, in units of carp captured per hour of electrofishing.

Date	Carp Caught	Electrofishing time (min)	CPUE	Average length (inches)	Population Estimate	Biomass Density Estimate (kg/ha)
9/15/2022	22	41.0	31.9	25.2	18,006	520.4
9/16/2022	15	41.0	22.1	26.4	12,596	417.1
9/22/2022	46	40.5	68.1	25.5	37,984	1140.8
Average	28	40.8	40.7	25.6	22,862	692.0
Total	83	122.5				

Table 2: The collected data from the three boat electrofishing surveys for West Arm Bay.

Date	Carp Caught	Electrofishing time (min)	CPUE	Average length (inches)	Population Estimate	Biomass Density Estimate (kg/ha)
9/15/2022	16	40.0	24.0	26.8	24,146	466.3
9/16/2022	37	40.5	54.7	27.3	54,254	1105.7
9/21 & 9/22	41	40.0	61.6	26.7	60,935	1171.7
Average	31	40.3	46.8	27.0	46,453	915.7
Total	94	120.5				

Table 3: The collected data from the three boat electrofishing surveys for Harrison's Bay.

Date	Carp Caught	Electrofishing time (min)	CPUE	Average length (inches)	Population Estimate	Biomass Density Estimate (kg/ha)
9/15/2022	8	40.0	12.0	25.9	5,182	217.9
9/16/2022	16	40.0	24.0	24.9	10,100	380.8
9/22/2022	25	40.1	37.4	26.6	15,609	712.1
Average	16	40.0	24.5	25.8	10,297	436.9
Total	49	120.1				

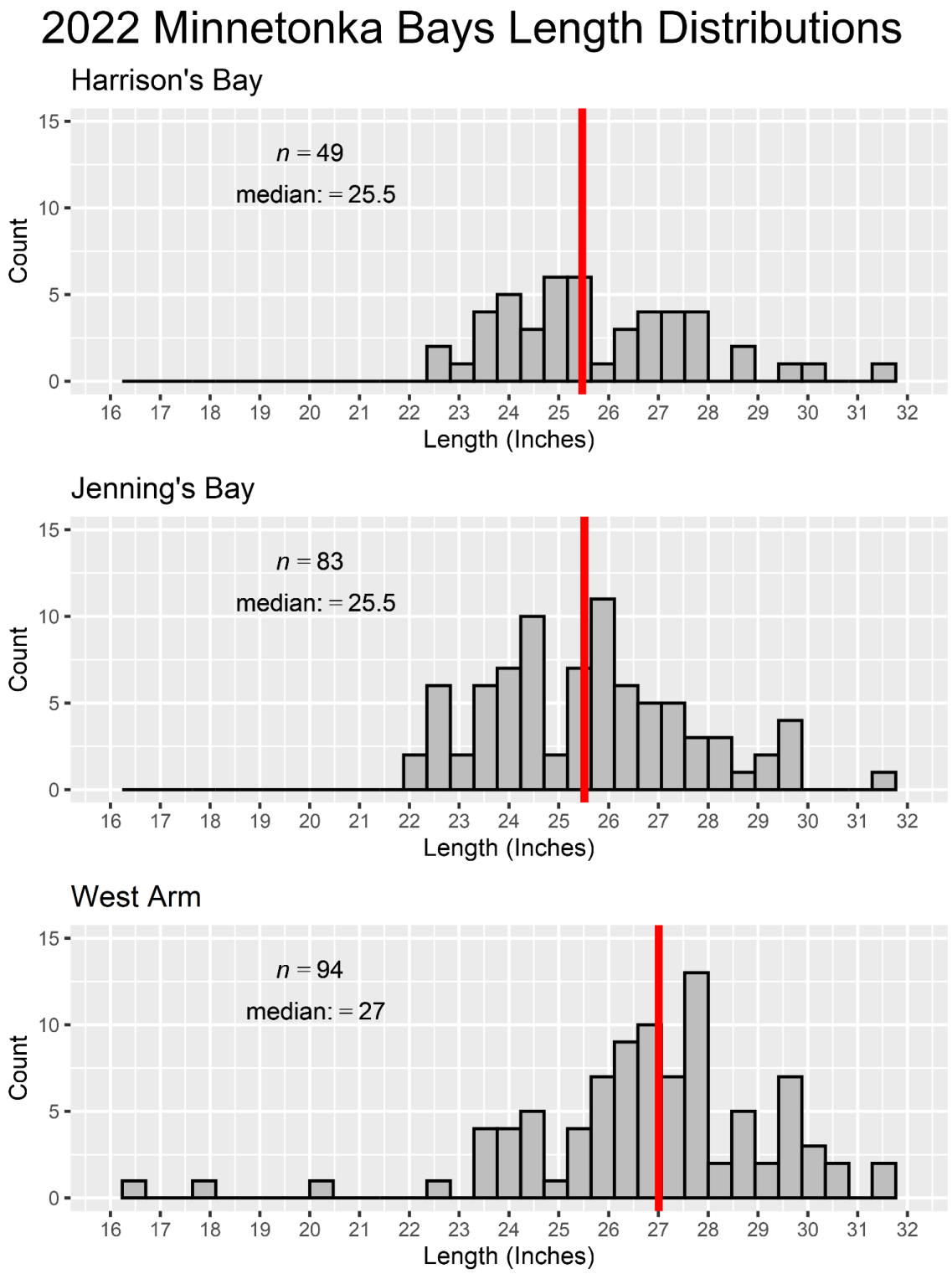

Figure 1: Histograms comparing the length (in inches) between the three bays. The red line indicates the median lengths for each bay.

Table 4: The total numbers of carp PIT tagged and measured per bay.

Bay	Number of carp PIT tagged	Number of carp measured only	Total carp caught
Harrison's Bay	44	5	49
Jennings Bay	55	28	83
West Arm	67	27	94
Total	166	60	226

Discussion

In these surveys, 166 carp were tagged out of a total of 226 collected and measured for length during the effort to obtain a biomass density estimate. Based on this data and the area of the bays, the carp population for Jenning's Bay is estimated to be 22,900 (90% CI: 10,162-35,562) with a biomass density estimate of 692 (90% CI: 320-1064) kg/ha. The population estimate for West Arm Bay is 46,500 (90% CI: 27,831 - 65,075) and a biomass density estimate of 916 (90% CI: 545-1,287) kg/ha. Additionally, the carp population estimate for Harrison's Bay is 10,300 (90% CI: 6,252-14,342) with a biomass density estimate of 437 (90% CI: 303-571) kg/ha. Carp biomass in lakes in the Midwest often range from 20-600 kg/ha. Carp biomass above 200 kg/ha is often associated with strong negative effects on lake habitat (aquatic vegetation) and water quality, and biomass of 100 kg/ha is often used as a management threshold (see Figure 2) (Bajer et al. 2016). The biomass densities for all three bays are well above the management threshold and for Jenning's Bay and West Arm, well above what is normally found.

Interestingly, the length of carp varies significantly between the bays. Using a Welch Two Sample T-Test, there is a statistically significant difference between the lengths of the carp in the different bays. Interestingly, Harrison's (average length: 25.8 inches) and Jenning's (average length: 25.6 inches) Bays are not significantly different ($p>0.1$) from each other, but each of these bays are significantly different from West Arm (average length: 27.0 inches) ($p<0.05$ for both). This could indicate that there are distinct populations of carp in these bays. In the future, recaptures of carp and the use of PIT antennas could shed light on this movement since each individual PIT ID will be linked to where and when a carp was caught.

The length distribution data suggests that several age classes of carp exist within each bay which is indicative of successful reproduction occurring within the system in the past. However, no juvenile carp were captured, which indicates that there has not been any successful reproduction in the system in the last several years. Further investigation is likely needed to better understand the hypothesized spawning migration of carp in these bays of Lake Minnetonka. Specifically, an aging analysis, PIT antennas, and trap netting could be used to better understand carp recruitment in the system. Combined, these methods will provide a greater understanding of the life cycle of carp in the three bays.

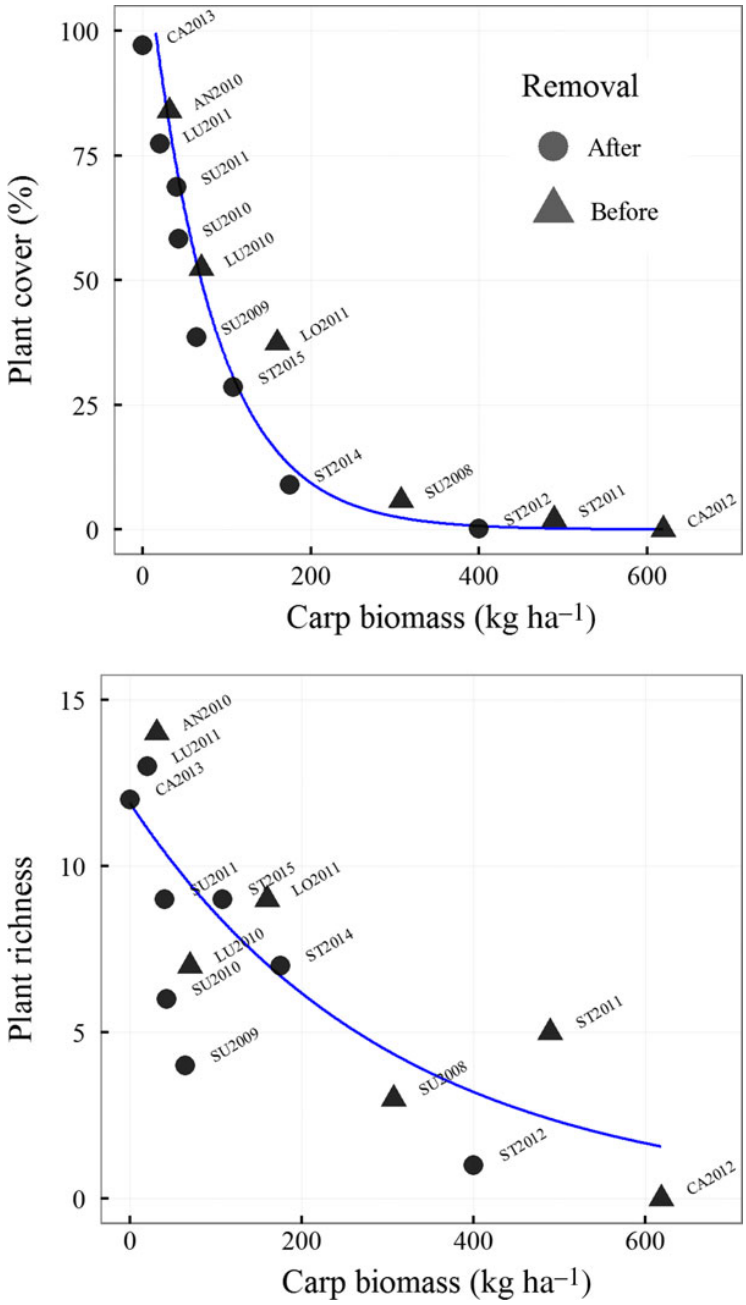

Figure 2. Relationship between common carp biomass and aquatic macrophyte cover in the littoral (top) and plant richness (bottom) in small Minnesota lakes. From Bajer et al. 2016.

Management Recommendations

Due to the high biomass of carp in the three bays, intensive carp management is required. This carp management needs to take the form of both continued information gathering and large scale removals. The primary information that still needs to be gathered concerns reproduction in the system. When carp are not able to successfully reproduce in the main waterbody, they are known to migrate out to spawn in shallow peripheral water bodies that frequently winterkill (Bajer & Sorenson, 2010). Three main methods should be used to do this. First, otoliths should be collected from a sample of carp to determine the age of the carp. This can show the frequency and pattern of reproduction in the system. Second, trap net surveys should be conducted in connected marshes where the carp are suspected to migrate and spawn. These surveys would involve the use of small-mesh trap nets in late summer or fall to collect small fish in shallow water. The objective of these surveys is to sample for the presence of juvenile carp. This will help to identify major nursery sites.Third, PIT antennas should be placed on major creeks feeding into the bays that connect to peripheral water bodies. These antennas would be installed before spring migration begins and removed after the seasonal run has concluded. The data from these PIT antennas shows the seasonal timing and approximate number of carp using different migration routes. If major spawning migration routes are found, barriers should be constructed to restrict their movement from the main lake bays to the spawning areas. Barrier sites can also be used for large-scale removal of migrating carp.

We also recommend a test of removal with baited box nets to manage the adult carp population. These nets (~ 30’ x 60’) are installed in shallow water near shore and baited with cracked corn to lure in the carp. The nets have PIT antennas in the center to understand the timing of feeding aggregations of carp. That information can be tracked in real time and is used to determine the best time to capture the carp. Once the nets are installed, they can remain in the lake during the entire season (late June - September) and rounds of baiting and removal can be repeated approximately every two weeks. Baited box nets are used during summer and fall when carp are actively feeding. Lake residents can take active part in this process by baiting the nets daily and monitoring carp activity.

Citations

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.

Bajer, P. G., & Sorensen, P. W. (2010). Recruitment and abundance of an invasive fish, the common carp, is driven by its propensity to invade and reproduce in basins that experience winter-time hypoxia in interconnected lakes. *Biological Invasions*, *12*(5), 1101-1112.