2022 Hess Lake Carp Management Report
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Summary of Work 2022

In the summer of 2022, Carp Solutions conducted a pilot project to assess the carp population and test baited box nets as a removal technique in Hess Lake. During these efforts, three boat electrofishing surveys were conducted that yielded 129 individuals, as well as two recaptured carp. The catch rates from these surveys produced a population estimate of 32,480 carp and a biomass density estimate of 253 kg/ha. Carp captured during boat electrofishing were tagged with a Passive Integrated Transponder (PIT) tag and released. Later in the season, three box nets were installed in the lake to capture carp with two separate pulls in August and September. Through the box netting removals, a total of 396 carp were collected and removed from the lake. Of these carp, only one had been tagged with a PIT tag earlier in the summer.

Our results suggest that current biomass of carp in the lake (253 kg/ha) exceeds the management threshold of 100 kg/ha by approximately 2.5 times. Future efforts are advised to reduce the carp population.

Boat Electrofishing Survey and Marking of Carp

A boat electrofishing survey was conducted over three days between August 16th and 18th, 2022 in Hess Lake. In the three days of electrofishing, carp were captured, measured, marked with a left pelvic fin clip, tagged with a PIT tag and released. In total, 129 carp were marked and tagged in three days of electrofishing. An additional two carp were recaptured during these surveys, bringing the total number of carp captured to 131. The length distribution of these carp is shown in Figure 1.

For each electrofishing survey a mean catch per unit of effort (CPUE; number of carp captured per one hour of electrofishing time) was calculated (Table 1) along with mean length and weight. These values were then used to estimate carp population abundance and biomass density, using formulas published by Bajer and Sorensen (2012). The overall mean population estimate was 32,480 carp in Hess Lake with a biomass density of 253 kg/ha.

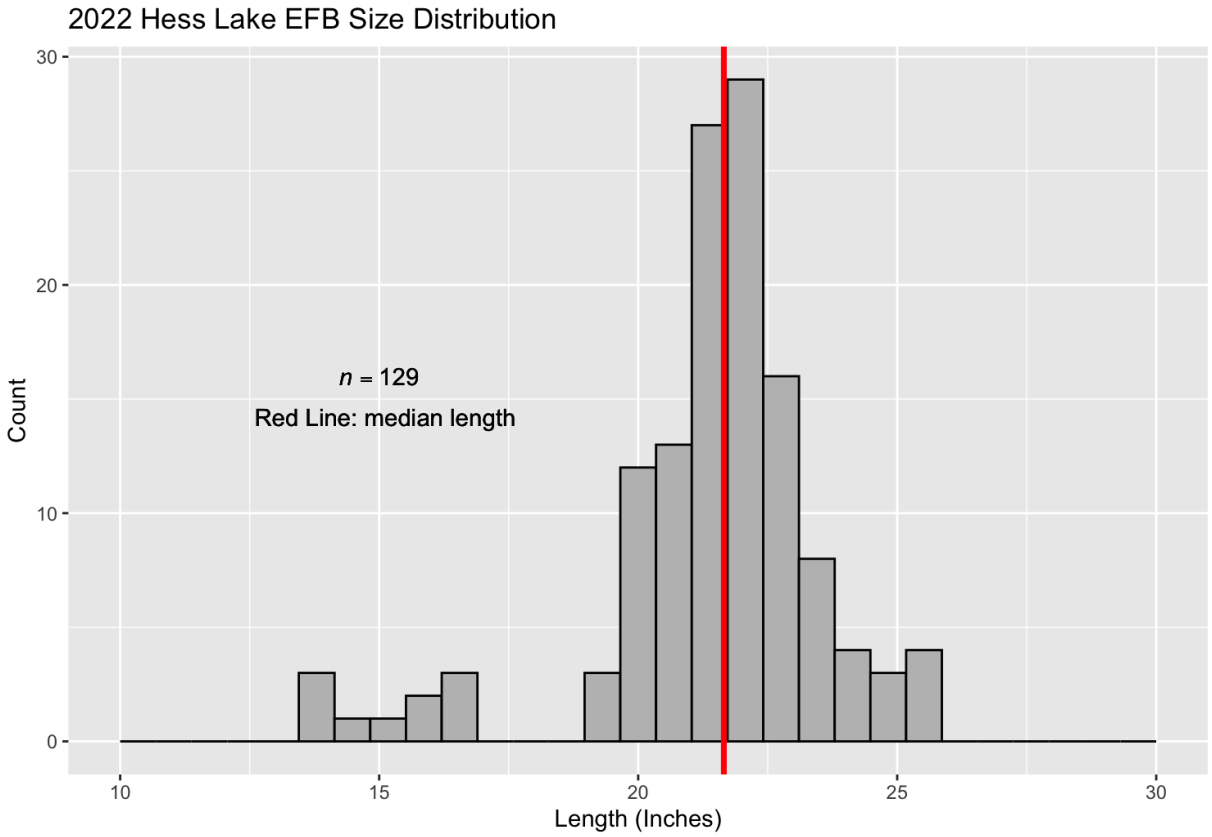

Figure 1: Length distribution of carp captured, marked, and tagged during the boat electrofishing survey. The red line indicates median length.

Table 1: Data for the three boat electrofishing surveys in Hess Lake in 2022. CPUE stands for catch per unit effort, in units of carp captured per hour of electrofishing.

Date	Transects	Catch	CPUE	Avg. Length (inches)	Population estimate	Biomass Density Estimate (kg/ha)
8/16/2022	6	47	24	21.5	34,800	249
8/17/2022	7	48	21	21.6	30,579	221
8/18/2022	5	36	22	21.2	32,061	220
Average	6	43.7	22	22.2	32,480	253
Total	18	131				

Baited Box Nets and PIT Antenna Systems

On August 6, 2022 three 30' by 60' box nets were installed in Hess Lake (See map in Figure 2). These three nets were pulled on August 27th and September 19th. The first pull on 8/27 yielded only 44 carp. Also, bait consumption before the first pull was minimal (see discussion). Following the first pull, two PIT antennas were placed in nets 2 and 3 to better understand peak times of carp activity. Baiting was also extended to 10 days and was conducted by volunteers. This strategy was effective as bait consumption increased to 50 lbs/day (all bait consumed) for several consecutive days before the second pull. Several PIT tagged carp were also detected at the bait each day (Fig. 4; 3-4 tagged carp detected daily). However, bait consumption and presence of tagged carp at the bait declined 24h before the second pull (see discussion below). The second net pull on 9/19 yielded 352 carp, including one PIT tagged carp. Although better than the first pull, it was still below expectations given the high bait consumption during the baiting period. In total, 396 carp were removed across both pulls (Table 2).

Post-removal analysis of the daily data for PIT-tagged carp at the bait showed that prior to the second box netting effort, a total of 7 tagged carp were detected on the bait between September 7 and September 19, 2022 (Fig. 4). One of the seven carp was detected in net 3, while the other six were detected in net 2. Carp appear to have been most active early in the morning, just after sunrise, and then again around noon (Fig. 5), which was unexpected as carp are usually most active at night.

Nets 2 & 3 were more successful than net 1 (Table 2); overall mean catch per net was 66. Of the 94 carp measured during box netting the mean length was 23.2 inches (589 mm), with the vast majority of carp measuring between 22-25 inches (560-650mm) (Figure 3). However, we did observe a small number (~ 5%) of small adult carp, potentially indicating successful carp recruitment event in the system in the last few years.

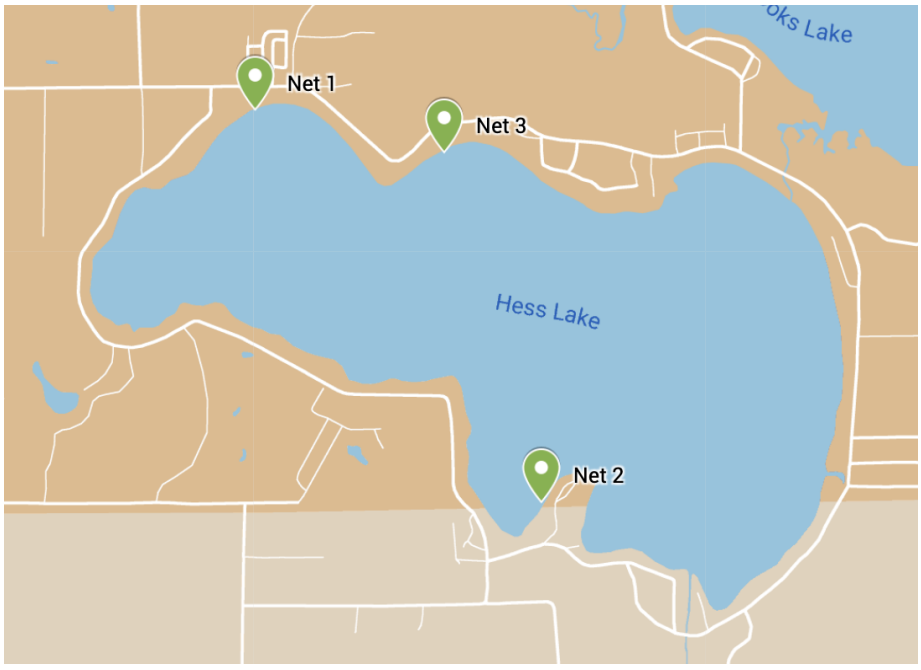

Figure 2: Map displaying the box net locations from the summer of 2022 in Hess Lake.

Table 2: Number of carp caught per net per day.

Site	8/27/2022	9/19/2022	Average	Total
1	3	14	8.5	17
2	32	165	98.5	197
3	9	173	91	182
Average	14.7	117.3		
Total	44	352		396

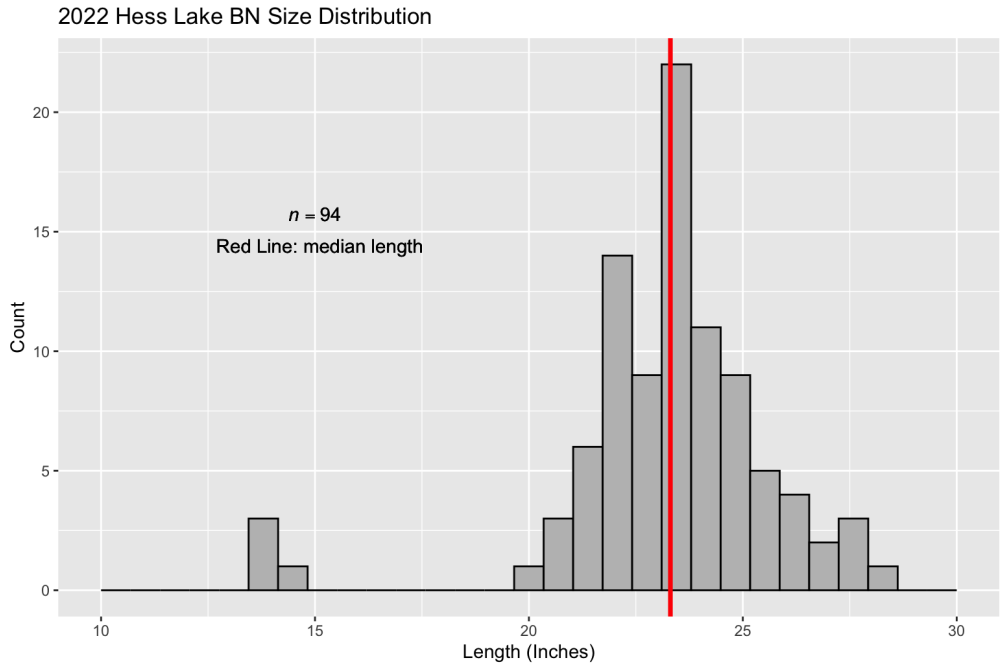

Figure 3: Length distribution of captured carp (n=94). The red line indicates median length = 23.2 inches.

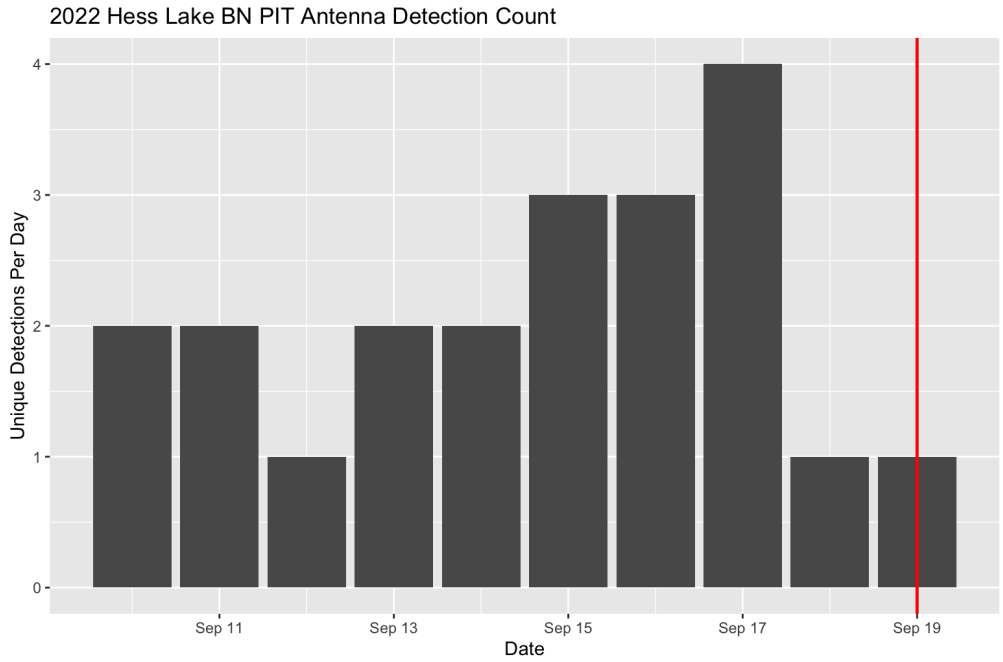

Figure 4: Number of unique PIT tags detected per day at PIT antennas in box nets 2 & 3 at Hess Lake after the PIT antennas were installed on September 9th. The vertical red line indicates the day on which the second box net removal was conducted.

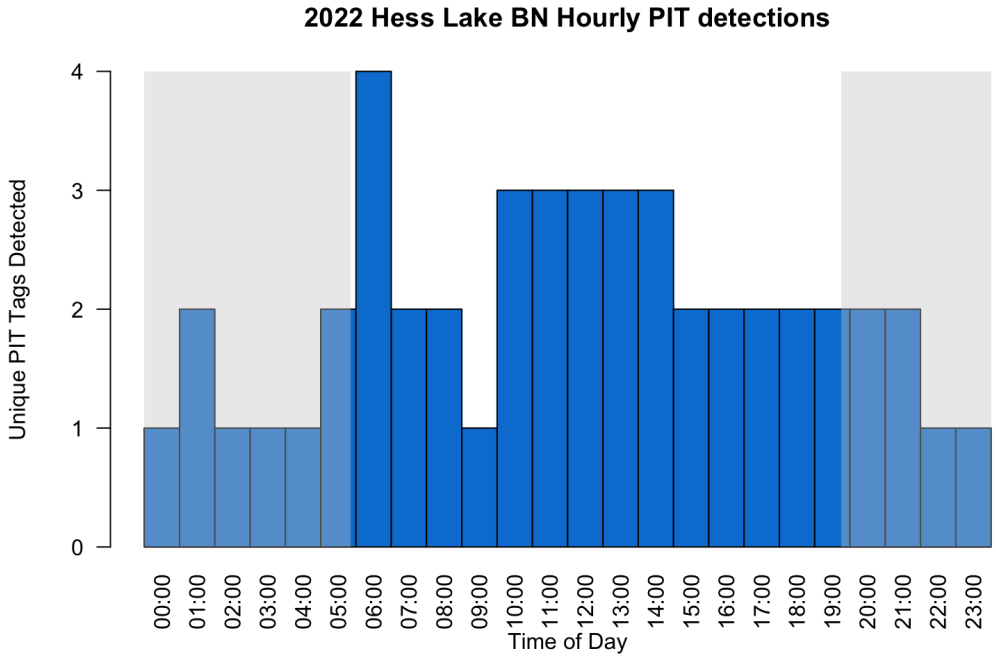

Figure 5: Hourly PIT detections from Hess Lake on the median date between removals. The gray areas indicate hours between sunset and sunrise.

Discussion

The preliminary estimate from boat electrofishing suggests that Hess Lake is inhabited by approximately 32,480 carp with a carp biomass density of approximately 253 kg/ha. In Midwestern lakes, it has been found that a carp biomass of 100 kg/ha or less is acceptable because at such biomass, carp do not cause significant damage to lakes (Bajer et al. 2016). Since carp biomass in Hess Lake is approximately 2.5 folds above that threshold, carp management is recommended. Excluding potential future recruitment (production of young) or migration and assuming that the average size of the carp does not change significantly, approximately 20,000 more carp need to be removed from the lake to reach the 100 kg/ha threshold. Notably, our abundance and biomass estimates were derived from boat electrofishing surveys because not enough carp were recaptured in 2022 to produce an accurate mark/recapture estimate. We recommend that this estimate is verified in the future using a mark-recapture approach, once/if carp removal begins.

The size distribution of carp observed during both electrofishing surveys and box netting was bimodal (see Figure 3). Most carp captured were adults around 22-25 inches. There was also a smaller portion of the population comprised of carp ~ 13-15 inches in length, most likely young adults. This suggests that the majority of carp in Hess Lake may be relatively old, but some carp recruitment likely occurred within the last 5 years as suggested by the presence of smaller carp. In the future, it would be worthwhile to extract otoliths from captured carp to determine their age in order to understand the patterns of reproduction in the system (also see below).

We recommend that an Integrated Pest Management (IPM) concept is applied to manage carp in Hess Lake. As a key element of IPM, it is important to identify and reduce carp reproduction in the system, because successful recruitment could undermine adult removal efforts. Carp recruitment can be complex and may vary across geographic regions. In shallow prairie lakes, carp recruit often in the lakes they inhabit year-round, possibly because such systems have high productivity and low abundance of micropredators, such as bluegills, that forage on carp eggs (Bajer et al. 2015). In lakes of the Eastern Temperate Forest Ecoregion, where Hess Lake is located, carp reproduction typically occurs in peripheral/attached shallow water bodies that frequently winterkill and lack bluegills and other micropredators (Bajer and Sorensen 2010). Carp tend to migrate to these water bodies in large numbers in the spring, often through small streams connecting them to the main lake. Carp reproduction in the main lakes is often very sporadic because of native micropredators. We recommend that carp recruitment history in the system is assessed (through aging analysis) and nurseries in Hess Lake watershed are located. PIT antennas can be used at inlet and outlet streams to track the migration of carp implanted with PIT tags in the main water body. If a large migration is observed, a barrier or behavioral deterrent can be used to block these migrations. These barriers can also be used to remove large numbers of carp during spawning migrations. For example, we often use low-voltage electric carp barriers and submersed conveyors to remove carp during spawning runs. This is often the most cost-effective strategy for removing adult carp and reducing their reproductive success. Similar seasonal barriers can also be used to reduce immigration of carp from other large lakes or rivers. It is not clear if immigration occurs in Hess Lake, but could also be addressed using PIT tags and antennas.

Another important element of the IPM is maintaining high abundances of bluegills in the main lake to control the survival of carp eggs and larvae. This, however, appears to be already occurring in Hess Lake and no additional management is needed.

Once carp reproduction and immigration is controlled, management can focus on the removal of adult carp. In addition to removal during spawning runs (above), the social foraging behavior of carp can be exploited to capture feeding aggregations in box net traps during the summer and fall (Hundt et al. 2022). We tested this removal strategy in 2022. A number of important lessons were learned from this effort:

- There are many locations suitable for box net installations in the lake
- Carp responded positively to bait. Before the first round, consumption of the bait was minimal. The carp likely had not established strong social feeding patterns prior to this pull, and likely needed more time to establish them. In order to do this, they were given more time, with baiting by local residents occurring for ten days prior to the second pull. This strategy was successful and full consumption of provided bait (50 lbs/day) occurred for a few consecutive days. Interestingly, the feeding fell off just before the second pull, possibly due to weekend activity on the lake, which also occurred to a lesser degree after the previous weekend.
- PIT antennas functioned well for detecting carp at the bait. Seven individual carp were detected at the PIT systems in nets 2 and 3. These 7 carp accounted for only 5.4% of the total carp tagged in 2022. This suggested that multiple nets would need to be used to remove a significant portion of the population in the future - see Management Recommendations below.
- The peak of activity at the bait occurred just after sunrise, but several tagged carp were also detected during late morning and early afternoon. Carp feeding aggregations are typically largest at night (Hundt et al. 2022). In Hess lake, however, detections were relatively low at night. This is potentially due to early consumption of the bait during the day. Insights from PIT antenna systems, like those seen in Figure 4, can aid in tripping nets at or near peak times of carp activity within the nets in the future. The data from the PIT antenna systems should be used in the future to guide the timing of carp removal efforts.

Finally, large numbers of adult carp can also be removed in late fall or winter using seining. Common carp tend to aggregate in large groups as water temperatures fall below 5℃ (41℉) (Bajer et al. 2011). These aggregations can be targeted by open water seines in the late fall or early spring or if ice conditions allow, late winter. This method utilizes the “Judas fish” technique, where some carp (~ 20 in lake the size of Hess Lake) are implanted with a radiotelemetry tag. These carp can then be tracked to observe their behavior, especially when they aggregate heavily.The aggregations located in this way can then be netted with a seine net. However, seining may be of limited use if obstacles (large rocks, trees, etc.) are present in areas where carp aggregate as these obstacles can snag the net.

Management Recommendations

Using the lessons learned from carp management in 2022, a few other techniques should be employed to learn about the carp population along with an expansion of removals. In line with the IPM approach, carp reproduction needs to be investigated and if necessary, limited. This would begin by tracking any potential migrations of carp out of the lake to spawn. Since 129 PIT tags were implanted in carp in 2022, this tracking could begin as soon as the spring of 2023. This would be accomplished by the installation of PIT antenna systems at major inlets and/or outlet locations. The main two streams of interest are the outlet towards Brooks Lake and the inlet from Wheeler Drain. If major migrations are observed, a barrier could be constructed as soon as the spring of 2024. This barrier could either be a physical or low voltage electric barrier. Blocking these migrations usually results in the aggregation of the migrating carp at the barrier, which could then be targeted for removal. In many cases spring migration removal efforts are more efficient and effective than box netting or seining, especially as the biomass density is reduced.

With a relatively high population estimate it is likely that carp management would require a multi-year removal plan to bring the biomass density down below the 100 kg/ha threshold. In the summer and fall of 2023 we recommend a relatively large-scale box netting effort along with more boat electrofishing to implant significantly more PIT tags. Since only 7 of the 129 (5.4%) tagged carp were detected at the antennas in the two box nets tested in 2022, more PIT tags would be needed to effectively track the feeding patterns of the carp to guide the removal. Another 300-500 carp would need to be captured and tagged. Box netting would need to include ~8 box nets, 4 PIT antenna systems, and at least 4 pulls per net. Following that, radiotelemetry could also be pursued, tracking carp movements in the late fall to look for aggregations that could potentially be targeted for seining.

In order to further understand the reproduction in the system, a sample of the captured carp should be aged using their otoliths. This would show pulses of reproduction over recent decades, potentially suggest nursery sites, how recently reproduction was occurring, and how long the carp survive in the lake. This would inform both removals and efforts to stop reproduction through blocking migration.

Citations

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