Chicagon Lake
Iron County, T42N/R33W/Sec. 31
Paint River Watershed, last surveyed 2022

Jennifer Johnson, Fisheries Management Biologist

Environment

Chicagon Lake is located approximately 10 miles west of Crystal Falls in southern Iron County and within the Paint River watershed. It has a surface area of 1,100 acres and is due south of U.S. Highway 2 (Figure 1). There is a public boat launch that is maintained by Iron County and two walk-in only access sites located on the northwest and eastern shorelines. There are multiple homes, a golf course, Pentoga Park (County owned) and campground that surround the perimeter of the lake. There are also Native American burial grounds next to the park and campground. Before European settlement, this land was part of the main village for the Ojibwe tribes in the area.

Wagner Creek flows from Wagner Lake, through a privately owned golf course and into the southwestern shoreline of Chicagon Lake. The outlet, known as the Chicagon Slough, flows northerly into Lake Emily which itself flows into the Paint River. The surrounding watershed is classified as low disturbance and is mostly forested with a mix of wetlands and agriculture (Midwest Glacial Lakes Conservation Planner). However, the shoreline of Chicagon Lake is classified as having moderate disturbances largely due to the anthropogenic alterations and activities. The shoreline land cover is mostly forest and wetland types. The surficial geology is comprised of glacial outwash sand and gravel and postglacial alluvium, and coarse-textured glacial till. The bedrock geology is part of the Paint River Group.

The morphology of the lake can be described as having a gradual slope with softer sediments along the western basin shoreline (Figure 1). Near the center of the lake there is a sharp drop off that turns into a relatively flat area around 90-100 feet. The eastern shoreline is rocky with steep drop offs that meet the flat area. In the northern bay, there is also rocky sediments and a quick drop off to a hole around 60 feet. Cover for fish includes submersed trees along the shoreline and aquatic vegetation, particularly along the southern, western, and northern shorelines.

In general, Chicagon Lake can be described as having oligotrophic and mesotrophic characteristics. Beginning in 2017, Chicagon Lake has been enrolled in the Michigan Cooperative Lake Monitoring, a citizen-science based monitoring program. Results from those efforts showed an increase in Secchi disk transparency over time. Spring and summer phosphorus samples were also taken but additional years of sampling are needed to determine baseline levels. The Michigan Department of Natural Resources Fisheries Division measured limnological parameters in September 2020 that included temperature and oxygen. Temperature ranged from 70°F at the surface to 43°F at 100 feet. Thermocline was between 23-37 feet. Oxygen levels were 8.6 ppm at the surface and decreased steadily to 0 ppm at 113 feet. Water transparency, as measured by Secchi disk, was recorded at 16 feet. Specific conductance was around 0.25 µS/cm. Alkalinity and chlorophyll samples were not collected during the survey.

The lake is currently classified as having high vulnerability to climate change impacts with coldwater species (Cisco, Lake Whitefish, and Lake Trout) unlikely to persist through 2050. However, cool (Northern Pike, Walleye) and warmwater (Bluegill) species are projected to be present (Midwest Glacial Lakes Conservation Planner) through 2050.

Chicagon Lake's early fisheries management was focused on Lake Trout but eventually evolved into a two-story lake with multiple fisheries to manage. Currently, Chicagon Lake's management goal is to manage for a balanced and diverse fishery that includes Lake Trout, Lake Whitefish, Cisco, Walleye, Northern Muskellunge, Yellow Perch, Northern Pike, Bluegill, Largemouth Bass, Smallmouth Bass, Rock Bass, and Pumpkinseed. There are aquatic invasive species confirmed in Chicagon Lake that include Eurasian Watermilfoil, Banded Mystery Snail and Zebra Mussels. Chicagon Lake has been chemically treated in a number of years by the Chicagon Lake Property Owners Association to help manage nuisance levels of Eurasian Watermilfoil.

Five angler tournaments were reported between 2019-2022 that targeted largemouth and smallmouth bass. The number of teams and anglers varied between 5-12 and 10-24 per year, respectively. The number of largemouth bass captured during each tournament ranged from 15-35 fish. The number of smallmouth bass captured varied between 5-30 fish. The total weight reported combined both large- and smallmouth bass. The largest bass reported was 6 lbs.

Chicagon Lake has a fish consumption advisory for Lake Whitefish (4 servings per month, any size), Rock Bass (2 servings per month, any size), and Walleye (1 serving per month for fish under 24" and 6 servings per year for fish over 24"). The consumption advisory is largely due to mercury levels. However, increased levels of PCB and DDT were also reported in the Lake Whitefish collected.

History

Stocking

Lake Trout of varying life stages were stocked into Chicagon Lake from 1897-present. A 1987 stocking evaluation survey found no evidence of survival of any trout species (including Rainbow Trout and Brown Trout) and stocking was cancelled for Rainbow Trout and Brown Trout. Since yearling Lake Trout were considered successful in previous stocking efforts, it was recommended to continue stocking yearling Lake Trout or preferably broodstock Lake Trout. An extensive stocking evaluation was conducted in 2000 and zero Lake Trout were captured. Consequently, yearling Lake Trout stocking efforts were cancelled.

Early stocking records also include Largemouth Bass (1905), Smallmouth Bass (1910), Yellow Perch (1934-1937), Northern Pike (1935-1942), Rainbow Trout (1943,1961-1971,1987), Northern Muskellunge (1965), Bluegill (1950), Walleye (1934-1942,1970-71), and Splake (1966,1971). Justifications for most of the early stocking activities were not found in the historical files. However, an analysis from a 1963 survey recommended the stocking of Northern Muskellunge because they were "compatible with Walleyes and Smallmouths" and could help prey on the over-abundant Yellow Perch population.

Between 1981-2003, Chicagon Lake was stocked with Walleye fry (721-2,000 per acre, Table 1) and spring fingerlings (23-62 per acre, Table 1). Results from a 2004 fisheries survey indicated the Walleye population was slow-growing, and natural recruitment was documented each year. The lack of

forage for Walleye was also listed as a reason to discontinue stocking at that time. In 2007, all Walleye stocking efforts were suspended statewide in response to fish health concerns due to the Viral Hemorrhagic Septicemia virus (VHS). Once VHS testing and fish health testing were established in 2011, statewide Walleye stocking resumed. However, managers did not resume Walleye stocking at that time, to see if Chicagon Lake could maintain the Walleye population without supplemental stocking. In 2014, angler reports and survey results indicated a declining Walleye population. Consequently, Walleye stocking was resumed in 2016 at a combined rate of 27 per acre (Table 1). Stocking also occurred in 2019, 2021, and 2022 (26/acre, 50/acre, and 57/acre, respectively, Table 1).

A 1997 survey indicated the Northern Muskellunge population was no longer self-sustaining and supplemental stocking was necessary to maintain the population. Consequently, Northern Muskellunge have been regularly stocked in Chicagon Lake since 1997.

The current stocking prescription for Chicagon Lake includes biennially stocking of fall fingerling Northern Muskellunge (1.5/acre), spring fingerling Walleye (50/acre), and adult Lake Trout (0.36/acre) when available.

Fisheries Management

There was no specific fishery survey information found on file prior to 1962 for Chicagon Lake. There were management records available from 1950-1961 that described a failed attempt at stocking warmwater species, in particular Bluegill. Additionally, Lake Trout stocking occurred throughout this time period and a suspension of Lake Whitefish and Cisco spearing occurred from 1956-1958 (no reason given for the closure). Poor fishing was reported from 1959-1961.

Multiple surveys conducted by the Michigan Department of Conservation between 1962-1971 reflected a relatively stable fisheries community that was often described as having overabundant Yellow Perch and White Sucker populations along with stable, albeit lower, numbers of Pumpkinseed, Rock Bass, and Walleye. Lake Trout, Lake Whitefish, Bluegill, Smallmouth Bass, and Largemouth Bass were present, but made up an even smaller component of the fishery. Northern Muskellunge were stocked in 1965 with the intent to prey on the smaller sized Yellow Perch and to provide an additional fishing opportunity for anglers. Minnow species captured in a 1968 survey included Bluntnose Minnow, Iowa Darter and Johnny Darter. Aquatic plant communities were low in abundance and isolated to the western and northern bays. In May 1970 there was a partial chemical treatment (antimycin) conducted to decrease the Yellow Perch and White Sucker populations.

Beginning in the late-1970s, the process for raising Walleye was vastly improved with the implementation of rearing ponds. Consequently, many waterbodies in the area were stocked with Walleye, including Chicagon Lake. Surveys conducted by the Michigan Department of Natural Resources (MDNR) showed increased Walleye survival over time. A survey in 1986 documented the first evidence of natural reproduction of Walleye. In 1987, Walleye were found to be numerous with a good size distribution. However, anglers were still unable to capture any Walleye during the summer months. In response, managers radio-tagged seven Walleye and monitored their movements within Chicagon Lake. Managers located Walleye mostly near aquatic vegetation beds in shallow areas and some along humps near drop offs. In conjunction with stocking Walleye, fish removal efforts were conducted in 1981, 1982 and 1985 that totaled 81,000 lbs of Yellow Perch, 4,050 lbs of Rock Bass, and 1,500 lbs of White Sucker. Post-removal surveys indicated improved Yellow Perch growth rates

and increases in the abundance of Lake Whitefish. During the 1980s, spearing of Northern Muskellunge was considered a legal method of take. A creel census was conducted over the winters from 1982-1987 and documented an average of 26 Northern Muskellunge speared each year. Concerned with overharvest, in 1988 managers increased the minimum size limit from 30 to 36 inches and only six Muskellunge were speared over that winter.

Management efforts during the 1990s were mainly concentrated on the Walleye and Northern Muskellunge populations. Evidence of natural recruitment of Walleye occurred throughout this time period, and natural recruitment contributed significantly to the population. However, stocking was determined necessary to maintain the population. Beginning in 1993, a full ban on Northern Muskellunge spearing was implemented due to the high rate of angler harvest. Stocking efforts began in 1997 due to the continuous decline of the Northern Muskellunge population which also coincided with an increase in the Northern Pike population. Moderate levels of recruitment were documented in Smallmouth Bass and White Sucker populations. Yellow Perch recruitment showed slight improvement during this time period.

In November 2001 and 2002, MDNR Fisheries Division employees obtained Lake Whitefish data mainly from a popular spear fishery that occurs each November. Survey results indicated the Lake Whitefish population in Chicagon Lake had excellent growth rates and multiple year classes. Also, in 2002, due to a perceived overabundance of White Sucker, managers removed 870 lbs of White Sucker. It was noted however that White Sucker numbers were not overabundant, and the populations of Smallmouth Bass, Largemouth Bass, Walleye, Northern Pike and Northern Muskellunge were aiding in keeping the White Sucker numbers low. White Sucker are known to be an important food source for multiple fish species that reside in Chicagon Lake.

In 2004, a fall Walleye survey was conducted by the MDNR Fisheries Division to evaluate recruitment. The 2004 young-of-year recruitment was poor (Table 2). However, yearling Walleye were captured at a rate of 10/mile, which is considered above average (Luehring et al. 2013).

Cisco were transferred from Thousand Island Lake (Gogebic County) to Chicagon Lake in 2006 (N=470, 10.8" average), 2007 (N=46, 10.8" average) and 2008 (N=31, 11.4" average) with the goal to rehabilitate a potentially historic population and to increase angler opportunities. Also in 2006, Zebra Mussels were confirmed in Chicagon Lake. In 2009, the daily bag limits were 5 fish combined for Lake Whitefish and Cisco.

In April 2007-May 2008, a temperature logger (Onset HOBO Water Temp Pro V2 Model U22-001) was deployed along the eastern shoreline, just north of Pentoga County Park. The minimum, maximum, and average temperatures recorded were 32.7°F, 81.2°F, and 50.5°F, respectively.

In May 13-21, 2008, a Northern Muskellunge stocking evaluation was conducted by MDNR Fisheries Division. A total of 24 Northern Muskellunge were captured ranging from 25-47 inches in length. Ages 3-5 were confirmed present in the population. Three of the captured fish were from previous stocking efforts. Technicians noted they likely missed the spawning period and did not capture the entire event. Other species captured and recorded during the survey included Black Crappie (N=1), Brook Trout (N=2), Black Bullhead (N=1), Bluegill (N=144), Bluntnose Minnow (N=1), Common Shiner (N=38), White Sucker (N=155), Horneyhead Chub (N=3), Largemouth Bass (N=4), Northern

Pike (N=46), Pumpkinseed (N=100), Rock Bass (N=434), Smallmouth Bass (N=47), Walleye (N=110), and Yellow Perch (N=796). The Walleye ranged from 11-24 inches in length. Samples were taken for aging and growth analysis and confirmed ages 2-7 present in the population with a mean growth index of 5.6 inches below the state average for Walleye. Growth rates were average for age 2 and 3 Walleye but declined as they grew older.

In 2009, a Walleye population estimate survey was conducted and indicated a good population for Western Upper Peninsula waters at 2.6 adult Walleye per acre (Table 3). Growth rates were almost 1 inch below the state average, which is still considered acceptable growth for Western UP inland lakes (Table 3). The population represented 6 strong year classes (2001, 2002, and 2005-2007, 5 of which were non-stocking years, indicating natural reproduction was occurring. A status and trends survey was conducted in 2009 that showed Bluegill dominated the panfish community. There was adequate recruitment documented for Bluntnose Minnow, Yellow Perch, White Sucker, and Lake Whitefish. Growth rates were described as good for both predator and prey species. The Northern Muskellunge population remained low enough to still require supplemental stocking. As part of the status and trends protocol, a temperature logger was deployed from May 12, 2009-November 03, 2009. The minimum, maximum, and average temperatures recorded were 43.9°F, 79.9°F, and 62.9°F, respectively.

A creel survey was conducted over the 2013 winter that indicated anglers targeted and harvested mostly Yellow Perch, but also harvested Bluegill, Lake Whitefish, Walleye, Cisco, and Northern Pike.

In May 2014, a survey was conducted to evaluate the current Walleye population in response to reported angler concerns of decreased Walleye abundance. Results showed the adult Walleye population estimate decreased from 2.6 (2009, Table 3) to 1.6 per acre, which is below what is expected from a population supported by natural reproduction (3-4.5/acre). To further evaluate the Walleye population, a fall Walleye recruitment survey was conducted on September 22, 2014. Walleye (N=9) ranged from 17-27 inches and averaged 20.3 inches in length with 100% of the catch of legal size for harvest (≥15 inches). No young-of-year Walleye were captured during the survey (Table 2). To boost the Walleye population, managers recommended stocking to occur biennially at a rate of 25/acre. Additional surveys were recommended to evaluate abundance and recruitment of Walleyes and to help inform managers if changes in management direction were warranted. Stocking of spring fingerling Walleye has occurred in 2016 (27/acre), 2019 (26/acre), 2021 (50/acre), and 2022 (57/acre). Additional fall recruitment surveys were completed in 2016, 2018, 2019, and 2020 to evaluate stocking efforts. The only survey to capture young-of-year Walleye was in 2016 (Table 2).

In 2014, anglers reported observations of thinner Lake Whitefish when compared to previous years. In response, a creel survey was conducted during the spear harvest on December 1-2, 2017. Biological data were collected for both Lake Whitefish and Cisco. Results showed the average size decreased for Lake Whitefish (Figure 2). For example, prior to the Zebra Mussel invasion (2006), lengths for age-4 Lake Whitefish between 1989-2009 ranged from 17-21.6 inches in length. In 2017, the average length for age-4 lake whitefish was 15.2 inches (Figure 2). Additionally, the length frequency shifted to a smaller size structure (Figure 3).

Temperature loggers have been deployed in Chicagon Lake at the same location and time range (Spring-Fall) from 2016-2022. The intent of the annual deployment of a temperature logger is to record data that can be added to a statewide database. This will allow managers to analyze statewide trends in

lake temperatures. It is too early to draw any climactic conclusions from the data collected thus far. However, this effort will continue into the foreseeable future.

A summer limnology profile was recorded on August 31, 2020. Temperature, oxygen, pH and specific conductance were recorded. Temperature ranged from 70.3°F at the surface and decreased to 44.9°F at 52 feet. The thermocline was recorded at depths between 23-37 feet. Oxygen levels were 8.6 ppm at the surface, decreased to 5 ppm at 79 feet and steadily decreased to 3 ppm at a depth of 112 feet. No critical oxygen levels were recorded. The pH was 8.4 at the surface and decreased to 6.9 at 91 feet. Specific conductance was recorded at 0.259 mS/cm at the surface and remained relatively constant throughout the water column, although there was a slight increase near the bottom 5 feet. Recorded Secchi depth was 16 feet.

Fisheries Division recognizes Chicagon Lake's importance for recreational opportunities and its cultural significance to Tribal Partners and scheduled comprehensive surveys in 2021 and 2022.

Current Status

Adult Walleye Population Estimate
During April 7-16, 2021, a spring adult Walleye population survey was completed by staff from the Michigan DNR Fisheries Division's Northern Lake Michigan Management Unit (NLMMU). Surface water temperatures ranged from 38°F-43°F. A total of 16 large mesh fyke nets were set (80 net nights (NN)) and 26.4 miles of shoreline were electrofished (April 11,13,16, 2021). All fish species captured in the fyke nets were recorded. Only Walleye, Northern Muskellunge, Northern Pike, Smallmouth Bass, and Largemouth Bass had lengths recorded. During the survey, staff observed a type of film covering the rocks along the eastern shoreline. This could be due to the high alkalinity in the water.

A total of 1,689 fish were captured and recorded during the April survey efforts. Species captured included: Black Crappie (N=3), Bluegill (N=986), Common Shiner (N=8), Creek Chub (N=3), Horneyhead Chub (N=7), Hybrid Sunfish (N=7), Largemouth Bass (N=3), Mottled Sculpin (N=1), Northern Muskellunge (N=5), Northern Pike (N=29), Pumpkinseed (N=88), Rock Bass (N=210), Smallmouth Bass (N=24), Walleye (N=185), White Sucker (N=42), and Yellow Perch (N=86). Technicians also observed additional Black Crappie and Bluegill that were not captured in the nets or by electrofishing.

Walleye (N=185) averaged 24.6 inches in length and ranged from 18-31 inches (Table 4) with 100% of the catch meeting or exceeding the legal size for harvest (≥15 inches). Age analysis indicated ages 4-16 present in the population with a mean growth index of 3.3 inches above state average (Table 3). The estimated adult Walleye population was calculated at 0.2 per acre.

Northern Muskellunge (N=5) averaged 33.3 inches in length and ranged from 16-51 inches, with 20% of the catch meeting or exceeding the legal size for harvest (≥50 inches). Age analysis was conducted on 4 of the 5 muskellunge captured and indicated ages 2 (16 inch muskellunge) and 5 (32-33 inch muskellunge) present in the population. A mean growth index was not calculated due to an insufficient number of fish being collected for analysis.

Northern Pike (N=29) averaged 18.9 inches in length and ranged from 8-28 inches (Table 4), with 14% of the catch meeting or exceeding the legal size for harvest (≥24 inches). Age analysis indicated ages

1-5 present in the population with a mean growth index of 0.1 inches below state average, which is above average for waters of the western UP.

Smallmouth Bass (N=24) averaged 13.0 inches in length and ranged from 8-16 inches (Table 4), with 50% of the catch meeting or exceeding the legal size for harvest (≥14 inches). Age analysis indicated ages 2-5 and 7-8 present in the population. A mean growth index was not calculated due to an insufficient number of fish collected for analysis.

Largemouth Bass (N=3) averaged 12.5 inches in length and ranged from 9-14 inches (Table 4) with 33% of the catch meeting or exceeding the legal size for harvest (≥14 inches). Age analysis indicated ages 3-5 present in the population. A mean growth index was not calculated due to an insufficient number of fish collected for analysis.

Status and Trends Survey

A Status and Trends survey was completed by staff from the Northern Lake Michigan Management Unit on Chicagon Lake during May 24-June 29, 2021 (netting and electrofishing) and September 14 (habitat shoreline count) to gather information on the status of the fish community. A limnology survey was conducted in 2020.

Surface water temperatures ranged from 57°F-69°F between May 24-June 28, 2021. During the survey, three-10 minute electrofishing transects were completed, 6 seine hauls were conducted, 3 experimental gillnets were set for 9 net nights (NN), 6 large mesh fyke nets were set for 18 NN, and 3 small mesh fyke nets were set for 6 NN. All fish species were recorded. Another electrofishing effort was conducted of the shoreline in addition to the three-10 minute transect but captured only gamefish. In addition to the collection of the biological data, staff also surveyed the entire shoreline (15 miles) for habitat features including the number of dwellings, docks, submerged logs, and total length of armored shoreline (i.e., riprap, seawall etc.).

A total of 2,233 fish were captured during the survey. A total of 18 fish species were recorded that included Bluegill, Bluntnose Minnow, Central Mudminnow, Cisco, Hornyhead Chub, Hybrid Sunfish, Iowa Darter, Lake Trout, Lake Whitefish, Largemouth Bass, Northern Muskellunge, Northern Pike, Pumpkinseed, Rock Bass, Smallmouth Bass, Walleye, White Sucker, and Yellow Perch (Table 5).

Bluegill (N=852) averaged 6.1 inches in length (Table 5) and ranged from 1-8 inches (Table 6) with 55% of the catch meeting or exceeding the recommended size for harvest (≥6" inches). Age analysis indicated ages 2-9 present in the population with a mean growth index of 0.1 inches below average, still considered good for U.P area lakes (Table 7).

Cisco (N=31) averaged 14.0 inches in length (Table 5) and ranged from 7-17 inches (Table 6). Age analysis indicated ages 1-6 present in the population (Table 7). There are no statewide averages for Cisco to compare growth rates.

Lake Trout (N=3) averaged 28.5 inches in length (Table 5) and ranged 27-29 inches (Table 6). Age analysis was conducted on the 27-inch Lake Trout; it was determined to be 8 years old (Table 7).

Lake Whitefish (N=25) averaged 15.3 inches (Table 5) in length and ranged from 7-18 inches (Table 6). Age analysis indicated ages 2 and 4-8 present in the population (Table 7).

Largemouth Bass (N=33) averaged 11.7 inches in length (Table 5) and ranged from 6-17 inches (Table 6) with 27% of the catch meeting or exceeding the legal size for harvest (≥14"). Age analysis indicated ages 1-5 and 7-8 present in the population with a mean growth index of 1.5 inches above state average, which is considered good growth (Table 7).

Northern Muskellunge (N=5) averaged 37.3 inches in length (Table 5) and ranged from 28-45 inches, with 0% of the catch meeting or exceeding the legal size for harvest (≥50"). Age analysis indicated ages 4, 6 and 9 present in the population (Table 7).

Northern Pike (N=38) averaged 21.7 inches in length (Table 5) and ranged from 15-38 inches (Table 6) with 26% of the catch meeting or exceeding the legal size for harvest (≥24"). Age analysis indicated ages 2-6 and 8 present in the population with a mean growth index of 1.5 inches above state average - which is considered good growth, especially for UP lakes (Table 7).

Pumpkinseed (N=414) averaged 5.4 inches in length (Table 5) and ranged from 2-8 inches (Table 6), with 21% of the catch meeting or exceeding the recommended size for harvest (≥6"). Age analysis indicated ages 3-9 present in the population with a mean growth index of 0.7 inches below state average, which is still considered average growth (Table 7).

Rock Bass (N=516) averaged 5.3 inches in length (Table 5) and ranged from 1-9 inches (Table 6), with 22% of the catch meeting or exceeding the recommended size for harvest (≥6 inches).

Smallmouth Bass (N=81) averaged 9.7 inches in length (Table 5) and ranged from 2-18 inches (Table 6), with 16% of the catch meeting or exceeding the legal size for harvest (≥14"). Age analysis indicated ages 1-9 present in the population with a mean growth index of 0.1 inches above state average (Table 7).

Walleye (N=7) averaged 26.1 inches in length (Table 5) and ranged from 21-28 inches (Table 6), with 100% of the catch meeting or exceeding the legal size for harvest (≥15"). Age analysis on one 24-inch and one 25-inch fish indicated they were ages 9 and 10, respectively (Table 7).

Yellow Perch (N=123) averaged 5.7 inches in length (Table 5) and ranged from 2-12 inches (Table 6), with 28% of the catch meeting or exceeding the recommended size for harvest (≥7"). Age analysis indicated ages 1-8 present in the population with a mean growth index of 0.5 inches below state average, which is still considered average growth. (Table 7).

Shoreline analysis documented 10.3 docks (small and large)/mile, 9.3% armoring, 55 submerged trees/mile, and 9.5 dwellings/mile (Table 8).

Fall Walleye Recruitment Survey 2021
A fall Walleye recruitment survey was conducted on September 21-22, 2021. Surface water temperature was recorded at 65°F. Three stations were surveyed totaling 6 miles of shoreline. Only Walleye were captured and recorded.

One Walleye was captured during the survey effort that was 25 inches in length. No young-of-year or yearling Walleye were captured during the survey effort (Table 2).

Fall Walleye Recruitment Survey 2022

A fall Walleye recruitment survey was conducted on October 3, 2022. Surface water temperature was recorded at 59.5°F. Three stations were surveyed totaling 6 miles of shoreline. Only Walleye were captured and recorded.

One Walleye (TL=21") was captured during the survey effort. No young-of-year or yearling Walleye were captured during the survey (Table 2). Other species observed included Northern Muskellunge, Smallmouth Bass, Rock Bass, Bluegill, Yellow Perch, Northern Pike, and White Sucker.

Analysis and Discussion

The fish community of Chicagon Lake can be described as follows:
1) A panfish community dominated by Bluegill, Pumpkinseed, and Rock Bass with good growth, reproduction and recruitment that enables fishing opportunities for anglers. Yellow Perch are also providing a fishery however in smaller numbers.

2) Northern Pike, Largemouth Bass, and Smallmouth Bass populations are experiencing consistent natural reproduction and above average growth rates, although Smallmouth Bass are showing evidence of a population decline.

3) A Northern Muskellunge population that does not have consistent natural reproduction, although there was a slight increase in the population between 2009 and 2021.

4) A Lake Whitefish population that continues to be naturally reproducing however the growth rates are slowing significantly over time. Cisco are naturally reproducing, and their growth rates are relatively stable. Lake Trout are stocked as adults and currently provide a unique inland lake trout fishery.

5) A Walleye population that is not recruiting and in severe decline.

6) Nearshore habitat has become more developed over time.

The number of docks per mile and the percent of shoreline armored have increased between 2009 and 2021 (Table 8). The number of dwellings per mile has remained the same and the number of submerged trees per mile has increased over time (Table 8). Comparing Chicagon Lake to lakes across the State of Michigan, Chicagon Lake has a higher rate of docks per mile and submerged trees per mile (Table 8, Wehrly et al. 2015). Chicagon Lake is considered average for percent shoreline armored and

for dwellings per mile compared to other lakes across the State of Michigan (Table 8, Wehrly et al. 2015). The increased anthropogenic impacts (docks and shoreline armoring) along the shoreline are concerning. A recent study evaluated shoreline development and Walleye recruitment and showed with an increase in shoreline development there is a decrease in young-of-year Walleye survival (Ziegler et al 2017). Lakes with a high density of development had a higher dependence on stocking; in particular larger, more expensive fingerlings.

Bluegill can play a key role in community structure and overall sport fishing quality in Michigan waters (Schneider 1981). Schneider (1990) suggests indices of Bluegill characteristics can be used to classify populations. The "Schneider Index" uses size scores of length frequency and growth data and relates them to an adjective ranking system ranging from "very poor" to "superior". Using the Schneider Index for classifying Bluegill populations, Chicagon Lake scored 3.5 for an "acceptable-satisfactory" ranking. Additionally, Bluegill catch-per-unit-effort (CPUE) increased substantially between 2009 and 2021. In 2009, the CPUE for Bluegill captured in large mesh fyke nets was 16.4 per net which was comparable to the average CPUE statewide (Table 9, Wehrly et al. 2015). Whereas in the most recent survey, CPUE was calculated at 43.5 Bluegill per net which is higher than the average CPUE statewide (Table 9, Wehrly et al. 2015).

Pumpkinseed have also increased from 5.5 per net (2009, Table 9) to 21.4 per net (2021, Table 9). Yellow Perch remained relatively unchanged between the 2009 and 2021 surveys (Table 9). Rock Bass continue to have consistent natural reproduction (Table 6) and high numbers (Table 5); however, the CPUE declined from 74.2 per net (2009, Table 9) to 26.9 per net (2021, Table 9).

Northern Pike increased slightly between the two sampling years (Table 9) and have an above average growth rate of 1.5 inches (Table 7), which is considered excellent growth for western Upper Peninsula inland lakes. Northern Muskellunge numbers increased slightly since 2009. However, the aging results show inconsistent natural reproduction that would not sustain a fishery if stocking were to be suspended (Table 7). A stocking evaluation survey that targets Northern Muskellunge would be beneficial in helping managers with future management decisions. Smallmouth Bass continue to exhibit consistent natural reproduction as evident by the 9 age classes present in Chicagon Lake (Table 7). However, there was an 87% decrease in CPUE between the 2009 and 2021 surveys (Table 9). A specific reason for the decline remains unclear. However, the increase in Bluegill numbers could have indirect impacts on the Smallmouth Bass population via competition (Spotte 2007).

Lake Whitefish continue to see decreased growth rates and size structure (Figures 2 and 3). Cisco growth is relatively steady. Age 4 Cisco have varied slightly between 14.2-15.3 inches since 2013 (Figure 4). Cisco aging and growth data are limited to post Zebra Mussel invasion (2006), making it difficult for a full analysis of Zebra Mussel impacts on Cisco. Impacts to inland lake populations of Lake Whitefish and Cisco have not been widely evaluated. However, there is research being conducted in the Great Lakes. A recent workshop (2018) titled "Developing research priorities for Lake Whitefish in the upper Great Lakes" was sponsored by the Great Lakes Fishery Trust and Great Lakes Fishery Commission. During the workshop, researchers described prolonged poor recruitment of Lake Whitefish resulting in decreases in spawning stock biomass in Lakes Michigan and Huron, where Zebra Mussels are present in both lakes. Continued monitoring of both Lake Whitefish and Cisco populations and their habitat is important and should be a management priority (Derosier et al. 2015). If Lake Whitefish trends continue, managers should evaluate fishing regulations and whether angling is

impacting populations during high harvest years. Cisco should be evaluated for any changes similar to those Lake Whitefish are exhibiting.

The Walleye population in Chicagon Lake continues to decline despite supplementary stocking efforts (Table 1). Fall Walleye index surveys have been conducted regularly since stocking efforts began. Unfortunately, there have been only three young-of-year Walleye captured in surveys conducted between 2014-2022 (Table 2). This is indicative of year class failures. Walleye typically have good recruitment every 3-5 years, so year class failures are not atypical in lakes. However, when there are multiple years with no strong year classes it impacts the Walleye population as a whole. Consequently, the adult Walleye population has declined since 2009 (Table 3). In 2009, the estimated adult population was 2.6 Walleye per acre. This most recent survey had an estimated adult population of 0.2 Walleye per acre (Table 3). Further evidence for a decreasing Walleye population can be observed in the length frequency over multiple years. The size structure of Walleye has shifted to the larger inch classes as the population "ages out" (Figure 5). In 2014, there were 932 males to 115 females captured during an April survey. In 2021, that ratio shifted heavily towards females (39 males to 98 females). Since female Walleye typically live longer than male Walleye, an aging population could be the reason why the sex ratio of males to females was skewed heavily towards females. Lastly, between the 2009 and 2021 status and trend surveys, the CPUE decreased by 89% for Walleye captured in fyke nets (Table 9), the length frequency shifted to larger Walleye (Tables 6 and 10), and representative age classes decreased from 5 to 2 (Table 10).

Michigan has a lake classification system that factors in lake habitat characteristics and the fish community (Wehrly et al. 2012). Chicagon Lake is a Class 3 lake because of its low degree days, low mean temperature, large surface area, and deep water. Class 3 lakes are considered to be the most suitable for Walleye and are thought to be able to buffer impacts to climate change (Herbst et al. 2022). This classification system is useful in how it can inform managers of what can be expected in lakes based on set criteria. However, it does not account for invasive species present, particularly Zebra Mussels. Walleye fry survival depends on having enough zooplankton available for consumption. While there have not been zooplankton surveys on Chicagon Lake, the Secchi depth (a measure of water clarity and indirect measurement of production) has been increasing over time. The shoreline development index (SDI) is another important factor when predicting juvenile Walleye numbers in Michigan lakes (Michigan DNR, unpublished data). The SDI is calculated by using measures of lake perimeter, lake surface area, and lake mean depth. The catch per unit effort (CPUE) for juvenile Walleye is expected to be higher when the SDI < 2 (less shoreline irregularity, Michigan DNR, unpublished data). Essentially, the more circular a lake is, the higher the expected juvenile CPUE. The SDI for Chicagon Lake is 2.26 which indicates lower expected Walleye recruitment.

The decline in the Walleye population is not unique to Chicagon Lake. There are multiple lake examples across the upper Midwest that have had similar patterns of decline (Hansen et al. 2017, 2020; Rypel et al. 2018). Most of these declines are attributed to climate change (Hansen et al. 2017) and aquatic invasive species (Kumar et al. 2016; Hansen et al. 2020). While there is a general pattern of decline in the region, each individual lake could have multiple factors that are influencing its own Walleye population. Therefore, it is worth examining both biotic and abiotic factors that could be contributing to the decline of Walleye in Chicagon Lake.

Previous studies have determined degree days and spring warming rates are primary factors in Walleye populations (Hansen et al. 2015, Honsey et al. 2020, Michigan DNR unpublished data). Growing degree days less than 3500 increases survival for young-of-year Walleye (Michigan DNR, unpublished data). The calculated degree days for Chicagon Lake (3,250 DD) is currently within the window for acceptable survival. Spring warming rates greater than 0.3°C/day have been shown to negatively affect Walleye recruitment (MDNR, unpublished data). Since 2016, May warming rates in four of six years were equal to or greater than 0.3°C per day (Table 11, Figure 6).

Environmental and biological changes due to the invasion of Zebra Mussels have been documented; these include increased water clarity, decreased species richness and decreased zooplankton abundance (Zorn and Kramer 2021). Chicagon Lake's secchi depth (water clarity) has increased over time (2021 Cooperative Lakes Monitoring Program report). Walleye require low light conditions and suitable habitat could be decreasing as a result of the increased water clarity. Although the species richness did not decrease between the 2009 and 2021 status and trends surveys, there were changes in catch-per-unit effort between the two surveys (Table 9). Bluegill, Pumpkinseed, and Northern Pike increased significantly while Rock Bass, Smallmouth Bass, and Walleye decreased (Table 9). Stocking efforts thus far have not been successful, despite increased stocking rates (Tables 1 and 2). Spring fingerling Walleye predation could be occurring by the increased numbers of Bluegill and Pumpkinseed.

Chicagon Lake is currently projected to be suitable for Walleye through the year 2050 (Midwest Glacial Lakes Partnership). Unfortunately, Chicagon Lake has seen lake wide changes largely due to Zebra Mussels. Furthermore, there is evidence of fast-warming spring temperatures that may be a cause of natural recruitment failures of Walleye (Table 11). The Michigan DNR recognizes the social importance that Walleye have for Chicagon Lake anglers. However, management decisions for Chicagon Lake are largely constrained by the biological and ecological factors (largely due to invasive species and weather) currently present. This is also not unique to Chicagon Lake or the Upper Peninsula. The State of Wisconsin has seen similar patterns of decline that are largely out of managers' control and therefore adopted a new method that will help guide management direction into the future for Wisconsin. The Resist-Accept-Direct framework (RAD) is a system designed to categorize lakes together based on similar attributes (temperature, fish community and water clarity) and how they relate to the current management strategies, and use these categories to adapt for future conditions (Feiner et al. 2022, Dassow et al. 2022). Briefly, the "resist" category can be described as managing a lake for historical and current conditions (e.g. stocking). The "accept" category is acknowledging that change is occurring and allow lakes to evolve into a new community naturally (e.g. no stocking). The last is "direct", which is managing for a fishery that is projected to be most suitable in the future (e.g. directly managing for warmwater fisheries rather than coldwater). Utilizing the RAD Framework will help guide fisheries managers into the future, but knowledge of local lake conditions should also be considered in the decision-making process (Dassow et al. 2022).

Management Direction

1) One of the goals for Chicagon Lake is to maintain the areas of undeveloped shoreline. Natural shorelines often contribute to large woody debris, thus providing cover that helps protect fish during critical life stages (i.e., predation while young). Conversely woody debris can provide cover for ambush predators such as Northern Pike. Additionally, aquatic vegetation should be preserved to protect spawning habitat and provide protection for prey fish species. A potential obstacle in this goal would be lake property owners who wish to develop the land and remove the trees and plants from the

water's edge. The riparian owner's education to the benefits of a natural shoreline is critical in reaching this goal.

2) Increase efforts to accomplish management goals for Cisco and Lake Whitefish that are listed in Michigan's Wildlife Action Plan. These actions include, but are not limited to, targeted surveys and aquatic habitat and water quality monitoring.

3) Northern Muskellunge should continue to be managed as a high-quality fishery. As such, stocking and habitat management efforts should continue until there is evidence of sufficient natural recruitment.

4) Chicagon Lake has seen a shift in the Walleye population that is largely out of managers' ability to change. Following the RAD Framework, the following are options managers should discuss with Tribal Partners and the angling community:
a. Resist: Continue stocking at the current rate of 50 spring fingerlings per acre every other year,
b. Resist: Seek funding and hatchery source for large fingerlings and stock at a rate of 10/acre, and close the Walleye fishery until/if the population rebounds,
c. Accept: Discontinue stocking of Walleye and accept Chicagon Lake no longer supports a healthy Walleye population either from stocking efforts or natural reproduction,
d. Direct: Focus on management efforts targeting a healthy panfish and bass fish community.

The Michigan DNR Fisheries Division's Northern Lake Michigan Management Unit recommends continuing stocking at the current rate of 50 spring fingerlings per acre every other year. If spring fingerling Walleye are available in a non-stocking year, then strong consideration should be given to stock the additional Walleye into Chicagon Lake. Fall young-of-year surveys should continue into the foreseeable future. Currently, fish stocking prescriptions are valid for 10 years. After 10 years, if stocking efforts do not produce a Walleye population of at least 1 adult per acre, management efforts should shift to the "accept" and "direct" options listed above.

References

Dassow, C., A. Latzka, A. Lynch, G. Sass, R. Tingley III, and C. Paukert. 2022. A Resist-Adapt-Direct Decision support tool for Walleye Sander vitreus (Mitchill) management in Wisconsin. Fisheries Management and Ecology, 29: 378-391.

Derosier, A.L., S. Hanshue, K. Wehrly, K. Farkas, and M. Nichols. 2015. Michigan's Wildlife Action Plan. Michigan Department of Natural Resources, Lansing, MI. www.michigan.gov/dnrwildlifeactionplan.

Feiner, Z., A. Shultz, G. Sass, A. Trudeau, M. Mitro, C. Dassow, A. Latzka, D. Isermann, B. Maitland, J. Homola, H. Embke, and M. Preul. 2022. Resist-Accept-Direct (RAD) considerations for climate change adaption in fisheries: The Wisconsin Experience. Fisheries Management and Ecology. 29: 346-363.

Gilbert, Stephen and Joseph Hennessy. 2014. Guidelines to evaluate walleye stocking success in inland lakes. Wisconsin Department of Natural Resources.

Hansen, J.F., A.H. Fayram, and J.M. Hennessy. 2012. The relationship between age-0 walleye density and adult year-class strength across northern Wisconsin. North American Journal of Fisheries Management 32 (4): 663-670.

Hansen, G., S. Carpenter, J. Gaeta, J. Hennessy, and J. Vander Zanden. 2015. Predicting Walleye recruitment as a tool for prioritizing management actions. Canadian Journal of Fisheries and Aquatic Sciences. 72:661-672.

Hansen, G., J. Read, J. Hansen, and L. Winslow. 2017. Projected shifts in fish species dominance in Wisconsin under climate change. Global Change Biology 23, 1463-1476.

Hansen, G., T. Ahrenstorff, B. Bethke, J. Dumke, J. Hirsch, K. Kovalenko, J. LeDuc, R. Maki, H. Rantala, and T. Wagner. 2020. Walleye growth declines following zebra mussel and Bythotrephes invasion. Biological Invasions 22:1481-1495.

Herbst, S., D. Hayes, K. Wehrly, C. LeSage, D.Clapp, J. Johnson, P. Hanchin, E. Martin, F. Lupi, and T. Cwalinski. 2022. Management plan for Walleye in Michigan's inland waters. Michigan Department of Natural Resources. https://www.michigan.gov/-/media/Project/Websites/dnr/Documents/Fisheries/NEW/Walleye_Management_Plan_FINAL.pdf?rev=40a59d0915f84c5a9dbe6ce25be41c5c

Honsey, A., Z. Feiner, and G. Hansen. 2020. Drivers of Walleye recruitment in Minnesota's large lakes. Canadian Journal of Fisheries and Aquatic Sciences. 77:1921-1933.

Kumar, R. D. Varkey, and T. Pitcher. 2016. Simulation of zebra mussels (Dreissena polymorpha) invasion and evaluation of impacts on Mille Lacs Lake, Minnesota: An ecosystem model. Ecological Modelling 331: 68-76.

Luehring, M., and J.D. Rose. 2013. Fish population assessments of Ceded Territory lakes in Wisconsin, Michigan and Minnesota during 2012. Great Lakes Indian Fish and Wildlife Commission Administrative Report 13-06, Odanah, Wisconson.

Rypel, A., D. Goto, G. Sass, and J. Vander Zanden. 2018. Eroding productivity of Walleye populations in Northern Wisconsin lakes. Canadian Journal of Fisheries and Aquatic Sciences Vol. 75.12: 2291-2301.

Schneider, J.C. 1981. Fish communities in warmwater lakes. Michigan Department of Natural Resources, Fisheries Research Report 1890, Ann Arbor.

Schneider, J.C. 1990. Classifying bluegill populations from lake survey data. Michigan Department of Natural Resources, Fisheries Technical Report 90-10, Ann Arbor.

Spotte, S. 2007. Bluegills: biology and behavior. American Fisheries Society, Bethesda, Maryland.
Wehrly, K., J.Breck, L. Wang, and L. Szabo-Kraft. 2012. A landscape-based classification of fish assemblages in sampled and unsampled lakes. Transactions of the American Fisheries Society, 141:2, 414-425.

Wehrly, K.E., D.B. Hayes, and T.C. Wills. 2015. Status and trends of Michigan inland lake resources, 2002-2007. Michigan Department of Natural Resources, Fisheries Report 08. Lansing.

Zorn, T. and D. Kramer. 2021. Changes in habitat conditions, fish populations, and the fishery in Northern Green Bay, Lake Michigan, 1989-2019. North American Journal of Fisheries Management, 42(3), pp. 549-571.

Ziegler, J.P., E.J. Golebie, S.E. Jones, B.C. Weidel, and C.T. Solomon. 2017. Social-ecological outcomes in recreational fisheries: the interaction of lakeshore development and stocking. Ecological Applications, 27(1), pp 56-65.

Table 1. History of Walleye stocking in Chicagon Lake, Iron County from 1981-2022. Rates vary largely based on life stage stocked. Data taken from DNR, Fisheries Division records.

Year	Number	Rate (Fish/acre)	Average Size (in.)	Life Stage
1981	2,093,095	1903	0.3	Fry
1981	32,888	30	2.4	Spring Fingerling
1982	3,600,000	3273	0.3	Fry
1983	67,825	62	2.2	Spring Fingerling
1985	2,000,000	1818	0.2	Fry
1985	50,500	46	1.8	Spring Fingerling
1987	36,051	33	2.5	Spring Fingerling
1988	25,580	23	1.5	Spring Fingerling
1989	60,134	55	2.1	Spring Fingerling
1991	68,586	62	1.8	Spring Fingerling
1993	26,555	24	1.4	Spring Fingerling
1995	25,421	23	2.0	Spring Fingerling
1996	900,000	818	0.5	Fry
1997	25,044	23	2.3	Spring Fingerling
1999	26,880	24	1.4	Spring Fingerling
2001	25,000	23	1.5	Spring Fingerling
2003	38,601	35	1.5	Spring Fingerling
2016	30,011	27	2.0	Spring Fingerling
2019	28,637	26	1.6	Spring Fingerling
2021	55,479	50	1.7	Spring Fingerling
2022	62,390	57	1.6	Spring Fingerling

Table 2. Year, number of Walleye stocked, stocking rate, calculated young-of-year per mile, and qualitative rating of year class for Chicagon Lake, Iron County. Qualitative rating based on Hansen 2012 and Gilbert and Hennessy 2014. Not all stocking years are shown. Only years when a fall survey was conducted are shown. Data taken from DNR, Fisheries Division records.

Year	# Walleye Stocked	Fry stocked/acre	Spring fingerling stocked/acre	YOY/mile*	Qualitative Rating YOY
1982	3600000	3273	-	6	low
1987	36051	-	33	3	Poor
1990	-	-	-	4.8	Poor
1993	26555	-	24	16.7	Average
1995	25421	-	23	2	Poor
1997	25044	-	23	39.1	Good
1999	26880	-	24	26.1	Good
2004	-	-	-	0.4	Poor
2005	-	-	-	1.9	Poor
2014	-	-	-	0	Poor
2016	30011	-	27	0.4	Poor
2018	-	-	-	0	Poor
2019	28637	-	26	0	Poor
2020	-	-	-	0	Poor
2021	55479	-	50	0	Poor
2022	62390	-	57	0	Poor

*4-6 inch Walleye for Age 0

Table 3. Weighted mean length (inches) at age and growth relative to the state average for Walleye sampled from Chicagon Lake, Iron County in April/May 2009, 2014, and 2021. Number of fish aged is in parentheses. Data taken from DNR, Fisheries Division records.

	Walleye Age Group																			
Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Mean growth index[1]	Population Estimate (# adults/acre)
2009			12.5 (39)	14.3 (21)	16.2 (30)	16.9 (5)	18 (11)	17.5 (22)	17.8 (48)	18 (4)	22 (6)	24.8 (2)	22.2 (5)	24.2 (3)	22.9 (2)			21.2 (1)	-0.9	2.6
2014			13.5 (3)	14.7 (10)	16.1 (11)	16.5 (8)	17.8 (39)	17.8 (39)	17.4 (12)	19.2 (2)	19.1 (3)	20.4 (2)	20.2 (8)	20.1 (1)	19.6 (1)	28.4 (1)			-1.4	1.6
2021					17.6 (1)	20.9 (13)	22.5 (3)		24.4 (1)	24.8 (3)	25.7 (2)	25.4 (5)	25.7 (12)	26.1 (15)	28.1 (3)		29.8 (1)		+3.3	0.2

[1]Mean growth index is the average deviation from the state average length at age.

Table 4. Total catch by length range of select fish species collected from Chicagon Lake, Iron County in April 2021. Data taken from DNR, Fisheries Division records.

Inch Group	Walleye	Northern Pike	Smallmouth Bass	Largemouth Bass
1				
2				
3				
4				
5				
6				
7				
8		1	1	
9			2	1
10			1	
11			1	
12		1		
13			1	1
14		4	2	1
15		2	2	
16		3	2	
17		5		
18	1			
19	7	1		
20	23	3		
21	18	3		
22	12	1		
23	9	1		
24	11			
25	25	1		
26	42	1		

Table 4. Continued.

Inch Group	Walleye	Northern Pike	Smallmouth Bass	Largemouth Bass
27	24			
28	8	2		
29	4			
30	1			
31	1			

Table 4. Number, length, and percentages of fishes collected from Chicagon Lake, Iron County in June 2021. Data taken from DNR, Fisheries Division records.

Common name	Scientific name	Number	Total weight (lbs.)	Average length (in)	Percent of catch by number	Percent of catch by weight	Percent legal or acceptable size
Bluegill	*Lepomis machrochirus*	852	146.9	6.1	38.2	21.8	55 (≥6")
Bluntnose Minnow	*Pimephales notatus*	46	0.2	2.5	2.1	0.0	-
Central Mudminnow	*Umbra limi*	8	0.1	2.9	0.4	0.0	-
Cisco	*Coregonus artedii*	31	22.8	14.0	1.4	3.4	-
Hornyhead Chub	*Nocomis biguttatus*	1	0.0	4.5	0.0	0.0	-
Hybrid Sunfish	-	30	6.4	6.4	1.3	0.9	63 (≥6")
Iowa Darter	*Etheostoma exile*	15	0.1	2.6	0.7	0.01	-
Lake Trout	*Salvelinus namaycush*	3	24.7	28.5	0.1	3.7	100 (≥15")
Lake Whitefish	*Coregonus clupeaformis*	25	31	15.3	1.1	4.6	-
Largemouth Bass	*Micropterus salmoides*	33	33.0	11.7	1.5	4.9	27 (≥14")
Northern Muskellunge	*Esox masquinongy*	5	64.6	37.3	0.2	9.6	0 (≥50")
Northern Pike	*Esox lucius*	38	102.0	21.7	1.7	15.1	26 (≥24")
Pumpkinseed	*Lepomis gibbosus*	414	50.0	5.4	18.5	7.4	21 (≥6")
Rock Bass	*Ambloplites rupestris*	516	62.9	5.3	23.1	9.4	22 (≥6")
Smallmouth Bass	*Micropterus dolomieu*	81	58.5	9.7	3.6	8.7	16 (≥14")
Walleye	*Sander vitreus*	7	41.8	26.1	0.3	6.2	100 (≥15")
White Sucker	*Catostomus commersoni*	5	10.8	17.7	0.2	1.6	-
Yellow Perch	*Perca flavescens*	123	17.5	5.7	5.5	2.6	28 (≥7")

Table 5. Total catch by length range of select fish species collected from Chicagon Lake, Iron County in June 2021. Data taken from DNR Fisheries Division records.

Inch group	Bluegill	Cisco	Lake Trout	Lake Whitefish	Largemouth Bass	Northern Pike	Pumpkinseed	Rock Bass	Smallmouth Bass	Walleye	Yellow Perch
0											
1	2							2			
2	3						3	2	3		31
3	14						6	32	1		18
4	136						143	192	1		4
5	228						175	172	3		9
6	259				1		66	76	12		26
7	187	4		1	4		19	27	17		16
8	23	1			3		2	12	8		5
9					5			1	2		2
10					3				7		2
11					1				3		6
12					1				7		4
13					6				4		
14		13		10	3						
15		8		7	4	2			5		
16		3		4	1	6			4		
17		2		1	1	5			2		
18				2		3			2		
19											
20						3					
21						1				1	
22						2					
23						6					
24						4				1	
25						1				1	

Table 6. Continued.

Inch group	Bluegill	Cisco	Lake Trout	Lake Whitefish	Largemouth Bass	Northern Pike	Pumpkinseed	Rock Bass	Smallmouth Bass	Walleye	Yellow Perch
26											
27			1			1				3	
28			1			1				1	
29			1								
30						1					
31											
32											
33						1					
34											
35											
36											
37											
38						1					

Table 6. Weighted mean length (inches) at age and growth relative to the state average for select fishes sampled from Chicagon Lake, Iron County in June 2021. Number of fish aged is in parentheses. Data taken from DNR Fisheries Division records.

	Age Group										
Species	1	2	3	4	5	6	7	8	9	10	Mean growth index[1]
Bluegill	-	3.4 (5)	4.9 (15)	6.1 (17)	6.6 (8)	7.6 (4)	7.5 (8)	7.9 (5)	7.2 (2)	-	-0.1
Cisco	7.5 (2)	7.7 (2)	14.8 (1)	14.7 (4)	15.2 (19)	15.7 (3)	-	-	-	-	-
Lake Trout	-	-	-	-	-	-	-	27.3 (1)	-	-	-
Lake Whitefish	-	7.4 (2)	-	14.8 (6)	15.0 (9)	15.6 (5)	18.1 (2)	16.7 (1)	-	-	-
Largemouth Bass	7.6 (2)	8.6 (7)	10.9 (9)	12.9 (7)	15.0 (5)	-	15.5 (2)	17.4 (1)	-	-	+1.5
N. Muskellunge	-	-	-	32.1 (2)	-	36.8 (1)	-	-	45.3 (1)	-	-
Northern Pike	-	18.7 (23)	22.8 (10)	26.9 (3)	30.5 (1)	33.6 (1)	-	38.1 (1)	-	-	+1.5
Pumpkinseed	-	-	4.1 (3)	4.9 (14)	5.4 (19)	6.8 (2)	7.1 (6)	7.5 (5)	7.2 (2)	-	-0.7
Smallmouth Bass	5.6 (7)	7.4 (29)	9.8 (13)	12.3 (15)	15.5 (2)	15.3 (2)	16.8 (4)	16.5 (1)	17.6 (3)	-	+0.1
Walleye	-	-	-	-	-	-	-	-	24.2 (1)	25.6 (1)	-
Yellow Perch	3.4 (12)	4.3 (3)	5.4 (9)	6.7 (10)	7.3 (23)	9.0 (6)	9.9 (3)	11.8 (5)			-0.5

[1]Mean growth index is the average deviation from the state average length at age.

Table 7. Habitat parameters recorded in 2009 and 2021 on Chicagon Lake, Iron County. Qualitative ratings are comparing Chicagon Lake metrics to statewide averages between 2002-2007 (Wehrly et al. 2015). Data taken from DNR, Fisheries Division records.

Year	# Docks Per Mile	Qualitative Rating*	Armored Shoreline %	Qualitative Rating	Dwellings Per Mile	Qualitative Rating*	Submerged Trees Per Mile	Qualitative Rating
2009	8.9	High	4.9	Medium	9.6	Medium	48	High
2021	10.3	High	9.3	Medium	9.5	Medium	55	High

Table 8. Catch-per-unit-effort (fyke nets) in 2009 and 2021 for various fish species collected from Chicagon Lake, Iron County. Qualitative ratings are comparing Chicagon Lake CPUE results to statewide averages between 2002-2007 (Wehrly et al. 2015). Data taken from DNR, Fisheries Division records.

Species	2009	Qualitative Rating	2021	Qualitative Rating	Change
Bluegill	16.4	Medium	43.5	High	+27.1
Pumpkinseed	5.5	High	21.4	High	+15.9
Rock Bass	74.2	High	26.9	High	-47.3
Largemouth Bass	0.08	Low	0	Low	-0.08
Smallmouth Bass	6.2	High	0.83	Medium	-5.4
Walleye	1.8	High	0.22	Medium	-1.6
Yellow Perch	2	Medium	1.72	Medium	-0.3
Northern Pike	0.25	Low	2.11	High	+1.9
Northern Muskellunge	0.08	N/A	0.28	N/A	+0.2

Table 9. Weighted mean length (inches) at age and growth relative to the state average for Walleye sampled from Chicagon Lake, Iron County in June 2009 and 2021. Number of fish aged is in parentheses. Data taken from DNR, Fisheries Division.

	Walleye Age Group											
Year	1	2	3	4	5	6	7	8	9	10	11	12
2009	7.2 (22)	10.9 (20)	12.6 (1)	14.8 (1)	-	-	-	-	-	-	-	23.4 (2)
2021	-	-	-	-	-	-	-	-	24.2 (1)	25.6 (1)	-	

Table 10. Average daily temperatures and calculated warming rates recorded in May 2016-2022 for Chicagon Lake, Iron County. Data taken from DNR, Fisheries Division records.

	2016	2017	2018	2019	2021	2022
May	Average Daily Temperature °C					
1		6.4			8.2	3.7
2		6.5			8.2	4.3
3		7.0			8.0	4.7
4	7.4	8.0			7.9	5.8
5	7.9	7.4			8.4	5.9
6	10.5	7.8			8.5	5.2
7	9.9	7.6			8.3	6.5
8	9.2	8.2			8.6	7.3
9	9.4	8.4			8.8	7.2
10	9.7	10.4			8.0	7.9
11	10.1	10.8			8.2	6.9
12	11.5	10.5			9.8	10.2
13	11.1	12.1			10.7	11.1
14	9.5	12.2			11.6	13.7
15	9.4	12.1		11.0	11.1	13.7
16	10.3	12.5	18.5	11.3	11.9	13.9
17	10.5	13.3	17.4	10.2	13.4	13.4
18	11.6	12.0	17.4	9.7	14.7	13.6
19	13.5	10.8	17.2	8.7	15.0	14.4
20	15.1	10.9	16.8	9.2	15.4	14.5
21	14.6	10.9	17.7	9.4	15.8	14.1
22	15.6	11.2	18.3	9.7	17.0	13.4
23	16.5	11.2	19.5	10.5	15.8	14.4
24	17.0	10.8	20.0	10.4	15.7	14.3
25	16.1	11.3	20.0	11.7	17.0	13.8
26	17.4	12.5	21.2	12.0	16.3	13.4
27	18.4	14.4	22.6	11.1	15.2	13.9

Table 11. Continued.

	2016	2017	2018	2019	2021	2022
May	Average Daily Temperature °C					
28	18.8	14.9	23.7	12.2	14.3	13.8
29	19.2	14.7	24.0	14.0	14.9	14.4
30	19.2	14.3	24.1	13.8	15.3	15.7
31	18.5	14.6	23.9	14.5	15.3	16.8
Warming Rate	0.4	0.3	0.4	0.2	0.2	0.4

Figure 1. Map of Chicagon Lake, Iron County Michigan.

Figure 2. Average size of Lake Whitefish from 1989-2021 in Chicagon Lake, Iron County. Data from MDNR, Fisheries Division records.

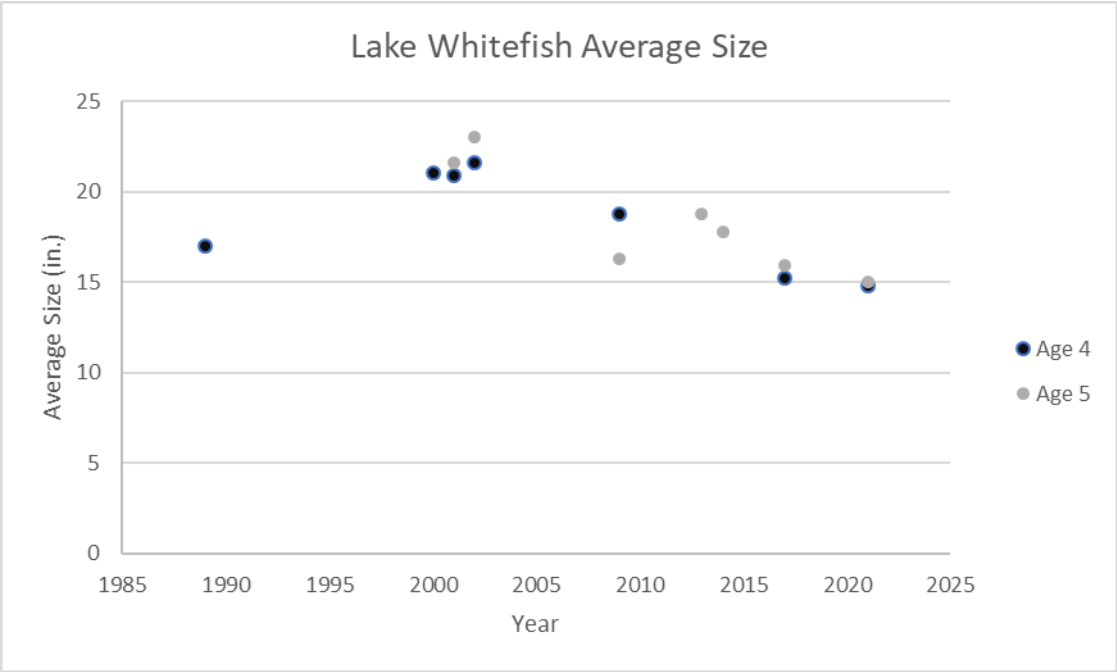


Figure 3. Length frequency of Lake Whitefish speared in 2001, 2017, and gillnetted in 2021 in Chicagon Lake, Iron County. Overall size structure has decreased over time in Chicagon Lake. Data taken from DNR, Fisheries Division records.

Figure 4. Average size of Age 4 Cisco between 2013-2021 in Chicagon Lake, Iron County. Average size has remained relatively consistent over time. Data taken from DNR, Fisheries Division records.

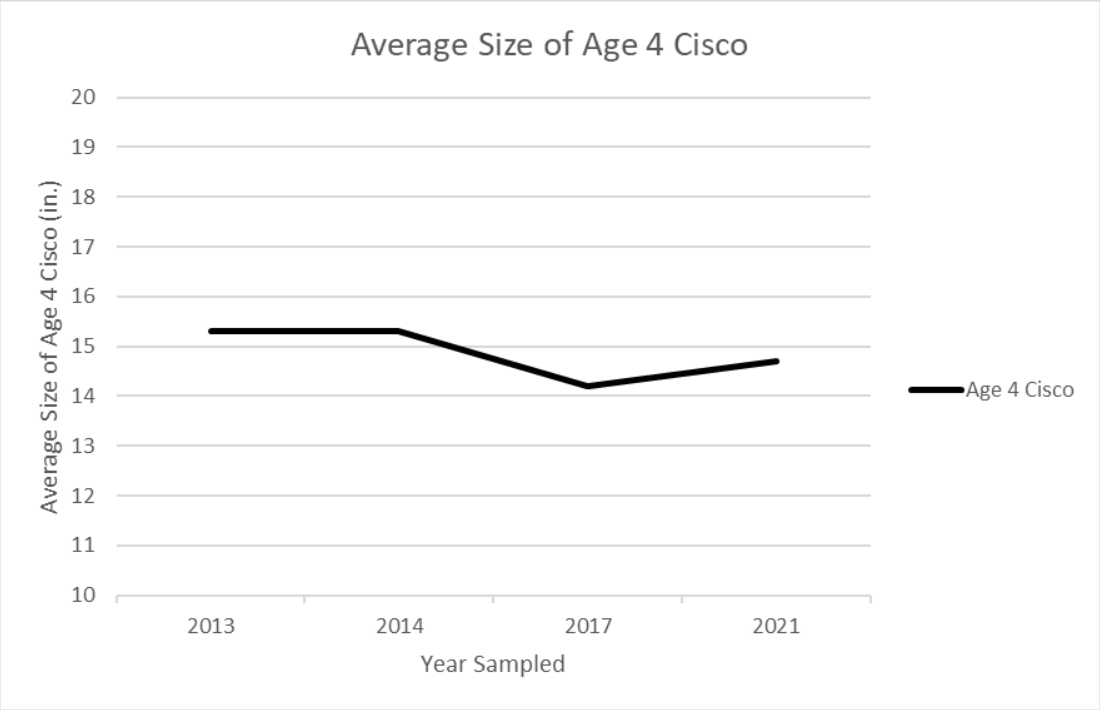


Figure 5. Walleye length frequency in 2009, 2014, and 2021 in Chicagon Lake, Iron County. Length frequency has increased in size over time, indicated Walleye are aging out of the population. Data from DNR, Fisheries Division records.

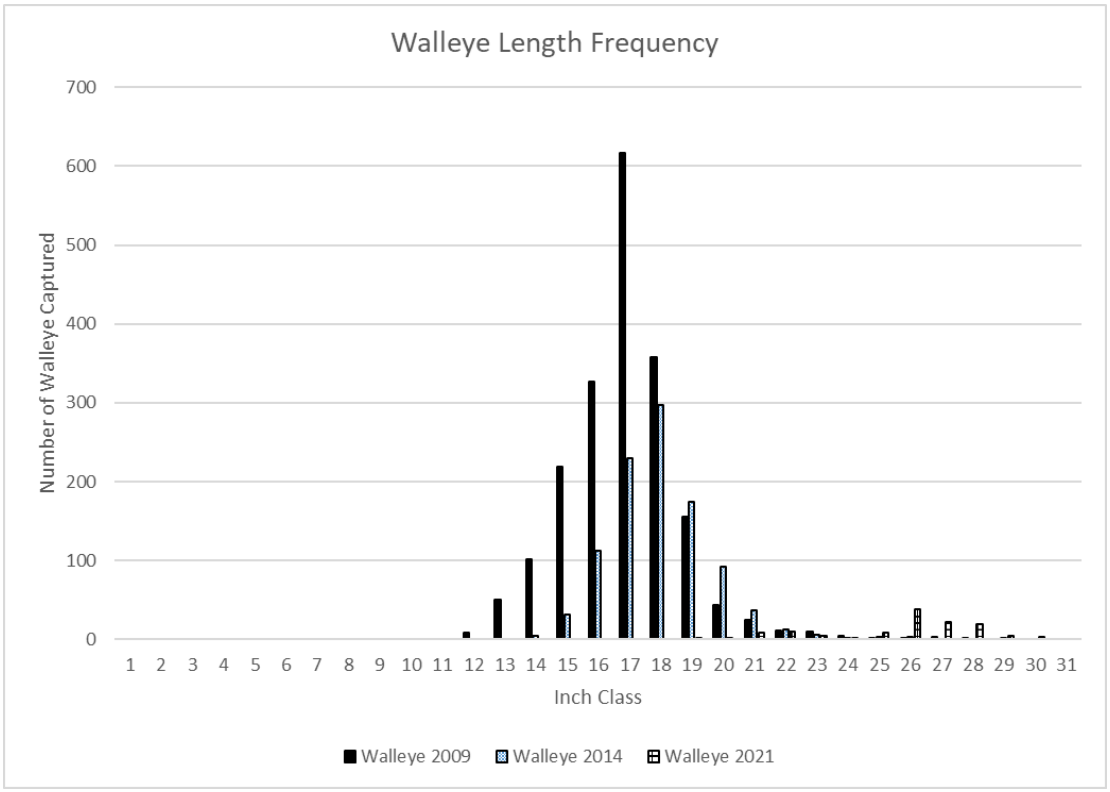
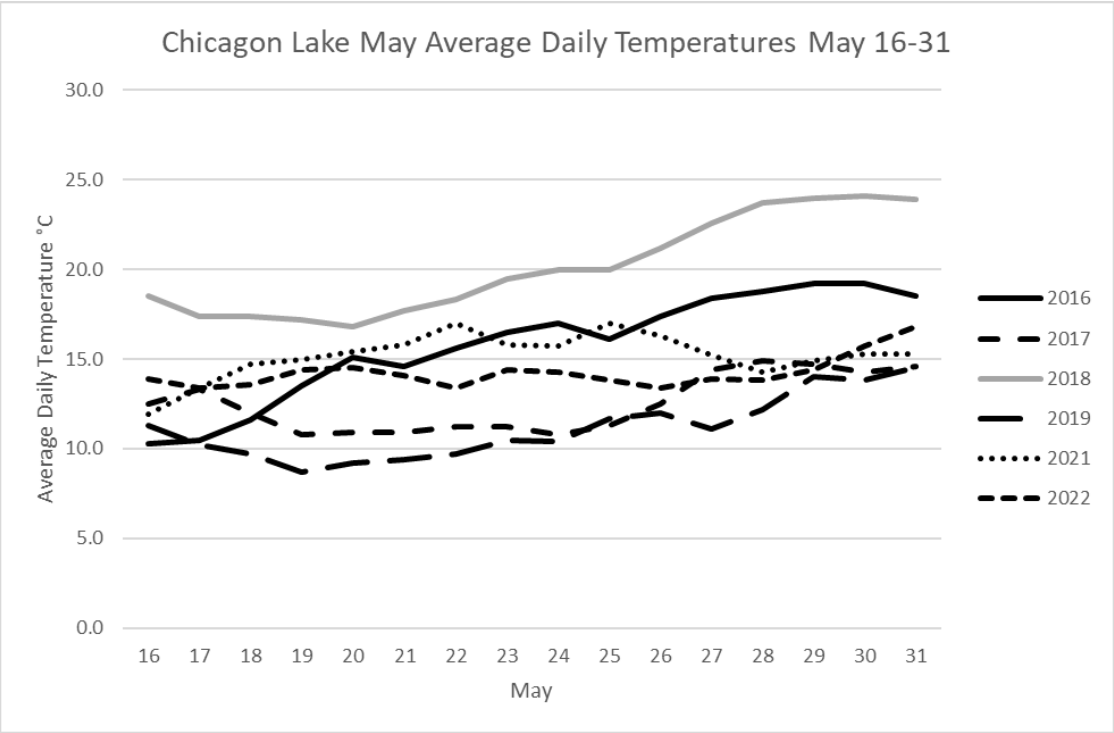


Figure 6. Average daily temperatures (°C) May 16-31 between 2016-2022 in Chicagon Lake Iron County. Data taken from DNR, Fisheries Division records.



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