Electrofishing Estimates of Common Carp in Cedar, Arctic, and Spring Lakes

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Project Background

Common carp are a wide-spread invasive species that cause significant changes to aquatic vegetation, water clarity, and native fish abundance (Bajer and Sorenson 2010; 2012). Common carp have been introduced into many aquatic ecosystems throughout the Midwest and recent research at the University of Minnesota has focused on reducing and controlling populations through various management techniques (Bajer et al. 2011; Bajer et al. 2009). Accurate estimation of carp densities is a critical first step in successfully managing and controlling invasive common carp.

Bajer and Sorenson (2012) recently published a study to validate the use of boat electrofishing to estimate common carp abundance in small Minnesota Lakes. Electrofishing is a preferable means of estimating carp abundance because it actively targets large adult carp and requires less effort than traditional mark-recapture techniques. Electrofishing estimates generally matched estimates from mark-recapture techniques and did not require multiple sampling efforts to recapture marked individuals.

Cedar, Arctic, and Spring Lakes are located in Scott County, MN and are known to have populations of invasive common carp. Cedar Lake (779.5 acres) and Spring Lake (591.9 acres) are similar in size and have a similar diversity of game fish. Cedar Lake (maximum depth of 13 feet) is much shallower compared to Spring Lake (maximum depth of 37 feet), requiring winter aeration to help sustain game fish (MNDNR 2012). The small size (33 acres) and shallow depth (25 feet) of Arctic Lake also suggests that this lake is subject to frequent winterkill, potentially reducing abundance and diversity of game species. All three lakes have impaired water quality due to excessive nutrients, experiencing reduced water clarity and algal blooms in the summer (MNDNR 2012).

Lake Estimates

Cedar, Arctic, and Spring Lakes were surveyed in mid-September, 2014 (Table 1). In each lake, the electrofishing boat was maneuvered in a zig-zag manner near the inshore zone for 20 minute intervals (Figures 1-3). This was completed 5-8 times in each lake to try and cover a minimum of 50% of the shoreline. Catch rates were maximized by targeting preferred carp habitat and actively chasing visible carp. All stunned carp were netted and placed in the boat for counting and removal. On Spring Lake, several boats trailed the shocking boat to net carp surfacing behind the boat, assisting with capture in windy and reduced visibility conditions.

The boat electrofishing unit used by Saint Mary's University's was similar to that used by Bajer and Sorenson (2012), except that the anodes in the front of the SMU boat were single electrodes that were submersed approximately 30 cm deeper in the water. Electrical control settings were identical to those used in the previous study: pulsed DC, 5-12 amps, 20% duty cycle, and 120-pulse frequency.

Densities of adult carp were estimated from the catch per unit effort regression developed by Bajer and Sorenson (Figure 4). Carp densities from Cedar Lake (7.71 carp/ha) were below those reported in the study for other Minnesota Lakes (13-400 carp/ha). Both Arctic Lake (52.91 carp/ha) and Cedar Lake (68.71 carp/ha) estimates were within the range of other Minnesota Lakes and close to the mean carp densities found in the previous study.

A large number of young-of-the-year carp were captured in Arctic Lake, but no young carp were collected in Cedar or Spring Lake. Typical carp spawning behavior maximizes reproduction by targeting small winterkill lakes that lack large predators. A comprehensive control strategy for carp within this system should address the potential for Arctic Lake to produce large numbers of juvenile carp and replenish adults removed from connected systems.

Conclusions

Preliminary estimates of common carp in Cedar, Arctic, and Spring Lake represent a conservative estimate of carp abundance in these lakes. Estimates for Arctic and Spring Lakes are very similar to other study lakes in Minnesota, suggesting that these estimates are reliable and reflect the true population size (Bajer and Sorenson 2012). The Cedar Lake estimate was lower than other study lakes, but was also larger than any other lake previously sampled using this technique. The inability to survey a significant portion of the shoreline and representatively sample concentrations of adult carp represents a potential bias and underestimate of the Cedar Lake population. In the future, repeated surveys or a combination of techniques is recommended for validating initial estimates of carp in these lakes.

Bajer and Sorenson (2012) concluded that electrofishing could accurately estimate carp numbers at low and moderate densities. However, the accuracy of these estimates can be influenced by multiple variables. Bajer and Sorenson identified several potential sources of error in electrofishing estimates that could have affected our study:

1. Carp distribution: Late summer and early fall represent the best time to uniformly sample carp throughout Minnesota lakes. However, daily weather and temperature changes can significantly affect carp distribution in near shore areas and bias sampling results.
2. Non-uniform habitat conditions: Carp tend to concentrate near areas of vegetation and woody structure. We observed that carp were not uniformly distributed around the shoreline, but aggregated in patches. Failure to representatively sample the shoreline habitat (patches with and without carp) can result in biased estimates.
3. Lake size: Lake sizes in the Bajer and Sorenson (2012) study ranged from 81.5-375.6 acres, placing both Cedar Lake (779.5 acres) and Spring Lake (591.85 acres) outside of

the range studied. Larger lakes potentially reduce the efficiency of carp capture and could lead to an underestimate of carp abundance, as likely observed in Cedar Lake.

4. Migration: The presence of inflows and outflows into Cedar, Arctic, and Spring Lakes mean that these populations do not represent a closed or single population of carp. Annual and seasonal carp abundance can increase significantly due to immigration from winter-kill lakes (similar to Arctic Lake) that provide plentiful spawning habitat and lack large numbers of predators (Bajer and Sorenson 2009).

These initial estimates are a starting point for determining the management steps needed to minimize ecological damage caused by invasive common carp. Carp densities of ~100 kg/ha has been suggested as a minimal threshold for managing carp densities in Minnesota Lakes (Bajer et al. 2009). Based on estimates of carp numbers and average adult carp sizes of 5 kg, Arctic Lake (264.5 kg/ha) and Spring Lakes (343.5 kg/ha) likely exceed this threshold and could see significant ecological improvement with active carp removal and long-term management.

Acknowledgments

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Table 1. Summary of electrofishing results from Cedar, Arctic, and Spring Lakes

Lake	Date Sampled	Transect Number	Total Effort (min)	Number Adults	Number YOY	Adult CPUE (Carp/hr)	Adult Carp Estimate (Carp/ha)	Adult Carp Estimate (Carp/acre)
Cedar	9/12/14	6	121	2	0	0.99	7.71	3.12
Arctic	9/13/14	5	102	18	411	10.59	52.91	21.41
Spring	9/14/14	8	142	33	0	13.94	68.71	27.81

Figure 1. Map showing length of shoreline surveyed in Cedar Lake and number of carp caught in each transect.

Figure 2. Map showing length of shoreline surveyed in Arctic Lake and number of carp caught in each transect.

Figure 3. Map showing length of shoreline surveyed in Spring Lake and number of carp caught in each transect.

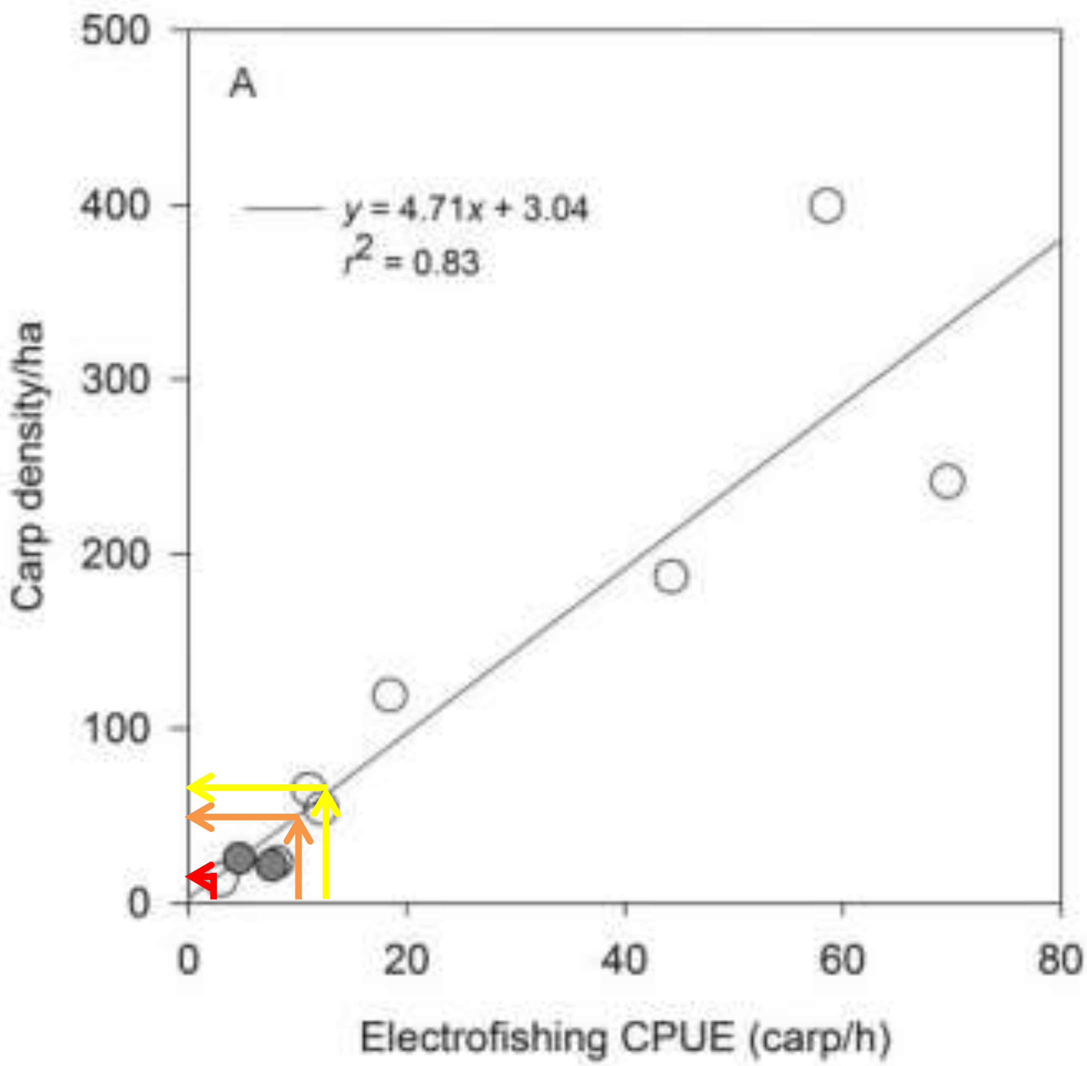

Figure 4. Estimate of common carp density in Cedar Lake (Red), Arctic Lake (Orange), and Spring Lake (Yellow) in relation to the eight other Minnesota Lakes. Figure modified from Bajer and Sorenson (2012).