Crystal Lake
2021 Comprehensive Fishery Survey Report
Sheboygan County
WBIC 45200

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Executive Summary

In 2021, a comprehensive fishery survey was conducted on Crystal Lake in Sheboygan County, Wisconsin, using a variety of sampling methods throughout the open water period to sample the major components of the fishery. The objectives of the survey were to 1) assess the status of the Northern Pike (*Esox lucius*), Walleye (*Sander vitreus*), Largemouth Bass (*Micropterus salmoides*) and panfish populations, 2) attain population estimates for Northern Pike and Walleye, and 3) update management recommendations for the fishery of Crystal Lake. The results of the 2021 survey were compared to lakes with similar characteristics and to the prior comprehensive fishery survey conducted in 2012 and 2001.

Sixteen Northern Pike were sampled during the 2021 spring fyke net (SNI) survey for a catch per unit effort (CPUE) of 0.15 Northern Pike/net night. This catch rate is well below average when compared to lakes with similar characteristics (complex, warm water temperatures and clear water) across the state. Northern Pike mean length was 18.1 inches with lengths ranging from 11.0 to 22.8 inches. The largest Northern Pike was a 22.8-inch female weighing 1.6 pounds. The low catch rate of Northern Pike sampled in SNI did not allow for a valid population estimate to be calculated. Northern Pike catch rate has decreased from 2001 SNI surveys.

Thirty-seven Walleye (including three resampled fish) were sampled during (SNI) for a CPUE of 0.36 Walleye/net night. Eight females, 17 males and nine unknown sex Walleye were marked with fin clips during SNI. Walleye mean length was 17.5 inches with lengths ranging from 9.0 to 25.2-inches. The largest Walleye was a 25.2-inch female weighing 5.8 pounds.

Sixty-two Largemouth Bass were sampled during spring electrofishing (SEII) survey for a catch rate of 8.8 Largemouth Bass/mile (19.7 Largemouth Bass/hour). This catch rate is below average when compared to lakes with similar characteristics (complex, warm water temperatures and clear water) across the state. Largemouth Bass mean length was 10.8 inches and lengths ranged from 2.9 to 17.1 inches. Largemouth Bass catch rate and mean length have decreased since prior surveys.

Two-hundred forty-nine Bluegill (*Lepomis macrochirus*) were sampled in SEII for a catch rate of 49.4 Bluegill/mile (100.8 Bluegill/hour). Bluegill mean length was 4.9 inches and lengths ranged from 2.0 to 8.6 inches. Bluegill catch rate and mean length have decreased since prior surveys. One-hundred and twenty-nine Rock Bass (*Ambloplites rupestris*) were sampled

during SNI for a CPUE of 1.24 Rock Bass/net night. Fish were not individually identified with a fin clip mark; therefore, individual Rock Bass may have been netted multiple times. Rock Bass mean length was 7.5 inches and lengths ranged from 4.2 to 11.2 inches. Rock Bass catch rates have declined since prior surveys. The Yellow perch (*Perca flavescens*) population is low in abundance as evidenced by low catch rates in all survey types (0.12 Yellow Perch/net night, 0.67 Yellow Perch/mile, 1.33 Yellow Perch/hour). Yellow Perch catch rates have declined greatly since 2001 SNI sampling.

Crystal Lake presents several challenges to effective fishery sampling using standard sampling gear. The steep shoreline drop-off inhibits effective fyke net sets and limits electrofishing effectiveness. This could contribute to the low catch rate of Northern Pike and Walleye in Crystal Lake. Development of new net-set locations and reevaluating sampling methods may result in more representative catch rates in Crystal Lake. Resolving these sampling challenges is crucial to assess the status of the fishery accurately and adequately.

Management recommendations include:

1. Reevaluate sampling methods and determine best net set locations to accurately sample gamefish including Walleye and Northern Pike.
2. Facilitate calculation of population estimates for Walleye and Northern Pike at the time of the next comprehensive fishery survey.
3. Evaluate the current no minimum length limit, five fish daily bag limit regulation and estimate angler effort for Northern Pike.
4. Discontinue biennial stocking of large fingerling Walleye due to the failure of stocking efforts to establish a minimum fishable population of 2 adults/acre.
5. Obtain aging structures from Largemouth Bass and measure weights to evaluate Largemouth Bass growth and condition. Assess effectiveness of current 14-inch minimum length, five fish daily bag limit regulation.
6. Determine if a more effective sampling methodology for Yellow Perch is feasible and in the interest of anglers.

Introduction

Crystal Lake is a 129-acre seepage lake located in northeastern Sheboygan County (Figure 1). Seepage lakes are characterized by a lack of an inlet or an outlet; the principal source of water is groundwater from the immediate drainage area, supplemented by precipitation and runoff. Since seepage lakes commonly reflect groundwater levels and rainfall patterns, water levels may fluctuate seasonally. Crystal Lake lies in the Mullet River watershed, an area of 88 square miles. Crop farming accounts for 57% of the land use in the watershed.

Crystal Lake is a glacial kettle lake comprised of two main basins, with 2.6 miles of shoreline, a maximum depth of 61 feet, and a mean depth of 20 feet. Bottom substrate consists of 10% sand, 80% gravel, 0% rock, and 10% muck. The two basins are oriented east to west to each other; the eastern basin is the deeper of the two and consists primarily of cobble, with some limited areas of organic sediment and marl. Areas of the western basin contain marl deposits, with some areas of organic sediment along the western shore. The western basin generally contains a larger photic zone than the eastern basin, with more beds of aquatic plants. The eastern basin has limited littoral habitat, with steep drop-offs to deep water habitat present along portions of the shoreline.

Nearly the entire Crystal Lake shoreline is developed with year-round and summer homes. The lake has two islands, one located on the west side of the western basin, and the other central island forms a point of division between the lake's two basins and is connected to the northern shoreline by a causeway. Both islands have been developed with private homes. There are a few pockets of undeveloped natural shoreline between homes, but most of the shoreline has been altered by seawalls, riprap, and private swimming beaches. Public access, provided by Sheboygan County, is available via a boat launch on the south side of the lake off County Highway C and offers parking for 15 vehicles and portable restrooms. Located close to the city of Elkhart Lake, a popular recreation destination, as well as the cities of Plymouth and Sheboygan, angling pressure on Crystal Lake can be high, especially during ice fishing. Recreational watercraft use is also very high on Crystal Lake which could contribute to shoreline erosion and loss of near-shore habitat. Aquatic invasive species continue to pose a threat to Crystal Lake; species established include Eurasian Watermilfoil (*Myriophyllum spicatum*), Zebra Mussel (*Dreissena polymorpha*), and Chinese Mystery Snail (*Bellamya chinensis*).

The water quality of Crystal Lake has been monitored by the Department since 1975 and monitored by the Citizen Lake Monitoring Network since 1986. Average Secchi depth from 1986-2012 (July and August only) was 16.1 feet. The average summer Secchi depth in 2021 was 19 feet (the average for the Southeast Georegion is 7.1 feet) and the latest Secchi depth measurement in September 2021, was 21 feet. The Trophic State Index (TSI) (Secchi) was 35 in 2021 and mean TSI (Secchi) from 1986-2021 was 37.5 inches. TSI less than 30 represents oligotrophy: clear, cold water; many algal species; oxygen throughout the year in bottom water; and oxygen-sensitive fish species in deep lakes. A TSI of 30-40 is still indicative of oligotrophic conditions, but bottom waters become oxygen-depleted during the summer months. A TSI of 40-50 indicates a mesotrophic lake; water is moderately clear, but there is an increasing chance of low dissolved oxygen in deep water during the summer. Crystal Lake is likely an oligo-mesotrophic waterbody that experiences low dissolved oxygen in the hypolimnion during certain periods.

Phosphorus is known to be a key limiting nutrient in 80% of Wisconsin's lakes. High levels of phosphorous can encourage excessive aquatic macrophyte and algae growth. Most major sources of phosphorus originate from anthropogenic activities including human and animal wastes, soil erosion, detergents, septic systems and runoff from agriculture and lawns. Total phosphorus (TP) includes both soluble reactive phosphorus (SRP; phosphorus dissolved in the water column available for plant uptake) and the phosphorus in plant and animal biomass fragments that are suspended in the water column. The average TP concentration for Wisconsin Lakes is between 20 and 30 micrograms per liter (µg/l). To maintain "very good" water quality, TP should be below 20 µg/l for Wisconsin lakes. The 2021 TP summer average for Crystal Lake was 12.4 µg/l, indicating excellent water quality.

Although not usually as limiting as phosphorus, nitrogen is the second most important nutrient for plant growth. Most nitrogen inputs come from runoff; therefore, land use determines nitrogen concentrations. Nitrogen can come from animal waste and fertilizer from agriculture, human waste from leaking sewage treatment plants or septic systems and lawn fertilizers. For lakes that are groundwater fed such as Crystal Lake, nitrogen can also originate from the water table. Nitrogen is present in many chemical compounds: nitrate (NO3-), nitrite (NO2-), ammonium (NH4+) and Kjeldahl nitrogen (organic nitrogen + ammonium). "Organic oxygen" refers to biomass nitrogen, or that which is tied up in plant and animal matter. Total nitrogen

(TN) is derived by adding nitrate + nitrate + Kjeldahl nitrogen. The statewide average TN concentration for Wisconsin lakes is 0.86 mg/l; the mean for southeastern Wisconsin lakes is 1.43 mg/l. The most recent TN concentration from September 2014 for Crystal Lake was 0.469 mg/l. Excess nitrogen does not appear to be a current concern for Crystal Lake.

Crystal Lake is a hardwater lake, as evidenced by high pH (8.77 SU; lab), total $CaCO_3$ (134 mg/l), total recoverable hardness (161 mg/l), and total recoverable calcium (23.9 mg/l). Data are from a September 2018 sampling event. The mean alkalinity for all Wisconsin Lakes is 52 mg/L. The mean calcium concentration for Wisconsin lake is 12 mg/L. Limestone is abundant in the area of Crystal Lake and is the source of the lake's high water hardness. Crystal Lake is unlikely to experience concerns related to acidity, including toxicity to fish and inhibited spawning.

Crystal Lake supports fish populations of Northern Pike, Walleye, Largemouth Bass, Bluegill, Black Crappie (*Pomoxis nigromaculatus*), Yellow Perch, Pumpkinseed (*Lepomis gibbosus*), and Rock Bass. Other species present include White Sucker (*Catostomus commersonii*), Green Sunfish (*Lepomis cyanellus*) and a population of Mudpuppies *(Necturus maculosus*). Historically, Cisco (*Coregonus artedi*) were found in Crystal Lake, providing a forage base for predators such as Northern Pike. However, only 1.0 Cisco/night gang was found in Crystal Lake during a recent statewide project investigating the status and distribution of Cisco in inland Wisconsin lakes (K.M. Renik et al. 2020). More sampling is needed to assess the status of the Cisco population in Crystal Lake. Low Cisco abundance could be the result of limited oxythermal habitat due to warming water temperatures, nutrient loading, recruitment failure, predation, or impacts from invasive species.

In 2016, a special panfish regulation was implemented on Crystal Lake to increase size structure and provide anglers with quality angling opportunities for panfish. During May and June 15 panfish may be kept, but only five of any one species. During the remainder of the year, 25 panfish may be kept. Unlike other lakes in the southern management zone that follow a 26-inch minimum length, two fish daily bag limit, the Northern Pike regulation for Crystal Lake is no minimum length limit, five fish daily bag limit. The Largemouth Bass regulation follows the statewide default of 14-inch minimum length, five fish daily bag limit. The Walleye population in Crystal Lake had been managed primarily under a 15-inch minimum length, five fish daily bag

limit regulation. However, a county-wide Walleye regulation of 18-inch minimum length and three fish daily bag limit was implemented in 2018.

Walleye have been stocked primarily biennially on Crystal Lake since 2000 (Table 1). Prior to 2010, mainly small fingerling Walleye were stocked. Large fingerling Walleye have been stocked since 2012, beginning in 2015 they have been stocked in alternate years as part of the Wisconsin Walleye Initiate (WWI). Fall electrofishing (FE) surveys to assess the success of these stocking events have been conducted in 2011, 2015 and 2018-2021. Historically, Largemouth Bass and Northern Pike were also stocked in Crystal Lake. Prior to 1972, fall stocking of Rainbow and Brown Trout occurred annually from 1956 until approximately 1970. In 1964 and 1965, 4,500 Brown and Rainbow Trout were stocked each year. Although the trout fishery was initially popular, public demand prompted a switch to establishing a Walleye fishery, and in 1972, trout stocking was abandoned in favor of Walleye.

Fish surveys of Crystal Lake have been conducted by the Wisconsin Department of Natural Resources since 1951. A spring electrofishing (SEII) survey targeting Largemouth Bass and panfish was conducted in May 2016. A partial comprehensive fishery survey, including SNI, and SEII was conducted in 2012. The last complete comprehensive fishery survey, including SNI, SEI, SEII and FE was conducted in 2001. The results of the 2021 survey were compared to these prior surveys. High public use of Crystal Lake by anglers justifies regular fisheries surveys to evaluate management opportunities and maximize the potential of the fishery.

In 2021, a comprehensive fishery survey was conducted on Crystal Lake using a variety of sampling methods throughout the open water period to sample the major components of the fishery. The objectives of the survey were to 1) assess the status of the Walleye, Northern Pike, Largemouth Bass and panfish populations, 2) attain population estimates for Walleye and Northern Pike, and 3) update management recommendations for the fishery of Crystal Lake.

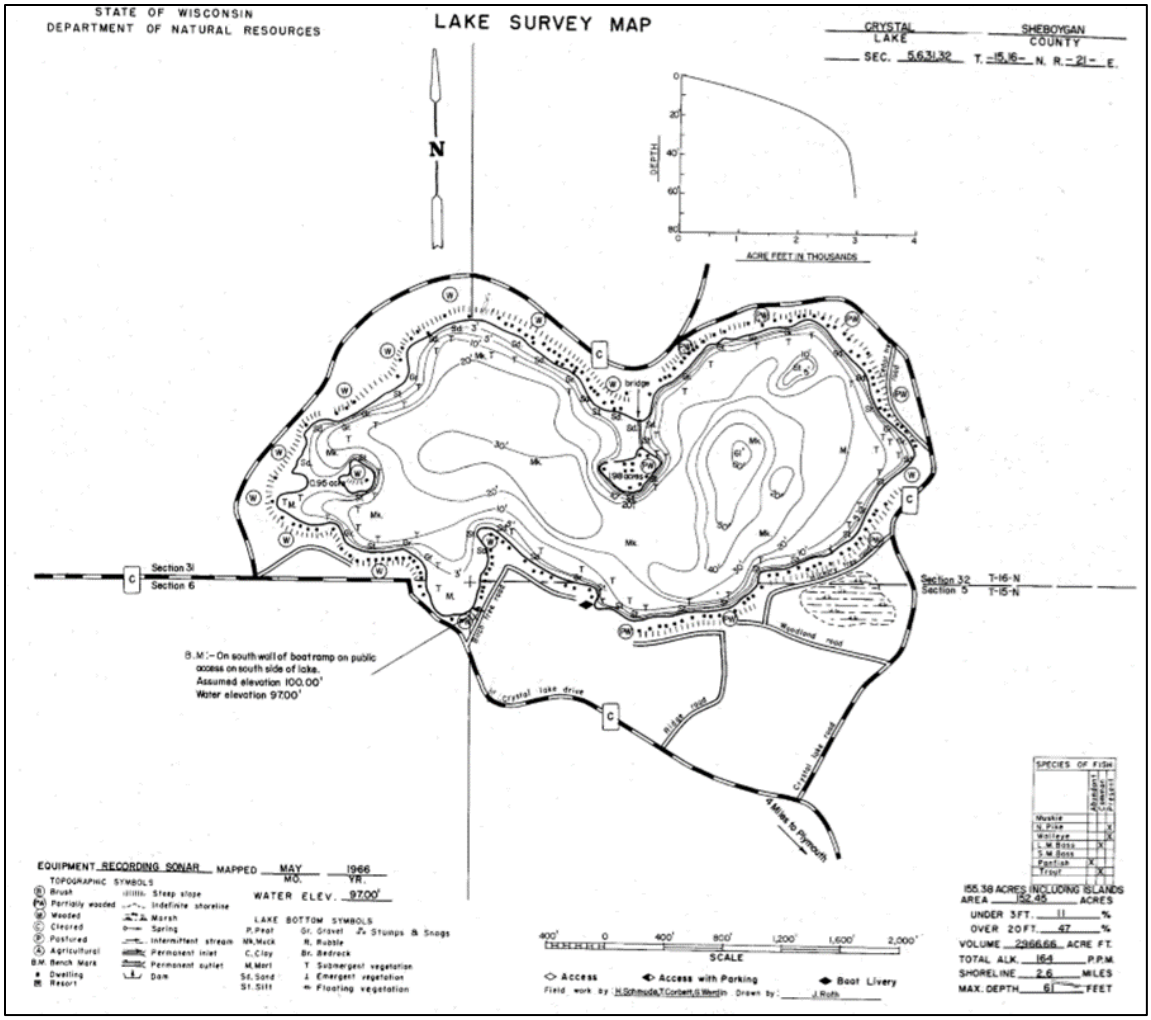

Figure 1. Contour map of Crystal Lake, Sheboygan County, Wisconsin.

Table 1. Fish stocked in Crystal Lake since 1972 including year stocked, species, age class, number of fish stocked and genetic strain type.

Year	Species	Age Class	Number of Fish Stocked	Strain Type
2021	Walleye	Large Fingerling	1,520	Mississippi Headwaters
2019	Walleye	Large Fingerling	1,536	Rock-Fox
2017	Walleye	Large Fingerling	1,290	Rock-Fox
2017	Walleye	Large Fingerling	1,282	Mississippi Headwaters
2015	Walleye	Large Fingerling	1,282	Mississippi Headwaters
2013	Walleye	Large Fingerling	998	Unspecified
2012	Walleye	Large Fingerling	999	Unspecified
2012	Walleye	Small Fingerling	4,090	Rock-Fox
2010	Walleye	Large Fingerling	781	Unspecified
2010	Walleye	Small Fingerling	4,906	Rock-Fox
2008	Walleye	Small Fingerling	5,676	Mississippi Headwaters
2006	Walleye	Small Fingerling	5,320	Mississippi Headwaters
2004	Walleye	Small Fingerling	15,200	Lake Michigan
2002	Walleye	Small Fingerling	12,010	Mississippi Headwaters
2000	Walleye	Small Fingerling	15,200	Unspecified
1995	Walleye	Fingerling	256	Unspecified
1989	Largemouth Bass	Fingerling	6,420	Unspecified
1987	Largemouth Bass	Fingerling	23,052	Unspecified
1985	Walleye	Fingerling	7,500	Unspecified
1984	Walleye	Fingerling	7,500	Unspecified
1982	Walleye	Fingerling	7,322	Unspecified
1981	Walleye	Fingerling	4,500	Unspecified
1980	Walleye	Fingerling	9,610	Unspecified
1979	Walleye	Fingerling	305	Unspecified
1978	Walleye	Fingerling	17,705	Unspecified
1974	Walleye	Fry	250,000	Unspecified
1973	Northern Pike	Fry	150,000	Unspecified
1972	Northern Pike	Fry	165,000	Unspecified

Methods

Data Collection

Four white nylon 0.75-inch bar mesh fyke nets were set on March 29, with an additional fyke net set on March 30, to target spawning Northern Pike and Walleye (Spring Netting I, (SNI)). Nets were checked daily from March 29 to April 19, for a total effort of 104 net nights. (Figure 2). Water temperature on the first day of SNI was 42 degrees Fahrenheit and at the conclusion of SNI the water temperature was 50 degrees Fahrenheit. Mean water temperature for the duration of SNI was 46.6 degrees Fahrenheit.

All gamefish and panfish netted were measured to the nearest 0.1 inch. Northern Pike and Walleye were also weighed to the nearest 0.1 pound. Non-game species were identified to species and counted but were not measured or weighed. Northern Pike and Walleye were given differential fin clips to identify recaptures and facilitate the calculation of population estimates. Female Northern Pike and Walleye were marked with a right ventral fin clip; males received a left ventral fin clip; unknown sex Northern Pike and Walleye received a top caudal fin clip. Additionally, all Largemouth Bass were marked with a top caudal fin clip to eliminate duplicate counts. All Northern Pike and Walleye netted were observed for fin clips from previous surveys. Additionally, age structures were removed from Northern Pike and Walleye according to standard sampling protocols. These protocols include removing an anal fin ray from Northern Pike, a dorsal spine from Walleye greater than 12 inches in length and a scale sample from Walleye less than 12 inches in length. Aging structures were collected until five structures were collected for each species and each sex for every half inch increment.

Spring electrofishing I (SEI) using a Wisconsin Department of Natural Resources (WDNR) standard pulsed direct current (PDC) boom shocker boat was conducted at night on April 19. SEI sampling encompassed the entire shoreline with 3.6 miles of sampling effort over a duration of 1.75 hours. Sampling began at 2025 h and concluded at 2210 h. Pulsed direct current was used at 220 volts, 14 amps, at a pulse rate of 70 per second and 25 percent duty cycle. Water temperature was 51 degrees Fahrenheit. SEI sampling utilized two dippers, two probes with a total of 16 droppers, and a dip net bar mesh of 0.375 inches.

The objective of SEI was to count and measure adult Walleye and Northern Pike and observe and record marks for adult Northern Pike and Walleye marked with fin clips during SNI to facilitate the calculation of population estimates for both species. All gamefish sampled were

measured to the nearest .01 inch. Walleye and Northern Pike were weighed to the nearest .01 pound. Aging structures were collected until five structures were collected for each species and each sex for every half-inch increment.

Spring electrofishing (SEII) using a WDNR standard PDC boom shocker boat was conducted at night on May 26, targeting Largemouth Bass and panfish species. SEII sampling encompassed the entire shoreline (3.5 miles) and included 1.43 hours of total sampling effort.

The first SEII sampling station, targeting all fish species began at 2033 h, concluded at 2050 h (17 minutes of effort) and covered 0.5 miles of shoreline. Water temperature was 72 degrees Fahrenheit. Pulsed direct current was used at 220 volts and 120 amps, at a pulse rate of 65 per second on a 25 percent duty cycle. The second sampling station, targeting only gamefish (Walleye and Largemouth Bass) began at 2059 h, ended at 2120 h (61 minutes of effort) and covered 1 mile of shoreline. Water temperature was 71.6 degrees Fahrenheit. Pulsed direct current was used at 220 volts and 120 amps, at a pulse rate of 65 per second on a 25 percent duty cycle. The third sampling station, targeting all fish species began at 2128 h, concluded at 2140 h (12 minutes of effort) and covered 0.5 miles of shoreline. Water temperature was 71 degrees Fahrenheit. Pulsed direct current was used at 210 volts and 120 amps, at a pulse rate of 65 per second on a 25 percent duty cycle. The fourth sampling station, targeting Walleye and Largemouth Bass began at 2152 h and ended at 2212 h (60 minutes of effort) and covered 1 mile of shoreline. Water temperature was 71 degrees Fahrenheit. Pulsed direct current was used at 230 volts and 120 amps, at a pulse rate of 65 per second on a 25 percent duty cycle. The fifth sampling station, targeting all fish species began at 2219 h, ended at 2235 h (16 minutes of effort) and covered 0.5 miles of shoreline. Water temperature was 71.8 degrees Fahrenheit. Pulsed direct current was used at 210 volts and 118 amps, at a pulse rate of 65 per second on a 25 percent duty cycle. At stations targeting all species, all fish were collected and gamefish and panfish were measured to the nearest 0.1 inch. Other fish were identified to species and counted. At stations targeting only gamefish, all gamefish sampled were measured to the nearest 0.1 inch and Northern Pike and Walleye were weighed to the nearest 0.1 pound. All gamefish were examined for the presence of fin clip marks from previous surveys. All SEII stations employed two dippers, two probes with a total of 16 droppers, and a dip net bar mesh of 0.375 inches. All gamefish and panfish sampled were measured to the nearest tenth inch.

During SEII, a subsample of Bluegill (5 individuals per half-inch length bin) was collected for otolith extraction as part of a statewide experimental panfish regulation study. An additional panfish electrofishing survey was conducted on June 2, 2021 to further assess the effect of the statewide experimental panfish regulation which was implemented in 2016. The entire shoreline (3.54 miles) was electrofished with a total of 1.72 hours of effort. Shocking began at 2000 h and concluded at 2143 h. Water temperature was 70 degrees Fahrenheit. Pulsed direct current was used at 288 volts and 14 amps, at a pulse rate of 65 per second on a 25 percent duty cycle. Two dippers were present using nets with a bar mesh of 0.375 inches. Two probes with a total of 16 droppers were used. A subsample of Bluegill (5 individuals per half-inch length bin) was collected for otolith extraction as part of a state-wide experimental panfish regulation study.

Fall electrofishing (FE) using a WDNR standard PDC boom shocker boat was conducted at night on September 21 to assess the abundance and recruitment of young-of-the-year and yearling Walleye. The FE survey encompassed the entire shoreline (3.54 miles) and included 1.72 hours of sampling effort. Sampling began at 1913 h and concluded at 2056 h. Pulsed direct current was used at 480 volts, 12 amps with a pulse rate of 80 per second and 25 percent duty cycle. FE sampling used one dipper (due to COVID-19 social distancing requirements), two probes with a total of 16 droppers, and a dip net bar mesh of 0.375 inches. Water temperature was 73 degrees Fahrenheit. During FE sampling, only Northern Pike and Walleye were sampled and were measured to the nearest 0.1 inch.

Figure 2. Fyke net locations during the 2021 Comprehensive Fisheries Survey of Crystal Lake, Sheboygan County, Wisconsin.

Data Analysis

Fyke net total catch and catch-per-unit effort (CPUE, #/net night) were calculated to estimate relative abundance; electrofishing total catch and CPUE (#/mile; #/hour) were also calculated. Length frequency histograms were constructed for Walleye, Northern Pike, Largemouth Bass, Bluegill and Rock Bass to assess size structure.

Relative weight, the ratio of a fish's weight to the weight of a standard fish of the same length based on a scale of 100, was used to assess body condition of Walleye, using a standard length-at-weight equation (Willis, 1998). Relative weight values between 75 and 100 indicate normal weight for a given length. A relative weight value greater than 100 indicates that a fish is in excellent condition. A relative weight value less than 75 indicates that a fish is in poor condition.

Proportional size distribution (PSD) was also calculated for Walleye, Largemouth Bass, and Bluegill. Stock lengths are based on standardized lengths for each species: Walleye (10

inches), Largemouth Bass (8 inches), Bluegill (3 inches); quality lengths used were Walleye (15 inches), Largemouth Bass (12 inches), and Bluegill (6 inches). Proportional size distribution-preferred (PSD-P) was also calculated for Walleye, Largemouth Bass, and Bluegill to assess the proportion of fish in the population that are a length preferred by anglers. These are based on standardized lengths for each species: Walleye (20 inches), Largemouth Bass (15 inches), and Bluegill (8 inches) (Anderson and Neuman, 1996). Age data was obtained from structures taken from Northern Pike (anal fin rays), Walleye (dorsal spines), and Bluegills (otoliths) collected throughout the survey. Structures were mounted in epoxy and sectioned using a Buehler Isomet low speed sectioning saw. Sectioned wafers were viewed and imaged using an Olympus SZX7 Microscope. Growth data from Crystal Lake was compared to statewide and regional mean growth rates utilized in the WDNR Fisheries Information System (FMIS) database.

Results and Discussion

Northern Pike

Sixteen Northern Pike were sampled during 2021 SNI for a catch rate of 0.15 Northern Pike/net night. This catch rate is well below average when compared to lakes with similar characteristics (complex, warm water temperatures and clear water) across the state. The average length was 18.1 inches, lengths ranged from 11.0 inches to 22.8 inches and the largest Northern Pike was 22.8 inches and weighed 1.6 pounds (Figure 3). Eight female Northern Pike, five male Northern Pike and three unknown sex Northern Pike were marked with fin clips during SNI. In 2012, twenty-seven Northern Pike were sampled during SNI for a CPUE of 0.21 Northern Pike/net night. Mean length was 18.7 inches; lengths ranged from a 10.6 to 27.9 inches and the largest Northern Pike was a female weighing 4.7 pounds. Twelve female, thirteen males, and one unknown sex Northern Pike were marked with fin clips during SNI; 1 female was resampled. In 2001, 280 Northern Pike were sampled in SNI for a catch rate of 4.83/net night.

Five Northern Pike were sampled in 2021 SEI for a catch rate of 1.39 Northern Pike/mile (2.86 Northern Pike/hour). Northern Pike mean length was 18.2 inches and ranged from 7.8 to 21.9 inches. In 2012, SEI sampling was not conducted due to the low catch of Northern Pike sampled in SNI. In 2001, 18 Northern Pike were sampled in SEI for a catch rate of 7.5 Northern Pike/mile (18 Northern Pike/hour). Zero Northern Pike were sampled in 2021 SEII. In 2012, eighteen Northern Pike were sampled in SEII for a catch rate of 3.0 Northern Pike/mile (5.84

Northern Pike/hour). Lengths ranged from 9.3 to 25.7 inches and mean length was 17.9 inches. In 2001, three Northern Pike were sampled in SEII, for a catch rate of 0.63 Northern Pike/mile (1 Northern Pike/hour). A Northern Pike population estimate was not obtained due to the small sample sizes obtained during the 2021 survey. A population estimate was not obtained from the 2012 survey for the same reason. Likewise, Northern Pike PSD, PSD-P, and relative weight were also not calculated due to small sample sizes.

Anal fin rays were collected from Northern Pike during the 2021 survey to obtain age estimates. Although mean length at age was calculated, the small sample size (n = 18) limits the use of this data. From the very limited data available, Northern Pike in Crystal Lake appear to grow on par with the statewide average (Figure 4). Only one age five fish was detected; therefore, the age five data point may be artificially low.

The 2001 comprehensive fishery survey reported much higher SNI catch rates (4.83 Northern Pike/net night) compared to SNI conducted in 1992 (0.8 Northern Pike/net night). Of the 280 Northern Pike sampled in 2001 SNI, only two Northern Pike were greater than the 26-inch minimum size limit, the regulation at the time of the survey. The majority of Northern Pike sampled were less than 21 inches (87%) and the population was dominated by Northern Pike in the 18-inch length mode. Reported growth was slightly above the statewide average for the species. Mortality rate was estimated via catch-curve data; and mortality for Northern Pike ages 2-6 was estimated at 70.8%. This was higher than expected given the 26-inch minimum length limit regulation, though still considered “normal” for the species. The increase in Northern Pike abundance between the 1992 and 2001 surveys resulted in the recommendation to remove the 26-inch minimum length limit, with the goal of increasing harvest to reduce predation pressure on Yellow Perch and satisfy angler needs.

The low catch rates during the 2021 and 2012 surveys may be attributed to low gear effectiveness. The challenges of achieving effective net sets in Crystal Lake impacts the ability to obtain a representative sample. Once placed in traditional set locations, fyke nets were not moved during the duration of the 2021 and 2012 surveys. During the 2001 survey, fyke nets were moved around the lake to attempt to better intercept fish, which may have contributed to a higher catch rate in 2001. The Northern Pike population should be more effectively evaluated during the next spring netting survey to facilitate calculation of a population estimate, PSD, PSD-P, condition, growth, and mortality. The current no minimum length, five fish daily bag limit

regulation is unlike other lakes in the southern management zone and needs to be evaluated pending population metrics obtained during the next comprehensive fishery survey and estimated angler pressure.

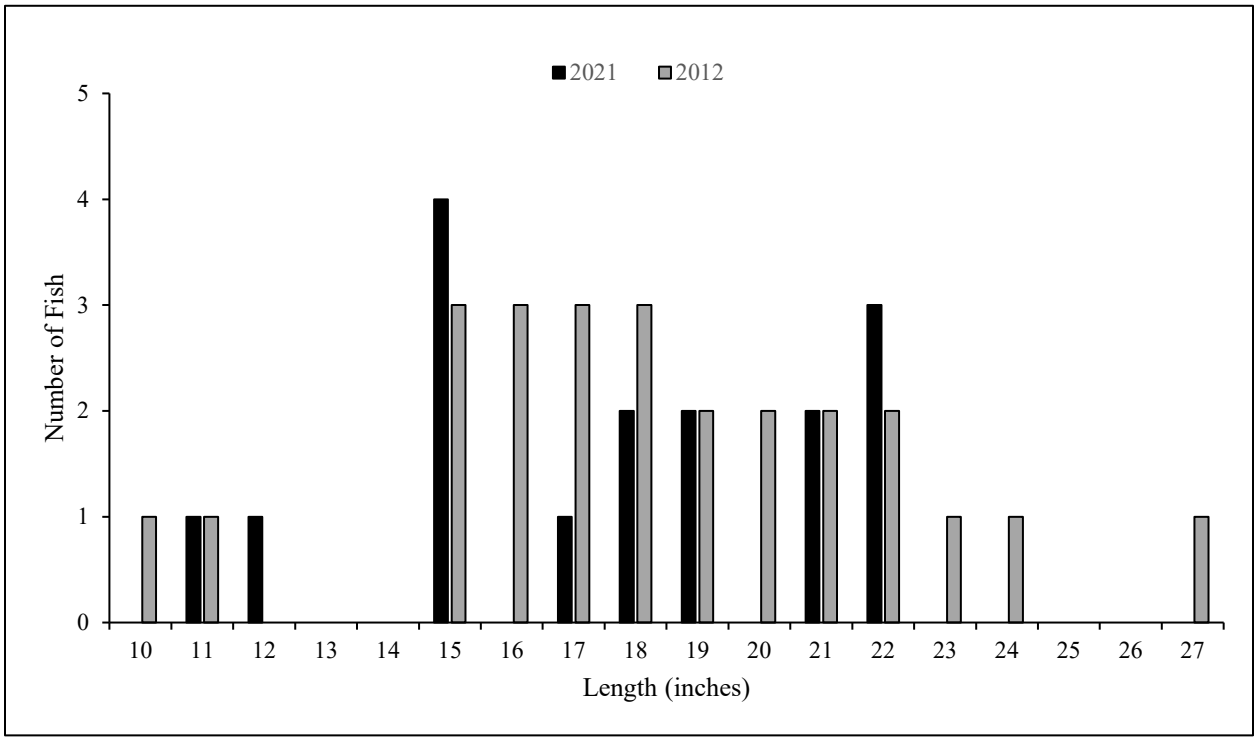

Figure 3. Length-frequency histogram of Northern Pike during the 2021 and 2012 spring netting (SNI) surveys of Crystal Lake, Sheboygan County, Wisconsin.

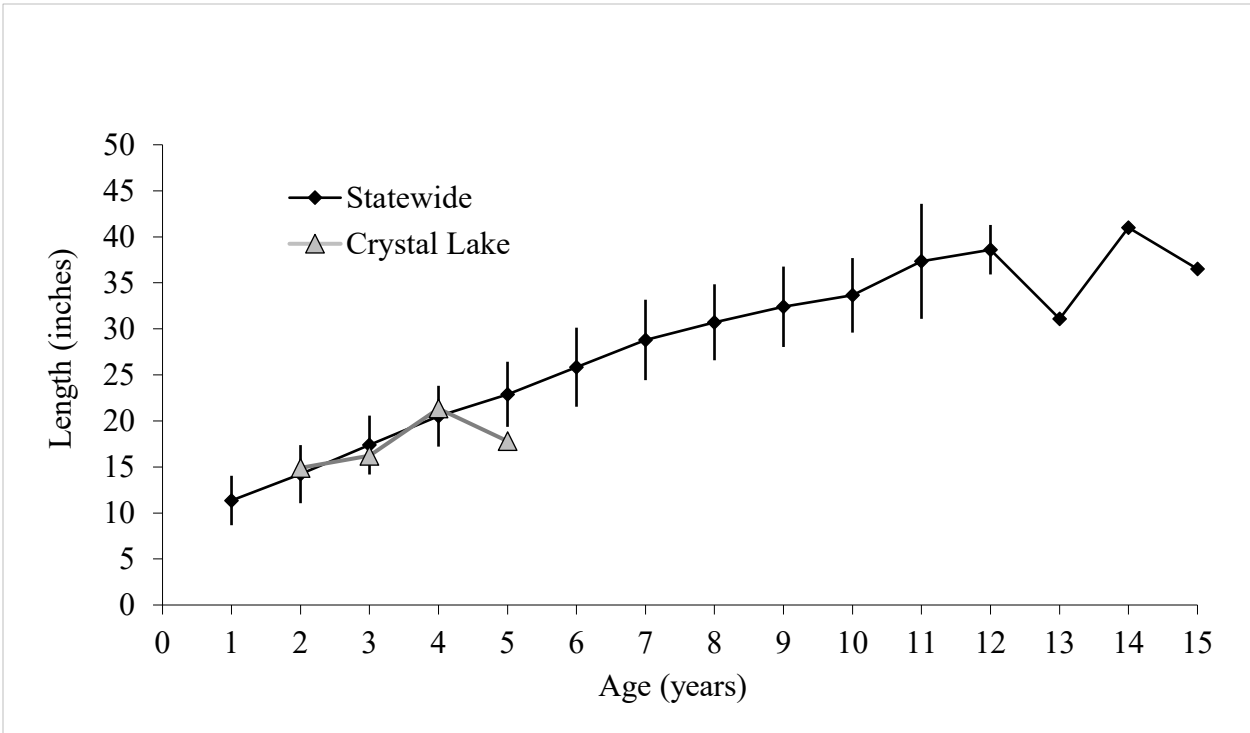

Figure 4. Northern Pike mean length at age compared to statewide mean, determined using anal fin rays collected during the 2021 spring fyke netting survey (SN1) of Crystal Lake, Sheboygan County, Wisconsin.

Walleye

Thirty-seven Walleye (including 3 resampled fish) were sampled during 2021 SNI for a catch per unit effort (CPUE) of 0.36 Walleye/net night (Figure 5). This catch rate is below average when compared to lakes with similar characteristics (complex, warm water temperatures and clear water) across the state. Eight females, 17 males, and nine unknown sex Walleye were marked with fin clips during SNI. Walleye mean length was 17.5 inches and lengths ranged from 9.0 to 25.2-inches. The largest walleye was 25.2 inches in length and weighed 5.8 pounds (Figure 5). Adult Walleye showed a length frequency mode of 20.0 inches (Figure 5). Female Walleye showed a length frequency mode of 21.0 inches, while males showed a modal length of 20.0 inches (Figure 5). Fourteen Walleye were sampled in 2012 SNI for a catch rate of 0.11 Walleye/net night. Mean length was 20.6 inches and fish ranged from 13.0 to 26.7-inches (Figure 6). The largest Walleye was a female weighing 6.5 pounds (Figure 6). Six females and six males were marked during SNI; 1 female and 1 male were recaptures. In 2001, nineteen Walleye were sampled in SNI for a catch rate of 0.33 Walleye/net night.

Two Walleye were sampled during 2021 SEI for a catch rate of 0.56 Walleye/mile (1.14 Walleye/hour), both were males, measuring 19.4 inches and weighing 2.5 pounds, and 20.5 inches, 2.6 pounds. A second SEI survey to intercept more marked fish was not attempted in 2021. In 2012, SEI sampling was not conducted due to the low catch of Walleye sampled in SNI. In 2001, four Walleye were sampled in SEI for a catch rate of 1.67 Walleye/mile (4 Walleye/hour).

During 2021 SEII, three Walleye were sampled for a catch rate of 0.43 Walleye/mile (0.95 Walleye/hour). Mean length was 13.6 inches, and lengths ranged from 10.5 to 18.8 inches. In 2012 SEII, thirteen Walleye were sampled for a catch rate of 2.2 Walleye/mile (4.2 Walleye/hour). Mean length was 12.8 inches, and fish ranged from 9.8 to 22.7 inches. In 2001, one Walleye was sampled in SEII for a catch rate of 0.21 Walleye/mile (0.33 Walleye/hour). No Walleye were sampled during 2021 FE; electrofishing was conducted when water temperatures were still high so that sampling could occur before the lake was stocked with large fingerling Walleye.

A Walleye population estimate was not obtained due to the small sample sizes obtained during the 2021 survey. A population estimate was not obtained from the 2012 survey for the same reason. Like Northern Pike, the low catch rates of Walleye during the 2021 and 2012 surveys may be attributed to low gear effectiveness. The challenges of achieving effective net sets in Crystal Lake impacts the ability to obtain a representative sample.

Gender-specific proportional stock density (PSD), using a stock length of 10 inches and a quality length of 15 inches was calculated for Walleye sampled during 2021 SNI (Table 2). Proportional stock density values for males and females were 100 because all sexually identifiable fish sampled were above the 10-inch stock size. Male relative stock density (PSD-20), using a stock length of 10 inches and a preferred length of 20 inches, was 47, compared to 63 for females. All females sampled were above the current 18-inch minimum length limit and 70.6% of males and 58.8% of all Walleye sampled were legal for harvest.

Walleye body condition during the 2021 SNI survey was very good, as suggested by relative weight (W_r) values ranging from 79 to 109, with a mean W_r of 96 (n = 34). Sex specific relative weight for females was very good and ranged from 89 to 109 with a mean W_r of 100 (n = 8). Male sex specific relative weight was good and ranged from 79 to 106 with a mean W_r of 91 (n = 17). Relative weight values between 75 and 100 indicate normal weight for a given length

and values greater than 100 indicate that a fish is in excellent condition. Relative weight for male Walleye was generally lower than females given the females' spawning condition and presence of eggs at the time of capture.

The last full comprehensive fishery survey in 2001 found Walleye to be scarce due to poor stocking effort and success. At that time, stocking had only recently resumed with the goal of reestablishing a Walleye fishery after several years of no stocking.

Walleye in Crystal Lake grow faster than the statewide and district averages after age two, with most fish reaching the current 18-inch minimum size limit by age four (Figure 7, Figure 8). On average, female Walleye reach legal harvestable size (18-inches) by age three and males by age four. Although Walleye are scarce in Crystal Lake, growth rates exceed state and regional averages, indicating that Walleyes are successfully finding adequate prey.

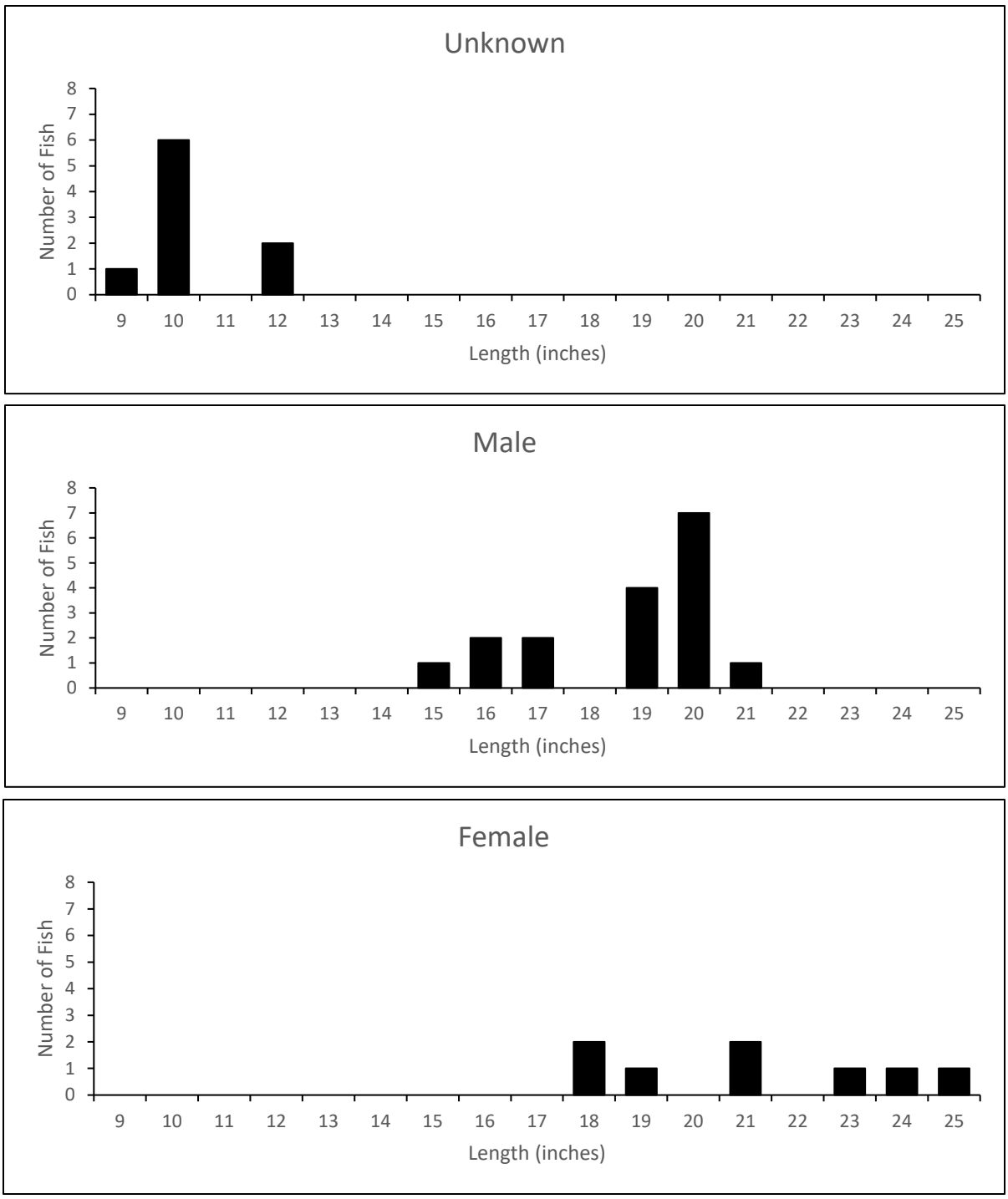

Figure 5. Length-frequency histogram of unknown, male, and female sex Walleye during the 2021 spring netting (SNI) survey in Crystal Lake, Sheboygan County, Wisconsin.

Table 2. Number of individual Walleye as 'stock' and 'quality' size and resulting proportional stock densities for Crystal Lake, including the percentage of fish at or above 18 inches (legal minimum length) for Walleye sampled during 2021 SNI.

	Stock	Quality	Preferred	Memorable	Trophy	PSD	PSD-P	% Legal
Length (in)	**10**	**15**	**20**	**25**	**30**			
All	33	25	13	1	0	75.8	39.4	58.8
Male	17	17	8	0	0	100.0	47.1	70.6
Female	8	8	5	1	0	100.0	62.5	100.0

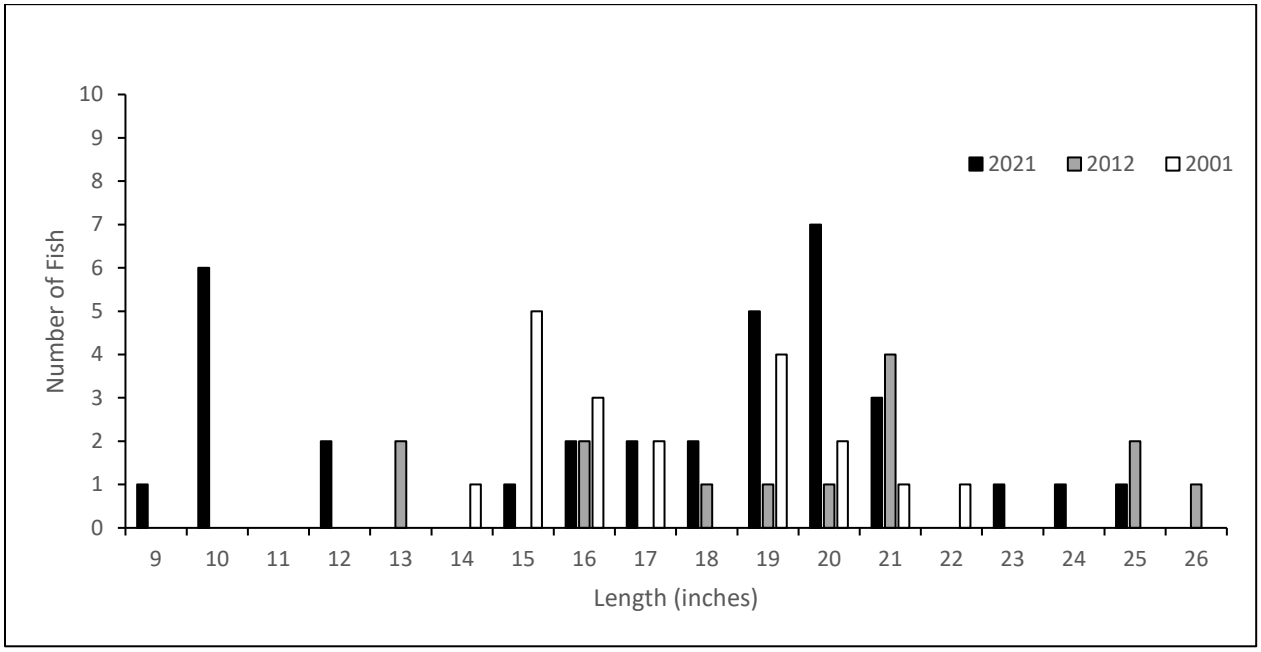

Figure 6. Length-frequency histogram of Walleye during the 2021, 2012, and 2001 spring netting (SNI) surveys in Crystal Lake, Sheboygan County, Wisconsin.

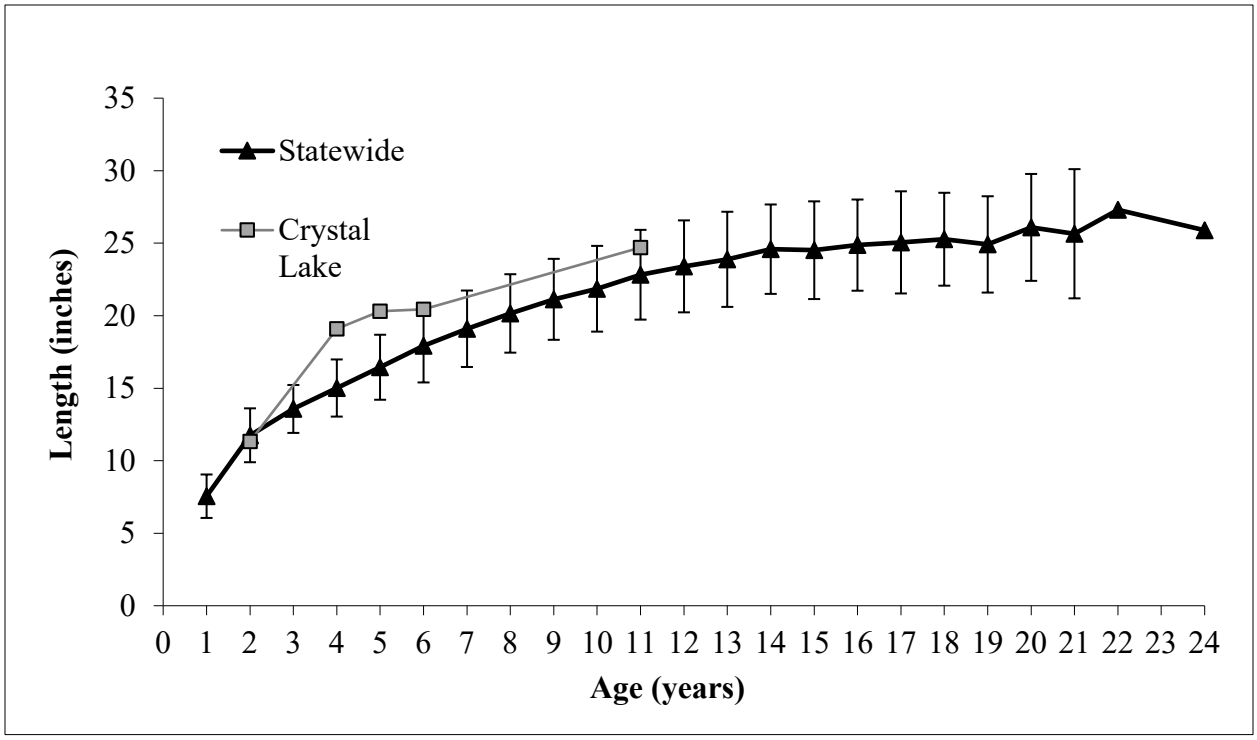

Figure 7. Walleye mean length at age compared to statewide mean length, determined using dorsal spines collected during the 2021 spring fyke netting survey (SN1) of Crystal Lake, Sheboygan County, Wisconsin.

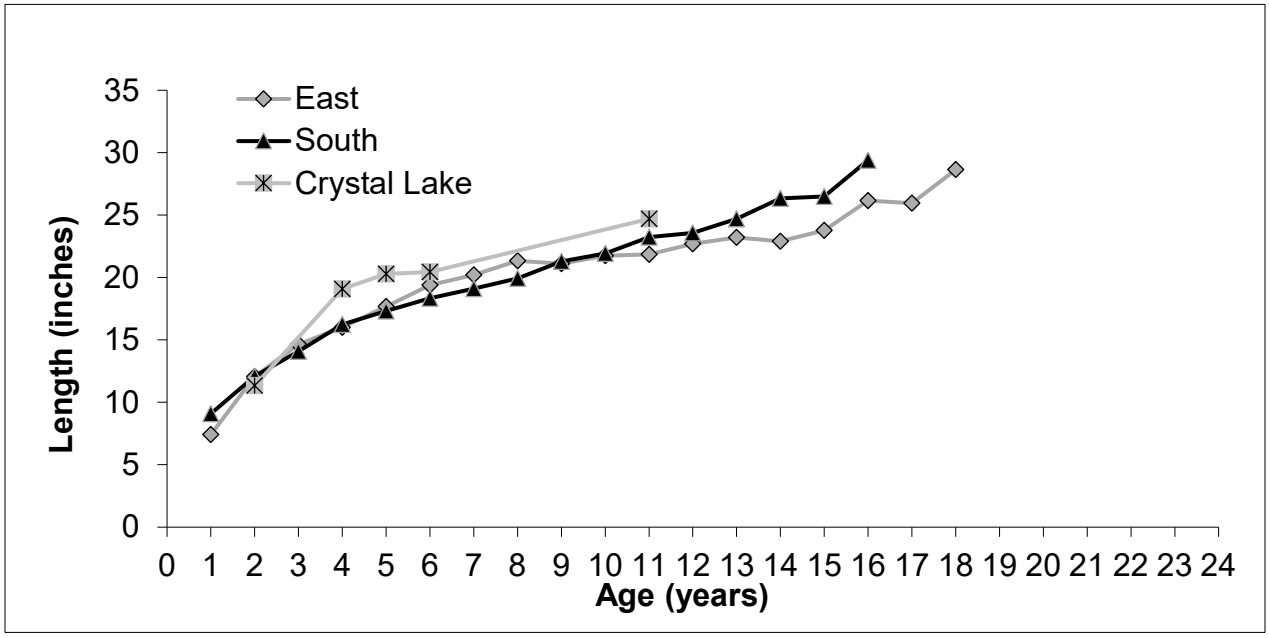

Figure 8. Walleye mean length at age compared to east and south district means, determined using dorsal spines collected during the 2021 spring fyke netting survey (SN1) of Crystal Lake, Sheboygan County, Wisconsin.

Crystal Lake has been stocked with large fingerling Walleye by the DNR as part of the Wisconsin Walleye Initiative (WWI) in alternate years since 2015 (Table 1). Stocking rate has ranged from 10/acre in 2015, 20/acre in 2017 and 12/acre in both 2019 and 2021. Prior to the WWI stocking, small fingerling Walleye were stocked by the DNR, with stocking rates varying from 118/acre in 2004 to 2/acre in 1995. By comparing aging data with stocking data, it appears that year classes have been established in years the lake was stocked with large fingerling Walleye. Age-6 fish were most likely a result of the first WWI large fingerling stocking in 2015 (Table 1; Figure 7). Age-4 fish, correlating to the second year of large fingerling stocking in 2017 and age two fish correlating to the large fingerling stocking in 2019 were also present. Interestingly, the small fingerling Walleye stocking in 2010 appears to have established a year class, represented by the oldest fish (age 11) sampled in the survey. Although sample size was small (n = 5) the 2021 survey did indicate the presence of age-5 Walleye, correlating to a 2016-year class, with no Walleye stocking occurring in 2016. Additionally, FE conducted in 2019 and 2020 suggest the presence of potentially naturally reproduced Walleye. More evaluation is needed, including validation by ageing, to best assess natural reproduction of Walleye in Crystal Lake.

Large fingerling Walleye stocking appears to be establishing year classes; however, a population estimate could not be calculated from the 2021 survey data due to a low number of recaptured Walleye. This likely indicates that the Walleye population is not providing a minimum fishable population for anglers and is below the desired level of 2/acre for stocked Walleye populations. This is further supported by very low catch rates for Walleye in previous fyke net and electrofishing surveys since 2001, despite stocking efforts. The high growth rate of Walleye in Crystal Lake is also indicative of a low-density population that is not resource limited by intraspecific competition. Given the apparent failure of extensive stocking efforts to establish a minimum fishable population of 2 adult Walleye/acre, agency stocking efforts may no longer be warranted. However, if sufficient public support and funding exists, private stocking events could be permitted to maintain a walleye angling opportunity.

Largemouth Bass

Twelve Largemouth Bass (including 3 recaptured fish) were sampled during SNI for a CPUE of 0.12 Largemouth Bass/net night. All fish were unknown sex. Mean length was 13.0

inches and lengths ranged from 7.5 to 15.6 inches. In 2001 SNI, 22 Largemouth Bass were sampled for a catch rate of 0.38 Largemouth Bass/net night. Since bass are not targeted during SNI fyke netting surveys, this data was not used in any analyses.

A total of 62 Largemouth Bass were sampled during the 2021 SEII survey for a catch rate of 8.8 Largemouth Bass/mile (19 Largemouth Bass/hour). This catch rate is below average when compared to lakes with similar characteristics (complex, warm water temperatures and clear water) across the state. The mean length was 10.8 inches, lengths ranged from 2.9 to 17.1 inches. Largemouth Bass sampled in 2021 SEII displayed a length frequency mode of 7.9 inches; additional year classes may be represented in the 10 to 11 and 12 to 13-inch length bins (Figure 9).

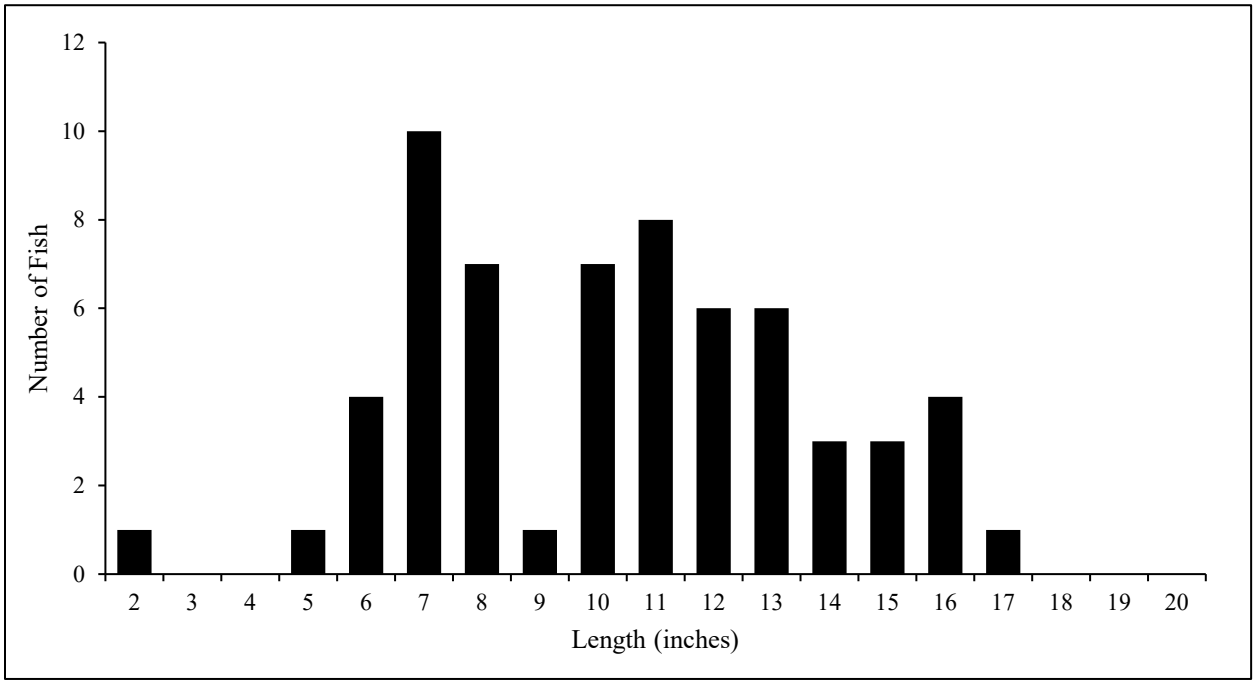

Figure 9. Length-frequency histogram of Largemouth Bass during the 2021 spring electrofishing (SEII) surveys in Crystal Lake, Sheboygan County, Wisconsin

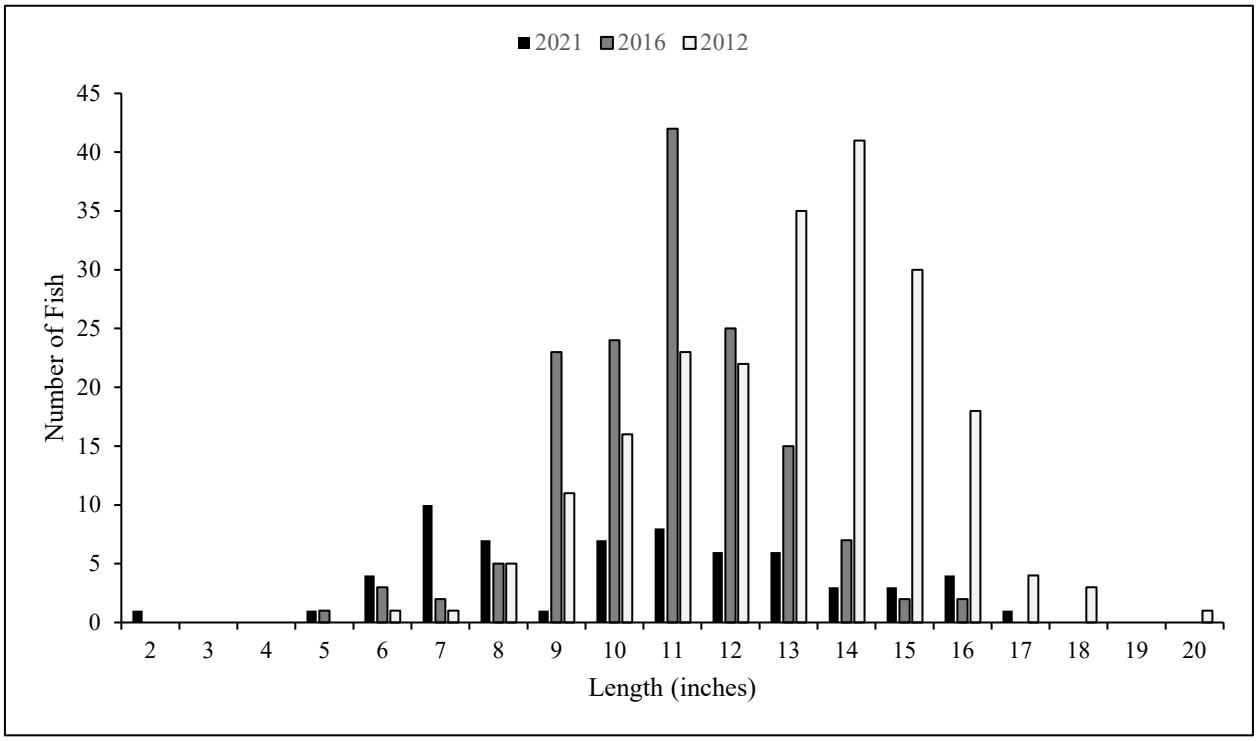

Figure 10. Length-frequency histogram of Largemouth Bass during the 2021, 2016, and 2012 spring electrofishing (SEII) surveys in Crystal Lake, Sheboygan County, Wisconsin.

One-hundred fifty-one Largemouth Bass were sampled during 2016 SEII for a catch rate of at 50.3 Largemouth Bass/mile (95.3 Largemouth Bass/hour). This catch rate is above average when compared to lakes with similar characteristics (complex, warm water temperatures and clear water) across the state. Lengths ranged from 5.2 to 16.6 inches; mean length was 11.2 inches. In 2012 SEII, 211 Largemouth Bass were sampled for a catch rate of 35.2 Largemouth Bass/mile (68.4 Largemouth Bass/hour). Mean length was 12.9 inches; lengths ranged from 5.7 to 20.1 inches (Figure 10). In 2001 SEII, 105 Largemouth Bass were sampled for a catch rate of 21.9 Largemouth Bass/mile (35 Largemouth Bass/hour). Catch rate of Largemouth Bass has decreased considerably since 2016 from 95.3/hour to 68.4/hour in 2012 to 19.7/hour in 2021.

Largemouth Bass PSD calculated from 2021 SEII data for quality size fish 12 inches and greater was 50 (n = 23); PSD-P was 17 for preferred size fish greater than 15 inches (n = 8). In the 2016 SEII survey data, PSD was 35 (n = 51) and PSD-P was 3 (n=4). PSD in 2012 was 69 (n = 143) and PSD-P was 20 (n = 41; Table 3). A balanced Largemouth Bass population typically displays PSD values between 40-60. The PSD of Largemouth Bass sampled during the 2021 SEII survey was 50, indicating small fish recruiting into the population, but limited quality and

preferred size bass. However, size structure did improve from 2016, where most bass sampled were stock size and PSD-P was only 3. The Largemouth Bass population displayed the best size structure during the 2012 survey, with 35.5% of all Largemouth Bass sampled being legal for harvest and many fish recruiting into the population.

No scales samples or ageing structures were taken from Largemouth Bass, so mean length at age cannot be obtained for 2021, 2016 or 2012. Relative weight could not be calculated, as no weights were taken to assess body condition. Future surveys should collect these data to evaluate Largemouth Bass growth and condition and assess effectiveness of the current 14-inch minimum length, five fish daily bag limit regulation.

Table 3. Number of individual Largemouth Bass as 'stock' and 'quality' size and resulting proportional stock densities for Crystal Lake, Sheboygan County, WI. The percentage of sampled fish equal to or greater than 14 inches was also calculated.

	Stock	**Quality**	**Preferred**	**Memorable**	**Trophy**	**PSD**	**PSD-P**	**% Legal**
Length (in)	**8**	**12**	**15**	**20**	**25**			
2021	46	23	8	0	0	50.0	17.4	17.7
2016	145	51	4	0	0	35.2	2.8	7.3
2012	207	143	41	1	0	69.1	19.8	35.5

Bluegill

Ten Bluegill were sampled during 2021 SNI for a catch rate of 0.10 Bluegill/net night, however fish were not individually identified with a mark; therefore, individual Bluegill may have been netted multiple times. Mean length was 6.9 inches and lengths ranged from 5.1 to 8.7 inches. During the 2012 SNI survey, 18 Bluegill were sampled at a CPUE of 0.14 Bluegill/net night, Mean length was 6.0 inches and lengths ranged from 3.3 to 8.0 inches. In 2001 SNI, 41 Bluegill were sampled for a catch rate of 0.71 Bluegill/net night. Bluegill are not targeted during SNI surveys; this data was not used in any analyses.

A total of 249 Bluegill were sampled during 2021 SEII for a catch rate of 49.4 Bluegill/mile (100.9 Bluegill/hour). The mean length was 4.9 inches, lengths ranged from 2.0 to 8.6 inches. A strong year class appears to be represented in the 5-inch mode (Figure 11). In 2016 SEII, 171 Bluegill were sampled for a catch rate of 171 Bluegill/mile (293.1 Bluegill/hour).

Mean length was 6.2 inches, lengths ranged from 2.4 to 8.6 inches. In 2012 SEII, 61 Bluegill were sampled for a catch rate of 61 Bluegill/mile (122/Bluegill hour). Mean length was 5.7 inches; lengths ranged from 3.1 to 8.4 inches (Figure 11).

Although size ranges remained similar between the three SEII survey events, mean length decreased from 6.2 inches in 2016, to 5.7 inches in 2012 to 4.9 inches in 2021. More notably, catch rate decreased from 171 Bluegill/mile in 2016, to 61/mile in 2012 to 49.4/mile in 2021.

The PSD value calculated from 2021 data for quality size fish 6 inches and greater was 33 (n = 74); PSD-P was 6 for preferred size fish greater than 8 inches (n = 13). In 2016, PSD was 68 (n = 116) and PSD-P was 7 (n=13). PSD in 2012 was 46 (n = 28) and PSD-P was 3 (n = 2). PSD values between 40-60 generally describe a balanced population. The minimum PSD-P guideline is 5; both 2021 and 2016 values were over this threshold, an increase from the 2012 survey. However, the PSD decreased since 2016.

Table 4. Number of individual Bluegill as 'stock' and 'quality' size and resulting proportional stock density and relative stock density for Crystal Lake, Sheboygan County, WI.

	Stock	**Quality**	**Preferred**	**Memorable**	**Trophy**	**PSD**	**PSD-P**
Length (in)	**3**	**6**	**8**	**10**	**12**		
2021	227	74	13	0	0	32.6	5.7
2016	170	116	13	0	0	68.2	7.7
2012	61	28	2	0	0	45.9	3.3

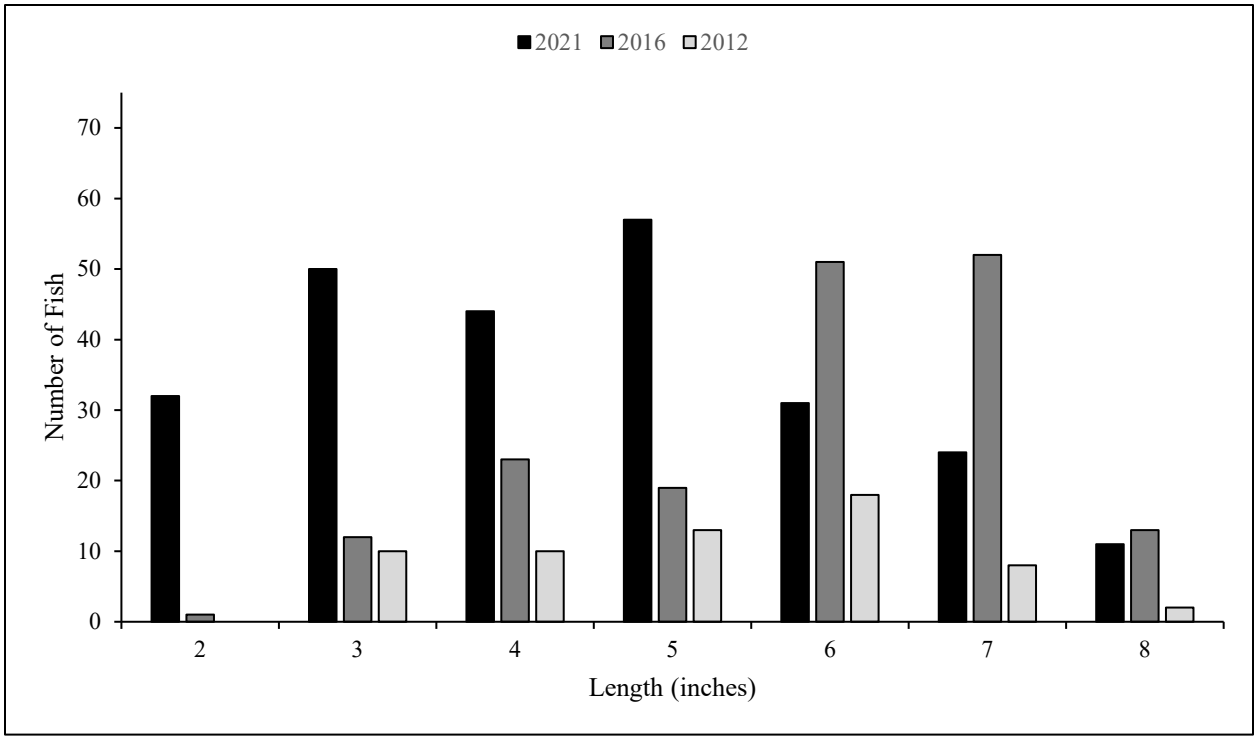

Figure 11. Length-frequency histogram of Bluegill during the 2021, 2016, and 2012 spring electrofishing (SEII) surveys in Crystal Lake, Sheboygan County, Wisconsin.

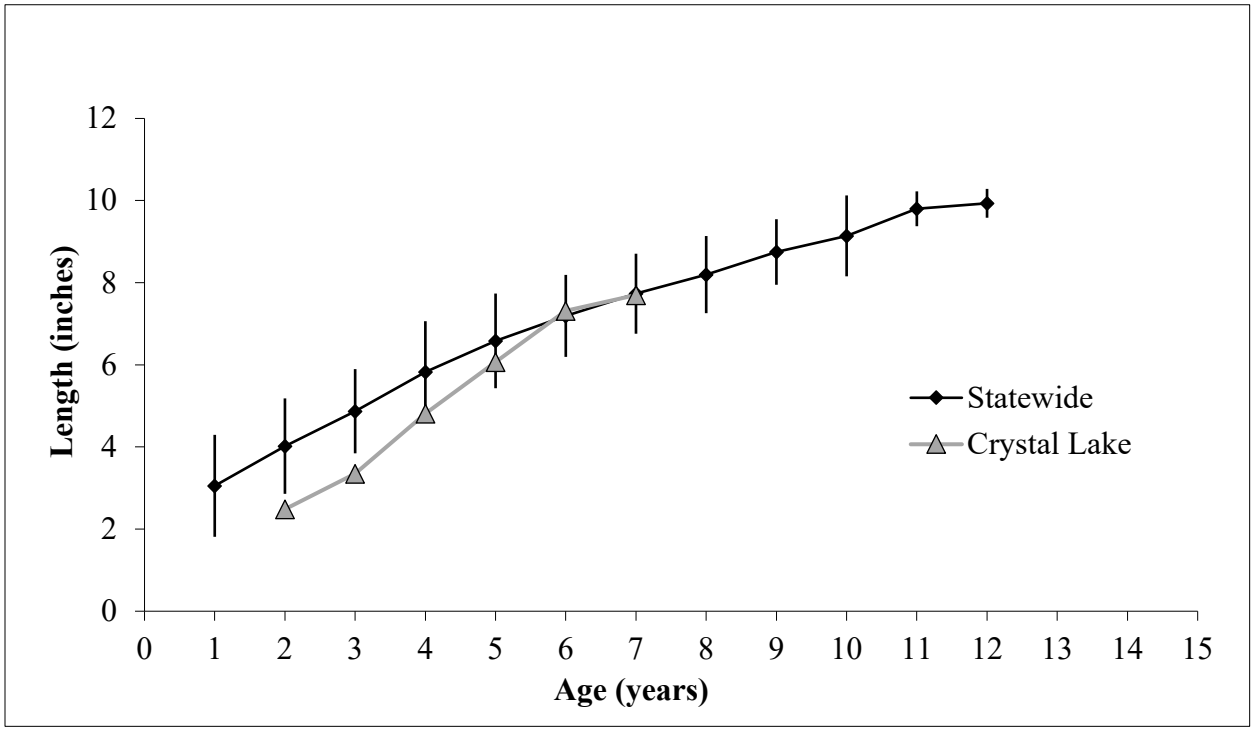

Figure 12. Bluegill mean length at age determined using otoliths collected during the 2021 spring electrofishing (SEII) survey of Crystal Lake, Sheboygan County (N=65).

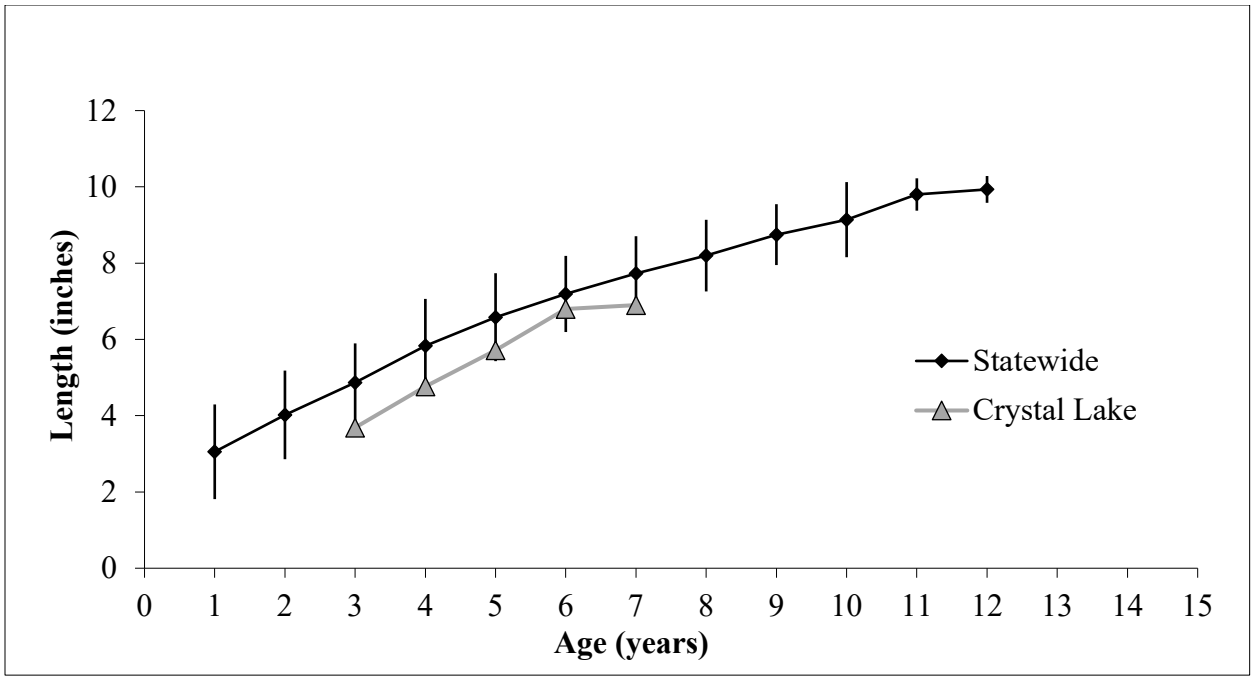

Figure 13. Bluegill mean length at age determined using otoliths collected during the 2012 spring electrofishing (SEII) survey of Crystal Lake, Sheboygan County (N=44).

Bluegill growth rate was lower than the statewide mean growth rate in both the 2021 and 2012 surveys (Figure 12, Figure 13). Due to slow growth, Bluegill might not be able to withstand a high level of exploitation without significantly reducing the percentage of quality and preferred size fish in the population, hence the low PSD and PSD-P. Bluegill may also be food limited due to intraspecific and interspecific competition among panfish species, leading to slow growth. An average length of five inches provides mediocre fishing opportunities for Bluegill in Crystal Lake. Few options exist to improve the size structure of Bluegill in Crystal Lake; perhaps with higher densities of predatory gamefish species, panfish that escape predation may experience higher growth rates with lessened competition for resources among panfish.

Rock Bass

One-hundred and twenty-nine Rock Bass were sampled during SNI for a catch rate of 1.24 Rock Bass/net night. Rock Bass mean length was 7.5 inches, lengths ranged from 4.2 to 11.2 inches (Figure 14). Fish were not individually identified with a fin clip mark; therefore, individual Rock Bass may have been netted multiple times. In 2012 SNI, 109 Rock Bass were

sampled. Lengths ranged from 2.8 inches to 10.4 inches; mean length was 6.5 inches (Figure 14). In 2001 SNI, 45 Rock Bass were sampled for a catch rate of 0.78 Rock Bass/net night.

Six Rock Bass were sampled during 2021 SEII for a catch rate of 4 Rock Bass/mile (8 Rock Bass/hour). Mean length was 6.7 inches, lengths ranged between 4.0 inches and 9.7 inches. In 2016 SEII, 12 Rock Bass were sampled for a catch rate of 12 Rock Bass/mile (20.6 Rock Bass/hour). Mean length was 6.5 inches; lengths ranged from 3.1 to 9.3 inches. In 2012 SEII 14 Rock Bass sampled for a catch rate of 28 Rock Bass/mile (56 Rock Bass/hour). Mean length was 6.2 inches.; lengths ranged from 3.3 to 11.3 inches. Although mean length remained similar between the three SEII survey events, catch rate decreased from 28 Rock Bass/mile in 2012, to 12 Rock Bass/mile in 2016 to 4 Rock Bass/mile in 2021.

Rock Bass provide an additional panfish species for anglers to harvest, although they are not typically targeted by panfish anglers. Due to the rocky habitat in Crystal Lake, Rock Bass are one of the most successful panfish species in the lake. Rock Bass in Crystal Lake average 7.5 inches in length and can reach sizes over 10 inches, offering a good fishing opportunity, especially for younger anglers.

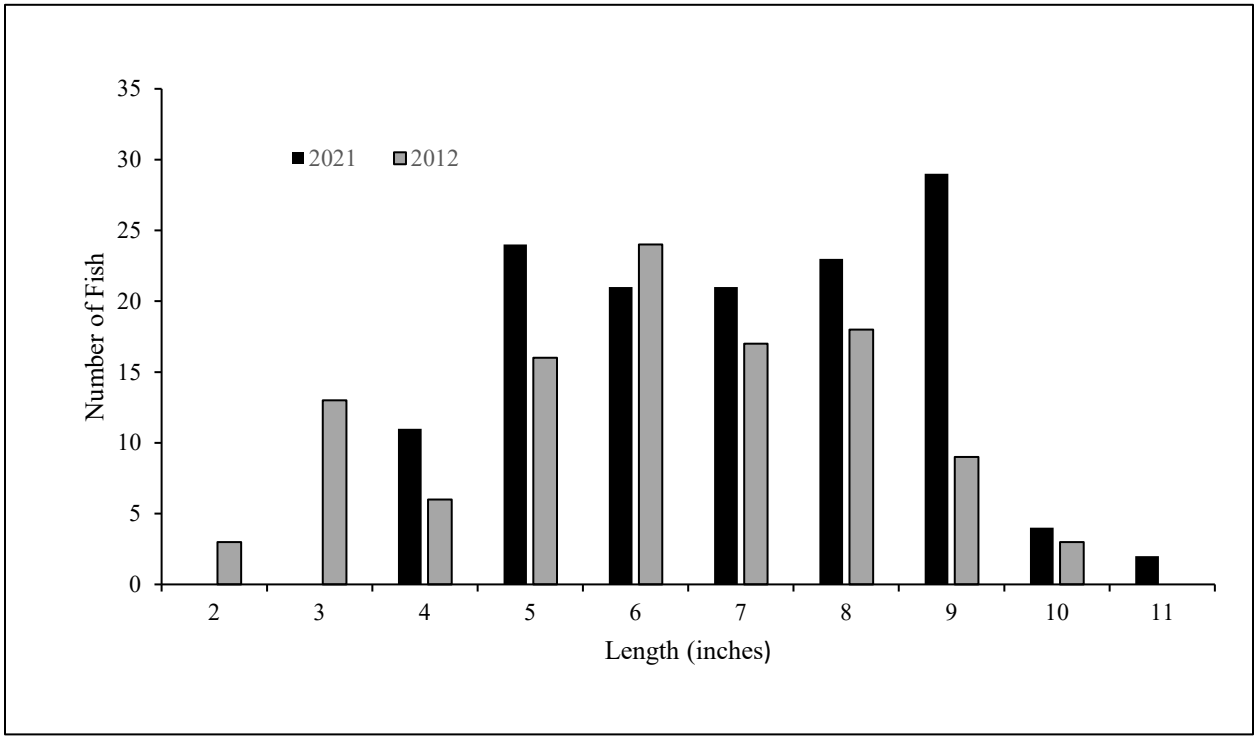

Figure 14. Length-frequency histogram of Rock Bass during the 2021 and 2012 spring netting (SN1) surveys in Crystal Lake, Sheboygan County, Wisconsin.

Yellow Perch

Twelve Yellow Perch were sampled during 2021 SNI for a catch rate of 0.12 Yellow Perch/net night. Fish were not individually identified with a fin clip mark; therefore, individual Yellow Perch may have been netted multiple times. Mean length was 7.1 inches, lengths ranged from 5.4 inches to 10.8 inches. In 2001 SNI, 253 yellow perch were sampled for a catch rate of 4.36 Yellow Perch/net night.

In 2021 SEII, one 6.2-inch Yellow Perch was sampled for a catch rate of 0.20 Yellow Perch/mile (0.41 Yellow Perch/hour). In 2016 SEII, one 4.8-inch Yellow Perch was sampled for a catch rate of 1 Yellow Perch/mile (1.7 Yellow Perch/hour). In 2012 SEII, one 8.6-inch Yellow Perch was sampled for a catch rate of 1 Yellow Perch/mile (2 Yellow Perch/hour). It should be noted that SEII surveys do not effectively sample Yellow Perch populations in inland lakes. The DNR is currently exploring other possible options to better sample Yellow Perch populations.

Historically, Yellow Perch were the most abundant fish encountered in SNI fyke net surveys. During the 2001 comprehensive survey, 259 Yellow Perch were sampled in SNI for a catch rate of 3.7/net night; in 1992 the CPUE was 5.9 Yellow Perch/net night. 2001 SEII catch rate was also low, with 15 Yellow Perch sampled over two nights of electrofishing for a catch rate of 3.1/mile and 5.0/hour. In 2001, length frequency was dominated by fish in the 4.5-5 half inch length bin, with very few Yellow Perch over 7.0 inches. A “quality” size perch of eight inches is widely considered the minimum size for harvest by anglers. The 2001 comprehensive survey report stated that Crystal Lake was once known for producing good catches of “jumbo” perch, postulating that the decline in Yellow Perch was due to an expanding Northern Pike population, as Northern Pike catch rate was higher in 2001 compared to previous surveys. Northern Pike are effective predators known to select for larger perch and have been regarded as the major problem in Yellow Perch populations with declining size structure. In 2001, the growth rate of Yellow Perch was similar to statewide averages at all ages; it was assumed that fish were able to find sufficient food. Mortality rate in 2001 was estimated at 71.1% for ages 3-6, considered normal to slightly higher than many lakes. Such metrics have not been calculated since the 2001 survey due to low catch.

The decline in the catch rate of Yellow Perch since the 2001 SNI survey cannot be fully attributed to population decline, as sampling events have not effectively targeted Yellow Perch. Low catch numbers of Northern Pike in more recent years make it unlikely that the reason for

low Yellow Perch catch rate is solely due to predation, as was suggested in 2001. A future survey that effectively targets Yellow Perch, along with collection of age structures to assess growth, is necessary to reevaluate the Yellow Perch population in Crystal Lake.

Pumpkinseed

Three Pumpkinseed were sampled during 2021 SNI for a catch rate of 0.03 Pumpkinseed/net night. Fish were not individually identified with a fin clip mark; therefore, individual Pumpkinseed may have been netted multiple times. Mean length was 6.7 inches, lengths ranged from 5.8 to 7.5 inches. In 2012, five pumpkinseeds were sampled during SNI; mean length was 7.3 inches, with lengths ranging between 6.6 and 7.8 inches. In 2001 SNI, 8 Pumpkinseed were sampled for a catch rate of 0.14 Pumpkinseed/net night.

In 2021 SEII, one 7.8-inch Pumpkinseed was sampled for a catch rate of .67 Pumpkinseed/mile (1.33 Pumpkinseed/hour). In 2016 SEII, 10 Pumpkinseed were sampled for a catch rate of 10 Pumpkinseed/mile (17.1 Pumpkinseed/hour). Mean length was 6.9 inches; lengths ranged from 4.0 to 8.0 inches. In 2012 SEII 10 Pumpkinseed were sampled for a catch rate of 20 Pumpkinseed/mile (40 Pumpkinseed/hour). Mean length was 5.8 inches; lengths ranged from 4.1 to 7.4 inches. Although low in abundance, Pumpkinseed provide an additional opportunity for younger anglers.

Black Crappie

Five Black Crappie were sampled during the 2021 SNI survey for a catch rate of 0.05 Black Crappie/net night. Fish were not individually identified with a fin clip mark; therefore, individual Black Crappie may have been netted multiple times. Mean length was 5.8 inches; lengths ranged from 4.3 to 8.2 inches. In the 2012 SNI survey, 17 Black Crappies were sampled, with a mean length of 6.3 inches and lengths ranged from 5.4 to 7.9 inches. In 2001 SNI one Black Crappie was sampled for a catch rate of 0.02 Black Crappie per net night. Black Crappie were not sampled in SEII sampling conducted in 2021, 2016, 2012 or 2001.

Other Species

In the 2021 comprehensive fishery survey, other species were observed in low abundance that do not warrant analysis but are reported here for consideration. These species included: Green Sunfish (n=1), White Suckers (n=9), and Mudpuppies (n=17).

Management Recommendations

Sampling challenges on Crystal Lake are the most crucial to resolve to accurately assess the status of the fishery. Challenges of sampling Crystal Lake may contribute to low catch for multiple species, including Northern Pike, Walleye and Yellow Perch. In many areas of the lake's shoreline, a steep drop-off inhibits effective fyke net sets and limits electrofishing effectiveness. Development of new net-set locations and reevaluating sampling methods may result in higher catch rates in Crystal Lake. Given the apparent failure of extensive Walleye stocking efforts to establish a minimum fishable population of 2/acre, agency stocking efforts may no longer be warranted.

The Northern Pike population was not able to be accurately assessed due to low catch, but the current, more liberal regulations on Crystal Lake should be evaluated following a successful population estimate at the time of the next survey. Scales, or other aging structures, from Largemouth Bass should be taken at the time of the next survey, as well as weights to evaluate growth and condition.

Future surveys should continue to evaluate the size structure and abundance of Bluegill, Crappie, and other panfish species in Crystal Lake.

Management recommendations include:

1. Reevaluate sampling methods and determine best net set locations to accurately sample gamefish including Walleye and Northern Pike.
2. Facilitate calculation of population estimates for Walleye and Northern Pike at the time of the next comprehensive fishery survey.
3. Evaluate the current no minimum length limit, five fish daily bag limit regulation and estimate angler effort for Northern Pike.

4. Discontinue biennial stocking of large fingerling Walleye due to the failure of stocking efforts to establish a minimum fishable population of 2 adults/acre.
5. Obtain aging structures from Largemouth Bass and take weights to evaluate Largemouth Bass growth and condition. Assess effectiveness of current 14-inch minimum length, five fish daily bag limit regulation.
6. Determine if a more effective sampling methodology for Yellow Perch is feasible and in the interest of anglers.

Acknowledgments

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