Lake Carmi Walleye Management
District 4

Vermont Fish and Wildlife Department
Annual Report

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Summary

A fall nighttime electrofishing survey was conducted on Lake Carmi to monitor the Walleye population and fish community. The catch rate, size, and age structure of Walleye were analyzed and the length distribution of Yellow Perch was compared to historical distributions. Alewife were sampled using a floating micro-mesh gillnet to assess relative abundance and length distribution.

Introduction

Lake Carmi in Franklin County, Vermont has a robust, self-sustaining Walleye *Sander vitreus* population that supports a popular fishery. From 1996 through 2004, the Walleye fishery was regulated with an open season from the first Saturday in May through March 15th; a minimum total length of 381 mm (15 inches) with a 432 to 508 mm (17 to 20 inches) protected slot; and a creel limit of five fish per day. These regulations were designed to allow harvest of the abundant smaller Walleyes while protecting the majority of the spawning stock and allow more Walleyes to reach quality sizes. In 2005, the protected slot was reduced to 432 to 483 mm (17-19 inches) while the creel limit remained at five per day, but with only one Walleye greater than 483 mm (19 inches). The change was made with the goal to allow further growth of the segment of quality-sized Walleyes in the population.

In 2018, Lake Carmi was the first lake in Vermont to be designated a “lake in crisis” by the Agency of Natural Resources following many years of large cyanobacteria blooms. This designation provided a mechanism to set in motion a state response plan which included the installation of a whole-lake aeration system in 2019 (Lake Carmi Crisis Response Plan 2018). The system was designed to prevent anoxic conditions at the water-sediment interface thereby preventing phosphorus bound in the sediment from being released into the water column. Although startup of the aeration system is delayed as late into the spring as possible, it is

unknown whether the altered water currents will affect the recruitment success of Walleye or other spring spawning fish species.

In December 2017, Alewife *Alosa pseudoharengus* were confirmed in Lake Carmi following a large die-off of approximately 3,000 fish (Good 2018). Multiple size classes were present indicating the population was likely present for many years and reproducing. However, Alewife had not previously been detected during annual fall nighttime boat electroshocking Walleye surveys and have only been sporadically detected during these surveys in subsequent years, resulting in a lack of information about the population. Floating micro-mesh gillnets were set during one sampling event in 2020 and many Alewife were captured across multiple age classes (Simard 2021). Subsequently, in late-November and early-December 2020, another large Alewife die-off was reported (Simard 2021).

The objectives of this study are 1) to monitor the Lake Carmi Walleye population response to the current harvest regulation, whole-lake aeration system, and establishment of Alewife, 2) to monitor trends in the Lake Carmi fish community with a specific focus on Yellow Perch *Perca flavescens* due to its popularity among anglers, and 3) sample for Alewife to establish basic information about the population in Lake Carmi.

Methods

A shoreline boat electrofishing fish community survey using pulsed DC current was conducted on the nights of October 19th and 20th, 2021. All eight standardized and georeferenced shoreline transects were surveyed (Table 1, Figure 1). Walleye, Largemouth Bass *Micropterus salmoides*, Smallmouth Bass *Micropterus dolomieu*, Northern Pike *Esox lucius*, and Black Crappie *Pomoxis nigromaculatus* were targeted during all transects. A sample of all other species were collected during the first 15 minutes of electroshocking on transects 3 and 6.

All fish collected were measured for total length (TL), and released. All game fish species noted above were weighed prior to being released. Based on past sampling, Walleye less than 254 mm (10 inches) were assumed to be age-0. The second dorsal spine was removed from all Walleye greater than 254 mm in length for age estimation. Walleye spines were cleaned in bleach, mounted in epoxy resin, and cross sectioned into typically five sections using an Isomet saw (1.605 mm thick). All five sections were mounted onto a single glass slide using Cytoseal 280 and then labeled with the sample information. Mineral oil was placed on each cross section before examining with a compound microscope. Two readers independently examined each slide to estimate the age of the fish in whole year increments. If there was disagreement between the two age estimates, a third reader would examine the slide. If two of the three readers agreed, that age estimate was recorded. If there was not 2/3 consensus but the three estimates were consecutive (e.g., 6 yrs, 7 yrs, 8yrs) the mean value was recorded. Ages were not recorded for samples with more disparate age estimates among the three readers.

Catch per Unit Effort (CPUE) expressed as number of fish caught per hour was calculated for all Walleye collected, as well as for subsets of those estimated to be age-0, those estimated to be age-1, those between 381 mm and 432 mm (15 in – 17 in, the harvestable size below the current slot limit), and for those over 483 mm (19 in, the harvestable size above the

current slot limit). The CPUE of other sportfish targeted during the first round of sampling was also calculated.

A floating micro-mesh gillnet was deployed in the northeast portion of Lake Carmi to sample for Alewife during both sample events. The net measures 6 m deep by 21 m in length with seven panels of mesh sizes including 6.24, 8, 10, 12, 15, 18, and 25 mm. Nets were set in approximately 7 m of water prior to starting electrofishing sampling on both October 19 and October 20. Due to boat malfunctions, the first net set was retrieved the morning of October 20 while the second net set was retrieved immediately after electrofishing sampling was completed. Fish were picked from the nets within a day of retrieval and the total length of all collected fish was measured. Catch-per-unit effort was calculated as the number of Alewife caught per 4-hour net set.

The length distribution of Yellow Perch collected was compared with values from perch collected during sampling at the same stations (3 and 6) since 2011.

Results

A total of 262 Walleye were collected in 3.92 hours of electrofishing (Tables 1 and 2). Water temperature averaged 16.0°C across the two sampling days (Table 1). Walleye lengths ranged from 175 – 676 mm (6.9 – 26.6 in). The catch was dominated by young-of-year walleye with total lengths between 175 mm to 246 mm composing 53.8% of the total catch (Figures 2, 3). Walleye from 10 other age classes ranging from age-2 to age-11 were also captured (Figure 3). Total Walleye CPUE was 66.84 Walleye per hour (Table 2, Figure 4), the highest level observed since 2006. CPUE of Walleye over 483 mm (19 in) was 9.95 Walleye per hour (Table 2), the highest level observed since routine sampling began in 1996 (Figure 5).

A total of 367 Yellow Perch were collected with lengths ranging from 56 - 286 mm with approximately 53% of the fish collected less than 175 mm (Figure 6). Fifty-six young-of-year Yellow Perch collected were not measured. The length range of captured Yellow Perch was relatively similar to previously sampled years although the maximum length observed was slightly shorter than typically observed (Figure 7). A total of 165 Smallmouth Bass, 66 Largemouth Bass, 41 Northern Pike, and 4 Black Crappie were collected (Table 3). Other species captured included Golden Shiner *Notemigonus chrysoleuca*, White Sucker *Catostomus commersonii,* Brown Bullhead *Ameiurus nebulosus*, Rock Bass *Ambloplites rupestris*, Pumpkinseed *Lepomis gibbosus,* and Creek Chub *Semotilus atromaculatus,* and an unidentified Cyprinid.

The floating micro-mesh gillnets were set for a total of 22.23 hours. A total of 155 Yellow Perch, 12 Golden Shiner, and one Black Crappie were captured. No Alewife were captured in the nets for a gillnet CPUE of 0.00 Alewife per four-hour gillnet set.

Discussion

Walleye catch rates on Lake Carmi in the fall of 2022 were very high with the overall catch rate the highest observed since 2006 and the catch rate of Walleye above the slot limit the

highest observed since annual fall shoreline electrofishing began in 1996. High catch rates appear to be transferring to the fishery as well with many anglers anecdotally reporting high-quality fishing over the past year, especially for larger fish above the slot limit. These reports and data indicate that the slot limit as currently implemented has been effective at achieving its purpose of allowing more Walleye to reach a quality size. Given the reduced limit for Walleye over 483 mm (19 in), these large fish should remain abundant and be observed in sampling events over the next several years. However, anglers also regularly comment that it has been challenging to fill a bag limit as they have caught very few legal-sized fish below the slot limit. Our data supports these comments as relatively few 381-432 mm (15-17 in) Walleye were observed during this survey.

A very robust age-0 year class of Walleye was also observed in 2021, the first successful year class since 2018. Robust year classes of Walleye typically occur every two or three years, although interestingly, these last two strong year class have both occurred following large die-offs of Alewife at the start of the previous winter. Alewife have the potential to significantly affect Walleye recruitment success. For example, in Saginaw Bay, Lake Huron, Alewife abundance is the dominant factor predicting production of wild age-0 Walleye with low Alewife abundance a prerequisite for a strong Walleye year class (Fielder et al. 2007). The complete absence of Alewife in the floating gillnets in 2021 suggests that a large proportion of the population likely died during the 2021 die-off limiting their ability to potentially predate larval Walleye. Floating micromesh gillnets should continue to be used to monitor trends in Alewife populations as they rebound from this last die-off to better understand the relationship between Walleye recruitment success and Alewife abundance in Lake Carmi.

The whole-lake aeration system in Lake Carmi was activated on May 19, 2021, several weeks earlier than in 2020 due to a warm spring that quicky warmed water temperatures and decreased oxygen levels within the lower portion of the water column. However, despite this early activation, a robust Walleye year class still recruited to the population. It is likely that the timing of Walleye spawning, which is also water temperature dependent, responded similarly and occurred earlier in the spring, possibly limiting any effects of the early activation of the aeration system. While this single year does not alone prove the aeration system does not have an impact on Walleye recruitment success, it does seem to indicate that the water quality metrics at which the system is activated and were agreed to by VFWD and the Department of Environmental Conservation may be appropriate to not harm larval Walleye as they hatch and develop.

The maximum length of Yellow Perch observed during sampling increased slightly relative to 2020, but still remained low relative to many other surveys conducted over the previous 10 years. The lack of Yellow Perch in larger size classes could be an indication the size structure of the population is being affected by harvest or other environmental factors. The current sampling methodology only provides a general overview of the population and alone is unable to provide details on what changes may be occurring within the population. However, this sampling could be expanded to collect a subset of fish whose ages could then be estimated from different length classes. Growth and length-at-age data could then be determined and compared to historical data when age information was also collected (e.g., Anderson 1977) to determine whether a shift has occurred in the population over this period.

Conclusions

The Lake Carmi Walleye population continues to provide a high-quality fishery for anglers with abundant large fish. Catch-rates of Walleye above the slot-limit (483 mm) were the highest observed since annual fall shoreline electrofishing began in 1996. A very strong age-0 year class was also present which should begin to recruit to the fishery in coming years. Sampling with a micro-mesh floating gillnet did not capture any Alewife indicating the Alewife die-off observed in late 2020 dramatically reduced the population in Lake Carmi. This reduction likely allowed such a strong Walleye year-class to survive and recruit to the population.

Recommendations

1. Continue monitoring the Lake Carmi Walleye population to track trends over time, especially in response to the fluctuation in Alewife populations and the continued use of the whole-lake aeration system.
2. Continue to sample Alewife in Lake Carmi using floating micro-mesh gillnets to track the relative abundance and size distribution of the species over time.
3. Continue collecting a subset of all species at stations 3 and 6 while sampling for Walleye to monitor the overall fish community in Lake Carmi. Consider collecting age-structures from a subsample of these fish, especially Yellow Perch, to evaluate growth and length-at-age data of the species.

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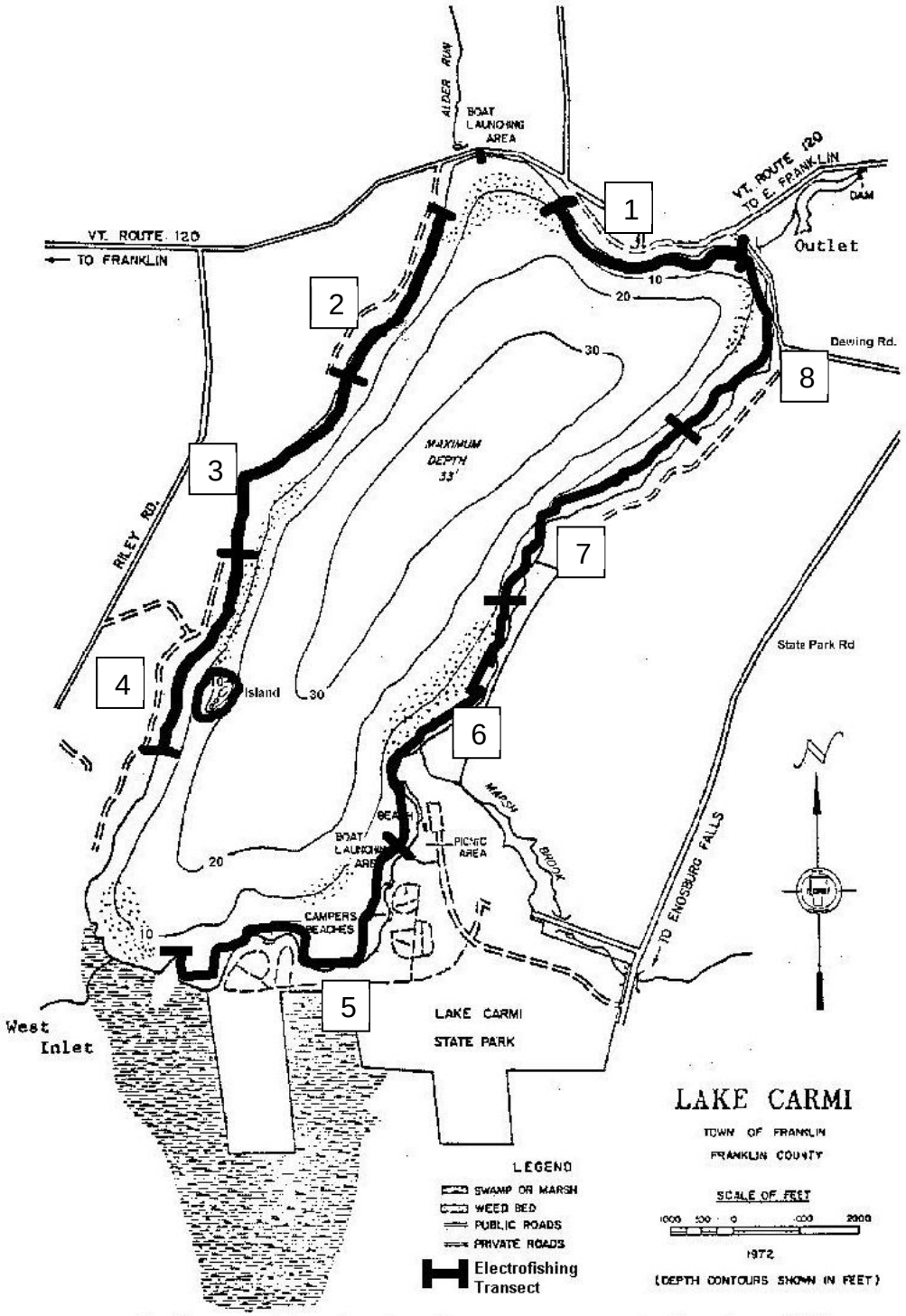

Figure 1. Locations of eight shoreline electrofishing transects on Lake Carmi typically sampled during the fall surveys.

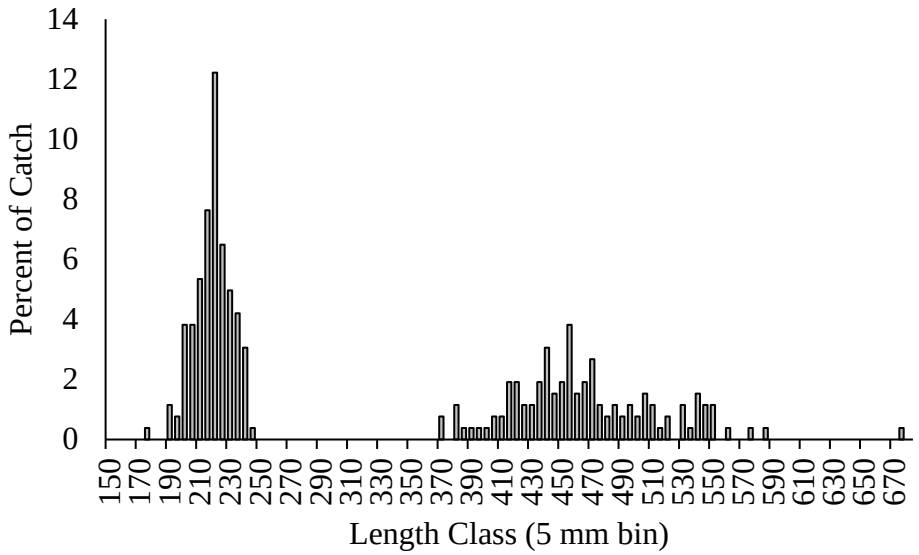

Figure 2. Relative length-frequency of Walleye captured during fall nighttime boat electroshocking on Lake Carmi on October 19 and October 20, 2021.

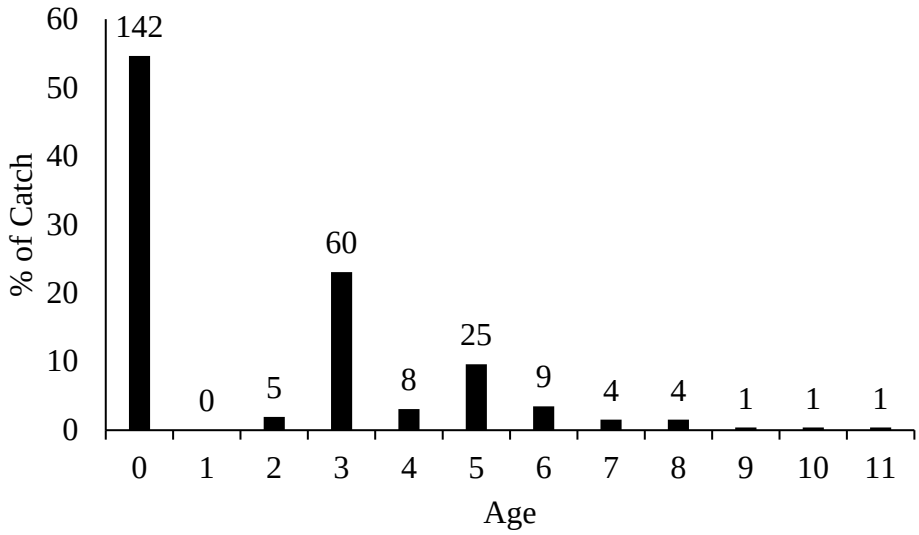

Figure 3. Relative age-frequency distribution of Walleye captured during fall nighttime boat electroshocking on Lake Carmi on October 19 and 20, 2021. Numbers above each bar indicate the count of Walleye within the given age bin. Walleye less than 254 mm were assumed to be age-0 based on length and were not aged with spines.

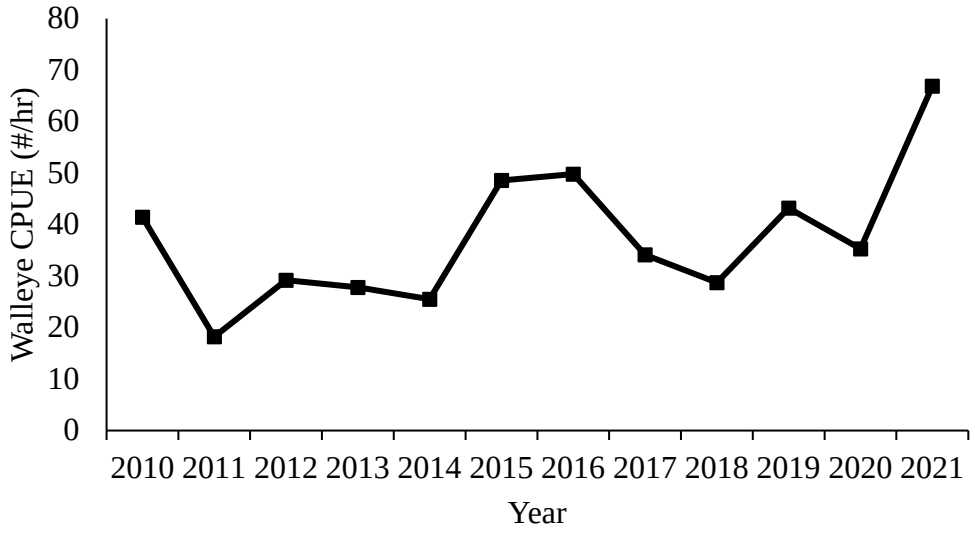

Figure 4. CPUE (number / hour) of Walleye collected during fall nighttime boat electroshocking on Lake Carmi from 2010 to 2021.

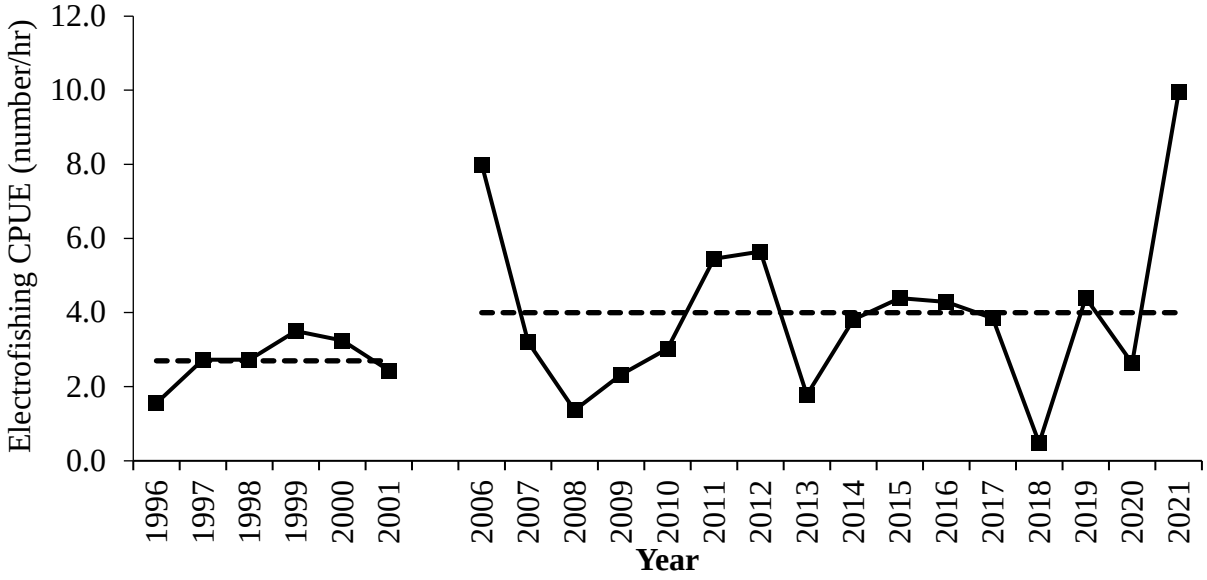

Figure 5. CPUE (number/hour) of Walleye over 483 mm (19 in) captured by fall nighttime boat electroshocking on Lake Carmi over time. Values are shown relative to the average CPUE calculated for the period before and after the Walleye slot limit was adjusted in 2005.

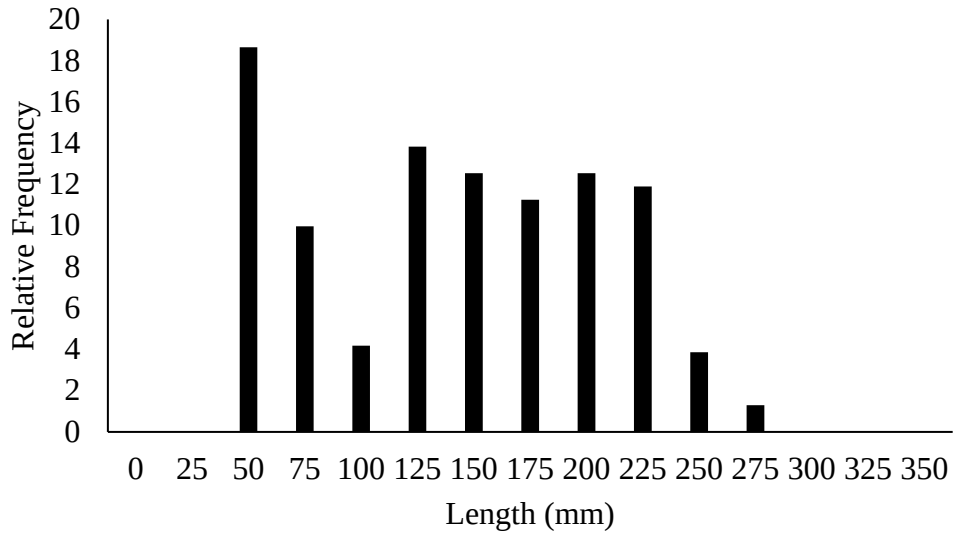

Figure 6. Relative length-frequency of yellow perch (n = 311) collected during the first 15 minutes of nighttime boat electroshocking in stations 3 and 6 on Lake Carmi, October 19 and 20, 2021.

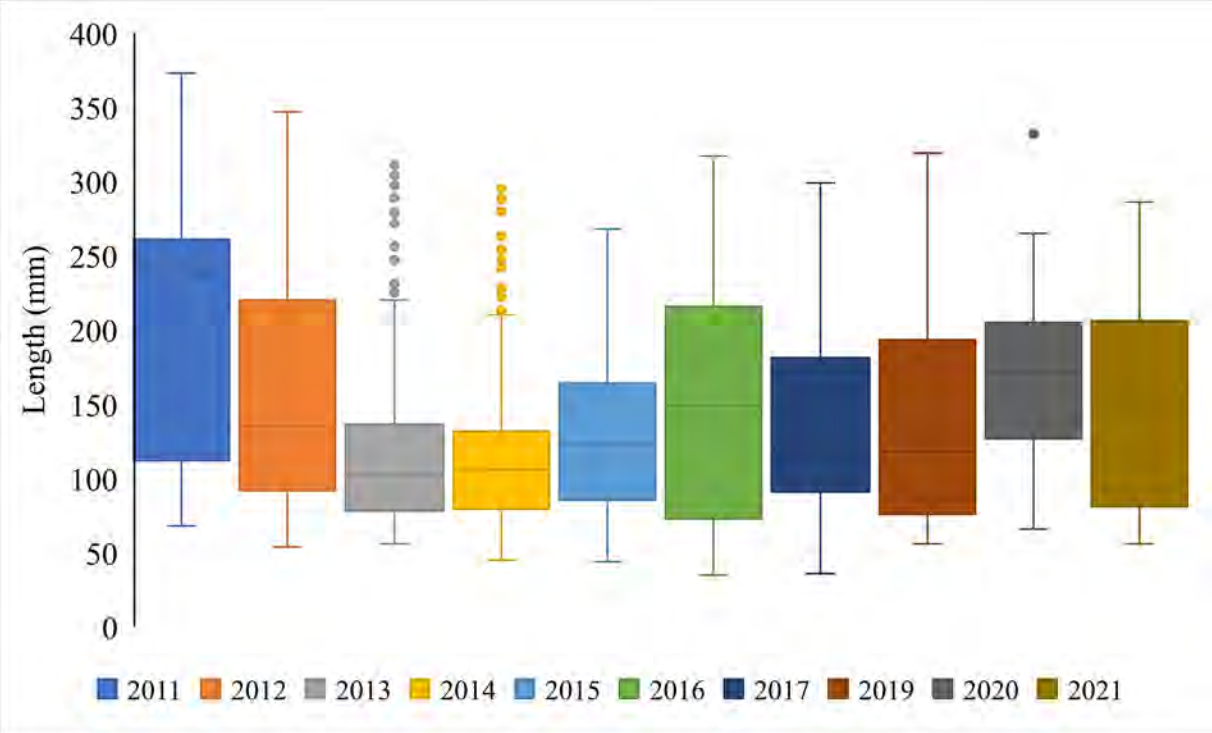

Figure 7. Total length distribution of Yellow Perch collected during fall nighttime boat electroshocking on Lake Carmi at stations 3 and 6 over time. Station 6 was not sampled in 2012.

Table 1. Lake Carmi nighttime boat electroshocking transects surveyed in 2021. Transect numbers refer to Figure 1. A representative subset of all species encountered were collected for the first 15 minutes of sampling on transects marked with an asterisk (*).

Date	Transects Surveyed	Species Targeted	Average surface Water Temperature (°C)	Hours Sampled
Oct 19	1, 2, 3*	WAL, LMB, SMB, NRP, BLC	15.6	1.51
Oct 20	4, 5, 6*, 7, 8	WAL, LMB, SMB, NRP, BLC	16.3	2.41
			16.0	*3.92*

Table 2. Number and CPUE (number per hour) of Walleye in various size and age classes captured during 3.92 hours of nighttime boat electroshocking on Lake Carmi, October 19 and 20, 2021.

Age or Size Range	N	CPUE
All	262	66.84
~Age 0	142	36.22
~Age 1	0	0.00
381-432 mm (15-17 in)	26	6.63
>= 483 mm (19 in)	39	9.95

Table 3. Number and CPUE of other sportfish targeted during 3.92 hours of nighttime boat electroshocking on Lake Carmi, October 19 and 20, 2021.

Species	Number	CPUE (#/hr)
Smallmouth Bass	165	42.1
Largemouth Bass	66	16.8
Northern Pike	41	10.5
Black Crappie	4	1.0