Long Lake

Oakland County, T03/R08E/35,36: T02N/R08E/01,02
Huron River, 2019

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Environment

Location

Long Lake is a 156-acre natural lake located in central Oakland County (Figure 1), in the northeast corner of Commerce Township, approximately 3.7 miles south of M-59. In Oakland County, Long Lake resides northwest of Farmington Hills and north of Novi approximately nine miles north of I-96.

Geology and geography

Located within the Coldwater Shale bedrock formation (MDNR 2001), Long Lake's land cover is dominated by urban development (79.8%), forest (11.4%), and wetlands (3.8%). Surrounding surficial geology consists mostly (99.7%) of course textured materials mixed with Spinks, Oakville and Urban loamy sands (USDA 2017). Course textured substrate materials, similar to those found in Long Lake, are commonly associated with acceptable levels of groundwater input.

Watershed description

Long Lake exists in the upper reaches of the Huron River watershed and receives intermittent flow from Cooley Lake via a culvert under Cooley Lake Road. Historically, Long Lake was likely connected through wetlands to Hayes Creek, which currently serves as a tributary to the Huron River, however construction of a water level control structure has reduced this connectivity.

Chemical and physical characteristics

On 12 August 2019, a limnological survey was conducted at the central-east basin of the lake to estimate transparency (Secchi depth) as well as measure temperature (°F), pH, conductivity (mS/cm), and dissolved oxygen (mg/L). Water transparency (measured using a Secchi disk) was reported to be 9.5 feet deep, which is comparable to similar-sized shallow waterbodies in the state. Water temperature ranged from 78.4 °F at the surface to 77.4 °F at the bottom (Table 1). This temperature profile from Long Lake suggests that the lake does not thermally stratify. Average pH and average conductivity of Long Lake, from the surface to 9.8-ft deep was 8.7 and 485.4 mS/cm, respectively. Dissolved oxygen ranged from 9.01 mg/L at the water's surface to 9.68 mg/L at the bottom (Table 1). These results are expected given the shallow average depth of this waterbody. Results from the 2019 limnological survey are comparable to those collected in August of 2015. The dissolved oxygen profile suggests that approximately 100 percent of the lake volume contains sufficient oxygen (> 4.0 mg/L) to support aquatic organisms (Wehrly et al. 2015). However, warm water temperatures and a lack of deep cool water for refuge may limit the amount of suitable habitat for coolwater fish impacting their growth, abundance and survival.

Long Lake is positioned on a northwest to southeast axis and contains a small island (Roselle Island) in the southeast region and a larger developed island in a cove in the northwest region of the lake. The total fetch length from the northwest to southeast is approximately 1.3 miles and the lake averages approximately 6.0 feet deep. The shoreline perimeter distance of Long Lake is approximately 2.87 miles

excluding islands and 3.16 miles including islands. There are multiple locations, particularly in the central region of the lake that reach 12-feet deep. During the early 1960s, Long Lake property funded a project ($185,000) to hydraulically dredge the lake (MDNR 2008). Prior to dredging, the average depth of Long Lake was 2.4 feet deep.

Development, public ownership, and access

On 12 August 2019, the Long Lake littoral zone and lake shore were visually surveyed to quantify physical habitat parameters including residential development (dwellings per shoreline mile), boat dock density (docks per shoreline mile), large woody debris density (trees per shoreline mile) and average percent shoreline armored (Table 2). Residential development in Long Lake is high relative to similar-sized waterbodies in southeast Michigan and across the state (Table 2). A large majority of the Long Lake shoreline is held in private ownership, however there is a MDNR public boat launch located (GPS 42.613972 -83.457109) on the northeast shore (Figure 1).

History

During the late 1800s and early 1900s, Long Lake was stocked with a variety of warmwater species with the likely intent to develop recreational fishing opportunities in public waterbodies. The first stocking record, dated 11 June 1884, indicates that Long Lake was stocked with more than thirty thousand spring fry Walleye. However, it is unknown if a recreational fishery ever developed as a result. That was the last year, until 115 years later (1999), that Walleye were reported to have been stocked in Long Lake.

From the early 1930s to the early 1940s Long Lake was stocked semi-annually with Bluegill, Largemouth Bass, and Yellow Perch (Table 3). However, by 1942 stocking of warmwater species had already been largely reduced given their unique ability to reproduce naturally beyond state hatchery capabilities (Cooper 1948). By 1946, the Commission had a policy to curtail stocking of warmwater species given the "incontestable evidence that the average planting of these-warmwater species has involved an insignificant number of fish as compared to the number already present" (Cooper 1948, pp 8). Long Lake might have been the exception; here, stocking of warmwater species was beneficial given the shallow nature of the lake and frequency of seasonal fish kills.

During the 1930s and 1940s, winterkills were reported often with dead fish being observed each spring during ice melt. In 1936, ice on Long Lake was reported to be 20 inches thick with an additional 12 inches of snow atop of that and a complete fish kill was documented the following spring. In April of 1945 the Michigan Department of Conservation (hereinafter referred to as "MI DNR") conducted an assessment of Long Lake using fyke nets (n = 2) and gill nets (n = 4), in attempt to evaluate the extent of a winter kill that had occurred over the previous winter. A total of 10 fish were captured including Golden Shiner, Yellow Bullhead and Yellow Perch. Although winterkills occurred often, the winter ice fishery attracted some anglers during a period when residents began populating the shoreline with cottages.

By the mid-1940s Long Lake was reported to be `well built up' with cottages yet the lake experienced low fishing pressure relative to neighboring lakes. An intermittent outlet was documented to arise from Cooley Lake and Northern Pike were observed migrating through this outlet during periods of high water. In February of 1948, a limnological profile was collected in Long Lake and 18 inches of ice was reported near the center of the lake at the 7-foot depth contour. There were no reports of mortality during this survey and multiple fish shanties were noted as being scattered over the 4 to 5-foot depth contour.

In 1961, interdepartmental documents reported that a Lansing firm had announced signing a contract for "the only lake reclamation project of its kind in history". The Waterways Control and Development Corporation was hired by the Long Lake General Council to hydraulically dredge organic material from the lake and deposit spoils on nearby land. The project was funded entirely by the Long Lake General Council and cost an estimated $185,000 in 1961 ($1,589,308 today). Following dredging, the lake measured 10 acres larger and averaged 4.2 feet deeper than before. Logistical and economic factors resulted in the project taking more time than anticipated but it was finalized by 1965. Following the dredging project, a legal lake level was established (933.00 ft above sea level).

Fisheries surveys were conducted in 1966, 1968, and 1969 and found typical species including Bluegill, Pumpkinseed, Yellow Perch, Black Crappie, Rock Bass, Largemouth Bass, and Yellow Bullhead. Agency stocking records indicate that in 1967, nearly 50,000 spring fry Muskellunge were stocked. In 1971, a MI DNR biologist attended a local meeting and anglers reported that they were satisfied with the Largemouth Bass fishing. Bluegill were noted as being small, but abundant, and Yellow Perch were large but scarce. No Northern Pike were being taken and no captures or observations of Muskellunge were reported. Muskellunge stocking was ceased, likely due to the lack of observations or captures. To improve the size structure of Bluegill and other panfish, a three-year plan was approved to treat the lake with Antimycin from 1971 to 1973.

In April of 1971, a brief write-up was published in the Spinal Colum (local paper) about a meeting in Commerce Township to discuss the Antimycin treatment with area residents and anglers. MI DNR representatives explained the treatment was intended to remove overabundant panfish (i.e., Bluegill) making forage or food resources less limiting to improve panfish growth. Following the April 1971 meeting, an additional write-up was published in the Spinal Column in May describing area residents' approval of the Bluegill thinning project. On 10 June 1971, Long Lake was treated with Antimycin (0.5 parts per million). A post treatment evaluation of the chemical application noted that the treatment may have been too light and therefore ineffective. A second treatment was administered March of 1972 and was reported to have been effective with approximately 1,200 Bluegill removed. There are no records that indicate a third treatment was conducted.

In April of 1988, the first annual Long Lake Association Meeting was held. MI DNR representatives attended to provide a history of lake management, including the dredging project that occurred in the 1960s. Additionally, MI DNR biologists presented a proposal to utilize Long Lake in state-wide research project. The intent of the project was to evaluate panfish growth rates and included surveys in addition to application of fish toxicants (i.e., Antimycin A). The project was met with some reservation on behalf of the residents; however, their response was generally favorable. There are no records of additional chemical treatments having been administered in Long Lake during the 1980s. So, it is difficult to ascertain whether Long Lake was treated as part of this experiment. However, there were surveys conducted in 1988 and 1996 to evaluate the panfish population. Results from fisheries surveys suggested that the average size of Bluegill remained poor and were growing below state average. However, the remainder of the fish community supported a good fishery. During this time, MI DNR managers recommended introducing Redear Sunfish in addition to stocking Walleye.

During the 1990s, MI DNR had begun a Redear Sunfish stocking program to provide anglers the opportunity to catch large, possibly trophy-sized panfish in southeastern Michigan (Towns 2003). This

program was especially attractive to anglers in southeastern Michigan given that a large number of lakes supported abundant, undersized, and often less desirable-sized panfish (e.g., Bluegill, Pumpkinseed). As a result, Redear Sunfish were stocked in Long Lake in 1997, 1998, and 1999. From 1999 to 2017, a total of 30 Master Angler catches have been reported for Redear Sunfish in Long Lake. In contrast, there have been a total of 8 Master Angler sized Bluegill captured during this period and no captures reported since 2006. In 2001 and 2005, a total of six Redear Sunfish Master Angler catches were reported in each year. In 2004, a total of nine Redear Sunfish Master Angler catches were reported. These Master angler catches suggest that the introduction of Redear Sunfish did provide trophy sized panfish angling opportunities in Long Lake relatively soon after stocking.

In the late 1990s, Long Lake was a popular destination for Northern Pike. In Fall of 1998, Long Lake was featured in "Fishing & Hunting News" magazine as having "great pike fishing". Northern Pike are still popular in Long Lake, which supports a two-season fishery (winter and summer). Master Angler records from Long Lake indicate that in 2009, a 41-inch Northern Pike was captured and released.

Prior to the onset of stocking Redear Sunfish or Walleye, a general fisheries survey was conducted in 1996 to evaluate the fish community in Long Lake. Bluegill were noted as being stunted with growth rates below the state of Michigan average. Catch per unit effort (CPUE) of preferred size Bluegill (≥6.0 inches) in trap nets during the 1996 survey was 10.1 fish per net night. By the early 2000s, interest for inland Walleye angling opportunities increased among angler groups. Also, interdepartmental research had found that introducing Walleye fall fingerlings into lakes, at rates ranging from 15 to 18 per acre, could potentially improve the size structure of panfish through predation (Schneider and Lockwood 1997). Therefore, a Walleye stocking prescription was drafted to 1) provide angling opportunities to area residents and 2) provide predation pressure on panfish (i.e., Bluegill) to reduce abundance and improve size structure.

From 1999 to 2006, Long Lake was stocked with spring fingerling Walleye at an average rate of 75 fish per acre (range from 31 to 99 fish per acre) (Table 3). Following state stocking guidelines, Walleye were stocked for several years consecutively (1999, 2000, 2001, and 2002) to establish the species and then biennially thereafter to maintain the fishery (Dexter and O'Neal 2004). During this initial period of Walleye stocking several fall electrofishing surveys (Serns 1982) were conducted to quantify the density of fingerlings that survived from spring to fall. The average density of fall fingerling Walleye was 0.9 fish per acre and ranged from 0.0 to 2.1 fish per acre (Table 4). The average density of yearling Walleye was 0.5 fish per acre and ranged from 0.0 to 1.7 fish per acre (Table 4). Fall survey results suggest stocking spring fingerling Walleye did not result in fall fingerling densities comparable to those that are likely to have an impact on panfish size structure via predation. However, Long Lake has a relatively large littoral zone and most of the lake would be considered habitable by fall fingerling Walleye. Therefore, it is plausible that an insufficient area was sampled to effectively make inferences about the density of fall fingerling Walleye in Long Lake.

After 2006, Walleye stocking ceased in Long Lake until 2011 due to the occurrence of Viral Hemorrhagic Septicemia (or VHS) and a subsequent moratorium on statewide stocking. Spring fingerling Walleye stocking resumed in 2011 following the stocking moratorium and has occurred biennially thereafter at the average rate of 68 fish per acre (range 43 to 98 fish per acre). In 2007, MI DNR conducted a survey to quantify the density of adult Walleye in Long Lake, which was estimated at 1.6 adults per acre. This population estimate demonstrated a sufficient density (greater than 0.5 fish per

acre, Schneider and Lockwood 1997) of adult Walleye existed in order to observe a positive impact on Bluegill size structure.

During the 2000s, MI DNR surveys and angler reports indicated adult Walleye density was high enough to provide a predator base that would prey upon panfish and improve panfish size structure. However, additional surveys were needed to document a shift in the panfish population from overabundant and undersize, to less abundant and preferable (> 6 inches) size. Collection of fish community data in 2019, in addition to habitat and water quality data, would provide information needed to continue managing a popular mixed-bag fishery in Long Lake that has persisted for decades.

Current Status

To assess the status of the Long Lake fish community, MI DNR conducted a survey beginning 28 May 2019. More specifically, the purpose of the survey was to evaluate impacts of Walleye stocking on the Long Lake Bluegill population and determine the status of the Redear Sunfish population. Survey protocols were similar to the Status and Trends survey program (Wehrly et al. 2015) however, time of sampling and gear types used differed slightly. A variety of gear types were used including 2 trap nets, 1 experimental gill net, 2 large mesh fyke nets, and 2 small mesh fyke nets. Trap nets and large mesh fyke nets were set for 3 nights, while the experimental gill net was set for one night. All net types deployed were checked daily. One small mesh fyke net was set for two nights, while the remaining small mesh fyke net was set for one night. On 18 June 2019, three boat electrofishing efforts (600 seconds each) were conducted to provide additional fish community information. All fish captured were enumerated and measured for total length to the nearest inch. Survey data collected by MI DNR in 1996 and 2003 were also referenced to compare catch rates of panfish species (i.e., Bluegill and Redear Sunfish).

Gamefish species including Black Crappie, Bluegill, Pumpkinseed, Redear Sunfish, Yellow Perch, Largemouth Bass and Northern Pike were measured to the nearest 0.1 inches. Aging structures (10 per inch group) were collected from each gamefish species for age analysis. Scales were collected from panfish species less than 6.0-inches and bass less than 10.0-inches. Anal fin spines were collected from panfish greater than 6.0-inches, bass greater than 10.0-inches, and all Northern Pike. Dorsal spines were collected from all Walleye captured.

A total of 1,795 fish weighing 500.7 pounds and representing 27 species were captured during the 2019 survey (Table 5). Piscivore or gamefish species, such as Largemouth Bass, Northern Pike, Smallmouth Bass, Walleye and Yellow Perch, comprised 23 percent of the total biomass. Benthivore species such as Common Carp, Common White Sucker and bullheads comprised 60 percent of the total biomass while pelagic species (planktivore-insectivores) such as sunfish, shiners and minnows comprised 16 percent of the total biomass. The total standing crop (Schneider 2000) for Long Lake in 2019 was 135 pounds of fish per acre.

Bluegill -
A total of 779 Bluegill were caught across all gear types. They averaged 5.0 inches and comprised 43 percent of the catch by number and 6.7 percent of the catch by biomass. Bluegill size ranged from 1.0 to 8.0 inches with 7 percent of the catch meeting or exceeding the preferred size for harvest (equal to or greater than 6 inches) (Table 6). The age distribution of Bluegill (Ages 1 to 10) indicated annual recruitment from 10 year-classes. One- and four-year-old Bluegill were growing slightly above state

average while five-year-old Bluegill were growing nearly an inch below state average. An insufficient number of samples were collected to make robust conclusions about the growth of remaining age classes, however, among 10 year-classes, Bluegill were generally growing below (-0.3 inches) state average (Table 7).

Trap net catch per unit effort (CPUE) of preferred size Bluegill was 10.1, 2.9, and 2.3 fish per net night (Table 8) during surveys conducted in 1996, 2003, and 2019, respectively. In 2019, the average size of Bluegill captured in trap nets was 6.5 inches and 82 percent of the trap net catch were equal to or exceeded the preferred size of 6-inches (Table 8).

The Bluegill size score index (Schneider 1990) uses metrics from trap net captured fish to assign a relative index to the population. The information used to generate a score includes average total length of fish captured in trap nets, and the percent occurrence of 6, 7, and 8-inch Bluegill in trap nets. According to the Bluegill size score index (Schneider 1990), fish captured in trap nets in 2019 were rated at 5.0 or "Good" (Table 9). Bluegill size scores from the 1996 and 2003 fisheries surveys were 2.0 (Poor) and 1.2 (Very Poor), respectively.

Redear Sunfish -

A total of 78 Redear Sunfish averaging 7.0 inches comprised 4.3 percent of the catch by number and 5.6 percent of the catch by biomass. Redear Sunfish size ranged from 2.0 to 10.0 inches with 76 percent of the catch meeting or exceeding the preferred size for harvest (equal to or greater than 6 inches) (Table 6). The age distribution of Redear Sunfish indicated annual recruitment from 10 year-classes (Ages 1 to 10). Four- and five-year-old Redear Sunfish were growing nearly an inch below state average. An insufficient number of samples were collected from additional age classes to make robust conclusions about growth, however remaining age classes were generally growing below state average. Approximately 21 percent of Redear Sunfish captured were equal to or greater than 9.0 inches.

Other Panfish -

A total of 84 Rock Bass averaging 6.3 inches comprised 4.7 percent of the catch by number and 2.5 percent of the catch by biomass. Rock Bass size ranged from 2.0 to 11.0 inches with 18 percent of the catch meeting or exceeding the preferred size for harvest (Table 6). A total of 29 Black Crappie averaging 7.3 inches comprised 1.6 percent of the catch by number and 1.5 percent of the catch by biomass. Black Crappie size ranged from 3.0 to 11.0 inches with 52 percent of the catch meeting or exceeding the preferred size for harvest (Table 6). The age distribution of Black Crappie indicated annual recruitment from eight of the previous ten years. There were no fish captured from the 2017 or 2009 year-classes, however, given the low capture number (n = 29) these age-classes may have been missed. Age four Black Crappie were growing more than an inch below state average. A total of 31 Hybrid Sunfish averaging 7.7 inches comprised 1.7 percent of the catch by number and 2.8 percent of the catch by biomass. Hybrid Sunfish size ranged from 2.0 to 9.0 inches with 90 percent of the catch meeting or exceeding the preferred size for harvest (Table 6).

Northern Pike -

A total of 23 Northern Pike averaging 19.1 inches comprised 1.3 percent of the catch by number and 7.9 percent of the catch by biomass (Table 5). Northern Pike size ranged from 15.0 to 22.0 inches; none met or exceeded the minimum size for harvest (i.e., 24-inches) (Table 6). Aging structures of Northern Pike indicated that ages 3, 4, 5, 6, and 7 were present in the population. Growth analysis of 3-, 4-, and 5-year-old Northern Pike indicated that growth in Long Lake is below state average. Average size of ages 3-, 4-, and 5-year-old Northern Pike captured in Long Lake were all below the state of Michigan 25th

percentile (Table 10). Catch per unit effort (CPUE) of Northern Pike in fyke and gill nets was 0.0 and 12.0 fish per net night, respectively.

Other gamefish -
A total of 32 Largemouth Bass and 2 Smallmouth Bass were captured, which collectively comprised 1.9 percent of the total catch by number and 7.4 percent of the total catch by biomass (Table 5). Thirty-eight percent of the Largemouth Bass and 100 percent of Smallmouth Bass were equal to or greater than legal size (Table 6). Range in size of Largemouth Bass and Smallmouth Bass was 1.0 to 17.0 inches and 15.0 to 17.0 inches, respectively. A total of 6 Walleye were captured comprising 0.3 percent of the catch by number and 3.4 percent of the catch by biomass. Walleye size ranged from 19.0 to 23.0 inches with 100 percent of the catch meeting or exceeding the minimum size for harvest (Table 6).

Common Carp -
A total of 45 Common Carp averaging 22.6 inches comprised 2.5 percent of the catch by number and 54.5 percent of the catch by biomass. Common Carp size ranged from 14.0 to 32.0 inches with 100 percent of the catch meeting or exceeding the preferred size for harvest (Table 6).

Forage fish captured during this survey included Banded Killifish, Blackchin shiner, Bluntnose Minnow, Blacknose Shiner, Brook Silverside, Common White Sucker, Iowa Darter, Central Mudminnow, Sand Shiner, and Spotfin Shiner.

Analysis and Discussion

The most recent survey conducted to evaluate the impacts of Walleye stocking on the Long Lake Bluegill population suggests that Bluegill size score has improved from 1996 and 2003 to 2019. Additionally, captures of Redear Sunfish suggest that the population is self-sustaining while providing fish of an attractive size with records of trophy size fish being captured. Recent survey data suggest Long Lake may be suitable for alternate Northern Pike management.

Bluegill -
Growth metrics derived from captures using all gear types show an abundant and undersized population of Bluegill still exists in Long Lake. However, comparing catch rate metrics using data gathered from identical gear used during previous and most recent surveys suggests Bluegill numbers have been reduced significantly and the Bluegill size score has improved. catch rates of preferred-sized individuals have improved. Although studies in Michigan have shown that stocking Walleye can result in improved size structure of panfish (Schneider and Lockwood 1997), these improvements in Bluegill size structure may not be (fully) due to the Walleye stocking program. Just prior to stocking Walleye, an additional panfish species (i.e., Redear Sunfish) was introduced in Long Lake and has since established a naturally reproducing population. Therefore, it is difficult to determine if Bluegill biomass has been redirected to support an additional panfish species, or if Bluegill are being consumed by Walleye. Other waterbodies in Michigan where Walleye do not exist have shown significant declines in catch rates of Bluegill without changes in size structure following the introduction of Redear Sunfish (Braunscheidel and Towns 2017). Since it would be difficult to determine which of these management strategies (stocking of Walleye or introduction of Redear Sunfish) resulted in improved Bluegill size structure, Long Lake should continue to be stocked with Walleye.

Redear Sunfish -

A large proportion of Redear Sunfish are of preferable size in Long Lake. Additionally, 21 percent of the Redear Sunfish captured were equal to or greater than the minimum size required for a Master Angler award. To date (June 2020), there have been 30 Master Angler sized Redear Sunfish captured in Long Lake. Size information collected from Master Angler catches suggest that Redear Sunfish can reach an impressive size (equal to 13.0 inches) in a very short time period. The Long Lake Redear Sunfish community is healthy and provides an additional species for the public to target when seeking large panfish angling opportunities.

Northern Pike -
Several metrics can be used to evaluate the density and growth of Northern Pike based on target reference points set forth in the statewide management plan (Smith et al. 2016). Catch per unit effort (CPUE) for Northern Pike captured in Long Lake using fyke nets was zero, which is below the state's 25th percentile (0.4 fish per net night, Smith et al. 2016) and suggests that Long Lake has a "low" density population. Conversely, CPUE for Northern Pike captured in Long Lake using gill nets was above the 75th percentile (5.4 fish per net night, Smith et al. 2016), which suggest that Long Lake has a "high" density population. Catch rate disparity of fyke and gillnets is confounding and may not be useful to gauge population metrics of Northern Pike. Therefore, growth-specific metrics may provide better insight into the population.

Growth metrics used to evaluate populations of Northern Pike also include comparing average total length at ages 3 through 5 to the state's 25th and 75th percentile range (Smith et al. 2016). Average total length of Northern Pike in Long Lake for ages 3 through 5 are below the state's 25th percentile range. Based upon data collected from Long Lake in Spring of 2019, and target reference points set forth in the statewide management plan, the Northern Pike population is considered to have "below average growth". Catch and growth rate information may suggest that alternate regulations may be appropriate for the Long Lake Northern Pike population. Because this population is "below average growth", the "No Minimum Size Limit, possession limit 5" regulation may be appropriate for Long Lake. However, a species-specific survey would be needed to more accurately quantify Northern Pike density and growth in Long Lake. Alternate regulations may provide additional angling opportunities (e.g., winter spearing) and increase angler participation during alternate seasons. A spring population assessment conducted in tandem with a Walleye population assessment would provide information needed to justify a regulation change.

Other gamefish -
Walleye, Largemouth Bass, and Smallmouth Bass all reside within Long Lake and help to provide mixed-bag angling opportunities. Given the shallow depth of the lake, anglers seeking `top-water' fishing opportunities are encouraged to visit Long Lake. In the past five years, Long Lake has been targeted by tournament bass anglers 15 times and there are favorable reports in terms of the number of fish boated at each event.

Walleye captured in Long Lake were large and are providing an attractive recreational fishery. A spring population estimate survey conducted in tandem with a Northern Pike assessment would provide beneficial information about the success of stocking. Additionally, a fall electrofishing assessment (Serns 1982) targeting fall fingerling Walleye could provide another source of information relative to the level of survival of spring fingerlings.

Walleye have been stocked to reduce the number and improve size structure of Bluegill. Currently the average size of Bluegill captured in trap nets is larger than it has been historically. However, it is difficult to determine whether this is due specifically to Walleye predation given the introduction of a competing panfish, the Redear Sunfish. Stocked spring fingerling Walleye are surviving to adulthood and are providing an attractive fishery for anglers. Therefore, stocking of spring fingerling Walleye should continue.

Common Carp -
Survey data show that a number of large Common Carp reside in Long Lake and are of an attractive size. Currently the biomass of Common Carp in Long Lake comprises a significant proportion (>54%) of the fish community. Long lake is shallow throughout, may warm sooner than neighboring waterbodies and aquatic vegetation may not emerge as soon as in other waterbodies. Therefore, Long Lake is a suitable early season candidate for bowfishing anglers to visit and get gear tuned in prior to the start of the season in larger lakes. Bowfishing is a growing sport in the area and in North America with many recent advances in technology (Scarnecchia and Schooley 2020). Harvest of Common Carp via bowfishing may improve this fishery by shifting lake biomass from Common Carp to more palatable species. Anglers seeking bowfishing opportunities in Long Lake are encouraged to check local ordinances to ensure the use of bowfishing equipment is permitted.

Management Direction

Based on the size score and catch rate of preferred size Bluegill, Walleye should continue to be stocked biennially with the goal of improving panfish size structure in Long Lake. Other panfish such as Redear Sunfish, Black Crappie, and Hybrid Sunfish provide an attractive high catch rate fishery with occasional Master Angler fish being reported. The presence of Walleye, in addition to Largemouth and Smallmouth Bass and Common Carp, provides anglers with an attractive waterbody to visit when seeking mixed-bag multi-gear angling opportunities.

Managers are encouraged to conduct a spring population survey targeting Walleye and Northern Pike. This survey will provide information needed to justify any regulation changes for Northern Pike or to document natural reproduction of Walleye.

The perimeter of Long Lake is heavily developed, and the nearshore littoral zone is void of sufficient habitat due to human activity. Improving nearshore habitat would be beneficial to the nearshore ecology of Long Lake and could also assist in improving the size structure of panfish. Therefore, riparian landowners are encouraged to: 1). Reduce or minimize nutrient inputs in the form of lawn fertilizer, 2) allow trees the opportunity to fall into the nearshore area and leave woody debris in the lake, and 3) only soft engineering approaches should be considered when modifying the Long Lake shoreline.

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Figure 1. Map where survey was conducted in Long Lake, Oakland County in 2019.

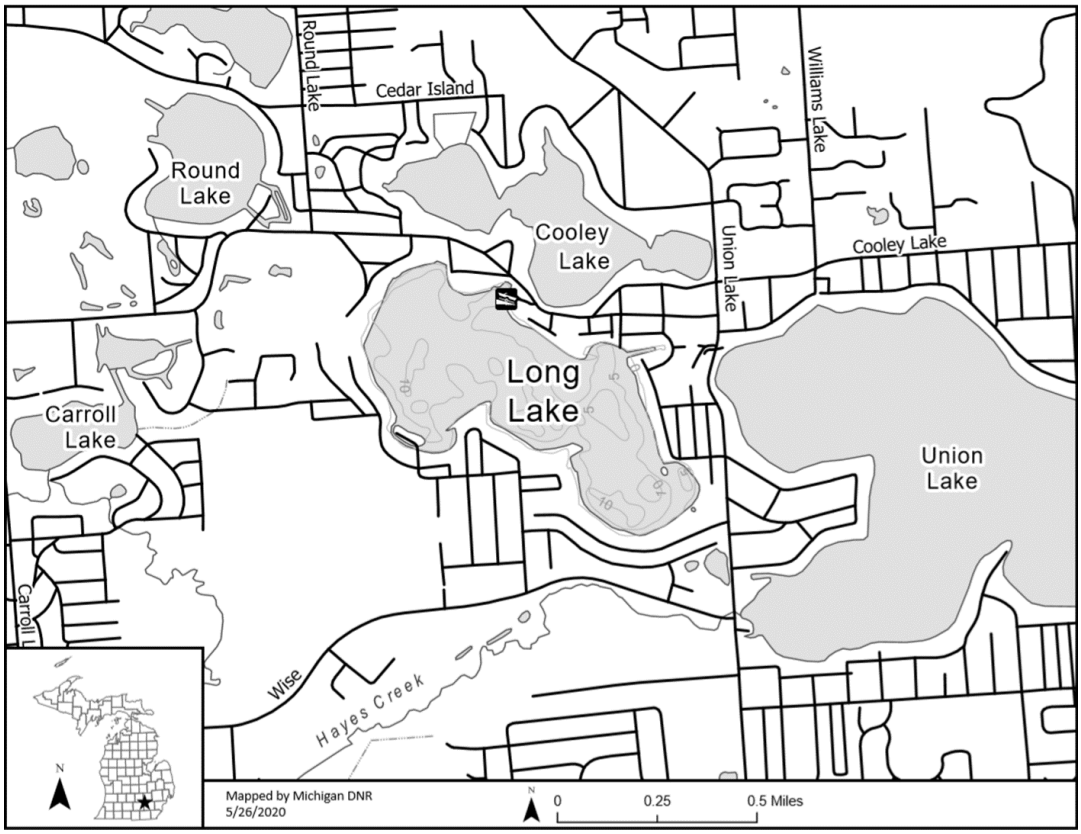

Table 1. Limnological profile of Long Lake collected 12 August 2019 including depth, temperature, dissolved oxygen, pH, and specific conductance.

Depth (ft)	Temp (°F)	Oxygen (mg/L)	pH	Specific Conductance (mS/cm)
1.3	78.4	9.1	8.7	487.6
2.2	78.1	9.0	8.7	487.6
3.3	78.1	9.0	8.7	486.2
4.2	78.1	9.0	8.7	486.0
5.2	78.1	6.1	8.7	485.3
6.2	78.0	9.1	8.7	485.1
7.3	77.9	9.2	8.7	485.0
8.3	77.9	9.2	8.7	485.1
9.2	77.4	9.5	8.7	484.3
9.75	77.4	9.7	8.7	484.1

Table 2. Physical indicators including dwelling density (per shoreline mile), boat docks (per shoreline mile), shoreline armoring (average % armored), and large woody debris (per shoreline mile) measured in Long Lake, the region (Lake Erie Management Unit) and statewide average for medium-shallow inland lakes, and the rating of Long Lake.

Physical Indicator	Long Lake	Region	Statewide	Long Lake Rating
Dwelling Density	73.2	20.5	9.2	High
Boat Docks	64.4	2.1	4.7	High
Shoreline Armoring	82.7	9.1	8.9	High
Large Woody Debris	1.1	0.5	74.6	Low

Table 3. Historical stocking record for Long Lake (Oakland County) by species, year, number (N) stocked, number (N) per acre, total length (TL) inches (in.) and age.

Species	Year	N Stocked	N/acre	TL in.	Age
Walleye	1884	33333	213.7		Spring fry
Bluegill	1933	1800	11.5		5 month
Largemouth Bass	1933	2000	12.8		2 month
Bluegill	1934	2000	12.8		5 month
Yellow Perch	1934	1500	9.6		7 month
Yellow Perch	1934	1500	9.6		Yearling
Bluegill	1935	3000	19.2		4 month
Largemouth Bass	1935	500	3.2		4 month
Yellow Perch	1935	2500	16.0		7 month
Bluegill	1936	3000	19.2		4 month
Largemouth Bass	1936	600	3.8		4 month
Yellow Perch	1936	10000	64.1		8 month
Bluegill	1937	6500	41.7		4 month
Largemouth Bass	1937	450	2.9		3 month
Yellow Perch	1937	2000	12.8		7 month
Largemouth Bass	1938	600	3.8		3 month
Bluegill	1939	11000	70.5		4 month
Largemouth Bass	1939	800	5.1		3 month
Bluegill	1940	5000	32.1		4 month
Largemouth Bass	1940	200	1.3		4 month
Bluegill	1941	10000	64.1		4 month
Largemouth Bass	1941	500	3.2		4 month
Bluegill	1942	4000	25.6		4 month
Bluegill	1943	6000	38.5		4 month
Largemouth Bass	1943	300	1.9		5 month
Bluegill	1945	9600	61.5	1	4 month
Bluegill	1945	50	0.3	8	Adults
Largemouth Bass	1945	3960	25.4	3.5	4 month
Muskellunge	1967	50000	320.5		Swim-up fry
Redear sunfish	1997	1042	6.7	5	
Redear sunfish	1997	733	4.7	5	
Redear sunfish	1998	857	5.5	4.69	
Walleye	1999	13320	85.4	2.28	Spring fry
Redear sunfish	1999	347	2.2	6.18	
Walleye	2000	200	1.3	1.1	Spring fry
Walleye	2000	15158	97.2	1.5	Spring fry
Walleye	2001	4895	31.4	1.85	Spring fry
Walleye	2002	13750	88.1	2.35	Spring fry
Walleye	2004	15380	98.6	1.9	Spring fry
Walleye	2006	9072	58.2	1.9	Spring fry
Walleye	2011	14658	94.0	1.81	Spring fry

Walleye	2013	8343	53.5	1.41	Spring fry
Walleye	2015	7838	50.2	1.45	Spring fry
Walleye	2017	6647	42.6	1.71	Spring fry
Walleye	2019	9109	58.4	1.7	Spring fry
Walleye	2019	6138	39.3	1.4	Spring fry

Table 4. Year, number of young-of-year (YOY) Walleye, estimated number of YOY per mile, estimated number of YOY per acre, number of yearling (YR) Walleye captured, estimated number of YR per mile and estimated number of YR per acre captured during fall electrofishing surveys (Serns 1982) from 1999 to 2004.

Year	YOY	YOY/Mile	YOY/Acre	YR	YR/Mile	YR/Acre
1999	11	8.8	2.1	0	0.0	0.0
2000	0	0.0	0.0	5	4.0	0.8
2001	3	2.0	0.5	0	0.0	0.0
2002	3	2.0	0.5	13	8.7	1.7
2004	10	6.7	1.6	0	0.0	0.0
AVG	**5.4**	**3.9**	**0.9**	**3.6**	**2.5**	**0.5**

Table 5. Species, number (N), percent by number (% by N), weight (WGT, in pounds), percent by weight (% by WGT), total length (TL) range in inches (in.), and average (AVG) total length of fish captured during 2019 fisheries survey conducted in Long Lake, Oakland County. Results include fish capture results from all gear types combined.

Species	N	% by N	WGT (lbs.)	% by WGT	TL Range (in.)	AVG TL (in.)
Black Crappie	29	1.62	7.4	1.47	3.0 to 11.0	7.3
Blackchin Shiner	10	0.56	0.03	0.01	1.0 to 2.0	2.3
Banded Killifish	10	0.56	0.04	0.01	1.0 to 2.0	2.1
Black Bullhead	25	1.39	16.0	3.24	8.0 to 13.0	10.8
Bluegill	779	43.40	33.3	6.66	1.0 to 8.0	5.0
Bluntnose Minnow	166	9.25	1.1	0.21	1.0 to 3.0	2.5
Blacknose Shiner	29	1.62	0.1	0.02	1.0 to 2.0	2.5
Brown Bullhead	13	0.72	7.98	1.59	8.0 to 12.0	10.9
Brook Silverside	2	0.11	0.0	0.00	3.0 to 3.0	3.5
Common Carp	45	2.51	272.8	54.50	14.0 to 32.0	22.6
Common White Sucker	1	0.06	3.9	0.78	21.0 to 21.0	21.5
Green Sunfish	8	0.45	0.06	0.01	1.0 to 2.0	2.2
Hybrid Sunfish	31	1.73	14.2	2.84	2.0 to 9.0	7.7
Iowa Darter	15	0.84	0.04	0.01	1.0 to 2.0	2.2
Largemouth Bass	32	1.78	32.5	6.49	1.0 to 17.0	11.8
Mudpuppy	4	0.22	0.04	0.01	2.0 to 3.0	3.0
Northern Pike	23	1.28	39.4	7.87	15.0 to 22.0	19.1
Pumpkinseed	20	1.11	1.9	0.37	2.0 to 7.0	4.9
Rock Bass	84	4.68	12.7	2.54	2.0 to 11.0	6.26
Redear Sunfish	78	4.35	28.0	5.59	2.0 to 10.0	7.0
Sand Shiner	2	0.11	0.0	0.00	1.0 to 2.0	2.0
Spotfin Shiner	230	12.81	1.8	0.36	2.0 to 3.0	2.8
Smallmouth Bass	2	0.11	4.7	0.94	15.0 to 17.0	16.5
Walleye	6	0.33	17.2	3.43	19.0 to 23.0	20.7
Warmouth	25	1.39	0.7	0.14	2.0 to 4.0	3.9
Yellow Perch	123	6.85	2.9	0.58	2.0 to 6.0	4.5
Yellow Bullhead	3	0.17	1.7	0.34	9.0 to 12.0	10.5

Table 6. Species, number (N), and percent (%) legal or preferred size fish captured during 2019 fisheries survey conducted in Long Lake, Oakland County.

Species	N	% Legal or Preferred Size
Black Crappie	29	52
Blackchin Shiner	10	100
Banded Killifish	10	100
Black Bullhead	25	100
Bluegill	779	7
Bluntnose Minnow	166	100
Blacknose Shiner	29	100
Brown Bullhead	13	100
Brook Silverside	2	100
Common Carp	45	100
Common White Sucker	1	100
Green Sunfish	8	0
Hybrid Sunfish	31	90
Iowa Darter	15	100
Largemouth Bass	32	38
Mudpuppy	4	100
Northern Pike	23	0
Pumpkinseed Fish	20	10
Rock Bass	84	18
Redear Sunfish	78	76
Sand Shiner	2	100
Spotfin Shiner	230	100
Smallmouth Bass	2	100
Walleye	6	100
Warmouth	25	0
Yellow Perch	123	0
Yellow Bullhead	3	100

Table 7. Mean length and age composition of selected panfish species collected in Long Lake, Oakland County 2019.

Species	Age	N Aged	TL Range (in.)	State AVG TL (in.)	AVG TL (in.)	Growth Index*
Bluegill	1	21	1.4 to 2.8	1.8	2.16	-0.3
	2	8	3.0 to 3.4	3.8	3.16	
	3	13	3.5 to 5.5	5.0	4.06	
	4	9	5.1 to 7.8	5.9	6.22	
	5	10	4.8 to 8.2	6.7	6.02	
	6	8	6.3 to 8.2	7.3	7.20	
	7	7	6.8 to 8.4	7.8	7.80	
	8	1	8.4 to 8.4	8.2	8.40	
	9	1	7.4 to 7.4	8.6	7.40	
	10	1	10.1 to 10.1	8.9	-	
Redear Sunfish	1	7	2.0 to 2.6	1.9	2.27	-1.0
	2	3	3.2 to 3.8	4.4	3.53	
	3	3	5.0 to 5.3	6.2	5.13	
	4	10	4.2 to 7.7	7.6	6.01	
	5	10	6.2 to 8.5	8.7	7.53	
	6	9	6.2 to 9.3	9.6	8.32	
	7	6	7.3 to 9.5	10.3	8.96	
	8	2	8.8 to 8.8	10.8	8.80	
	9	1	8.0 to 8.0	-	8.00	
	10	4	9.2 to 10.6	-	9.85	

*Growth index is the average deviation from the state average length at age.

Table 8. Year, number (N) of Bluegill (BLG) captured, trap net effort (net nights), number of preferred size Bluegill captured, percent preferred size Bluegill, average (AVG) trap net total length (TL, inches), and trap net catch per unit effort (CPUE) of preferred size Bluegill.

Year	N BLG	Trap Net Effort	N Preferred Size*	% Preferred Size*	AVG Trap Net TL (in.)	Trap Net CPUE of Preferred Size* BLG
1996	491	12	121	25	5.5	10.1
2003	148	9	26	18	4.5	2.9
2019	17	6	14	82	6.5	2.3

*Preferred size for Bluegill is equal to or greater than 6 inches.

Table 9. Scores (1 – 7) for five indices of Bluegill population characteristics obtained during lake surveys. Ranks (very poor to superior) correspond to the scores provided. (Reproduced from Schneider 1990).

		Trap Net				
Rank	Score	AVG TL[a]	%>6 (in.)[b]	%>7 (in.)[c]	%>8(in.)[d]	Growth Index[e]
Very Poor	1	<5.0	0-9	0-1.9	<0.1	<-1.0
Poor	2	5.0-5.4	10-24	2-4	<0.1	-1.0 to -0.6
Acceptable	3	5.5-5.9	25-49	5-9	<0.1	-0.5 to -0.1
Satisfactory	4	6.0-6.4	50-74	10-29	0.1-0.9	0.0 to 0.4
Good	5	6.5-6.9	75-85	30-49	1-9	0.5 to 0.9
Excellent	6	7.0-7.5	86-95	50-79	10-39	1.0 to 1.4
Superior	7	≥7.6	≥96	≥80	≥40	≥1.5

[a] Average total length of catch in inches.

[bcd] Percent of catch greater than 6.0, 7.0, and 8.0 inches in total length, respectively.

[e] Average deviation (inches) from the state average length at age.

Table 10. Long Lake and Statewide mean length at age for Northern Pike ages 3, 4 and 5 and calculated growth metric based on length quartiles for ages 3 to 5. Mean lengths based on fin ray data. Statewide means calculated from 109 populations sampled during March-May 1990 to 2015 (Smith et al. 2016).

		Statewide			
Age	Long Lake	Mean (in.)	25th Percentile (in.)	Median (in.)	75th Percentile (in.)
3	18.3	20.8	19.1	20.6	22.2
4	20.4	23.4	20.9	22.7	24.5
5	19.8	25.5	22.8	24.4	26.2