Maple and Ackley Lakes

Van Buren County; T3S / 14W / Sec 1,12,13 and T3S / R13W / Sec 6
Surveyed May 7 – 10, 15 and August 21, 2018

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Introduction

Maple and Ackley Lakes are located in Van Buren County in the Village of Paw Paw. Maple Lake is an impoundment on the South Branch Paw Paw River. The water level in both lakes is maintained by a retired hydroelectric dam that is 27 feet high with a head of 17 feet. Ackley Lake is connected to Maple Lake through a small channel and culvert that passes under M-40. Maple Lake is approximately 172 acres and Ackley Lake adds approximately 65 acres in surface area. Both lakes are shallow with maximum depths of around 15 feet. There is a small impoundment (Briggs Pond) on the South Branch Paw Paw River just upstream of Maple Lake and the East Branch Paw Paw River flows into the south end of Maple Lake between the Briggs Mill Dam and W Michigan Avenue. The South Branch and East Branch of the Paw Paw River drain 58 mi^2 and 34 mi^2 watersheds. The land use of these watersheds is 47% agriculture, 24% forested, 16% urban, and 10% wetland. The watershed is 75% ice contact and glacial outwash sand and gravel and postglacial alluvium and 25% end moraines of coarse textured till. These rivers transport sediment and phosphorus into Maple and Ackley Lakes. The residence time of water entering Maple Lake is very short (estimated average of 7 days; SWMPC 1978) resulting in limited stratification of the water column.

A village-owned boat ramp is located on the northeastern shore of Maple Lake that accommodates up to 8 vehicles with trailers and an additional 15 vehicles without trailers. There is also good shoreline fishing access from the park on Maple Island, near the dam on the north shore, and a boardwalk with piers along the south shore. Ackley Lake can be accessed by small boats through the connecting channel if the water level is not too high. Both lake shorelines are highly residential because of the proximity to the village of Paw Paw.

Bluegill, Largemouth Bass, Yellow Perch, and Black Crappie were stocked in Maple and Ackley Lakes from 1933 through 1945. Walleye stocking was initiated in 1954 with 21,200 fingerlings stocked over a 3-year period (Table 1). The Maple Lake Dam breached in 1937 resulting in high recruitment of Common Carp. Anglers began to complain of a poor fishery resulting from overabundant Common Carp. A fisheries survey was conducted on Maple and Ackley Lakes in 1962 and the sport fishery was in good shape with all sportfish exhibiting good to average growth. However, Common Carp made up 43% of the total biomass and managers proposed to eradicate Common Carp and the existing fish populations and restock. The proposal was defeated due to lack of public support. A drawdown of Maple and Ackley Lakes was conducted in 1979 resulting in complaints from anglers about the poor quality of fishing. Walleye stocking was resumed in 1980 and Maple Lake has been managed for Walleye until the present. Walleye stocking was conducted annually by the Michigan Department of Natural Resources (DNR) from

1980 through 1999 and biannually from 1999 through the present (other than a brief period from 2007 through 2011 when DNR stocking of Walleye was not conducted statewide due to disease issues). Additional drawdowns were conducted in 1990 and 1993 and sediments were mechanically removed by bulldozer as part of the 1993 drawdown. Fisheries surveys were conducted in 1991 (Dexter 1993) and 1995 (Dexter 2000) to evaluate the fishery following these disturbances. The surveys indicated that the fishery had remained unchanged since previous surveys. Fewer fish were captured in the 1991 survey, but growth rates during both surveys were good for all sportfish. The fishery was rated as excellent. However, recruitment variability was identified as a potential issue in the future. Loss of Walleye due to dam escapement during drawdowns was identified as a major obstacle to maintaining the Walleye fishery. Dredging and drawdowns have continued to this date.

Survival of stocked Walleye was evaluated using targeted fall electrofishing in 1990 through 1995, 1997, and 2001. Survival of age-0 and age-1 Walleye can be evaluated using the Serns index to estimate the number of fish per acre from catch per effort in shoreline electrofishing surveys (Serns 1982, Serns 1983, Ziegler and Schneider 2000). Very few young-of-year or juvenile Walleye were captured throughout the years of surveys and index scores were rarely calculated due to the lack of fish. Although Maple Lake surveys evaluated fisheries that were connected to Ackley Lake, no specific efforts were conducted on Ackley Lake since 1962.

Maple Lake is not meeting the designated use for fish consumption due to PCB in fish tissue. Fish consumption advisories above state levels are in place for Common Carp (PCBs) and Largemouth Bass and Smallmouth Bass (mercury). Fish were collected during the 2018 fish survey to update these advisories and analysis is ongoing. A TMDL (total maximum daily load) study is scheduled for Maple Lake beginning in 2022.

Maple and Ackley Lakes have had a long history of sediment, vegetation, and water level management. Briggs Pond has acted as a sediment trap for Maple Lake and maintenance dredging has been conducted to limit sediment transport to Maple Lake. The southern basin of Maple Lake has also undergone maintenance dredging. Dredging projects have become complicated due to the identification of contamination in the sediments of Briggs Pond and Maple Lake primarily due to elevated arsenic concentrations. This contamination results in additional sediment management requirements and restricts disposal options for dredge spoils. The Briggs Mill Dam breached in a flood during the fall of 2017. The breach sent additional contaminated sediment downstream into Maple Lake. The dam was rebuilt as an earthen dam with an emergency spillway with capacity up to the 200-year flood event. Sedimentation continues to be an issue for Briggs Pond and Maple Lake.

Maple and Ackley Lakes have experienced vegetation management through mechanical removal, chemical treatment, and winter drawdowns. There are several species of invasive vegetation, and native vegetation is abundant due to the shallow bathymetry of the reservoir and abundant supply of nutrients. Winter drawdowns of 4 feet were initiated experimentally in fall 2015 with the goal of reducing the need for chemical treatment of vegetation. Drawdowns were conducted annually from 2015 through 2018 in October (6 inches a day, completed by October 15). The purpose of this fisheries survey was to evaluate the fish community following multiple years of drawdown.

Methods

A fisheries survey was conducted in 2018. The survey design followed standard methods for conducting a random lake survey as described in the DNR Status and Trends protocol (Wehrly et al. Draft). Netting efforts took place from May 7 through May 9, 2018. Two gill nets were set overnight on Maple Lake for each of two nights and one gill net was set on Ackley Lake for two nights for a combined total of six net nights. Three large-mesh fyke nets were set overnight on Maple Lake and one net was set on Ackley Lake for each of three nights for a total of twelve net nights. Two small mesh fyke nets were deployed for two nights on Maple Lake and one was deployed for two nights on Ackley (total of 6 net nights). Three beach seine hauls were conducted to quantify minnow and inshore prey species abundance levels on Maple Lake and one additional seine haul was conducted on Ackley Lake. Three 10-minute nighttime electrofishing transects were conducted on Maple Lake and one 10-minute transect was conducted on Ackley Lake on the evening of May 15, 2018 for a total of 40 minutes of effort. All fish were identified, counted, and measured (total length). Weights for all fish species were calculated using length-weight regression equations compiled by Schneider et al. (2000b). The relative stock density for each fish species was assessed using catch-per-effort (CPE) calculated as the number of fish caught per net night (gill and fyke nets), per hour of electrofishing (boomshocker), or per haul (seine). CPE data from this survey were compared to a summary of CPE data from lakes surveyed in the Status and Trend Program from 2002 through 2007 on a statewide and regional level for the Southern Lake Michigan Management Unit (SLMMU). Age structures (scales or spines) were collected from ten fish in each inch class for all sportfish. Weighted age compositions using length and age keys for each game fish species were calculated as described by Schneider (2000b). The difference between the state average mean length for each age class and mean length-at-age from surveys was used to calculate size differences for each age class. Age classes represented by a minimum of five fish were averaged to provide an index of fish growth (Schneider et al. 2000a). Growth index scores between +1 and -1 are considered similar to the state average while scores less than -1 and greater than +1 are considered below or above the state average, respectively. Bluegill size structure was rated using an index based on the mean length, growth, and the proportion of fish >6 inches, >7 inches, and >8 inches for different gear types (Schneider et al. 2000a, Schneider 1990). Annual mortality was estimated for abundant fish species with adequate age data using catch curve analysis (Ricker 1975).

A fish habitat assessment of Maple and Ackley Lakes was conducted on August 21, 2018. Shoreline surveys of the three lakes included 30 transects of 1,000 feet each with an additional 56 feet and 150 feet added to two transects for a total of approximately 30,206 feet (18,056 feet on Maple Lake shoreline, 3,000 feet on the island, and 9,150 feet in Ackley Lake). The number of docks (large and small), dwellings, submerged trees, and the percent of the shoreline that was armored (riprap or seawalls) were recorded for each transect. A temperature and dissolved oxygen profile was collected for 1-foot increments at the deepest spots in both Maple and Ackley

Lake. Detailed methods for limnological, shoreline, and fish sampling can be found in Wehrly et al. (Draft).

Results

A temperature and dissolved oxygen profile was conducted to a depth of 12 feet on both Maple and Ackley Lakes. Light could penetrate to the bottom of both lakes with Secchi depths of 11 feet and 8 feet respectively and light penetration to twice the Secchi depths. Neither lake was strongly stratified. Water temperatures varied from 74.8 F at the surface in Maple Lake to 70.7 F at the bottom, and 77.9 F at the surface in Ackley Lake to 75.4 F at the bottom (Figure 1). The water was well oxygenated at all depths. A total of 30,206 feet of shoreline was surveyed between Maple and Ackley Lake. The density of docks was 6.9 docks per 1,000 feet of shoreline. Dock density was similar between Ackley and Maple Lake with a density of 6.7 docks per 1,000 feet and 7.0 docks per 1,000 feet respectively. The densities were slightly above the median for SLMMU lakes (5.3 docks per 1,000 feet) and above the 75th percentile for statewide lakes (5.9 docks per 1,000 feet). The density of dwelling followed a similar pattern with density of 7.3 dwellings per 1,000 feet of shoreline. Ackley had a higher density of houses at 8.9 per 1,000 feet of shoreline compared to Maple Lake at 7.0 per 1,000 feet of shoreline. Dwelling density was close to the 75th percentile for SLMMU lakes (8.2 per 1,000 feet of shoreline) and above the 75th percentile for statewide lakes (5.9 per 1,000 feet of shoreline). The average percent of the shoreline that was armored on both lakes was 79.6% with Ackley being lower (67.0%) than Maple Lake (86.7%). The armoring is well above the 75th percentile for lakes in SLMMU (46.7%) and statewide (31.3%). The density of submerged trees along the Maple and Ackley Lake shoreline averaged 8.1 logs per 1,000 feet of shoreline with Ackley Lake being slightly higher at 8.7 per 1,000 feet of shoreline compared to Maple Lake at 7.8 per 1,000 feet of shoreline. Wood density was well above the 75th percentile of SLMMU (2.8 per 1,000 feet of shoreline) and statewide lakes (5.7 per 1,000 feet of shoreline).

A total of 3,444 fish were collected across all gears in Maple and Ackley Lakes for a total of 687 pounds (Table 2). Minnows were abundant in small mesh fyke nets and seines with Blacknose Shiner being the most abundant species captured across gears (1,146 fish) along with high numbers of Bluntnose Minnow (n = 641). White Suckers were also common with 76 fish caught across gears ranging from 8 to 22 inches. Few Common Carp were collected (n = 5) ranging from 18 to 26 inches. Snapping, Eastern Spiny Softshell, Map, Painted, and Musk Turtles were also captured in fyke nets.

Bluegill was the second most abundant species caught across gears (n = 1,106) making up 32% of total catch by numbers and 23% by weight. Bluegill ranged from 1 to 9 inches with a mean length of 4.6 inches. Fish over 6 inches made up 45% of the total catch for Bluegill resulting in an abundance of fish of the preferred size for harvest. Fish age 1-9 were captured and on average grew to 6 inches by age 3 or 4. The mean growth index was +0.6. Length-at-age was above the state average for Bluegill ages 3 and older (Figure 2). The population size structure was rated as excellent/superior from large mesh fyke net data, satisfactory from electrofishing data, and good based on growth index. CPE from large mesh fyke nets for Bluegill was 38.2 fish per net night across lakes, with Ackley Lake CPE being much lower at 8.3 per net night compared to Maple Lake at 48.1 per net night. The mean Maple-Ackley CPE was slightly above the 25th percentile for SLMMU lakes (29.3 per net night) and above the statewide median (26.0 per net night).

Age-1 fish made up 37% of the total Bluegill catch across lakes representing a large year class from the 2017 cohort (Figure 3). Small mesh fyke nets captured a high number of 1-inch Bluegill on Ackley Lake (n = 325). These fish made up 43% of all Bluegill captured in Maple and Ackley Lakes and 81% of those captured on Ackley Lake. CPE for Bluegill in small mesh fykes was 66.0 fish per acre (18.3 in Maple and 161.5 in Ackley) which is between the median (56.5 per net night) and the 75th percentile (107.8 per net night) for SLMMU lakes and above the statewide 75th percentile (64.3 per net night). The age 3 year class (mean length = 5.0 inches) appears to be poorly represented and both age 4 and age 5 fish were more abundant. The age-4 year class recruited particularly well and averaged 7.4 inches and age 5 fish averaged 8.0 inches. The 7-inch size class made up 14% of all Bluegill caught and if the high number of 1-inch fish are excluded, 7-inch fish made up 43% of Bluegill captured. Annual mortality rate was estimated at 67% (Figure 4) and was in the middle of the range reported in other studies (59 to 87%; Coble 1998; Crawford and Allen 2006). This annual mortality rate resulted in few fish being captured that were older than age 5 (Figure 5). However, growth rates were high enough that age 4 and 5 fish produce a quality fishery with average sizes of 7.4 and 8.0 inches respectively.

A total of 109 Yellow Perch were captured in the 2018 survey that averaged 8.7 inches and ranged from 3 to 12 inches. Mean lengths were similar between lakes with Maple Lake being slightly higher (8.9 inches) than Ackley Lake (8.2 inches). CPE from gill nets was 5 fish per net night with Ackley Lake having a higher catch rate (6.5 per net night) than Maple Lake (4.3 per net night). The catch rate was relatively high being between the median and 75th percentile for SLMMU (2.9 and 6.2 per net night respectively) and higher than the 75th percentile for statewide lakes (4.9 per net night). Yellow perch exhibited average growth with an index score of +0.7, and mean length at age was slightly higher than the state average for all age classes captured (Figure 6). Yellow Perch abundance was evenly distributed among size classes 6 inches and greater (Figure 7). Yellow Perch size structure was excellent with good numbers of large fish. Yellow Perch greater than 8 inches made up 62% of the total catch and fish over 10 inches made up 34%. Few other panfish were collected with only 32 Pumpkinseed, 15 Black Crappie, 56 Warmouth, 6 Hybrid Sunfish, and 1 Rock Bass captured.

Largemouth Bass were the most abundant predators in Maple and Ackley Lakes. A total of 112 Largemouth Bass were collected across gears with a mean length of 10.6 inches and a range from 3 to 18 inches. CPE from nighttime electrofishing was 128 fish per hour which is close to the 75th percentile for SLMMU lakes (144 per hour) and above the 75th percentile for statewide lakes (94 per hour). CPE was higher on Ackley Lake at 162 per hour compared to Maple Lake at 116 per hour. Growth rates were average with an index score of +0.2. Fish age 1 to 10 were captured. Annual mortality was estimated at 35.6% which is quite low compared to the range reported by Allen et al. (2008) for North American Largemouth Bass populations. Only 8% of the fish caught were greater than 14 inches (Figure 8). There was a strong year class of age 2 fish averaging 7.9 inches that was present in both lakes. Most of the bass larger than 10 inches were captured in Maple Lake. No Smallmouth Bass were collected or observed.

Northern Pike were also captured in low numbers (n = 8) during the 2018 survey. Fish ranged from an age-2 fish of 17 inches in length to an age-9 fish of 35 inches in length and averaged 27 inches. Because the sample size was so low, growth index scores could not be calculated. Lengths of captured fish generally were very close to the statewide average length-at-age. This is the first time Northern Pike have been collected in Maple Lake since the 1962 survey when 4 fish under 24 inches were caught. No Northern Pike were captured in the 1975, 1991, or 1995 surveys.

Largemouth Bass and Northern Pike were the only predators captured. These species made up 18% of the total fish biomass. Predators typically make up 20-50% of the biomass in lakes with desirable fish communities (Schneider 2000a). Thus, the predator:prey ratio in Maple and Ackley Lakes appears to be skewed towards prey. No Walleye were captured in any gear despite extensive stocking.

Discussion

Maple and Ackley Lakes were not thermally stratified and likely do not stratify due to the shallow profile of the lakes and the short residence time. The water was well oxygenated to the bottom but was also warm throughout the water column limiting the fishery to warmwater and transitional species (Lyons et al. 2009). Although the density of dwellings and docks were near the SLMMU median, armoring was very extensive and well above the 75th percentile. Armoring may be more prevalent due to the maintained flow in Maple Lake or a result of past water level manipulations and increased erosion. Despite the extensive shoreline armoring, submerged wood was abundant in the littoral zone. Submerged wood creates excellent fish habitat and riparian landowners should be encouraged not to remove wood. Drawdowns give riparian landowners an opportunity to “clean” their shorelines. Removing trash promotes good lake health, but it is encouraging to note this has not resulted in widespread removal of wood.

The Bluegill population in Maple and Ackley Lakes is growing well and there are good numbers of fish over 7 inches available for harvest. The fishery is supported primarily by a strong year class of fish from 2014 that are averaging over 7 inches in length. As frequently observed in other Bluegill populations, a combination of natural mortality and sport fishing harvest has resulted in low densities of age 6 and older fish. Growth rates are good and younger fish should readily recruit to the preferred harvest size annually. There is some concern that the age-2 and -3 cohorts are less abundant than the age-4 cohort. This could indicate that fewer fish will recruit to the fishery in future years and the fishery will decline as the 2014 cohort is subjected to the higher mortality rate (i.e., fishing mortality added to natural mortality). Ackley Lake has a lower overall abundance of Bluegill compared to Maple Lake, but a high density of age-1 fish. Ackley Lake may be providing critical spawning and nursery habitat for both lakes. Although there were fewer large Bluegill in Ackley Lake, fish up to 8 inches were captured and available for harvest.

The high abundance of age 1 Bluegill suggests good recruitment from the 2017-year class. Bluegill from Ackley Lake in particular contributed to this year class. Bluegill recruitment is often variable and tied to a suite of environmental conditions, predator prey interactions, and human-induced impacts. Two unique occurrences during the 2017-2018 fall and winter could have influenced survival of young-of-year Bluegill. The Briggs Dam failure occurred in fall of 2017 resulting in the release of water and sediment into Maple Lake. The dam failure resulted in the halt of the winter drawdown of Maple Lake and Maple and Ackley Lakes remained at full pool throughout the winter. There is some concern that drawdowns can impact survival of young-of-year and juvenile fish as they are displaced from nearshore habitats that serve as refuge from predators (Hulsey 1957; Lantz et al. 1967; Groen and Schroeder 1978). We also observed a huge year class in 2014 followed by poor year classes in 2015 and 2016. It is unclear what is driving recruitment success in Maple and Ackley Lakes, but it is worth noting that the 2014 cohort was the last year class to overwinter prior to initiation of drawdown activities. Both 2015 and 2016 young-of-year fish were subjected to drawdowns during the first winter of life and the strong year class from 2017 was not. If drawdowns are to continue on Maple and Ackley Lakes, the Bluegill fishery should be monitored to ensure populations are not impacted. The fishery is supported by a few critical year-classes and mortality rates of older fish are high. It is likely that if densities of Bluegill become low, strong year classes will replace them, but if artificial conditions are limiting recruitment success there could be longer term impacts. When considering drawdowns, the benefits need to be demonstrated in order to justify the risk to the fishery.

The Yellow Perch fishery in Maple and Ackley Lakes is excellent. There were good numbers of large fish captured in the 2018 survey. A majority of fish caught were over 8 inches, and a third were over 10 inches which is considered the preferred size for harvest (Willis et. al 1993; Gabelhouse 1984). The largest Yellow Perch captured was 12.5 inches which is considered memorable size.

Largemouth Bass produce an average fishery on Maple and Ackley Lakes. Although large fish are not abundant, there are acceptable numbers of legal fish (> 14 inches) available to anglers. Catch rates and growth rates were average. The fishery has room to expand as prey fish are abundant. Predator populations are low density in Maple and Ackley Lake. Available habitat is most likely a limiting factor. Ackley Lake appears to provide important spawning and refuge habitat as catch rates of younger fish were highest there. Larger fish may migrate to Maple Lake due to habitat needs or may out-migrate when water levels recede in the winter. There is a large year class from the age-2 cohort averaging 7.9 inches. This year class corresponds with 2016, the first year following the initiation of the drawdown. Despite high abundances (and potential competition) in this year class, mean length is well above the statewide average of 7.1 inches for age-2 fish. This large year class of Largemouth Bass likely contributed to the low recruitment of Bluegill due to high levels of predation. Overwinter, Bluegill were likely more vulnerable to predation due to displacement from shoreline habitat as a result of the drawdown. Largemouth Bass populations benefited from the available prey resulting in high survival through winter which is a bottleneck for Largemouth Bass populations (Miranda and Hubbard 1994; Garvey et al. 1998; Post et al. 1998).

Northern Pike make up a low-density fishery with average growth. More fish were caught in the 2018 survey than in past surveys indicating that the population could be growing. Northern Pike should do well in Maple and Ackley Lakes because there is plenty of available prey including large-bodied White Sucker. However, Northern Pike optimal temperature range for juvenile and adult growth is 66 F to 70 F (Casselman 1978) and habitat is limited during periods of high temperature (Headrick and Carline 1993). Cool water within the optimal range for pike is not available in Maple and Ackley Lakes in late summer. Northern Pike also rely on shallow vegetated habitat and wetlands immediately after ice out for spawning. Drawdowns could result in poor recruitment of pike if this habitat is not yet inundated with water at this time. Although wetland habitat is limiting, the shallow southern end of the lake does create extensive flats that could be used for spawning.

Predators are available in low proportion compared to prey in Maple and Ackley Lakes. Often low-density predator populations do not control abundance of small prey fish resulting in high competition for resources. Bluegill stunting is often associated with low predator densities. Despite the low proportion of predators to prey, there was no evidence of Bluegill stunting in Maple and Ackley Lakes. Yearling Bluegill did make up a large portion of the population (37% of total number caught) and mean length at age was slightly below the statewide average for this year class. This may be an indication that there is some potential for competition resulting in poor growth. However, age-2 and -3 cohorts were only observed in low densities and growth rates were above average as a result.

Walleye stocking has not created a successful fishery. There is ample prey available and Walleye should not be limited by resources. Walleye have survived in Maple Lake in the past reaching advanced ages (see Dexter 1993 and 2000). However, stocked Walleye stocked in recent years either have not survived or have moved out of Maple and Ackley Lakes. Maple and Ackley Lakes do not have ideal habitat for Walleye fisheries and do not fit the general guidelines for Walleye stocking. Walleye require cool oxygenated water which usually occurs at deeper depths and this species generally does better in larger lakes. Maple and Ackley Lakes do not readily stratify resulting in warm water to the deepest part of the lake. Dam escapement can be an issue in sustaining Walleye populations in reservoirs (Walburg 1971, Weber et al. 2013). Escapement can be accelerated by drawing down reservoirs, especially when they are shallow resulting in poor critical winter depth. Walleye may be moving downstream into the South Branch Paw Paw River.

We could consider stocking fall fingerlings in Maple Lake. These fish are stocked at a larger size (6-8 inches) and are large enough to increase survival due to reduced predation (Santucci and Wahl 1993). Fall fingerling Walleye are much more expensive to produce than spring fingerlings due to the extended rearing period and shifting to minnow prey (which have to be reared or purchased) at larger sizes. Production of fall fingerlings is limited in SLMMU and the potential of successful stocking of fall fingerlings in Maple and Ackley Lakes is low.

Vegetation management has been challenging for the Village of Paw Paw and the Maple Lake and Ackley Lake Associations. These lakes are typical reservoir systems that are shallow and eutrophic with continuously accumulating sediment. Vegetation can be especially difficult in the headwater of a reservoir as this is the area where organic sediments settle out resulting in a shallow productive flat. Despite high densities of vegetation potentially impeding recreation, native vegetation is important for fish habitat and macroinvertebrates. All undeveloped shorelines and vegetated littoral zones are important to fish for spawning, nursery, and feeding and native weed treatments should be limited in these areas. Any removal of aquatic vegetation should preserve 60 to 80% of the native aquatic plants in a water body (see DNR Fisheries policy 02.02.014). In addition, it is important to maintain vegetation in a minimum of 20% of the littoral zone. Research on invasive vegetation suggests disturbance of native vegetation increases the potential for invasion as invasive species recolonize rapidly and outcompete native vegetation (Capers et al 2007, Smith et al 2004, Hobbs 1989, Hobbs and Huenneke 1992). Starry Stonewort is an aggressive invasive algae species present in Maple and Ackley Lakes and chemical treatment is one of the few techniques that have shown promise in preventing its spread. However, success with chemical treatments has been variable. Areas with extensive Starry Stonewort infestations should be treated using targeted treatment and care should be used to prevent impacting native vegetation. Starry Stonewort can expand in areas where native vegetation is removed as it establishes quickly. Chara was listed as the predominant vegetation type in Maple and Ackley Lakes in 1991 and 1995. Chara is a native algae species and is often treated as a nuisance species. There is a risk that Starry Stonewort can colonize areas where Chara densities have been decreased by treatment. Eurasian Water Milfoil is heavily treated using herbicides in Maple and Ackley Lakes. Mechanical harvesting of vegetation allows for increased open water but is very short lived as vegetation regrows quickly. Mechanical harvesting of Eurasian Water Milfoil is not advised as this species can reproduce and spread by segmenting. Cutting Eurasian Water Milfoil can lead to the spread to new parts of a lake. Management plans should evaluate potential spread of invasive species and impact on fish habitat if considering treating native vegetation.

Copper-based chemicals have been used to treat vegetation in Maple and Ackley Lakes. DNR Fisheries strongly recommends against using copper prior to July 1 to prevent impacting spawning fish. There are permit restrictions that do not allow for applying chemicals onto spawning fish. However, identifying spawning locations can be difficult during application especially when applying to large areas. Copper is a fish irritant and fish will leave the nesting area when chemicals are applied (Giattina et al. 1982; Hartwell et al. 1989; Van Genderen et al. 2016). This results in disrupting nest guarding and egg mortality resulting in failed reproduction similar to angling off the nest (see Diana et al. 2012) but on a much larger spatial scale. Nesting fish are highly stressed and chemical application can contribute to stress. Fish kills are often observed during spawning and several recent fish kills in southwest Michigan occurred shortly after application of copper-based herbicides. We encourage lake management organizations to consider potential impacts to fish and fish habitat in addition to the recreational use of the lake when making vegetation management decisions. DNR Fisheries can assist in evaluating treatment plans proposed by private companies and provide feedback to lake associations.

Winter drawdowns have been sparsely utilized in Michigan as an attempt to reduce vegetation densities and biomass. Drawdowns have been demonstrated to reduce inshore density and biomass of vegetation in some studies but pose a risk to the ecological integrity of littoral zones (see review by Carmignani and Roy 2017). The use of drawdowns should be carefully monitored, and the benefits must be demonstrated to warrant the risk from artificial manipulation. Winter drawdowns impact beneficial native vegetation as well as invasive species. Nutrient and sediment release, algal blooms, and low dissolved oxygen levels often result from drawdowns and human users are often dissatisfied due to access and aesthetic issues (Cooke 1980). Reducing the biomass of vegetation can result in shifts to an algae-dominated system as nutrients are no longer processed by vegetation resulting in poor water quality (Blindow 1992). Invertebrates are also impacted by winter drawdowns by reducing species richness and species composition as littoral communities shift towards tolerant species (Kraft 1988; Aroviita and Hämäläinen 2008; White et al. 2011). There must be derived benefit to drawdowns on Maple and Ackley Lakes to justify risking the ecological integrity of the lakes.

Lake monitoring has been conducted as part of the EGLE permit for drawdowns. Vegetation, invertebrate communities, water chemistry, dissolved oxygen, and spawning habitat were monitored during 2015 through 2019 (Jermalowicz-Jones 2019). Fall vegetation surveys were conducted in 2015 (pre-drawdown) and 2018 (a non-drawdown fall but following 2015 and 2016 drawdowns). Eurasian Water Milfoil comprised 31.5% in fall of 2015 and 10.5% in 2018 in Maple Lake demonstrating a decrease in total cover. Starry Stonewort increased from 1.1% to 11.9% from fall of 2015 to 2018 respectively. Ackley Lake had low densities for both species (<2% cover). Spring surveys were also conducted but are not good indicators of density for these species. Chemical treatment of vegetation continued during drawdown and non-drawdown years on both lakes (Table 3 and 4). The acreage treated and amount of chemicals remained the same or even increased since 2015 on both lakes. In 2018, the largest total area of Maple and Ackley Lakes was treated with chemicals compared to the previous 5 years. This at least confounds results and chemical treatment may have been a major factor in decreased Eurasian Water Milfoil coverage. Drawdowns have not reduced the use of chemical treatments or (presumably) the monetary costs of vegetation control. Fish spawning habitat area and macroinvertebrate density and diversity showed some declines. Maple Lake macroinvertebrate index of biotic integrity (IBI) scores dropped from 24 (excellent) to 19 (fair), the number of taxa decreased from 17 to 10 from 2015 through 2019, and species composition shifted toward Chironomids (Jermalowicz-Jones 2019). Ackley Lake IBI scores dropped from 24 (excellent) to 22 (good) with the number of taxa decreasing from 16 to 11. Late and early season boat access have been impacted as well as the quality of ice fishing due to low lake levels in winter. The benefits of drawdown have not been demonstrated, the use of chemical treatment remains high, and there are indications of potential impacts to fish and invertebrates in Maple and Ackley Lakes.

Management Direction

We will discontinue Walleye stocking in Maple Lake. Walleye have been stocked for decades with little success. No stocked Walleye were observed in the 2018 survey. Maple Lake does not fit the profile of a lake where Walleye stocking is encouraged. Fall fingerlings may improve survival but are not available for stocking at this time. We would not be opposed to issuing a stocking permit if private parties were interested in Walleye stocking.

We will support activities focused on reducing sediment loading of Briggs Pond and Maple and Ackley Lakes. We continue to work with the Southwest Michigan Planning Commission to implement the Paw Paw River Watershed Management Plan. Activities will include identifying critical sources of sediment and promoting best management practices in the watershed upstream of the lakes.

DNR Fisheries does not recommend continued winter drawdowns on Maple and Ackley Lakes. There is little evidence the drawdowns are reducing vegetation densities, chemical treatments have not been reduced as a result of drawdowns, native vegetation is being impacted, and there are indications of biological impacts to fish, invertebrates, and habitat as well as impaired use of the resource. Fisheries Division staff are willing to review proposed future actions and provide input to the Village of Paw Paw and the Maple and Ackley Lake Associations regarding vegetation management and control.

References

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Table 1. The history of Walleye stocking in Maple Lake.

Year	Number	Average Length (inches)
1954	5,000	spring fingerlings
1955	14,000	spring fingerlings
1956	2,200	spring fingerlings
1980	160,000	0.67
1980	85	0
1981	160,000	0.31
1982	2,000	0
1983	1,750	0
1984	407	4.09
1985	3,550	0
1986	4,076	1.89
1987	75	21.57
1987	3,552	1.89
1988	3,502	1.5
1989	3,555	1.69
1990	9,306	1.38
1990	4,352	1.65
1991	8,943	2.01
1992	10,806	1.89
1994	4,296	1.69
1994	4,950	1.69
1995	8,655	1.5
1996	303	1.3
1996	355	1.5
1996	8,931	1.57
1997	8,816	1.22
1998	15,476	0.47
1999	17,265	1.06
2001	10,111	0.98
2001	8,647	0.98
2003	9,966	0.91
2005	13,365	1.13
2006	172	16.28
2012	8,060	1.3
2014	8,694	1.33
2016	8,932	1.06

Table 2. Total catch from fisheries surveys conducted in 2018 on Maple and Ackley Lakes.

Species	Total Number Caught	Total Weight (lbs)	Mean Length (inches)	Length Range (inches)
Black Crappie	15	4.8	7.2	2 - 12
Blacknose Shiner	1,146	5.6	2.5	1 - 2
Bluegill	1,106	159.5	4.6	1 - 9
Bluntnose Minnow	641	3.6	2.4	1 - 3
Brook Silverside	2	-	3.5	3 - 3
Brown Bullhead	13	17.0	14.1	12 - 16
Channel Catfish	1	5.5	25.5	25 - 25
Common Carp	5	27.3	22.3	18 - 26
Common White Sucker	76	229.8	19.3	8 - 22
Golden Shiner	28	2.2	5.9	2 - 9
Green Sunfish	3	0.1	3.2	1 - 4
Hybrid Sunfish	6	1.6	7.0	6 - 7
Iowa Darter	18	0.0	1.8	1 - 2
Johnny Darter	2	0.0	2.5	2 - 2
Lake Chubsucker	1	0.4	8.5	8 - 8
Largemouth Bass	112	82.8	10.6	3 - 18
Northern Pike	8	40.4	27.0	17 - 35
Pumpkinseed	32	7.5	6.3	2 - 8
Rock Bass	1	0.6	9.5	9 - 9
Warmouth	56	13.2	6.2	1 - 8
Yellow Bullhead	63	47.8	11.5	6 - 14
Yellow Perch	109	36.3	8.7	3 - 12
Grand Total	**3,444**	**686.0**	**4.5**	**1 - 35**

Table 3. Chemical treatment history from 2012 through 2018 for Maple Lake. Chemical treatment has occurred annually since at least 1998 on Maple Lake based on EGLE ANC Records (Bacon, Personal Communication).

Year	Date	Acres	Target	Chemicals
2018	June 11	87.7	EWM, SSW	Diquat, Flumioxazin, Chelated Copper
	July 30	11.2	EWM, SSW	Triclopyr
	July 30	6.5	EWM, Elodia, Algae	Diquat, Flumioxazin, Chelated Copper
2017	June 13	88.5	EWM, SSW	Diquat, Flumioxazin, Chelated Copper
2016	June 16	40	Not Specified, Algae	Diquat, Flumioxazin, Chelated Copper
	June 28	33	EWM	Triclopyr
2015	June 28	45	EWM, Algae	Diquat, Flumioxazin, Chelated Copper
2014	June 10	10	Hybrid Milfoil, PW	Diquat, Flumioxazin, Chelated Copper, Endothall
	June 10	25	Hybrid Milfoil	Triclopyr
	June 22	6	Hybrid Milfoil, PW	Diquat, Triclopyr
	June 22	21	Algae	Chelated Copper
2013	June 4	4	Hybrid Milfoil	2,4-D, Triclopyr
	June 14	5	Hybrid Milfoil, PW, Algae	Diquat, Flumioxazin, Chelated Copper, Endothall
2012	May 29	35	Hybrid Milfoil, PW, Algae	Diquat, Chelated Copper, Endothall
	Aug 7	35	Hybrid Milfoil, PW, Algae	Diquat, Chelated Copper, Endothall

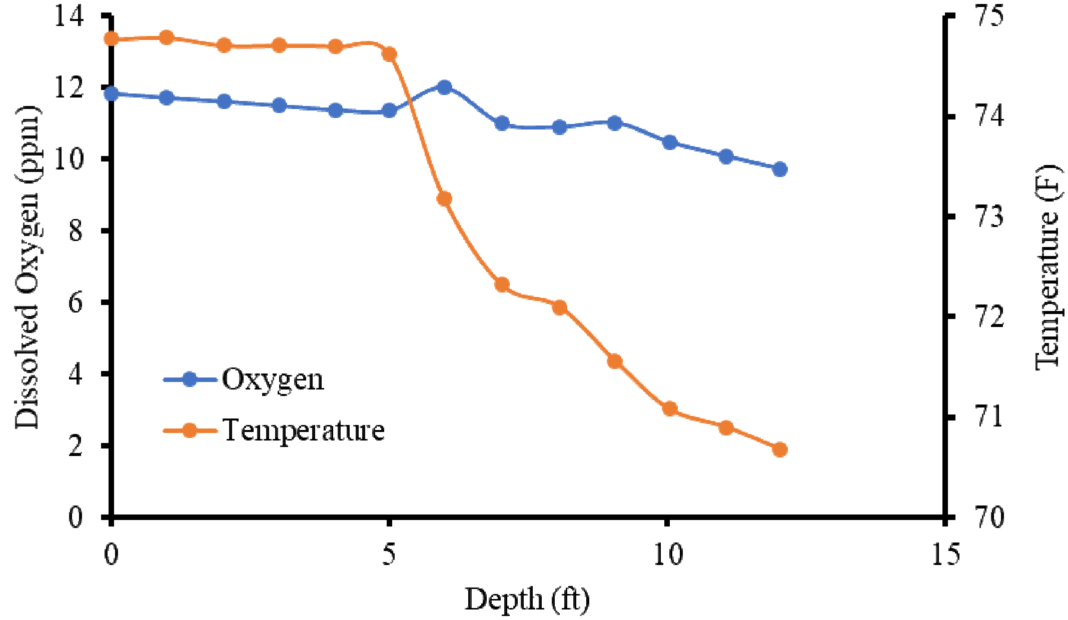
*EWM=Eurasian Water Milfoil; CLP=Curly Leaf Pondweed; FA=Filamentous Algae; PW=Native Pondweeds

Table 4. Chemical treatment history from 2013 through 2018 for Ackley Lake. Chemical treatment has occurred annually since at least 1995 on Ackley Lake based on EGLE ANC Records (Bacon, Personal Communication).

Year	Date	Acres	Target	Chemicals
2018	May 24	19.5	Algae	Copper
	May 24	~30	EWM CLP	Triclopyr, Diquat
	June 11	8.8	Filamentous Algae	Copper
	June 11	4	EWM, CLP	Diquat
	July 2	18	SSW	Copper
	August 6	6	EWM, CLP	Diquat, Copper
	August 6	8.5	SSW	Copper
2017	May 22	2	EWM, CLP	Diquat
	Jun 5	14.8	FA	Copper
	July 13	13.5	FA, EWM, PW	Copper, Diquat
	August 7	10	FA, EWM, Naiad, PW	Diquat, Endothall, Copper,
2016	May 17	7	FA	Copper
	May 17	7	EWM, CLP	Diquat
	June 8	12.3	FA	Copper
	June 8	2.5	EWM, CLP	Diquat
	July 11	4.5	FA, EWM, PW	Copper, Diquat
	August1	10	Naiad, EWM, Chara	Diquat. Endothall, Copper
2015	May 6	16	FA	Chelated Copper, Copper
	June 11	5	CLP	Endothall
	June 11	15	Algae, EWM	Chelated Copper, Diquat
	August 5	2.25	EWM, Naiad, FA	Diquat, Flumioxazin, Chelated Copper, Copper
2014	NA	~10	Algae, EWM, Natives	Diquat, Triclopyr
	June 19	~10	Algae	Copper
	July 27	~10	Naiad	NA
	August 12	~5	Naiad	NA
2013	June 25	~10	Natives, CLP, algae, PW	Endothall, Diquat, Copper
	July 17	~20	Natives, CLP, algae, PW	Endothall, Diquat, Copper, Chelated Copper
	August 14	~10	Natives, CLP, algae, Naiad	Diquat, Flumioxazin

*EWM=Eurasian Water Milfoil; CLP=Curly Leaf Pondweed; FA=Filamentous Algae; PW=Native Pondweeds

A.



B.

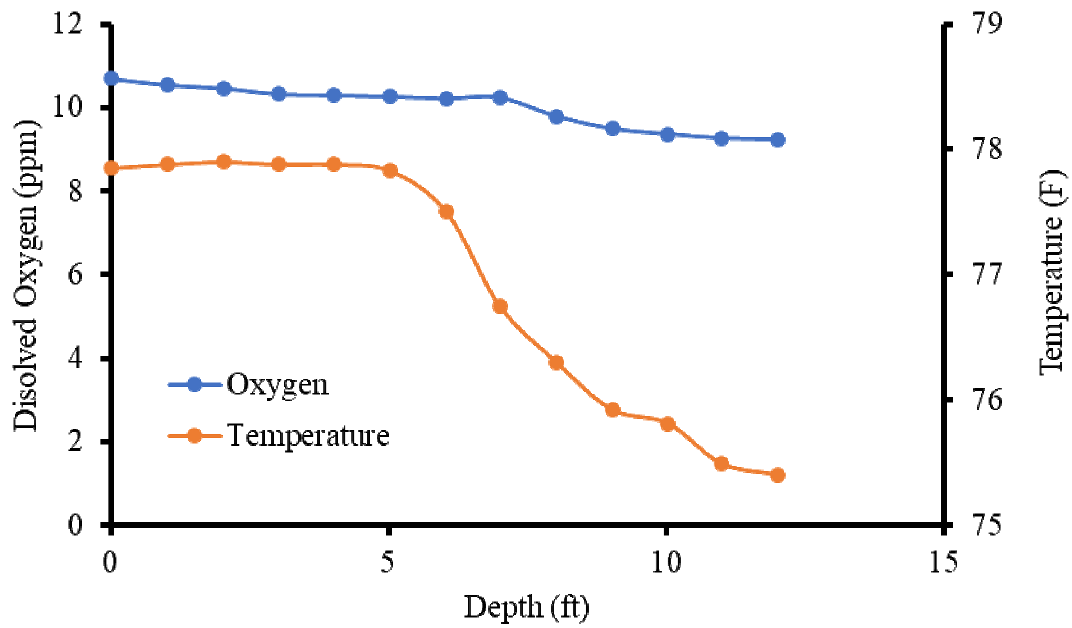


Figure 1. Temperature and dissolved oxygen profiles for (A) Maple Lake and (B) Ackley Lake surveyed on August 21, 2018.

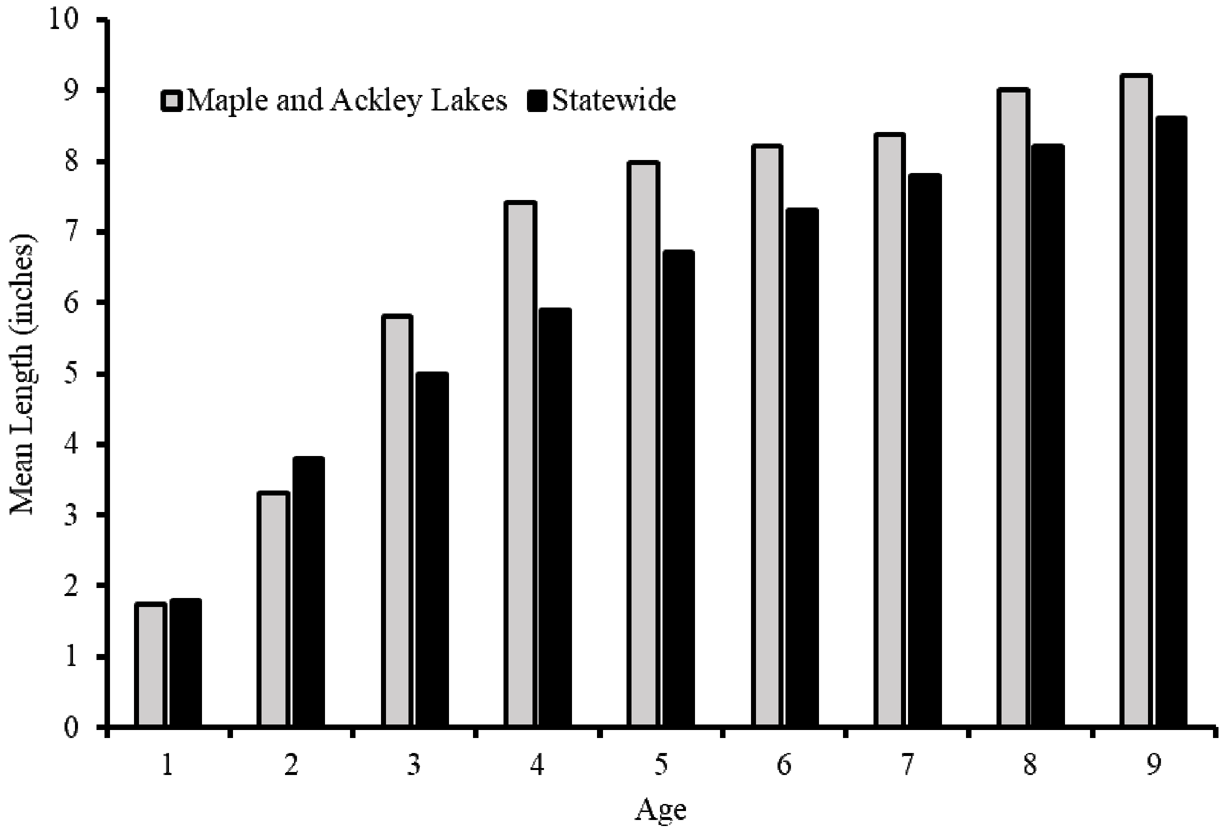


Figure 2. Mean lengths-at-age for Bluegill captured in Maple and Ackley Lakes compared to statewide averages. Not enough individuals (<5) were captured for age 6 and older age classes to compare statistically and are provided only for reference.

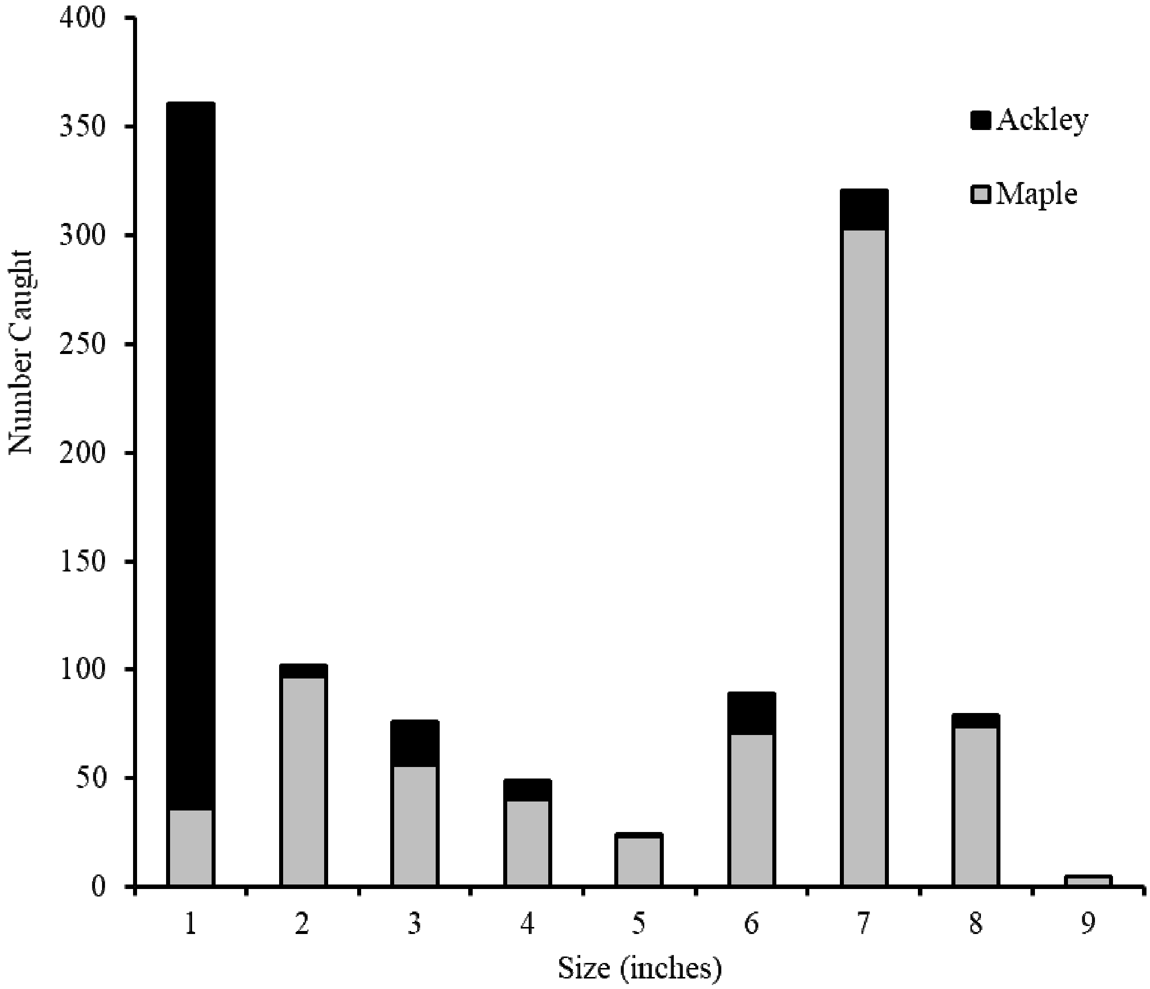


Figure 3. The number of Bluegill captured across all gears in each inch group for Maple and Ackley Lakes during the 2018 survey. Inch groups represent the minimum size for the bin (e.g. 4-inch fish range from 4.0 to 4.9 inches).

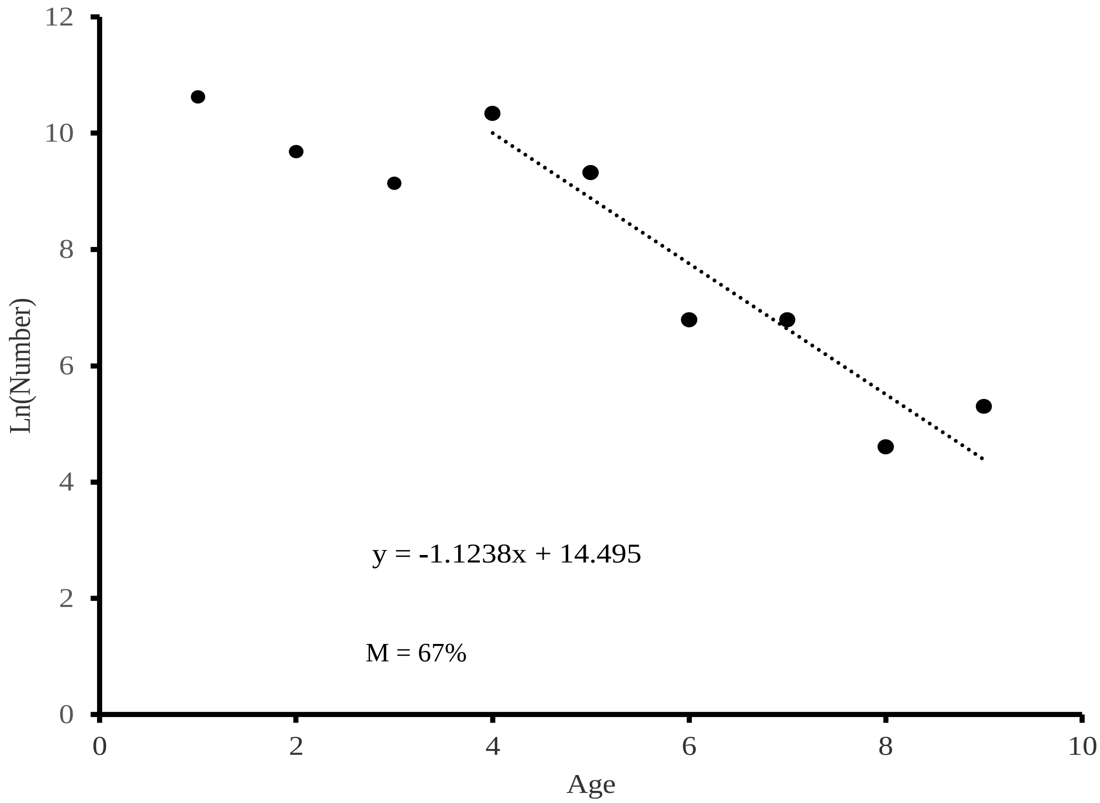


Figure 4. Catch curve and mortality estimate for Bluegill in Maple and Ackley Lakes based on catch from the 2018 survey. The numbers represent the estimated total fish caught based on length-age keys.

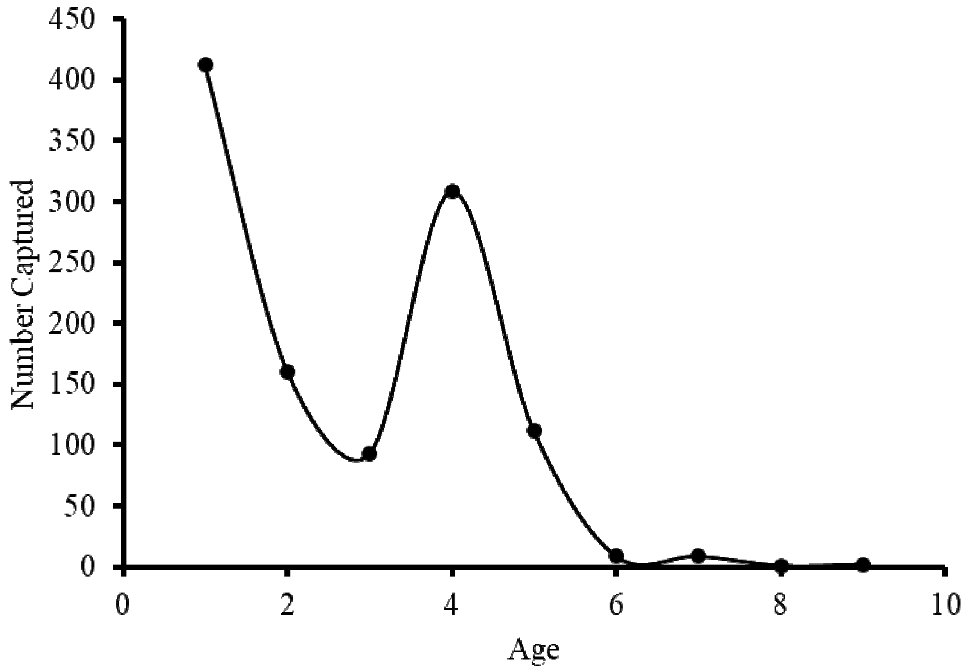


Figure 5. Number of fish captured of each age class across all gears during the 2018 fish survey of Maple and Ackley Lakes. Numbers are estimated from catch for each inch group and ages are assigned using length-age tables.

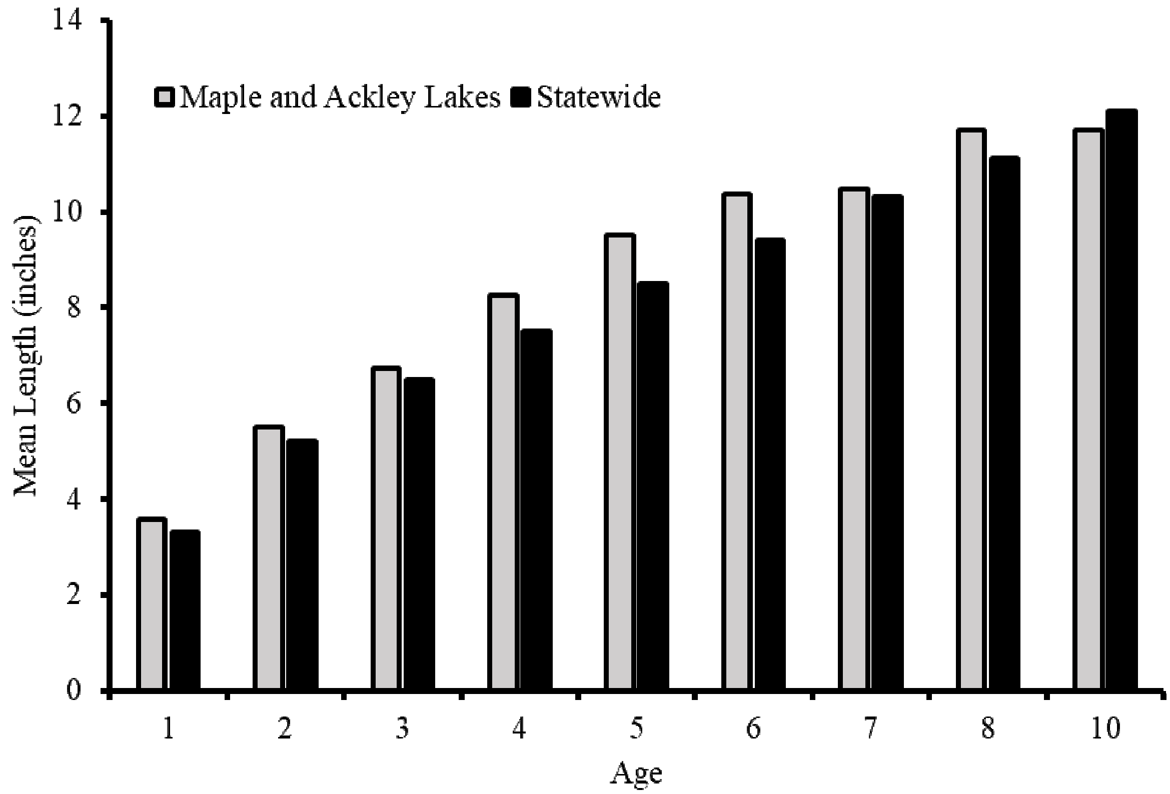


Figure 6. Mean length-at-age for Yellow Perch captured in Maple and Ackley Lakes compared to statewide averages. Not enough individuals were captured for age 6 and older age classes to compare statistically (<5) and are provided only for reference.

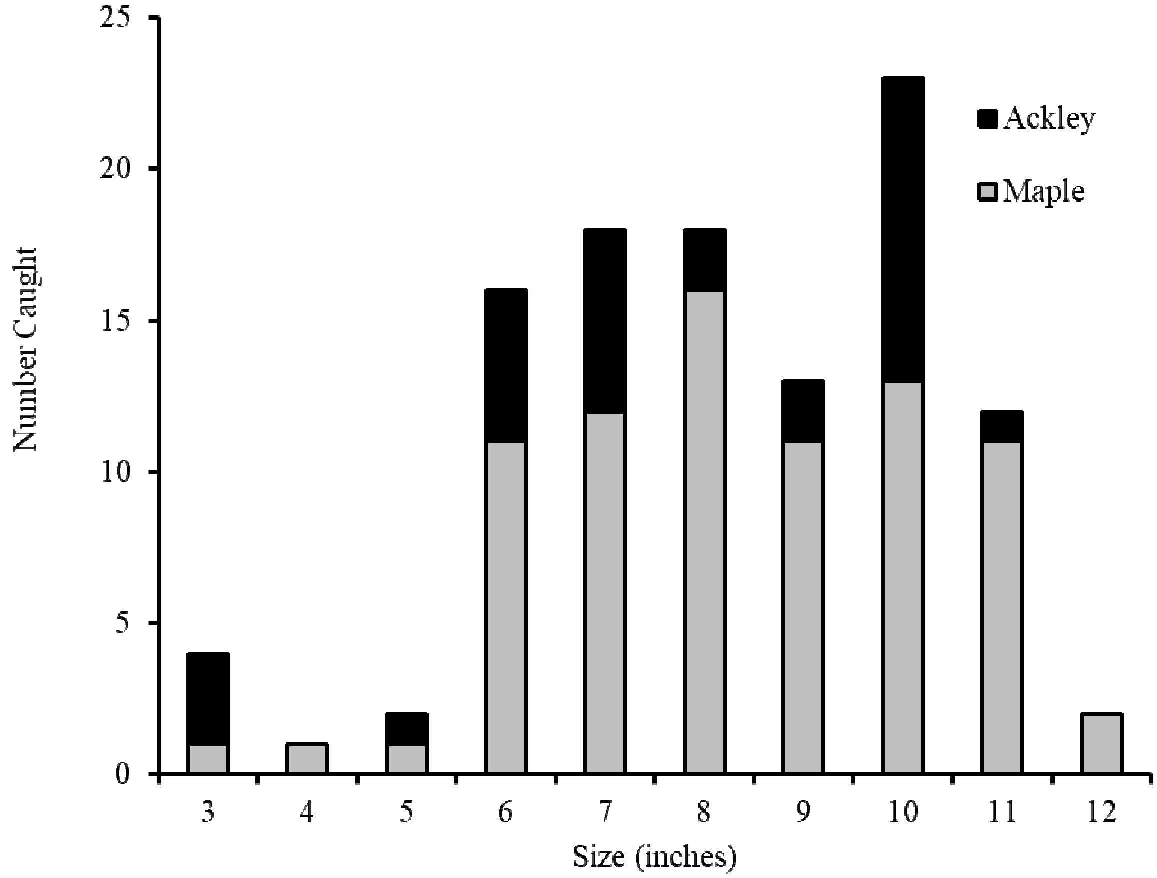


Figure 7. The number of Yellow Perch captured across all gears in each inch group for Maple and Ackley Lakes during the 2018 survey. Inch groups represent the minimum size for the bin (e.g. 4-inch fish range from 4.0 to 4.9 inches).

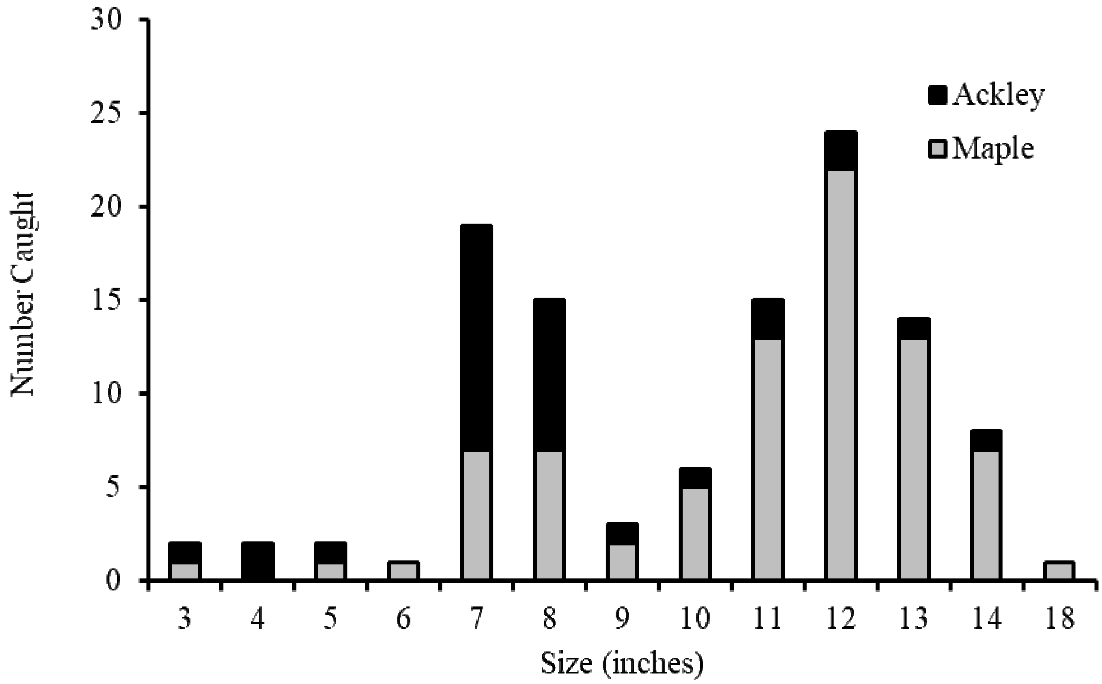


Figure 8. The number of Largemouth Bass captured across all gears in each inch group for Maple and Ackley Lakes during the 2018 survey. Inch groups represent the minimum size for the bin (e.g. 4-inch fish range from 4.0 to 4.9 inches).