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Report: Determining the abundance and recruitment history of common carp in Shields Lake

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Reporting on results of a population survey for carp management on Shields Lake for the Comfort Lake-Forest Lake Watershed District

Introduction

Shields Lake is located near Forest Lake, MN and is within the Comfort Lake/Forest Lake Watershed District (Figure 1). Shields Lake is hydrologically connected with Forest Lake via an unnamed creek. It has been suspected that Shields Lake might function as a nursery for carp from Forest Lake. Thus, an electrical fish barrier was installed at the mouth to Shields Lake to prevent carp movement between the two lakes. This assessment was conducted to determine the current status of the carp population specifically in Shields Lake and if there is a need for management of the population in the future.

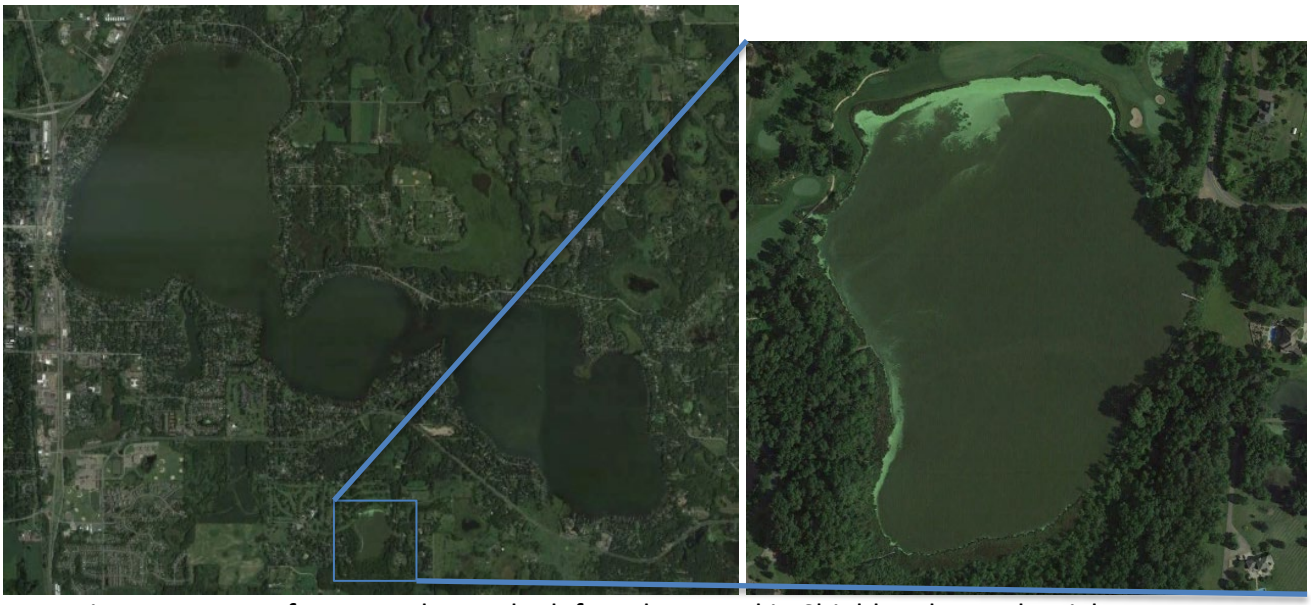

Figure 1: Map of Forest Lake on the left and zoomed in Shields Lake on the right.

Objective 1: Estimate carp abundance and biomass in Shields Lake

Rationale and Methods

Determining the abundance and biomass of carp in the system was needed to assess the severity of the infestation. To do this, Carp Solutions (CS) conducted nine (20-minute pedal time) electrofishing transects over the period of three days (8/28, 8/31, and 9/10) following protocols developed by Bajer and Sorensen (2012).

Results

A total of 62 carp were captured with an average catch per unit effort (CPUE) of 20.7 carp per hour (raw data, Table 1). The length range spanned from 405 mm to 945 mm (Figure 2 and 3). The average mass was 5.9 kilograms (13 pounds) and length of 783 mm (30.8 inches). This translates to a population of about 1,083 carp and a biomass of 529.8 kg/ha (Table 2). This is more than 5 times the desired management threshold of 100 kg/ha (Bajer et al. 2009).

Figure 2: A picture of a large carp captured near a group of trees. Many of the carp captured were in the same area in the lake and were similarly sized.

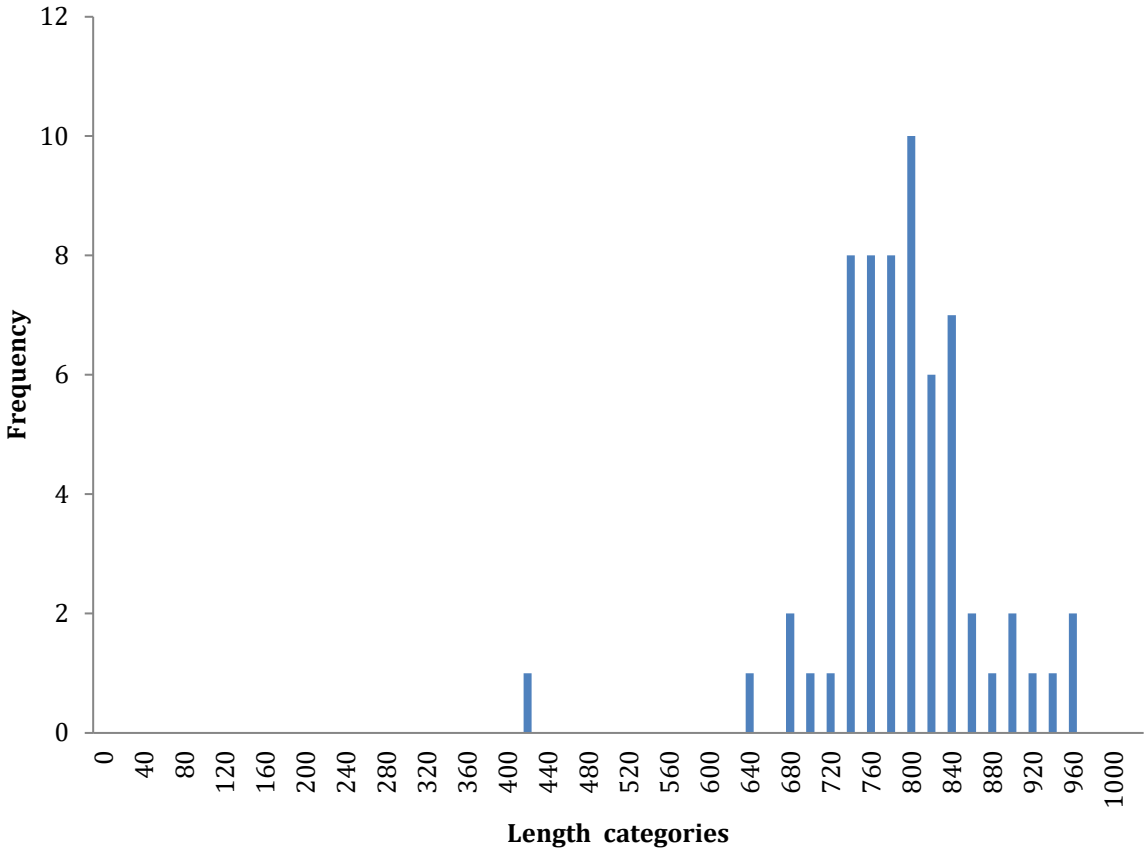

Figure 3: Histogram showing the length structure of carp in Shields Lake.

Table 1: Raw data from electrofishing transects.

Date	Transect #	Minutes	Carp captured	Transect CPUE
8/28/2018	1	20	13	39
8/28/2018	2	20	7	21
8/28/2018	3	20	11	33
8/31/2018	1	20	13	39
8/31/2018	2	20	6	18
8/31/2018	3	20	4	12
9/10/2018	1	20	3	9
9/10/2018	2	20	3	9
9/10/2018	3	20	2	6

Table 2: Summary of carp population and biomass calculations

Lake Area	Ave. Length	Ave. CPUE	Ave. mass	Density	Abundance	Biomass
12.14 ha	783 mm	20.7 carp/hr	5.9 kg	89.2 carp/ha	1083.0	529.8 kg/ha

Objective 2: Age structure analysis

Rationale and Methods

To determine how to control carp populations in a cost-effective manner, it was important to estimate how many carp recruit into the population and how often. In some populations, carp recruit annually, in which case intensive removal efforts are needed on a quasi-annual basis. In most cases, carp recruit only infrequently (once every several years), in which case only sporadic removal is needed (i.e. winter seining or box netting once every several years). Ageing analyses are used to determine the history of recruitment (i.e. production of young during prior years) in a population. Specifically, gaps between year classes are used to determine the frequency with which recruitment spikes occurred in the past. Therefore, recurring years of recruitment along with high biomass would suggest further work be done to manage carp in Shields Lake and the watershed.

CS collected a sample of carp captured in Shields Lake during electrofishing surveys (Objective 1) for ageing analyses. These fish were euthanized and CS removed their otoliths for ageing purposes. The otoliths were then embedded in epoxy, sectioned and aged under a microscope by an experienced reader.

Results

45 carp were euthanized for ageing analyses. Their ages ranged from 3 years old to 36 years old (Figure 4). In summary, 11% were between 3 and 10 years old, 60% were between 11 and 21 years old, and 29% were between 22 and 36 years old. It appears that there has not

been a significant recruitment event in over a decade and suggests the population is relatively stable.

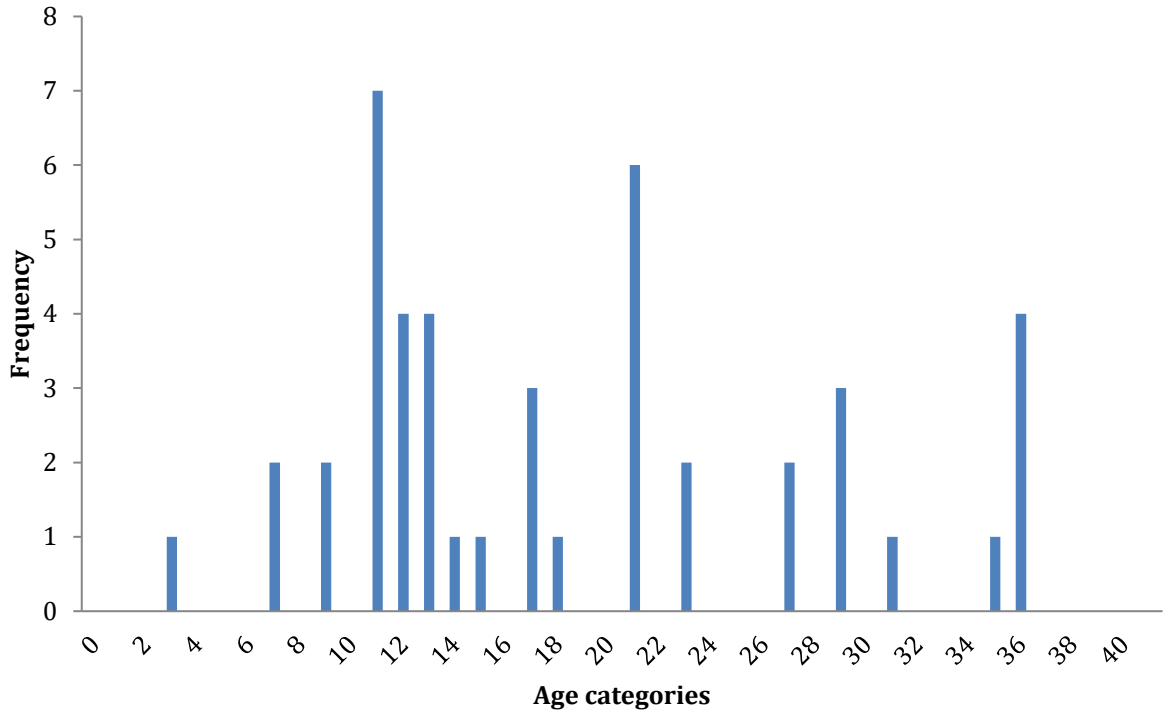

Figure 4: A histogram representing the ages and the age class frequencies of the sample.

Conclusions and management discussion

The results of the electrofishing surveys suggest a very high biomass estimate for Shields Lake (529 kg/ha) with just over 1,000 individuals. It is noteworthy to mention that their distribution was limited and most were captured in a small number of locations where there was lots of submerged debris like tree branches. Once these locations were fished, their capture was fast. Hence, it's possible that our CPUE was abnormally high due to those "easy capture" locations. Ultimately, even if it overestimated the biomass to a degree, it would likely still suggest that the carp biomass exceeds the management threshold. Although it suggests that to reach the carp biomass goal of 100 kg/ha we would only need to remove around 800 carp, that still translates to around 80% of the population, which could prove to be quite difficult. Our baited box nets could help to reduce the population. However, the soft consistency of the sediment may make it quite difficult. We suggest placing corn bait in the lake and monitoring for several days to generally test if these systems would be effective.

Seeing that the Minnesota Department of Natural Resources surveyed the fisheries in the lake found a healthy sustained bluegill population, it is not surprising to see low recruitment in the past decade. It would seem unlikely that the carp population would rebound quickly to removals due to this relatively low recruitment level.

Relatively little is known about the movement of carp in this system. It is likely that at some point, Shields Lake was serving as a carp nursery to the connected Forest Lake. However, it is possible that fish barriers have limited movement of carp between these water bodies in the recent past. To better understand if there is movement into or out of Shields Lake, a sample of carp could be captured and implanted with passive integrated transponder (PIT) tags within Shields Lake as well as Forest Lake. An antenna could be placed at the mouth of the stream connecting to Forest Lake to detect if any of the tagged carp crossed over it. These systems are solar powered and can be rented and maintained by Carp Solutions. This is also an effective way to test the effectiveness of fish barriers.

Literature cited

Bajer, P. G., Sullivan, G., & Sorensen, P. W. (2009). Effects of a rapidly increasing population of common carp on vegetative cover and waterfowl in a recently restored Midwestern shallow lake. *Hydrobiologia*, *632*(1), 235-245.

Bajer, P. G., Chizinski, C. J., & Sorensen, P. W. (2011). Using the Judas technique to locate and remove wintertime aggregations of invasive common carp. *Fisheries Management and Ecology*, *18*(6), 497-505.

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), 817-82.