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2019 Common Carp and Fishery Assessment Report: Silver Lake and Clear Lake

for Sibley Soil and Water Conservation District (Sibley SWCD)

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Introduction

The Sibley Soil and Water Conservation District (SWCD) commissioned WSB to complete an assessment of the common carp population in three lakes within the district in 2018 and 2019. These lakes included Silver Lake and High Island Lake (2018) and Silver Lake and Clear Lake (2019). This project was initiated to assess the potential impact common carp may be having on the water quality and ecological integrity of lakes within the district. In 2018 a report was delivered to the Sibley SWCD with the results from the assessments completed in that year on Silver and High Island. This document provides a full report on results from 2019 sampling period on Silver and Clear Lakes.

Common Carp Management

Although carp management is not the only action to improve water quality, it may be a necessary component of an overall lake management plan. Carp can cause loading of nutrients internally within a basin due to their feeding habits and excretion rates when biomass becomes elevated. An elevated carp biomass threshold value currently used and established by the scientific community is ~90 lbs./acre (Bajer, 2012).

By estimating the population size, resource managers may be able to assess existing carp density against this threshold value to determine if additional carp management is necessary. If future management is required and/or desired, additional components of an integrated pest management (IPM) approach, which may include collection of movement data (radio-telemetry, PIT tag monitoring), physical or chemical removal, and suppression of carp recruitment with the use of barriers to movement, predator species enhancement, habitat restoration, and a component of outreach and education, may be pursued.

Shallow lake basins in the Upper Midwest are prone to low oxygen levels that lead to winterkill events. These basins can support recruitment of young carp because of low predator abundance resulting from such events. Carp commonly use migration routes in the springtime to access shallow lake basins to exploit the absence of predator species to hatch young. Additionally, carp can withstand low dissolved oxygen concentrations and live to exploit basins they overwinter in that also experience winterkill.

Project Area

Sibley County is in central Minnesota approximately 50 miles to the southwest of the Twin Cities Metropolitan Area. The most dominant land use is agriculture while ditches, streams and 39 lakes dot the landscape.

High Island Lake and Silver Lake are the two largest waterbodies in the High Island Creek Watershed (HICW), Sibley County. They are both considered to be hypereutrophic due to high concentrations of nutrients, intense warm weather algal blooms, and limited submerged aquatic vegetation. They were added to the Minnesota Pollution Control Agency 303(d) list of impaired waterbodies in 2018 due to high nutrient concentration. MN DNR fish survey data show that

carp are present in High Island and Silver while 2016 walleye rearing pond checks show that carp are present in Clear Lake; however, an abundance estimate is not provided. This project was completed to develop that abundance estimate and determine if carp may be having an impact on water quality in these three lakes.

High Island Lake is a shallow lake basin and is being managed, in part, as a walleye rearing pond by the MN DNR who have stocked walleye fry in 2009, 2011, 2013, 2014, and 2016, and harvest them for stocking other Minnesota Lakes. Adult crappie (876 adults) were stocked in 2015. High Island Lake was planned to be drawn down in late 2018/early 2019 to upgrade the outlet structure. Intense precipitation events throughout 2019 prevented any work being accomplished on the outlet and any chance at a successful drawdown. Multiple partners including the MN DNR are working towards completing a permanent repair to the outlet structure with plans restore lake levels back to the agreed elevation by the fall of 2020.

Silver lake is a shallow (mean depth = 5 feet, maximum depth= 8 feet) lake basin within the High Island Creek Subwatershed and the Northcentral Hardwood Forests Ecoregion. Roughly 99% of Silver lake is considered littoral area, but there is little aquatic vegetation within the lake. Trophic state index values show that the lake is eutrophic (transparency index), and hypereutrophic using chlorophyll-a and total phosphorous concentration index values. Due to this, the lake was listed as impaired for aquatic recreation based on nutrient impairments in 2016. The 1994 status of the fishery (MN DNR) states that the fishery is limited due to low dissolved oxygen levels that is prone to frequent winterkill. To address this the Silver Lake Sportsmen Club installed a pump and baffle aerator, but the efficacy of this structure is unknown.

Clear Lake is another shallow lake basin with little aquatic vegetation. Trophic state index values show that the lake is hypereutrophic, meaning that nutrient levels are very high, resulting in visibly green water between June and September (MPCA). Clear lake was historically used as a walleye rearing pond by the MN DNR that was last stocked in 2015. The most recent stocking effort was in 2018 with Northern Pike (124), and yearling (8,000) and adult (70) Yellow Perch (MN DNR). There are two boat ramps on Clear Lake, one is a MN DNR public access in the north west portion of the lake while the other is in a Sibley County Park on the east side of the lake. The inlet and outlet to the lake is through a series of ditches that eventually drain to the South Branch of the Rush River. A fish barrier and drawdown structure are located at the outlet of Clear Lake.

Methodology

As part of this project we proposed to use two methodologies to estimate carp population and biomass. The first, and most rapid is to employ an electrofishing catch per unit effort (CPUE) methodology. To do this, a boat electrofisher is used to stun and capture carp and other fish species as it traverses representative habitat types in the lake littoral zones. Time spent electrofishing is recorded, and all carp are captured, measured for length and weight, given a

unique fin clip, and released. The number of carp captured is used as an input into an existing model that provides an estimate on the number of individual carp per acre. Average weights and lake acreage can be used to estimate carp density and overall abundance.

Typical protocol for these surveys is to complete three (3) separate electrofishing CPUE events per waterbody during each season (late summer/early fall). This is done to gain confidence in estimates developed through this method of estimation. To gain further confidence, multiple transects are traversed through different habitat types along the lake's shoreline. Time and catch rate are recorded to report a CPUE index value for native fish species (recorded as relative abundance, while a model developed at the University of Minnesota is used to calculate common carp density (equation 1).

$$\text{Common carp density} = (4.71 * \text{CPUE}) + 3.04$$

Equation 1: Density of carp abundance equation. Density is reported in density/hectare that is then multiplied by the average weight of carp sampled and converted to pounds per acre to report common carp biomass.

The second method is the mark-recapture estimate which takes additional effort but may be more accurate. If a large enough sample is marked and recaptured, this method can be used to confirm estimates developed by the electrofishing CPUE estimate. The typical mark that we utilize is a unique fin clip. Once carp are marked, they are released for eventual recapture. By using the number of recaptured carp, the total number of carp, and the total number captured, we can develop an estimate. This estimate will be used to report if a 95% confidence interval is achieved.

These two methods were completed simultaneously to reduce the amount of effort and cross validate estimates generated by each method.

In 2019, Silver Lake was sampled on two occasions and Clear Lake was sampled on three occasions between September and October. Marks were employed on all captured carp and can be used in future sampling events to determine any potential mixing of the population of carp into neighboring lakes. Using these marks to complete a mark-recapture after the winter of 2019-20 is not recommended since it is unknown if movement out of or into these basins occurs.

In addition to marking and capture, we measured and weighed each captured carp to calculate average weight to be used in the CPUE model. Lengths and weights will also be used to develop a length-weight frequency to understand size structure of the population and to plot size frequency distribution which may be used as a surrogate for aging data to estimate recruitment intervals.

Native fish CPUE was estimated based on catch rate and observations during the electrofishing survey. Fish were counted that were within nettable distance from the boat and the counts are accumulated by year, the CPUE estimate is reported in observation per hour. This data is reported in relative abundance in each lake and is included for both 2018 and 2019 for Silver Lake that was sampled in both of these years and for Clear Lake in 2019.

A fisheries research permit was obtained from the MN DNR in September 2019 that authorized the collection of fish for this project (Appendix A).

Results

Carp Population/Biomass Estimate

Using a boat electrofisher, multiple transects were traversed on Silver Lake and Clear Lake on two to three visits to the lake (Appendix B). Time spent electrofishing, number of carp captured, and length and weight data were collected to be used in a common carp catch per unit effort model. Each transect was averaged to report a daily CPUE and each date was averaged to report a yearly CPUE for each lake and variation between dates is used to calculate a standard deviation (Table 1). The results of the 2019 electrofishing CPUE survey indicate that biomass in both Silver Lake (160 ± 40.8 lbs./acre) and Clear Lake (289.4 ± 174.4 lbs./acre) are above the management threshold of 90 lbs./acre.

Lake	Date (2019)	Event Type	# of Transects/ Total Time (hrs.)	Total # Carp Captured	2019 Fin Clip	CPUE estimate (lbs./ac) By Date	2019 CPUE estimate (lbs./ac)
Silver	9/18	CPUE/Fin Clip	6 / 2.05	112	Right Pelvic	200.9	**160.1 ± 40.8**
	9/27		7 / 2.25	78		119.3	
Clear	9/16	CPUE/Fin Clip	6 / 1.62	169	Left Pelvic	532.9	**289.4 ± 174.4**
	9/25		4 / 1.34	71		201.5	
	10/3		4 / 1.52	53		133.8	

Table 1 – 2019 Sibley County's Silver Lake and Clear Lake Electrofishing CPUE survey data.

Length data collected on captured and observed common carp has been analyzed and used as a surrogate for aging data. In 2019, Silver Lake carp ranged from 2.2 to 25.5 inches and Clear Lake ranged from 3.4 to 27.2 inches. Studies show that carp born in the springtime can grow upwards of 6.3 inches in the first growing season meaning that is likely that in the spring of 2019, carp spawning in both Silver and Clear Lakes resulted in a recruitment of young event. After the first year the growth rate of carp can vary, making predicting age at length difficult. However, a look at the length distribution in both lakes may provide some insight into how often recruitment of young carp occurs (figure 1; figure 2).

In Silver Lake it appears that recruitment happens frequently, and the year classes indicate that recruitment was strong in these years (figure 1). Because carp can grow over 6 inches in the first growing season, it is likely that carp from 3-8 inches are year one carp while carp from 10-15 inches may be in year two to four. As carp get older their growth rate is slower and variable based on several environmental factors, therefore carp over 17 inches are being categorized as greater than four.

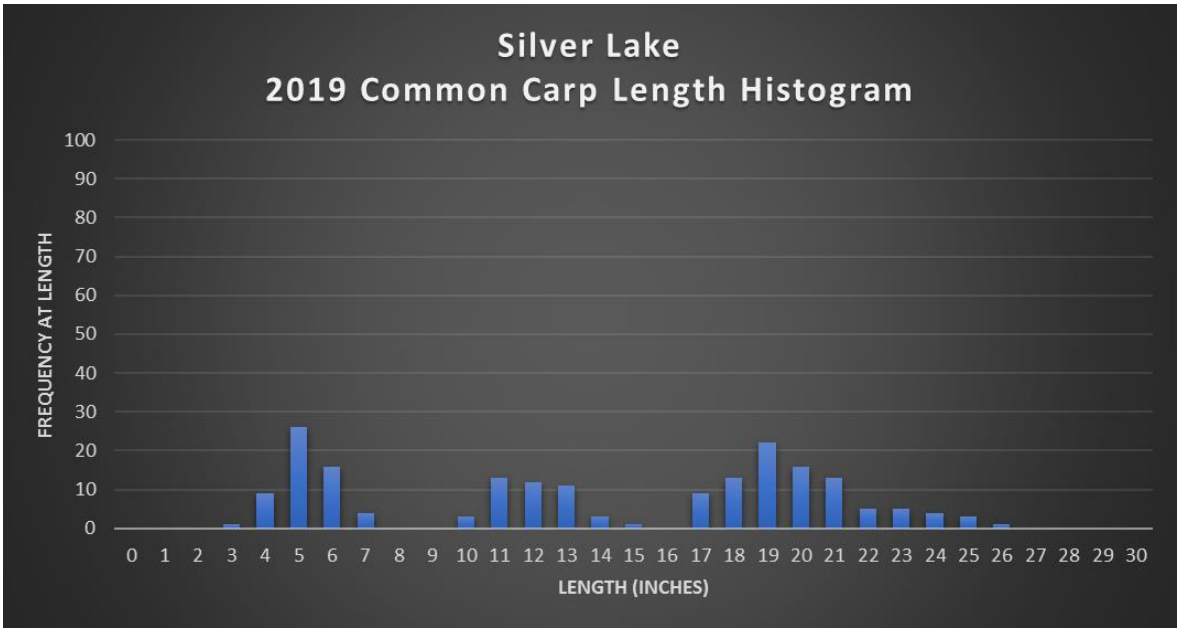

Figure 1: Length histogram of carp captured or observed in Silver Lake via boat electrofishing on September 2019.

In Clear Lake, recruitment events occur slightly less frequently as in Silver Lake and recruitment in some years is not as strong as in others (figure 2). Carp lengths in Clear Lake range from 3.4 to 27.2 inches with the majority of fish between 13 and 20 inches in length where nearly 75% of them are between 14.1 and 17.8 inches. Ages are estimated and assigned to these groups the same way as they are in Silver Lake with the majority over the age of four years. In 2019, a young of year age class is present between 4.1 and 7.8 inches, indicating that carp were hatched in Clear Lake in this year.

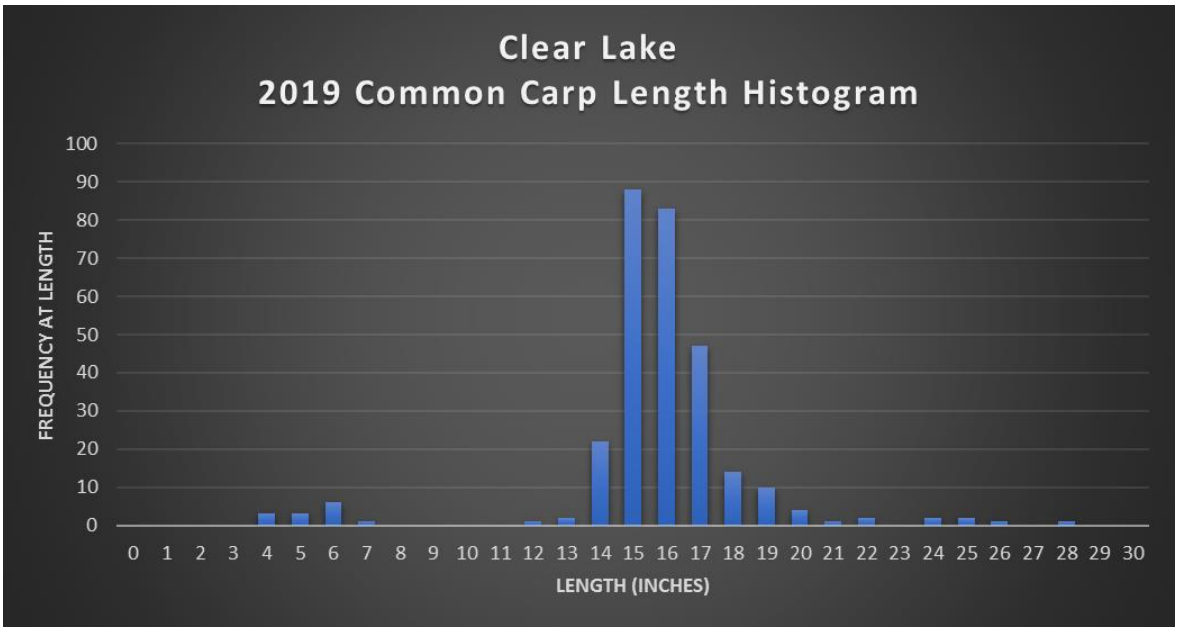

Figure 2: Length histogram of carp captured in Clear Lake via boat electrofishing on September – October 2019.

Native Fish Assemblage and Electrofishing Observations CPUE

Native fish catch rates are included with this report to give managers an opportunity to use data comparisons if carp management actions are pursued in the future. Observations of native fish were estimated on each boat electrofishing survey date and compiled by year, they are reported in observations or catch per hour (table 2). Data was not available for Silver Lake and Clear Lake from the MN DNR historical database for electrofishing, so no comparison is provided. Electrofishing survey protocol in 2018 and 2019 can be followed in future surveys to record a trend in fisheries data over time.

Lake	Fish	Native Fish CPUE 2018	Native Fish CPUE 2019	MN DNR Average CPUE for Lake Class 43 (September EF)[1]
Silver	Black Crappie	2.7	0.8	12.75
Silver	Bluegill/Sunfish	0.5	0	7.36
Silver	Buffalo	0	0	NA
Silver	Bullhead	0.5	80.2	363[2]
Silver	Carp (adult)	7.6	31.4	18.6[3]
Silver	Carp (YOY)	1.1	13.1	NA
Silver	Green Sunfish	0	0.9	2.16
Silver	Minnow	0.5	0	NA
Silver	Walleye	2.7	0	26.9
Silver	White Crappie	0	0.3	71.5[4]
Silver	Yellow Perch	1.1	0	54.76
Clear	Black Crappie	n/a	15.5	12.75
Clear	Bluegill/Sunfish	n/a	4.0	7.36
Clear	Buffalo	n/a	3.2	NA
Clear	Bullhead	n/a	7.5	363[2]
Clear	Carp (adult)	n/a	62.5	18.6[3]
Clear	Carp (YOY)	n/a	2.9	NA
Clear	Green Sunfish	n/a	8.6	2.16
Clear	Minnow	n/a	147.4	NA
Clear	Walleye	n/a	7.6	26.9
Clear	White Crappie	n/a	0	71.5[4]
Clear	Yellow Perch	n/a	6.8	54.76

Table 2: Native fish catch per hour (CPUE) using boat electrofishing comparison for Silver 2018 to 2019 and CPUE in Clear Lake 2019.

1- Averages are calculated using MN DNR fisheries data quired for Lake Class 43, electrofishing gear, and a September survey date.

2- The data range for the average bullhead CPUE includes one (1) survey with a CPUE of 3,250. Standard deviation is 1,082. When this data point is filtered out the average is 2.19 CPUE.

3- The dataset includes one (1) survey that has a value of 142 CPUE. When this data point is filtered out the average is 11.71.

4- There is no specific data for white crappie. Generic “crappie” data was used to calculate this value.

Discussion

Results of the carp electrofishing CPUE model of estimation show that common carp biomass density is elevated in both Silver Lake and Clear Lake in 2019 (figure 3).

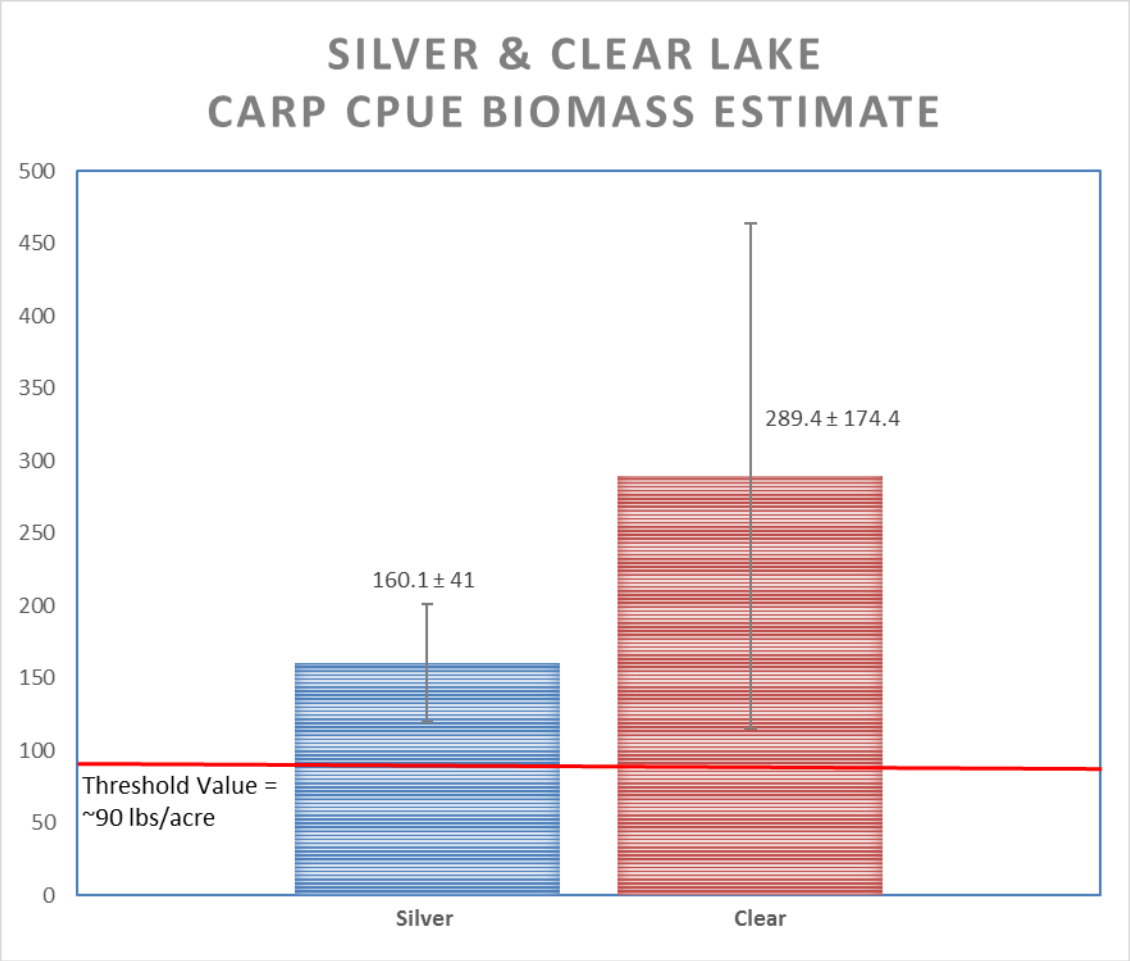

Figure 3: Graphical representation of 2019 CPUE estimate in Silver and Clear Lakes and how it compares to threshold value known to be damaging in a shallow lake system of 90 lbs./acre.

In 2018, survey data resulted in a biomass estimate for Silver Lake to be 27.6 ± 7.0 lbs./acre. However, the timing and low water temperatures during the first and only survey completed as part of this project, may have suppressed the CPUE value for carp and other fish species. The 2019 sampling events were completed to provide additional data points to calibrate the existing estimate. The presence of young carp in 2018 give us confidence in the biomass estimate that is being reported in 2019.

Biomass is elevated in both basins and the observation of young of the year carp suggest that new recruitment has occurred in 2019. A review of the length structure in both basins confirms that this occurs in regular intervals, though the strength of the year classes may vary by year. Efforts to monitor the effectiveness of the aeration system on Silver Lake should be evaluated with periodic dissolved oxygen readings throughout the lake in wintertime. Supporting the survival of native fish species with higher oxygen levels could help to reduce the successful reproduction and recruitment of common carp in the basin. Bluegill sunfish are known to predate upon eggs and larvae of common carp and bass and other predatory fish species are known to predate upon carp fry.

Relative abundance of native gamefish and panfish species in Silver Lake is low when comparing CPUE data from the 2018 and 2019 surveys to average CPUE data for Lake Class 43. Carp are very abundant, especially in the 2019 survey, while bluegill were not recorded in 2019 and only had a CPUE value of 0.5/hour in 2018, well below the average value of 7.36.

Clear Lake, however, does support a robust assemblage of gamefish and panfish, with some species being abundant when comparing 2019 CPUE values to statewide value for Lake Class 43. While the 2019 bluegill CPUE value (4) is below the statewide average (7.36), it falls within between the 50th and 75th percentile values. The 2019 black crappie CPUE value is above the statewide average CPUE. Walleye fall below the average statewide CPUE value for Lake Class 43 electrofishing survey data but fall within the 25th and 50th percentile. Unfortunately, the 2019 carp CPUE value is three times the average statewide CPUE value, showing that carp are very abundant in this basin.

In addition to supporting native fish species, an effort to more fully understand the dynamics of carp life history in these basins could be pursued. Collecting data on carp movement into and out of these basins will aid managers in determining appropriate and relevant management activities which may include: implementation of carp barriers to movement and large scale carp biomass removal through trapping or diverting carp en masse either in stream crossings or in lake when carp aggregate together in late fall or over winter. Carp management often requires a combination of techniques to combat regular recruitment, additional this additional data would be helpful to guide these potential future management decisions.

Management of carp in these basins will help to support the native fish in each basin. Both basins have evidence of a good diversity of native fish species that would thrive with increased suitable habitat. Suitable habitat would include the return of native aquatic vegetation for predator and forage fish cover. The return of rooted native aquatic vegetation would, in-turn, reduce the amount of nutrients available to algae, reducing the severity and frequency of algae blooms. Carp management is not a silver bullet to improving water quality but should be part of an overall strategy to improve water quality. It will still be important to continue to address external sources of nutrients and potentially sequester the release of nutrients from the lake sediments.

References:

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