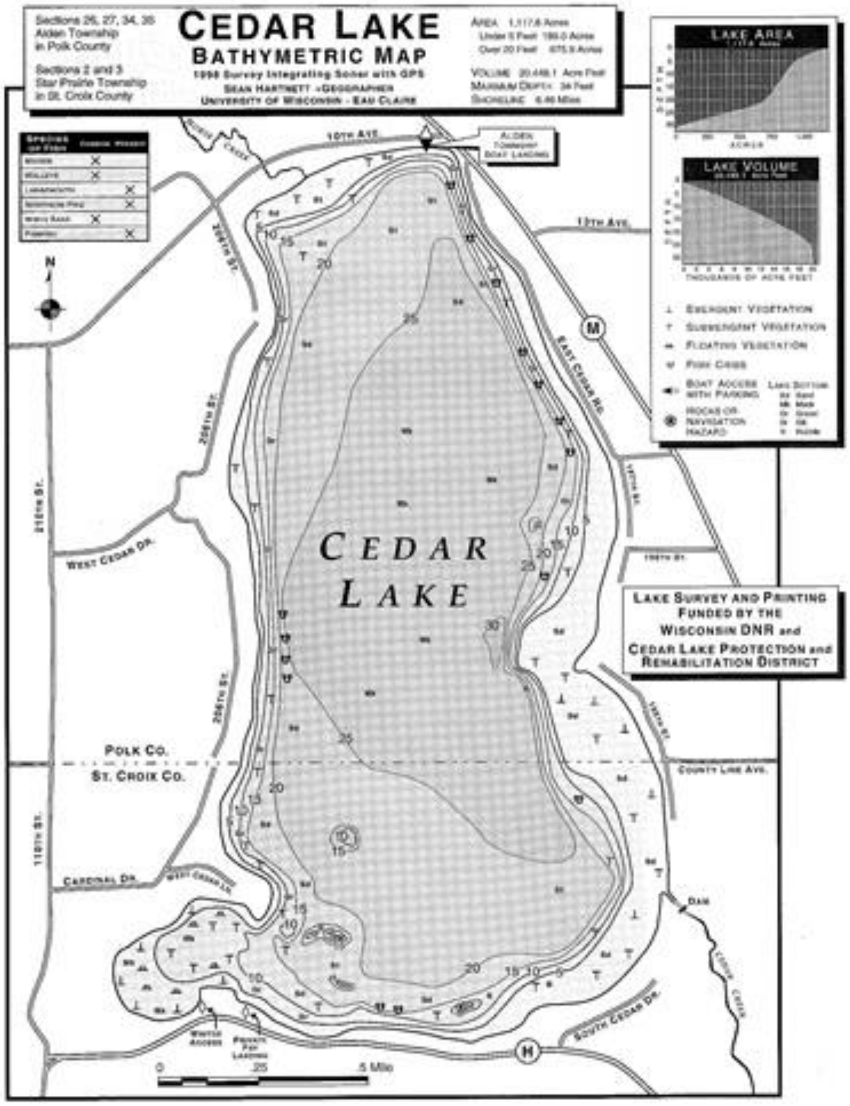
WISCONSIN DEPARTMENT OF NATURAL RESOURCES

Fisheries Survey Report for Cedar Lake, Polk and St. Croix County, Wisconsin 2021

WATERBODY IDENTIFICATION CODE 2615100



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March 2023

Introduction

Cedar Lake is an 1,107 acre eutrophic drainage lake located on the St. Croix and Polk County line approximately 7 miles north of New Richmond. The lake has a maximum depth of 38 feet and 6.4 miles of shoreline. Water levels are subject to artificial fluctuation by manipulation of a low head dam at the south end of the lake. There are two public accesses located on the lake. The south access lane is open only in winter to drive-on traffic. The northeast public boat landing consists of a single ramp with overflow parking available across 10th Avenue in the old Cedar Lake Schoolhouse parking lot. Cedar Lake is a “Trend Lake” and is surveyed on a four-year rotation. Cedar Lake lies within the Ceded Territory and is a popular destination for both hook-and-line and Ojibwe Spring Fishing. Aquatic invasive species include curly-leaf pondweed (*Potamogeton crispus*), Chinese mystery snail (*Cipangopaludina chinensis*) and rusty crayfish (*Orenetes rusticus*). Alum treatments have been implemented by the lake district since 2017 in an effort to improve water quality. A total of 400 fish cribs have been installed in the lake from 2004 to 2014.

The lake is classified as a Complex Warm Dark lake in Wisconsin’s lakes classification system in order to compare lakes with similar lakes in terms of trophic status, thermal regime and fish community. Historically, Cedar Lake consisted of a simpler fish community in the early 20th century, which was composed of Cisco *Coregonus artedi*, White Bass *Morone chrysops* and centrarchids in low abundance. Walleye *Sander vitreus* were introduced and stocked annually in the lake as early as the 1930s. Walleye were dependent on stocking for most of the 20th century until the 1990s when natural reproduction and recruitment was very successful, and stocking was discontinued. Natural reproduction was strong until 2012 when the walleye population experienced several poor year classes annually. Natural reproduction has not recovered, and stocking began again in 2019 for the first time in decades. Currently, Muskellunge *Esox masquinongy* and Northern Pike *Esox lucius* are common. Largemouth Bass *Micropterus salmoides*, Bluegill *Lepomis macrochirus* and Black Crappie *Pomoxis nigromaculatus* have experienced sharp increases in their populations in the past decade and White Bass and Smallmouth Bass *Micropterus dolomieu* are present in low abundance. Cedar Lake is stocked with approximately 1000 large Muskellunge fingerlings in odd years and the lake is now stocked with extended growth Walleye in odd years at a rate of 15/acre. Cedar Lake is currently classified as a Class A1 Muskellunge lake. Class A waters are considered premier Musky waters with the highest quality fishing opportunities. The Class A waters are divided into two different classes. Class A1 waters are known as the “trophy waters” because of their ability to produce large Muskellunge with relatively low abundance of Musky overall. Class A2 waters are considered to provide the most consistent angling action with the potential to produce large fish. These lakes have higher relative abundance but large fish make up a smaller percentage of the population compared to the A1 waters.

Methods

Sampling

Cedar Lake was surveyed in the spring of 2021 using fyke nets and electrofishing gear to assess the status of the current fish community. Immediately after ice out on March 30th, 12 fyke nets (3x6 ft, 0.75 inch mesh and 4x6 ft, 0.5 inch nylon mesh) were set targeting Walleye, Muskellunge and Northern Pike. Nets were lifted daily for 13 days for a total of 130 net nights.

All Walleye were marked with fin clips during netting and Muskellunge were marked with fin clips and PIT tags. Immediately following the netting survey, one night of electrofishing (SEI) was conducted for the recapture survey for Walleye to obtain a population estimate. Additionally, after water temperature reached 55°F, another night of electrofishing (SEII) was conducted to target bass and panfish species. The entire shoreline was divided into three stations that were approximately 2 miles in length each. Within each of these stations, a ½ mile substation was sampled for all fish species. All Common Carp observed during these substations were counted to obtain relative abundance estimates. Only gamefish species were captured within the remaining 1.5 mile stations. In the fall, after water temperature dropped below 70°F, another night of electrofishing was conducted on the entire shoreline to sample the young-of-year Walleye population. Spring electrofishing was conducted with a pulsed DC miniboom shocker with two booms and one dip netter while the fall electrofishing survey was conducted with a pulsed DC maxi-boom shocker with two booms and one dip netter.

All gamefish were counted and measured and a subsample of 5 per each ½ inch length group of both sexes (if possible) were weighed and aging structures were removed for age analysis in the lab. Gender was determined for each Walleye, Muskellunge and Northern Pike. Dorsal spines were removed from Walleye for aging. Otoliths were removed from Largemouth Bass, Bluegill, Black Crappie and Yellow Perch and anal fin rays were removed from Muskellunge. Cleithra were removed from a subsample of Northern Pike in the 18-19 inch range.

Analysis

Data analysis included calculation of catch rates for each species (CPE-Catch per unit effort) as a measure of relative abundance. A population estimate was conducted for the Walleye population using the Schnabel method of population estimation with the formula (sum of (Ct x Mt))/R. The size of the adult Muskellunge (≥ 30 inches) was estimated using Bailey's modification of the Peterson single-census method (Hanson 1986). Condition of individual fish was estimated by computing relative weight (Wr) for each fish based on length and weight where a value of 100 or higher indicates very good condition and values less than that resulting in poorer condition. Size structure of each species was evaluated by creating length frequency distributions and computing Proportional Size Distribution (PSD) which is a measure of the proportion of fish equal to or larger than stock size and equal to or larger than quality size fish in the population. Relative Stock Density (RSD-Preferred) was also calculated for Walleye and Northern Pike as a measure of the proportion of fish in the population larger than Preferred size (20 inches-Walleye, 28 inches-Northern Pike). PSD was also calculated for Muskellunge using 30 inches as minimum stock size. PSD38, PSD42 and PSD45 were also calculated and compared to quartiles that have been calculated for A1 Muskellunge lakes in Wisconsin. Growth rates of Walleye were calculated using the von Bertalanffy growth coefficient and median length at age and were compared to other lakes within the same lakes classification. Walleye recruitment was evaluated through residual analysis where the sign and magnitude of residuals from a catch-curve regression indicate relative year-class strength. Larger, positive residuals indicate years of higher recruitment and zero or negative residuals indicate years of poorer recruitment. Growth rates of Northern Pike were estimated by calculating the mean age at 18-18.9 inches for male and female Northern Pike and categorized into percentiles of statewide distributions of growth rates for both sexes.

Results

Gamefish

A total of 383 Walleye were captured during the 13-day netting survey. Catch rates of Walleye were relatively low at 2.4 fish/net night which resulted in the 50th percentile for catch rates compared to lakes in the same lakes classification. The population estimate was lower than it has been since prior to 2009 and resulted in 1.1 total adult Walleye per acre or 1161 fish (Figure 1). The female population estimate resulted in 0.8/acre or 927 fish, while males were estimated at 0.2/acre or 220 fish. Ages of Walleye collected during the survey ranged from age-2 to age-13 representing the 2019-2008 year classes (Figure 2). The population within our sample was heavily skewed towards large older females which were overrepresented in this analysis and prevented accurate analysis of total annual mortality.

Walleye recruitment was highly variable and residual analysis estimated 4 poor year classes with negative residuals which included the age 3, 4, 5 and 11 (2018, 2017, 2016, 2008) year classes (Figure 2). Year classes with positive residuals or stronger year classes were the age-2 and ages 6-10 year classes (2019, 2015-2009).

Walleye ranged in length from 10.0 to 27.6 inches with a mean length of 18.4 inches (Figure 3). Condition of individual Walleye was excellent with a mean condition (Wr) for all Walleye of 104. The size structure of the population was heavily skewed towards large individuals and resulted in a high PSD estimate of 74 and an RSD-P of 42. Growth of Walleye overall was similar to statewide growth rates of Walleye in Wisconsin lakes of the same classification. However, immature fish and males exhibited slightly slower growth rates relative to the statewide median (Figure 4). These fish represented ages 2-6. After fish reached 7 years of age, which were represented by mostly females, growth rates improved and were above the statewide median for ages 7-13 (Figure 4).

The fall young-of-year sampling resulted in the capture of 0 young-of-year Walleye and 0 age-1 fish (Figure 5). Water temperatures were warm during the time of sampling and visibility was poor which may have influenced catch rates of young fish.

Muskellunge were abundant during the 2021 netting survey in which 120 fish were captured, tagged and marked. This resulted in a catch rate of 0.92 fish/net night or 75th percentile for catch rates in similar lakes across Wisconsin. During the 2022 recapture survey, a total of 102 Musky were captured which included 76 new unmarked Musky that were tagged with PIT tags. Catch rates were higher in 2022 with a catch rate of 1.8/net night. The Musky population estimate resulted in 0.4 adult Musky per acre or 419 adults (≥ 30 inches). The population estimate and CPUE estimates resulted in a population size above the median quartile for Class A2 Musky lakes and within the third quartile for Class A1 Musky lakes. Fall juvenile (<20 inches) Muskellunge CPE was 1.5/mile, however these fish were likely the result of stocking according age analysis. Fish ranged in length from 10.2 to 48.7 inches long with a mean length of 36.6 inches (Figure 6). Maximum observed length of Musky in Cedar Lake was similar to maximum length predicted for the size of the lake with the maximum length of Musky captured in 2021-2022 at 48.7 inches. A total of 11 juvenile fish or fish of unknown gender were captured ranging in length from 10.2 to 21.2 inches. The male and female sex ratio was approximately 50:50 with females exhibiting a larger mean length of 40.6 inches and males with a mean length of 36.8 inches. PSD estimates resulted in excellent size structure with a PSD38 value of 57 (3rd quartile), PSD42 value of 19 (median quartile) and PSD45 value of 10 (3rd quartile). Musky were in good condition with a mean relative weight of 95. Growth rates of Musky were similar to the statewide median length at age with fish less than 6 years of age growing at a slightly fast rate than the statewide median rate (Figure 7). Growth of older fish (> 6 years) was slightly slower than the statewide median length at ages for similar lakes. Age analysis of Muskellunge resulted in the vast majority of fish produced within stocked years with a large year class of age 7 fish from the 2015 stocking event (Figure 8). Low numbers of fish resulting from non-stocked years are apparent via age analysis.

A total of 121 Largemouth Bass were captured during the SEII electrofishing survey resulting in a CPE (catch per effort) of 20.5/mile or 60th percentile for catch rates for lakes in the same lakes classification. Lengths of Largemouth Bass collected ranged from 2.3 to 19.4 inches with a mean length of 9.4 inches (Figure 9). Largemouth Bass exhibited excellent size structure with a PSD value of 74 and an RSD-14 of 56. Growth rates of Largemouth Bass were comparable to statewide median lengths at age for similar lakes, with fish exhibiting slightly faster growth rates than the statewide median until 15 inches is achieved at which point growth rates slow (Figure 10). On average, fish reached 14 inches by 4.5 years of age. Largemouth Bass were in excellent condition with a mean relative weight (Wr) of 115. In terms of recruitment, Largemouth Bass exhibited somewhat erratic recruitment with several weak year classes and a missing year class from 2017 (age 4; Figure 11). Smallmouth Bass were present within the sample but were in very low abundances with a total of 2 captured during the netting survey and 8 captured during the SEII electrofishing survey. No further analysis was completed on Smallmouth Bass.

Northern Pike were surveyed during the netting portion of the survey and a total 130 fish were sampled which resulted in a catch rate of 1 fish/net night or 40th percentile for catch rates of Northern Pike in similar lakes. Lengths of Northern Pike ranged from 7.9 to 38.2 inches with a mean length of 19.7 inches (Figure 12). The size structure of Northern Pike was somewhat poor with a PSD of 27 and an RSD-P value of 16. The sample was composed of a balanced sex ratio with 51 males and 47 females sampled with females representing all fish captured larger than 27 inches. Northern Pike growth rates as described by mean age at 18-18.9 inches for male and female Pike were relatively fast with mean age of females within this length bin at 2 years of age (90th percentile) and mean age of males at 2.75 years of age (80th percentile). Average condition (Wr) of fish was 101.

Panfish

Bluegill were the most abundant panfish species captured during the SEII electrofishing survey with a catch rate of 226/mile or 80th percentile for catch rates within lakes of the same classification. The average catch rate of Bluegill from the previous 3 surveys was 29/mile (Figure 1). Bluegill ranged in length from 1.6 to 8.1 inches with a mean length of 5.2 inches (Figure 13). Bluegill size structure within Cedar Lake was relatively poor with a PSD of 20. Bluegill growth rates were very similar to the statewide median growth rates for similar lakes with fish growing slightly faster than the statewide rates after they reach the age of 4 years old or larger than 6 inches (Figure 14). On average, it takes Bluegill approximately 5 years to reach a desired size of 7 inches. Age analysis revealed erratic recruitment and likely high mortality for adult fish. The age-2 and age-3 year classes were very strong with very few fish in the sample from the age-4 to age-6 year classes (Figure 15). The age-1 year class may not have been fully recruited to our gear at the time of sampling. Bluegill were in excellent condition with an average condition factor (Wr) of 108.

Black Crappie were highly abundant during the SEII survey and represented a large proportion of the total catch. Catch rates or relative abundance of Black Crappie was 189/mile which is considerably higher than the average from the previous 3 surveys of 51/mile (Figure 1). Black Crappie lengths ranged from 2.5 to 10.7 inches with a mean length of 9 inches (Figure 16). Growth rates of Black Crappie were considerably slower than the statewide median length at age for all ages of fish, especially for smaller fish (less than 8 inches). On average, it takes Black Crappie approximately 5 years to reach 8.5 inches in Cedar Lake (Figure 17). According to age analysis, Black Crappie recruitment is erratic within Cedar Lake with several weak year classes and 1 missing year class of age-4 fish (2017 year class). Crappie production and recruitment was strong during the years of 2014 to 2016 (Figure 18). Black Crappie were also in good condition with a mean relative weight of 105.

Yellow Perch were more effectively captured during the netting survey with a total of 571 Yellow Perch captured and a catch rate of 4.4 fish/net night or 50th percentile for catch rates in similar lakes across the state. Fish ranged in length from 3.7 to 10.4 inches with a mean length of 6.1 inches (Figure 19). Yellow Perch exhibited very poor size structure with a PSD of 10. Growth rates of Yellow Perch were very similar to the statewide median growth rates for all size classes of fish (Figure 20). On average, it takes Yellow Perch approximately 4 years to reach 7 inches in length. The age-3 year class (2018) of fish was the strongest with very few fish representing the age-4 through age-8 year classes (Figure 21). Mortality of Yellow Perch is likely high according to age-frequency analysis. Condition of Yellow Perch was very good with an average condition factor (Wr) of 119.

Discussion

While Walleye were previously the dominant gamefish species within Cedar Lake, the population has since experienced sharp declines in both natural reproduction and recruitment and subsequent adult abundances. Walleye have been stocked in Cedar Lake since the early 20th century with inconsistent success. The Walleye population then became self-sustaining with natural reproduction and successful recruitment and stocking ceased in the 1970s and 1980s. Natural reproduction was low from 1990 to 1995 but sustained the population. From 1996 to 2011 the Walleye population within the lake was thriving with natural reproduction and recruitment, and adult population estimates were high at 5.3/acre in 2009. Since then, surveys have documented a steady decline in adult abundances with the population not producing an influential year class to date since 2011. The lack of successful recruitment has driven the declines in the population but the mechanism(s) influencing this are unknown and likely complicated. This trend of declining Walleye recruitment and abundance has been documented on other lakes in Polk County over the past several decades (Benike 2005a, 2005b, 2006 and 2009). The lake has undergone substantial changes within the last several decades including shoreline development and protection, reduction in nearshore woody habitat, aquatic plant community alterations, fish crib installation and more recently alum treatments. These changes coupled with the effects of a warming climate may have influenced fish community changes which include the increase in centrarchid populations and decline in cool-water species populations.

Walleye populations across the northern Great Lakes states have been experiencing declines as well in once viable and strong naturally reproducing populations. Research of potential drivers or factors affecting Walleye declines is ongoing and findings have revealed complicated results with many factors likely playing a role. Studies have documented that recruitment bottlenecks likely happen during the first summer of life. Extreme temporal changes in the timing of lake warm up following ice off and the timing of the spawn have been found to be correlated with the strength of subsequent year classes. The longer growing season and increase in average growing degree days each year may also play a role in benefiting warmwater species to the detriment of cool-water species. Many lakes with declining Walleye populations have also experienced dramatic increases in centrarchid populations. Specifically, within Cedar Lake, factors that may affect Walleye and other species include the increase in shoreline stabilization because of lakeshore erosion. Shoreline stabilization with the use of riprap or seawalls has become increasingly prevalent and can reduce the recruitment of natural substrates of gravel and cobble into the lake that historically provided excellent Walleye spawning habitat. Shoreline development and the removal of nearshore woody habitat may also be detrimental to many fish species as well as the removal and destruction of native aquatic vegetation.

Because of the decline in Walleye recruitment, biennial extended growth fall fingerling stocking began in 2019 at a rate of 15/acre. According to our survey, the resulting year class from the 2019 stocking likely had good survival resulted in a relatively strong year class. Stocking will continue for the immediate future to fully evaluate the adult population after at least three stocking events to determine if the stocking has resulted in an increase in the adult population and/or a resurgence in natural reproduction and recruitment. The current walleye fishing regulation is protecting the majority of the large females within the population (20-24”) which are essential for increased reproduction and population rebounds, if possible. However, because of the small and declining population, very limited harvest is encouraged by all anglers. With recreational anglers encouraged to limit the harvest of Walleye, tribal spearing has also been reduced beginning in the 2023 season. The reduction in safe harvest levels of Walleye that are allowed to be speared each spring is based on continued failed annual recruitment and low adult population estimates. The number taken annually by spearing has been very low during the past several seasons.

Adult Muskellunge were abundant compared to previous surveys of the lake. The 2016 survey resulted in catch rates of 0.16/net night with the 2022 survey resulting in 0.92/net night in 2021. The same net locations were used in all surveys and Musky were collected during the same timeframe (SN1) in 2022 and 2016, just prior to peak spawning activity. The 2022 survey resulted in substantially higher catch rates than previous surveys due to sampling during the peak Musky spawn when water temperatures were adequate for spawning activity (SNII). Abundance of Musky is currently moderately high compared to other Class A1 Musky lakes in Wisconsin. The current population exhibits excellent size structure and condition with growth rates comparable to statewide growth rates in similar lakes. There appears to be small contributions from non-stocked years, potentially indicating small amounts of natural reproduction. Genetic parentage analysis may be a useful tool to validate the influence of potential natural reproduction versus stocking. The 2015 stocked year class is substantially larger than other stocked year classes. Bluegill and Black Crappie produced a large year class in 2015 that would have been available as forage to newly stocked Musky fingerlings in the fall of 2015. This abundant forage may have contributed to survival of that year class. Hatchery stocking shortages occurred in 2017, 2019 and 2021 which is likely the cause of the weaker year classes of Musky since 2015. With the high abundance of Musky and growth rates similar to the statewide average, a reduction in the number of Musky stocked bi-annually may further improve growth rates and allow fish to reach a larger maximum size. The population size is currently higher than the target value of 0.3/acre for Class A1 Muskellunge lakes.

Northern Pike were also in lower abundance relative to the 2016 survey in which catch rates of Pike resulted in 1.6 fish/net night. Size structure was relatively poor in terms of PSD but was improved from the 2016 survey that documented only 7% of Northern Pike larger than 26 inches compared to the current survey which contained 18% of Pike larger than 26 inches. Overall, Pike exhibited good growth rates and condition, fairly stable recruitment and are in relatively low abundance which may indicate that the lack of large Pike within the population may be due to high harvest pressure.

In contrast, Largemouth Bass abundance within Cedar Lake was high in the 2021 survey relative to previous surveys. Previously, Largemouth Bass relative abundance averaged 5 fish/mile from 2009 to 2016 while the 2021 survey documented a 4-fold increase from the previous average. This is consistent with other lakes in Polk County where an increase in Largemouth Bass abundance has coincided with declines in Walleye abundance (Benike 2005a, 2005b, 2006 and 2009) Causative factors for these changes are not well understood. While these catch rates are higher than in previous surveys of Cedar Lake, Largemouth Bass are in relatively moderate abundances when compared to similar lakes statewide. Bass also exhibited good size structure and good growth rates and condition. With abundant forage and moderate densities, the Largemouth Bass population has the potential to produce a trophy fishery if densities remain low. Additionally, the Bass population exhibited fairly erratic recruitment with a missing age-4 year class (2017 year class) and several other weak year classes.

Overall, panfish abundance was high during the survey; however, very few large individuals of any species were captured. Catch rates of Bluegill and Black Crappie were very high and experienced large increases relative to the previous 3 surveys of the lake. Bluegill, Black Crappie and Yellow Perch exhibited relatively poor size structures with very few large or preferred size individuals present within the sample. Bluegill and Yellow Perch exhibited growth rates comparable to the statewide growth rates for lakes in the same lakes classification while Black Crappie exhibited relatively slow rates of growth. All three species are likely subject to high angling pressure and harvest which is likely the cause of the "cropped off" size structure. The poor growth rates exhibited by Black Crappie may be due to density dependent factors at play on several large year classes from 2014-2016 resulting in high intraspecific competition. Black Crappie recruitment was inconsistent and erratic from year to year with a missing age-4 year class, similar to Largemouth Bass. This is consistent with the majority of Black Crappie populations in which recruitment is heavily influenced by many environmental factors including water level fluctuations, water temperature changes during the spawn and alterations in habitat (Hooe 1991; Allen and Miranda 1998; Maceina and Stimpert 1998). Yellow Perch abundance was higher in the 2021 survey than in previous surveys, however, the timing of previous surveys may have been inconsistent with Perch vulnerability to sampling gear or the result of several poor year classes and recruitment prior to the 2016 survey. Yellow Perch exhibited good growth rates and good individual condition likely because sampling occurred during the Yellow Perch spawn which caused an increase in weight and overall condition.

Cedar Lake has undergone substantial changes and alterations within the past couple of decades and the fish community has responded with its own changes. Walleye are in decline along with many other Walleye populations across the upper Midwest. Habitat alterations within Cedar Lake include the installation of seawalls and riprap, reduction in nearshore woody habitat, installation of 400 offshore fish cribs, alum treatments and fluctuations in the aquatic plant community. Because of the many variables in habitat changes and water quality occurring simultaneously and the unknown timing in the response of the fish community, detecting the mechanisms with the largest impacts is difficult. Approximately 400 fish cribs were installed from 2004 to 2013 in offshore areas of 14-20 feet depths. The cribs are located outside of the littoral zone which is the zone that is naturally occupied by the majority of fish species during the productive times of year. It is still unknown how fish cribs influence or benefit individual fish species and population level effects. Installation of nearshore woody habitat in the form of tree drops and fish sticks would greatly benefit fish communities by offering natural habitat in the littoral zone. This habitat type is severely lacking within the lake and would also help to naturally slow shoreline erosion and stabilize aquatic vegetation beds. With almost the entire shoreline of the lake developed, this type of habitat is generally undesired by landowners but should be considered for erosion reduction and habitat benefits.

The effects of alum treatments on fish populations has been documented in the literature with mixed results. Studies documented significant declines in macroinvertebrate densities directly following alum treatments (Pilgrim and Brezonik 2005; Steinman and Ogdahl 2008) and declines in Yellow Perch condition (Smeltzer 1990). A major concern with alum treatments is the alteration of aquatic habitats by fluctuating water clarity which can cause aquatic macrophytes to occupy varying depths. Increased water clarity can also reduce preferred habitats used by Walleye because of the reduction in thermal optical habitat (Hansen et al. 2019). Several studies have documented that increasing water clarity and temperatures have been associated with Walleye declines and increases in centrarchid populations in many North American lakes (Robillard and Fox 2006, Hansen et al. 2015; Irwin et al. 2016). With increasing summer water temperatures, lengthening of growing seasons and increased water clarity, Walleye are likely to experience extreme reductions in available preferred habitats which can lead to declines in carrying capacity and yield of the population (Lester et al. 2004).

Moving forward with regional declines in Walleye populations that are likely to be heavily impacted by a warming climate, decisions of whether to resist changes, accept changes or direct the changes (RAD framework, WDNR) must be made. According to climate modeling, Cedar Lake is unlikely to contain a persistent Walleye population in the future because of lack of adequate thermal habitat. The lake will continue to be stocked with extended growth fall fingerling Walleye to determine if stocking can aid in the rebound of the population and natural recruitment can be regained. Muskellunge stocking will continue on a biennial basis with a reduction in the stocking rate by 50% in order to attempt to produce a lower density population with higher trophy potential. Nearshore woody habitat projects are highly encouraged to improve habitat and reduce shoreline erosion in place of hard armoring with the use of rip-rap. Panfish continuously experience high harvest pressure in both the winter and summer fishing seasons. Consideration may be given to more restrictive experimental panfish regulations in order to protect larger individuals within the populations and distribute available fish to a larger group of anglers. Continued monitoring of the fish population is essential for adaptive management strategies and future success of the fishery.

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Figures and Tables

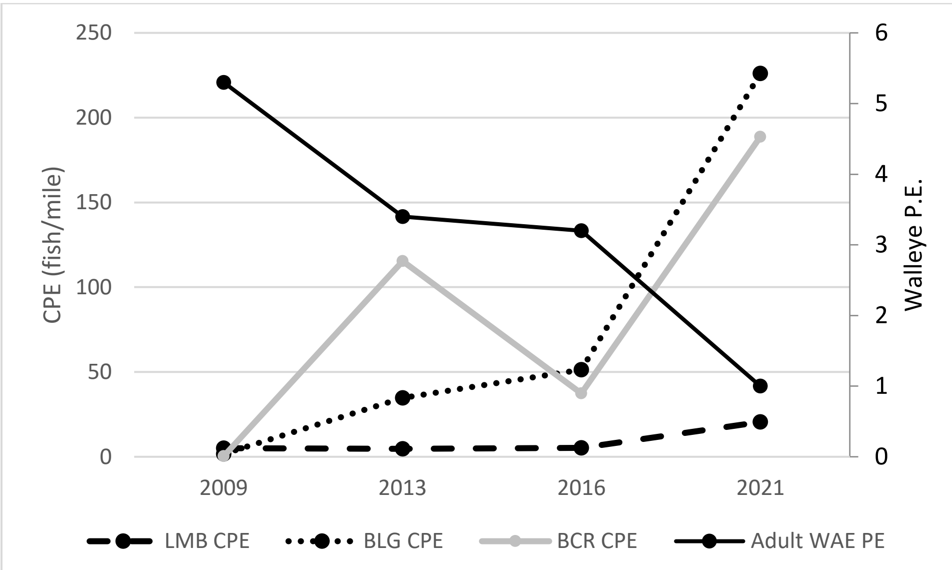

Figure 1. Catch rates (CPE) of Largemouth Bass (LMB), Bluegill (BLG), Black Crappie (BCR) and population estimates of Walleye (WAE) from 2009-2021 in Cedar Lake, St. Croix and Polk counties.

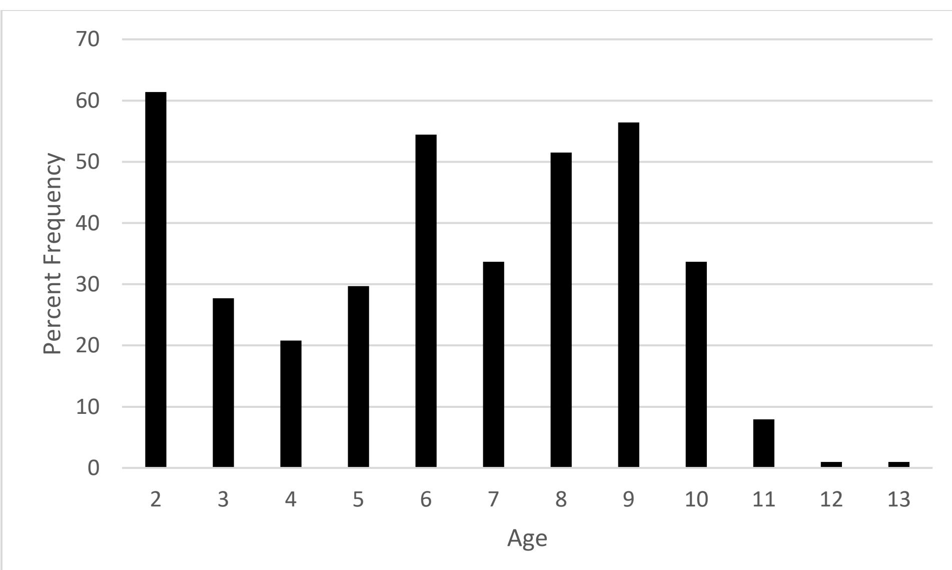

Figure 2. Age frequency distribution of Walleye collected from Cedar Lake, Polk and St. Croix counties, spring 2021.

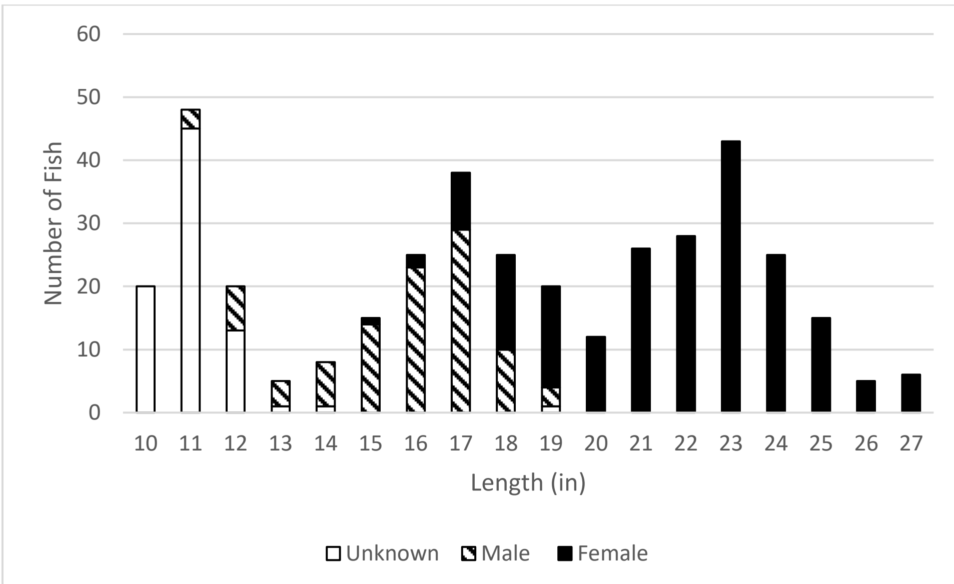

Figure 3. Length frequency distribution of Walleye collected from Cedar Lake, Polk and St. Croix counties, spring 2021.

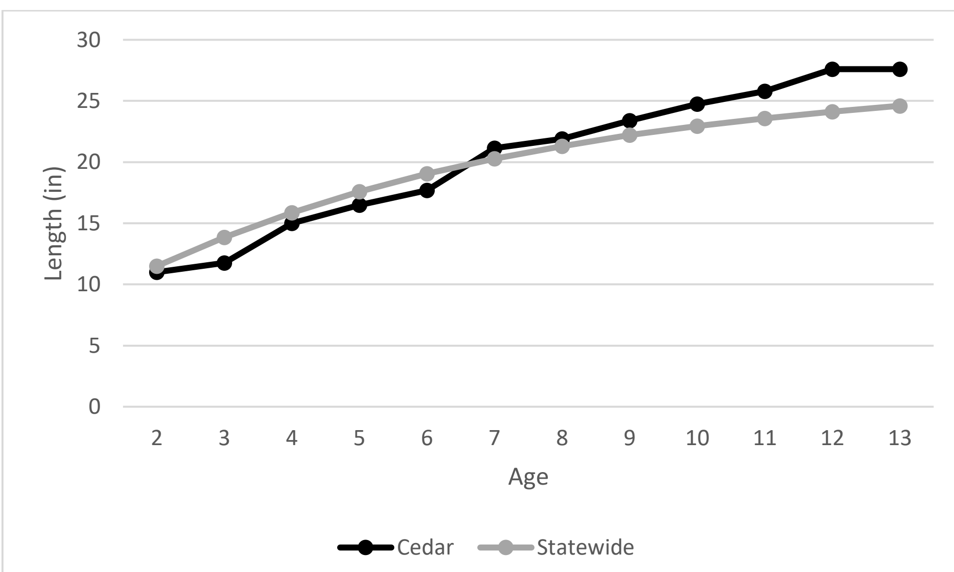

Figure 4. Median length at age of Walleye collected from Cedar Lake, Polk and St. Croix counties in spring 2021 compared to statewide median length at age of Walleye within Complex Warm and Dark classified lakes.

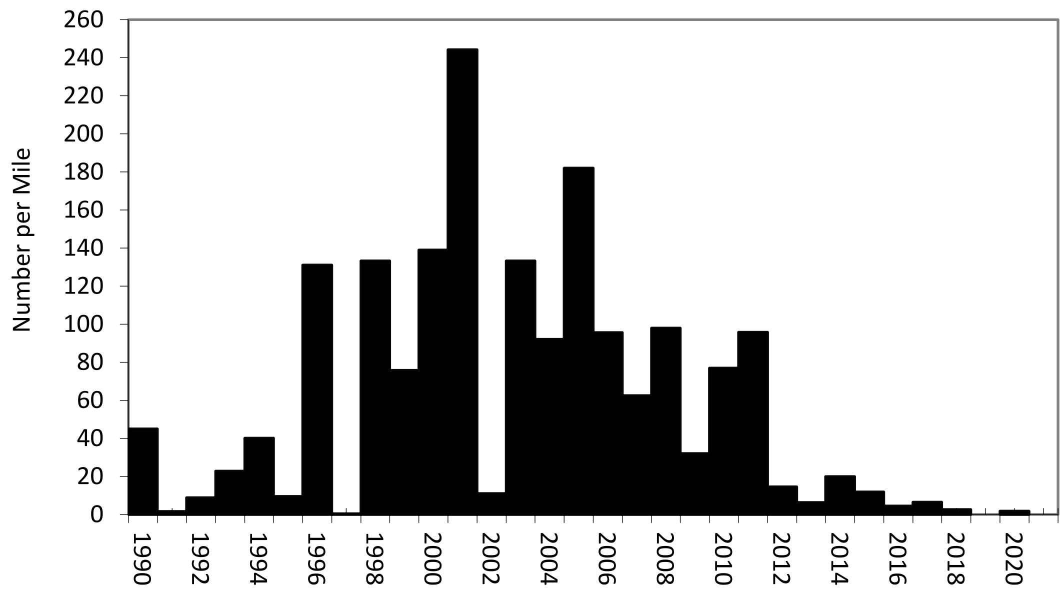

Figure 5. Catch rates (number per mile of shoreline) of young-of-year Walleye collected annually in the fall from 1990 to 2021 in Cedar Lake, Polk and St. Croix counties.

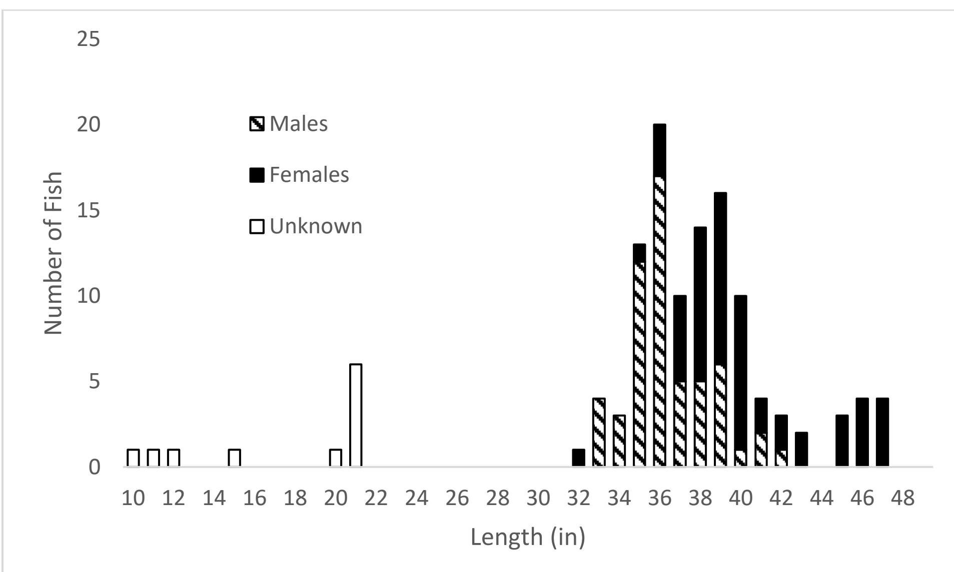

Figure 6. Length frequency distribution of Muskellunge collected from Cedar Lake, Polk and St. Croix counties, spring 2021.

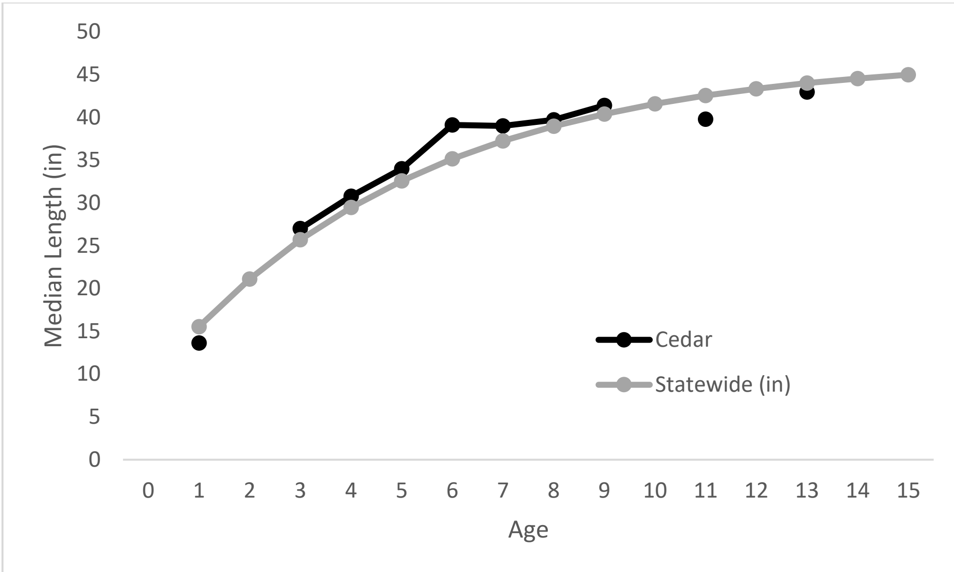

Figure 7. Median length at age of Muskellunge collected from Cedar Lake, Polk and St. Croix counties in spring 2021-22 compared to statewide median length at age of Muskellunge within Complex Warm and Dark classified lakes.

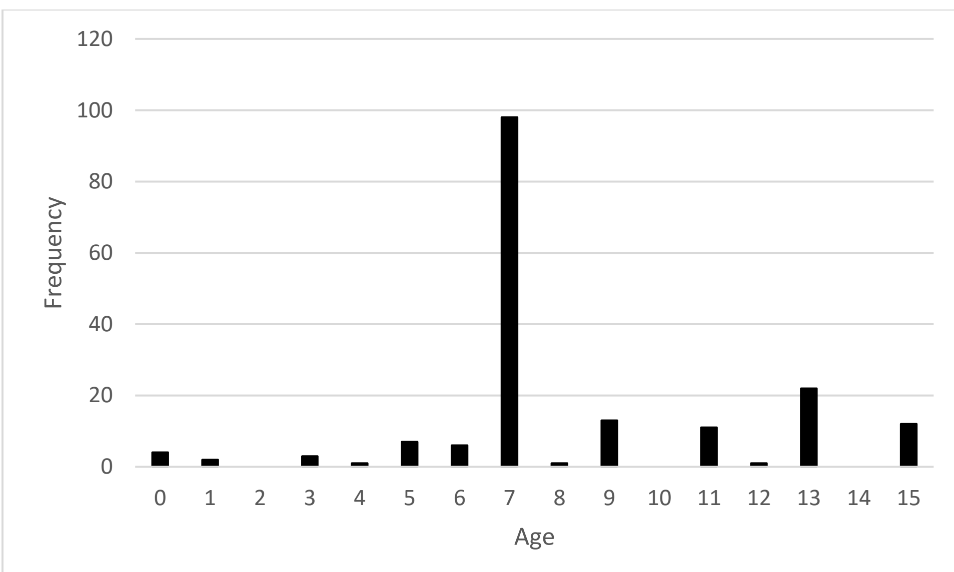

Figure 8. Age frequency distribution of Muskellunge collected from Cedar Lake, Polk and St. Croix counties, spring 2021 and 2022.

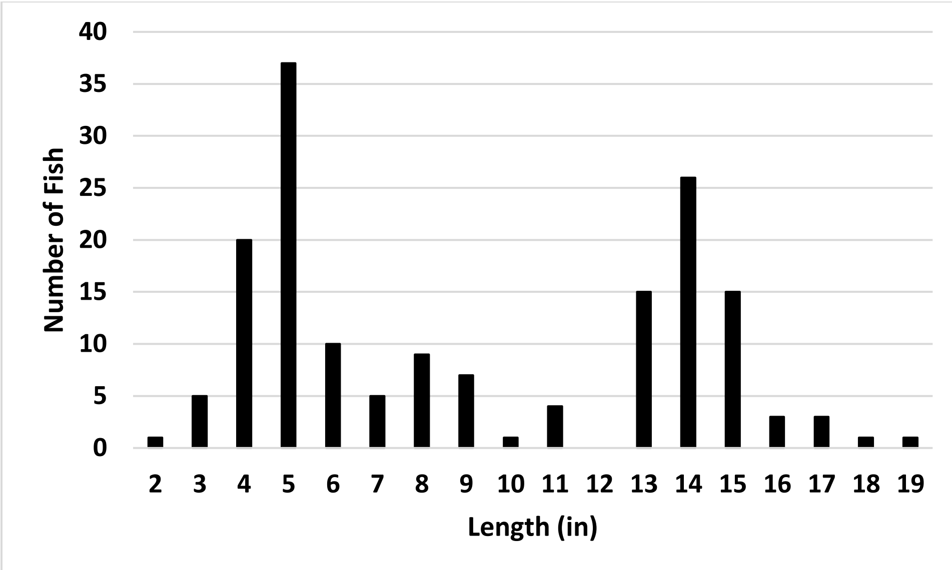

Figure 9. Length frequency distribution of Largemouth Bass collected from Cedar Lake, Polk and St. Croix counties, spring 2021.

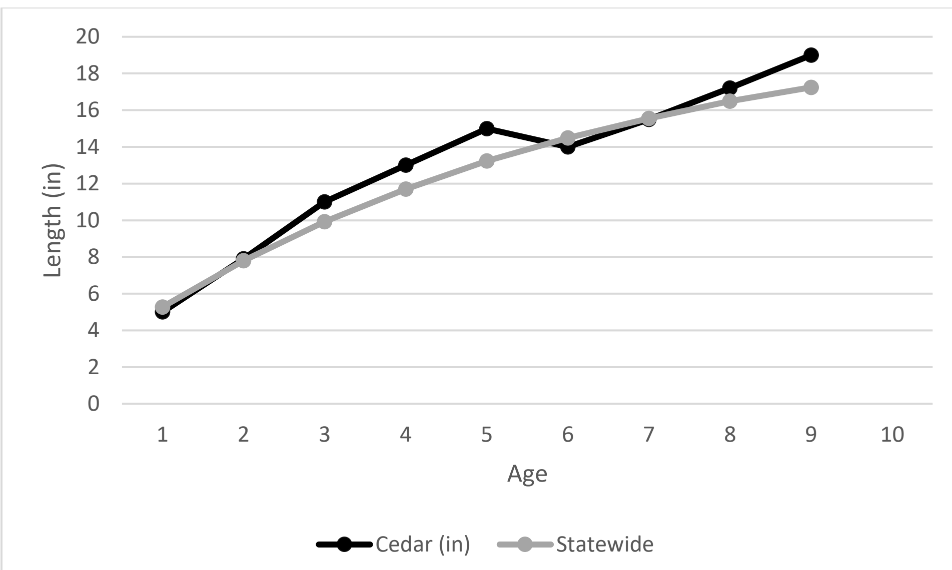

Figure 10. Median length at age of Largemouth Bass collected from Cedar Lake, Polk and St. Croix counties in spring 2021 compared to statewide median length at age of Largemouth Bass within Complex Warm and Dark classified lakes.

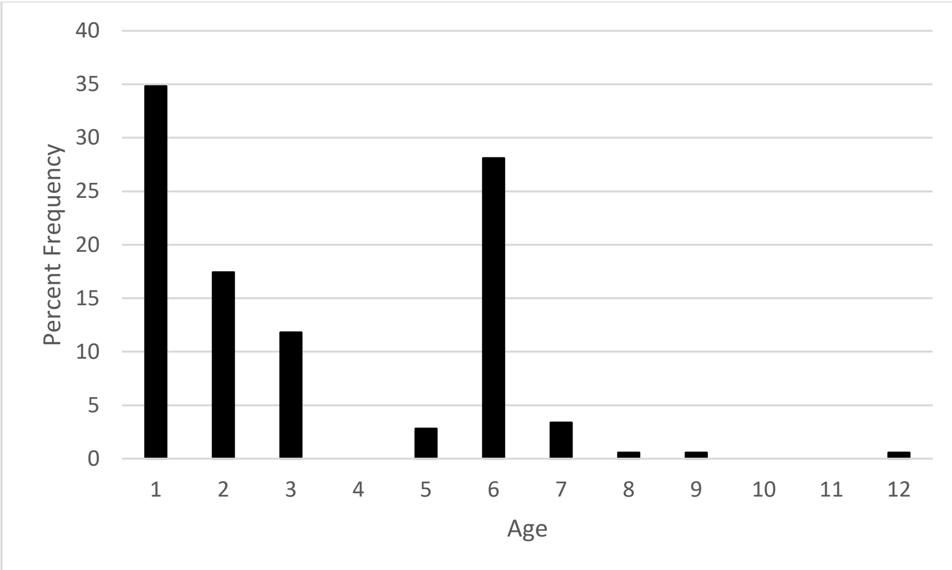

Figure 11. Age frequency distribution of Largemouth Bass collected from Cedar Lake, Polk and St. Croix counties, spring 2021.

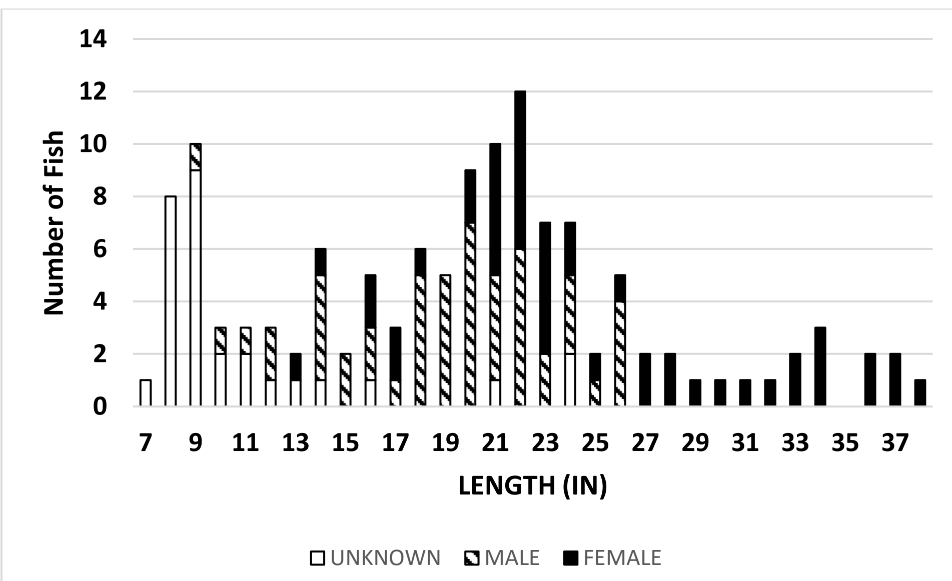

Figure 12. Length frequency distribution of Northern Pike collected from Cedar Lake, Polk and St. Croix counties, spring 2021.

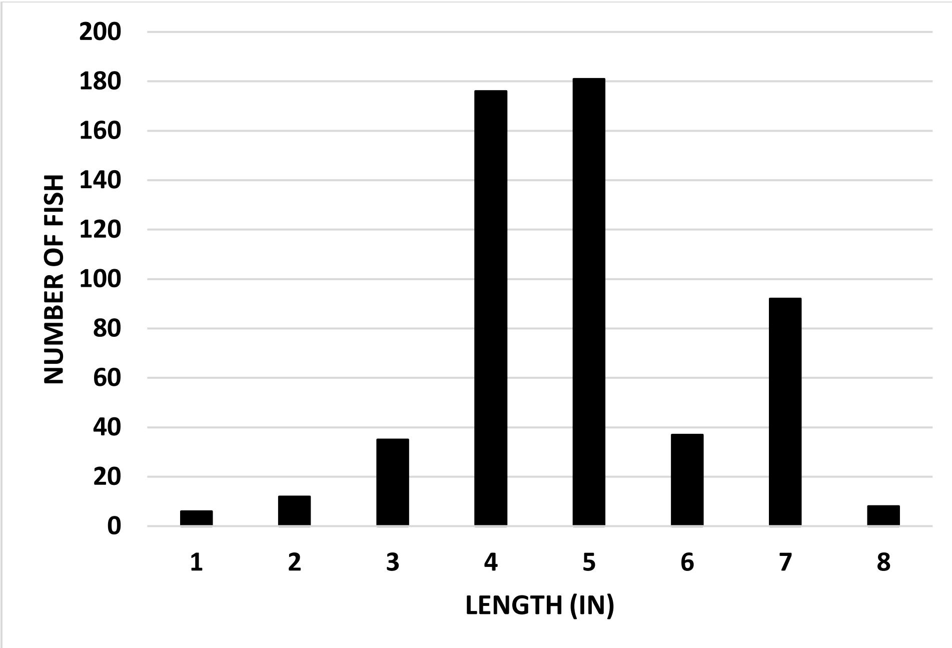

Figure 13. Length frequency distribution of Bluegill collected from Cedar Lake, Polk and St. Croix counties, spring 2021.

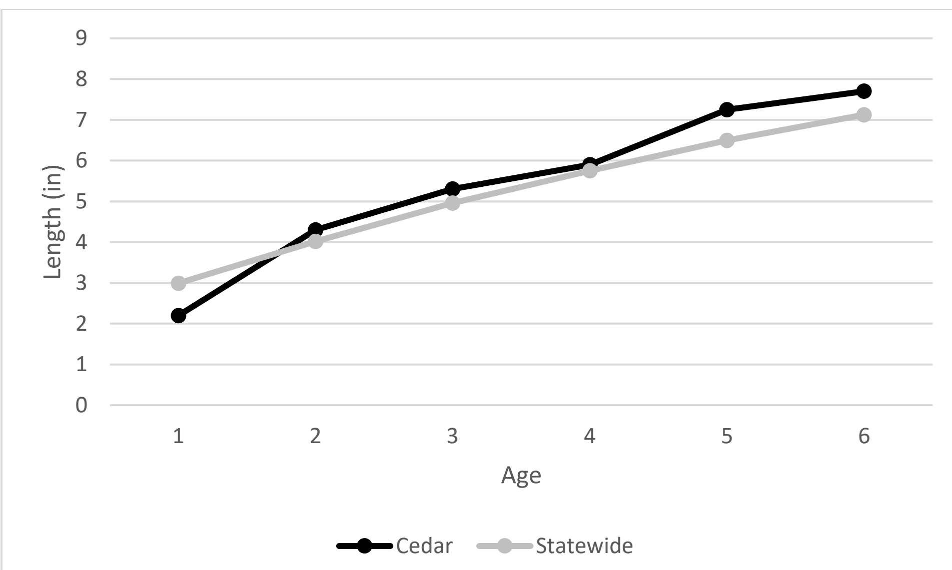

Figure 14. Median length at age of Bluegill collected from Cedar Lake, Polk and St. Croix counties in spring 2021 compared to statewide median length at age of Bluegill within Complex Warm and Dark classified lakes.

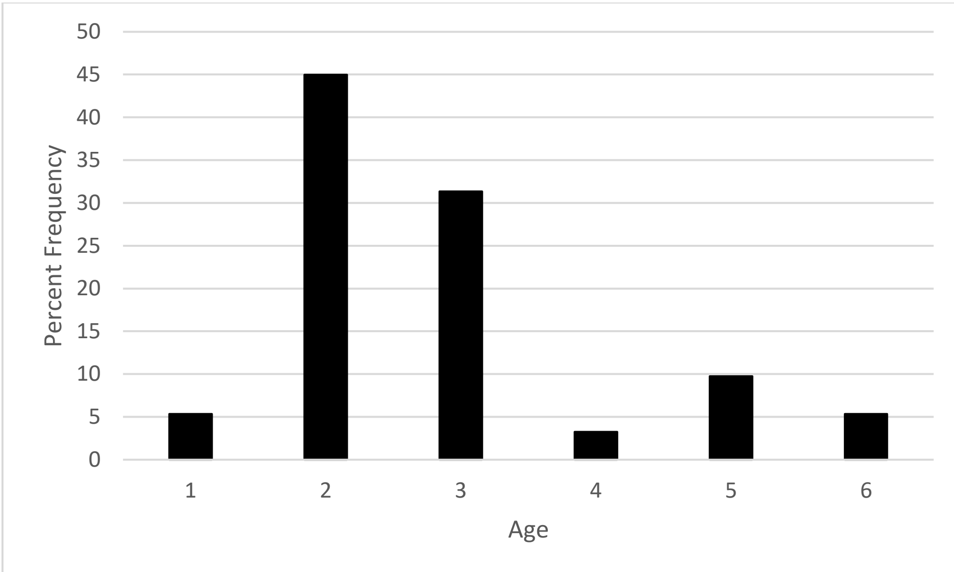

Figure 15. Age frequency distribution of Bluegill collected from Cedar Lake, Polk and St. Croix counties, spring 2021.

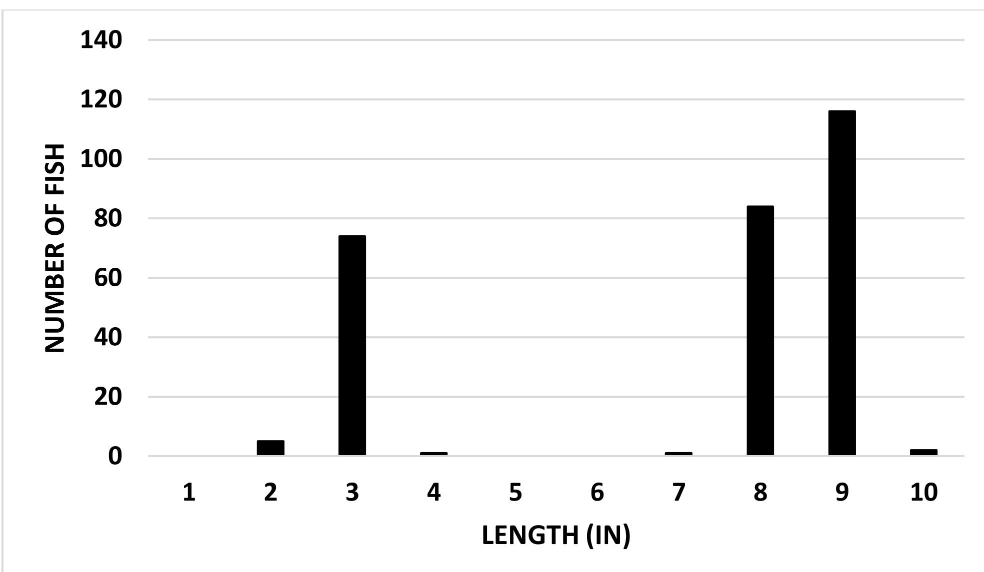

Figure 16. Length frequency distribution of Black Crappie collected from Cedar Lake, Polk and St. Croix counties, spring 2021.

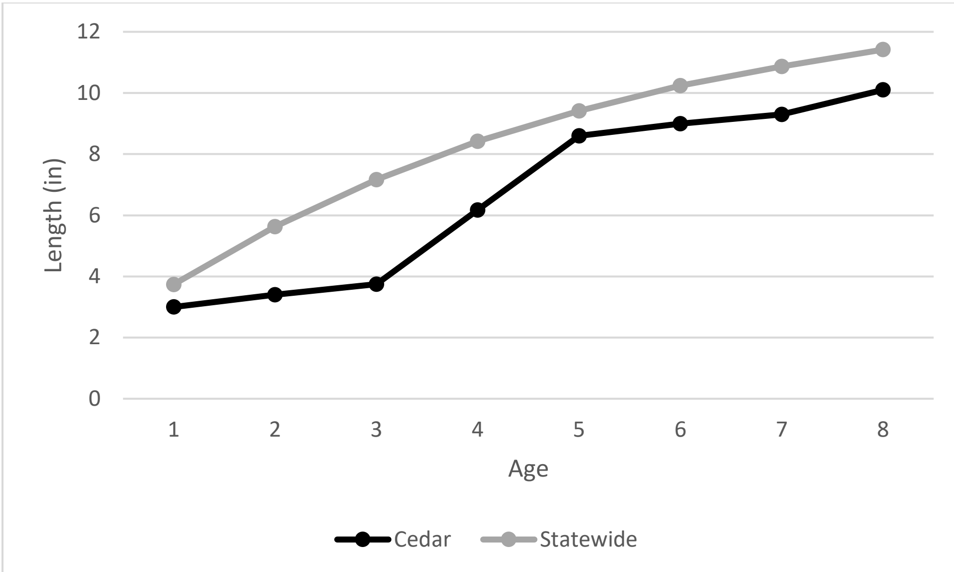

Figure 17. Median length at age of Black Crappie collected from Cedar Lake, Polk and St. Croix counties in spring 2021 compared to statewide median length at age of Black Crappie within Complex Warm and Dark classified lakes.

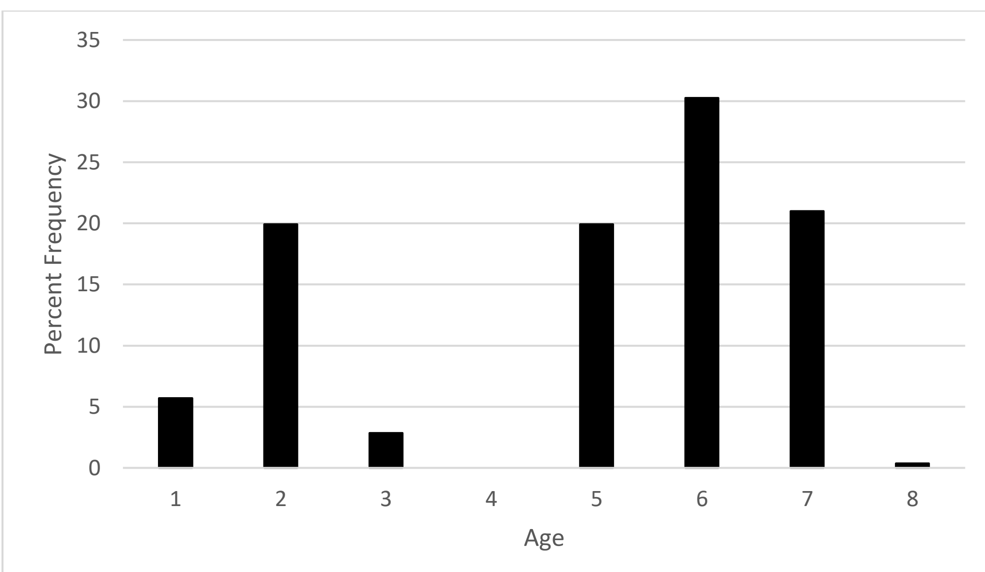

Figure 18. Age frequency distribution of Black Crappie collected from Cedar Lake, Polk and St. Croix counties, spring 2021.

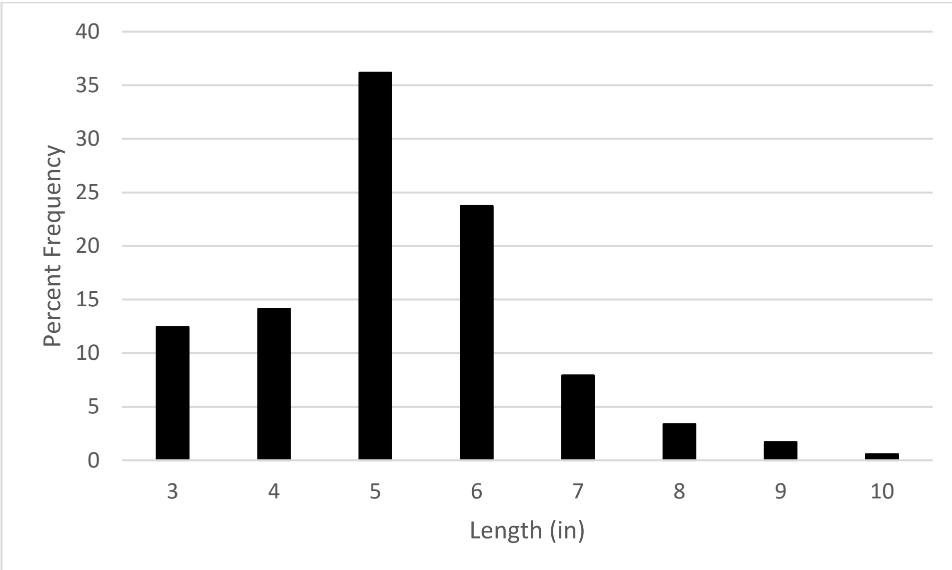

Figure 19. Length frequency distribution of Yellow Perch collected from Cedar Lake, Polk and St. Croix counties, spring 2021.

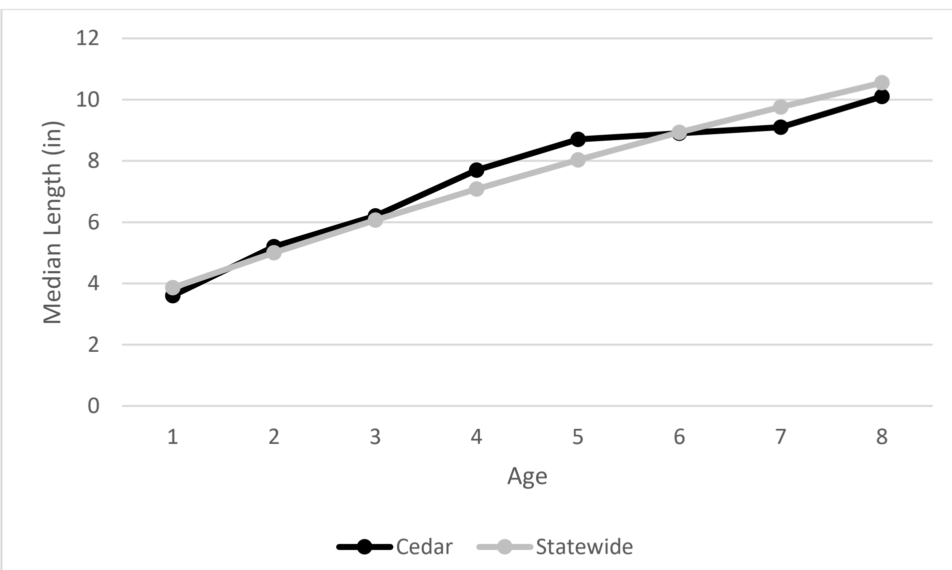

Figure 20. Median length at age of Yellow Perch collected from Cedar Lake, Polk and St. Croix counties in spring 2021 compared to statewide median length at age of Yellow Perch within Complex Warm and Dark classified lakes.

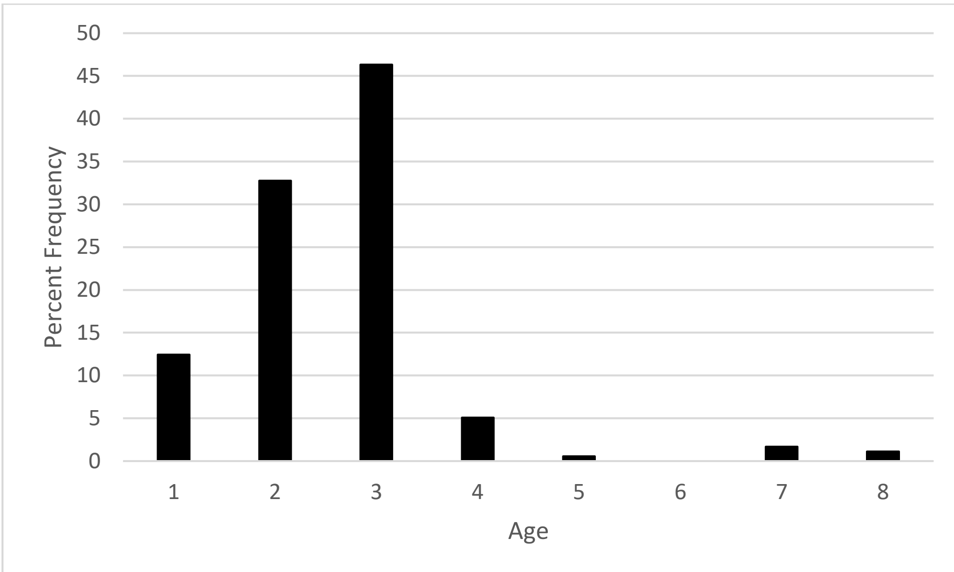

Figure 21. Age frequency distribution of Yellow Perch collected from Cedar Lake, Polk and St. Croix counties, spring 2021.