White Lake
Muskegon County
White River Watershed, surveyed 2023

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Environment

White Lake (Figures 1-3) is located in Muskegon County, Michigan, in the central-western Lower Peninsula. It is 2,571 acres in size and is classified as a drowned river mouth lake due to its proximity to Lake Michigan and its location at the downstream end of the White River. White Lake drains into Lake Michigan via a 1/3-mile-long channel. White Lake is approximately 5 ½ miles long, averages a mile wide, has an average depth of 23 feet, and a maximum depth of approximately 70 feet (Anonymous 2005). Due to its proximity and connection to Lake Michigan, the lake levels of White Lake vary according to lake levels in Lake Michigan. Substrates of White Lake are primarily sand and gravel, although the upper portion of the lake also has a lot of organic (muck) substrate. Aquatic plant growth is also quite heavy in places on White Lake, in particular the upper portion of the lake near where the White River flows in. Between the Thompson/Dowling Street crossing and US-31, the White River forms a large coastal wetland that is approximately 2 miles long and _ mile wide.

The city of Montague lies on the north shore of upper White Lake, while the city of Whitehall lies on the southern shore. Most of the shoreline of White Lake is privately owned and developed with residential housing, including boat docks, and shoreline stabilization. Upper White Lake is very heavily developed, with large marinas occupying a substantial portion of the lake's surface. In recent years, dense condominium developments (with accompanying boat docks and habitat alteration) have also been built on the southern shore of upper White Lake.

Access to White Lake is somewhat limited, particularly for those seeking to launch trailered boats. The primary launch is the Montague Municipal Boat Launch on the upper end of White Lake (Figure 1). This facility has extensive parking for 60 vehicles and trailers, and also has a fish cleaning station. The only other launches are at Scenic Road on the south side of White Lake, and Lau Road on the north shore. Both of these launches are on western White Lake, and both are small facilities with parking for only a few vehicles and trailers. Shore access (and access for carried watercraft) to White Lake can be found at Covell, Lions, Svenson, and Goodrich Parks in Whitehall, along with the Charles Mears Mill Historical Site, also in Whitehall. Maple Grove Park provides good shore access in Montague.

The White River is the primary tributary of White Lake, providing the majority of the water flowing into White Lake. The White River is approximately 90 miles in length, with a watershed area of approximately 344,166 acres (DeMol 2009) and an average summer discharge of approximately 300 cubic feet per second (Tonello 2021). The landscape that forms the White River watershed is relatively undeveloped and is primarily forested (approximately 58%, DeMol 2009), with some agricultural areas and a few wetlands. Much of the watershed (23%) lies in federal ownership that is part of the Manistee National Forest, which is administered by the United States Forest Service (USFS). There are also privately-owned parcels interspersed throughout the watershed. The forested land within the watershed typically consists of aspen, white pine, and northern hardwoods. There are currently two large dams on the White River mainstem, the Hesperia Dam and White Cloud Dam. The White River hosts annual

migrations of migratory fish from White Lake and Lake Michigan, including Rainbow Trout (Steelhead), Chinook Salmon, Coho Salmon, Walleye, White Suckers, and several Redhorse species. Hesperia Dam is the lower dam on the White River and is a fish passage barrier, so migratory fish cannot access the middle and upper reaches of the White River.

In addition to the White River, there are seven other named tributaries that flow into White Lake. The largest is Pierson Creek, which flows into the northern side of the lake, near the outlet channel to Lake Michigan. Raccoon and Buttermilk Creeks flow into the north and west side of the lake within the city limits of Montague. Bush and Mill Pond Creeks flow into the south side of upper White Lake within the city limits of Whitehall, while Wildcat Creek and Birch Brook flow into White Lake further south. Of these, Birch Brook, Wildcat Creek, and Mill Pond Creek are Designated Trout Streams, while portions of Pierson Creek, Raccoon Creek, and Buttermilk Creeks are designated county drains.

The White Lake Area Sport Fishing Association (WLASFA) is an advocacy group focused on White Lake. WLASFA started in 1982, "in the turmoil surrounding holding Occidental Petroleum (Hooker Chemical) responsible for the contamination of ground water, and the cleaning up of mercury and chromium contamination from the tannery and other industrial legacy contamination in the area. Founders were local charter boat captains and sportsmen who were part of the grass roots movement to clean up and provide a legacy of protection of our sportfishing resources and ensure that fishing opportunities will be available and accessible to the common man for generations" (Bob Ingalls, WLASFA, personal communication). The WLASFA mission statement is as follows: "To improve the quality of fishing in White Lake."

Another advocacy group that focuses on White Lake is the White Lake Association (WLA), which was founded in 1988. The primary functions of WLA are conducting annual water quality surveys on White Lake with the Cooperative Lakes Monitoring Program and annually monitoring and assessing the aquatic plants (both native and non-native) in White Lake. WLA also participates in other White Lake projects, including installing and maintaining the no-wake buoys on the east and west ends of the lake (http://www.whitelakeassociation.org/about/).

History

Fish Stocking

The first records of fish stocking in White Lake date back to 1886 when Lake Whitefish were stocked by the Michigan Fishery Commission (Table 1). Largemouth Bass were stocked in 1903 and again in 1904, and Walleye were first stocked in 1904. Lake Trout were stocked in 1906 and 1907, and Smallmouth Bass were stocked sporadically between 1911 and 1928. Bluegill were stocked once, in 1928. Walleye were commonly stocked into White Lake in the early 20th century, with 16 stocking events occurring between 1904 and 1939. No fish were stocked into White Lake between 1940 and 1972. Rainbow Trout were then stocked twice, in 1973 and 1974. Walleye stocking resumed in 1981 and has continued on a fairly regular basis since then.

In an attempt to restore a species that had disappeared from White Lake in the 1950s, adult White Bass were stocked in 1983 and 1984. The White Bass were caught via hook and line from the Detroit River by volunteer anglers and then transported across the state and stocked into the White River just upstream of White Lake by MDNR. Over the course of two years, approximately 2,289 White Bass were stocked

(Table 1). According to a Muskegon Chronicle article (date unknown, possibly 1985) the White Bass stocking program was halted due to the fear of accidentally introducing White Perch into White Lake and possibly Lake Michigan.

In 2013, Great Lakes-strain Muskellunge were first stocked into White Lake, and they have been stocked three times since then (Table 1).

Historical Fisheries/Lake Management Issues

In the MDNR White Lake file (Cadillac MDNR office), correspondence entries begin in the late 1940s. File entries from 1949 discuss that White Lake was known for its White Bass and Yellow Perch fisheries, and that an extensive fish kill occurred in 1949. Species mentioned in the correspondence include Common Shiner, Johnny Darter, Log Perch, Northern Pike, Rock Bass, Smallmouth Bass, Walleye, White Sucker, and Yellow Perch. No specific source of the mortality was found, and the fish kill was attributed to prolonged heat creating low oxygen conditions. Several dead Cisco (Lake Herring) were also observed, but they were believed to have died from lamprey mortality, not from the fish kill event. This is the only mention of Cisco being in White Lake.

The first mention of overly abundant aquatic plants in the file occurs in a 1960 complaint from the Whitehall Chamber of Commerce. The first record of chemical treatment to control aquatic plants is also mentioned in 1960, with Curly-leaf Pondweed being the targeted species. Correspondence in 1962 notes a fish kill attributed to the chemical treatment of aquatic plants and is the first mention of treating the lake with copper sulfate in attempt to control swimmer's itch. Correspondence from the summer of 1963 includes the first mention of algae complaints by riparian landowners, in addition to abundant aquatic plants. There are also multiple correspondences from the early 1960s regarding large dredging projects in White Lake (MDNR files, Cadillac office).

The disappearance of White Bass from White Lake is also discussed multiple times in the file. In correspondence from 1962, Gerald Cooper, then Director of the Institute for Fisheries Research at the University of Michigan discusses White Bass and how they were abundant in White Lake and the White River (and Pentwater Lake and Pentwater River) up until about 1954. In 1973, Fisheries Division Chief Wayne Tody wrote to State Rep. Warren Goemaere regarding White Lake, and in particular mentions that the White Bass fishery has "completely disappeared" and poses alewife abundance in the early 1950s as a possible cause. Borgeson (1973) also discussed the White Bass run of the lower White River: "until 1950 the river near Whitehall was known more for its fine spring fishing for White Bass which ran the river in droves at spawning time. These were sizeable fish, too; often running 2-3 pounds and up to 17-18 inches long". Other than one White Bass caught in a fisheries survey in 1994, no White Bass have been observed in White Lake by MDNR personnel in recent years. There have been unsubstantiated reports of anglers catching the occasional White Bass from White Lake in recent years (MDNR files, Cadillac office).

In the 1970s, citizens began to speak out against Hooker Chemical's (now Occidental Chemical) discharge of chlorinated solvents and pesticide related materials into White Lake. In 1976, 1978, and 1979, fish from White Lake were captured by Fisheries Division and then tested for contaminants. In 1979, the Michigan Department of Public Health issued a warning against eating fish from White Lake due to the discovery of hexachlorobenzene in White Lake fish, although the warning was later rescinded. Also, high chloride levels were found at some locations in the lake, particularly on the bottom. DuPont

and Muskegon Chemical (now Koch Chemical) also discharged chlorinated organic chemicals into White Lake through both groundwater and surface water discharges. Contaminants in White Lake and various viewpoints on them are prominent in late 1970s file entries. In 1985, due to contamination issues from multiple sources, White Lake was declared a Great Lakes Area of Concern by the U. S. Environmental Protection Agency (EPA).

Many file entries from the 1970s, 1980s, and early 1990s are regarding marina construction, impacts of the facilities on habitat and fisheries of White Lake, and written objections from Fisheries Division staff to state permitting authorities. Throughout the 1990s, Fisheries Division staff invested a large amount of time combating marina development projects which would result in habitat degradation. In the mid-1990s, The Ellenwood Marina project was extremely controversial and was staunchly opposed by Fisheries Division and other stakeholders. Despite the opposition, much of upper White Lake has been systematically developed with marinas over the years. The marina developments have eliminated natural shoreline habitat and natural bottomland habitat (through dredging), in addition to occupying large areas of public lake surface on upper White Lake.

In 1994, a sediment assessment conducted under the leadership of the U. S. EPA showed major pollution near the defunct Whitehall Leather Company factory in an area known as Tannery Bay. The sediments adjacent to the old factory in Tannery Bay were found to have elevated levels of arsenic, chromium, and mercury. Several projects were eventually conducted to remove the contaminated sediment from the lake bottom, and by 2011 the site was considered to have been remediated.

In 2005, the White Lake Shoreline Habitat Management Plan (Anonymous 2005) was written by the White Lake Public Advisory Council. Among other things, the plan recommended placing conservation easements on critical shoreline parcels, implementing a restoration plan to connect these areas, and establishing a 130-foot riparian vegetation buffer along the lakeshore. Unfortunately, none of these recommendations were implemented to any great extent.

By the spring of 2014, the US EPA determined that the sediment and groundwater contamination issues had been appropriately remediated, and White Lake was officially de-listed as an Area of Concern (Riley 2014). Despite the de-listing, discussions about further remediations have continued, particularly regarding the Dupont Nemours site, which is located north of White Lake and may be continuing to contaminate groundwater that is reaching White Lake.

White Lake is very popular among bass tournament anglers. Between 2016 and 2022, there were 208 tournaments conducted on White Lake. In those tournaments, a total of 20,640 bass were reported as caught. Of those, 19,273 were Largemouth Bass, and 1,367 were Smallmouth Bass (Tom Goniea, MDNR Fisheries Division, unpublished data).

Since 1994, a total of 219 exceptional fish caught from White Lake have been entered in the MDNR Fisheries Division Master Angler program. A total of 25 different species have been entered for White Lake (Table 2). Freshwater Drum was the most frequently entered species, with 56 entries, followed by Channel Catfish with 30 entries, and Bowfin with 24 entries. The most frequently entered gamefish for White Lake was Walleye, with 23 entries.

Historical Fisheries Surveys

Compared to other large lakes in Michigan's Lower Peninsula, White Lake has not been historically surveyed frequently. The first fisheries survey was conducted in 1892 by the Michigan Fish Commission. Details are scarce, but the gear used was likely gill nets. Nine different fish species were caught (Table 3), although the ninth species is unknown- the writing on the ancient copy is illegible, although it finishes with "pike." At that time Walleye were known as "walleyed pike", so the ninth species was either Walleye or Northern Pike. The researchers also noted that they caught a number of White Bass on rod and reel in addition to those caught by netting. They also recommended stocking of "walleyed pike".

The next recorded fisheries survey of White Lake was conducted by the Michigan Department of Conservation (MDOC; the precursor to the Michigan Department of Natural Resources or MDNR) in 1965. The survey was conducted with trap nets, inland gill nets, and electrofishing, and a total of 21 species were caught (Table 3). White Bass and Flathead Catfish were both caught in the 1965 survey. No Flathead catfish has and only one White Bass have been caught in any MDOC/MDNR fisheries surveys since then. Bluegill as large as 10 inches were also caught in the 1965 survey. Only one Walleye was caught in the 1965 survey. No report was produced from the 1965 fisheries survey effort.

In 1976, 1978, and 1979, fish were collected from White Lake for contaminant analysis, typically near the outlet of the Hooker Chemical plant. Gear used in those collection efforts included gill nets, trap nets, and electrofishing. Detailed catch records for these surveys are not available, although species presence was recorded (Table 3). No report was produced for any of these surveys/collections.

Fisheries surveys were conducted on White Lake by MDNR personnel in May of 1985 (trap nets and electrofishing) and July of 1987 (trap nets). Unfortunately, detailed catch records from these surveys are unavailable, and no report was ever produced.

A series of fisheries surveys were conducted on White Lake from 1988 to 1991 with the goal of comparing fish abundance between developed marina sites and sites with undeveloped shorelines. Gear used in the surveys included an electrofishing boat, gill nets, and trap nets. While no formal report was ever completed for these surveys, MDNR Fisheries Biologist Rich O'Neal noted significant reductions in game fish associated with the marina (disturbed) sites vs. the sites with undisturbed shoreline. He also noted a lower species diversity associated with the disturbed sites. O'Neal used these findings in his objections to further marina developments and associated habitat destruction (MDNR files, Cadillac). The 1989 survey marked the first time that any substantial number of Walleye were caught in an MDNR or MDOC survey of White Lake.

In April of 1994, an extensive survey of White Lake was conducted by MDNR with trap nets, large mesh fyke nets, and small mesh fyke nets. Electrofishing was also conducted in August of 1994. A total of 26 different fish species were captured in the survey (Table 3). Unfortunately, no report of any kind was ever produced from the survey. Of note was the capture of one 14-inch White Bass, the only one captured from White Lake by MDNR in recent records.

Another comprehensive fisheries survey was conducted on White Lake by MDNR in the summer of 2007. MDNR Status and Trends survey protocols (Wehrly et al. 2009) were used for the survey. Netting with trap nets and inland gill nets was conducted from June 11 to June 14, while seining and electrofishing was conducted on June 26. In the 2007 survey, a total of 1,987 fish were caught, representing 25 species (Tables 3-5). Age and growth analysis was conducted on all gamefish collected

in the 2007 survey (Table 6), as was shoreline habitat data (Table 7). No report for the 2007 MDNR survey of White Lake was ever produced. The 2007 survey represents the first official documentation of White Perch in White Lake.

In the fall of 1999, the first electrofishing survey targeting juvenile Walleye was conducted according to protocols outlined by Ziegler and Schneider (2000), and by Serns (1982 and 1983). The goal of this survey was to assess Walleye year class strength (both stocked and wild) by targeting juvenile Walleye in the shallows. The survey results were inconclusive because only a few Walleye were caught (Table 8). One result of the 1999 fall electrofishing survey was the first actual written fisheries report for White Lake, produced by MDNR Fisheries Biologist Rich O'Neal (1999). O'Neal's recommendations included continued Walleye stocking, evaluation of stocking survival by electrofishing, and protecting White Lake's remaining shallow water habitat from dredging, filling, and excessive marina development.

Between 1999 and 2019 a total of 16 fall electrofishing surveys targeting juvenile Walleye were conducted on White Lake (O'Neal 2017, Tonello and O'Neal 2020; Table 8). In most of the surveys, very few Walleye were caught, regardless of whether Walleye had been stocked or not. One exception was 2005, when 55.2 age-0 Walleye per mile were caught. The next-highest age-0 catch rate of Walleye was in 2011, when 18.2 per mile were caught. Walleye were stocked in both of those years. Another electrofishing survey targeting juvenile Walleye was attempted in the fall of 2022 but was aborted due to mechanical issues with the electrofishing boat. In the 2022 survey, approximately 1.7 miles of nearshore habitat was electrofished, and only one 7-inch Walleye was caught.

Current Status

The most recent fisheries survey of White Lake was conducted in the spring and summer of 2023. The purpose of the 2023 fisheries survey was to assess the overall fish community of White Lake. The netting portion of the survey took place from May 15 through May 18, 2023. Gear used included two trap nets (6 net-nights), three large-mesh fyke nets (6 net-nights), two experimental graded-mesh inland gill nets (6 net-nights), and two small-mesh fyke nets (4 net-nights). Seining and electrofishing were conducted on June 28. A total of five seine hauls were completed, along with three ten-minute electrofishing transects. Total length to inch class (e.g., 7-inch class = 7.0-7.9 inches) was recorded for all fish captured. Weights for all fish species were calculated using the length-weight regression equations compiled by Schneider et al. (2000b).

A total of 2,795 fish were caught, representing 37 different species (Tables 3, 9, and 10). Bluegill (n = 588), Pumpkinseed (n = 478), and Yellow Perch (n = 467) were the most abundant species in the catch (Tables 9 and 10). Predators (Bowfin, Channel Catfish, Largemouth Bass, Northern Pike, Smallmouth Bass, and Walleye) made up 36% of the fish biomass. Previously recorded fish species that were not present in the 2023 survey included Black Bullhead, Central Mudminnow, Common Shiner, Flathead Catfish, Johnny Darter, Lake Trout, Longnose Gar, Rainbow Trout, Warmouth, and White Bass (Table 3). Species caught in the 2023 survey that were not present in previous surveys included Banded Killifish, Bluntnose Minnow, Brook Silverside, Emerald Shiner, Golden Redhorse, Hybrid Sunfish, Lake Sturgeon, Mimic Shiner, Sand Shiner, Shorthead Redhorse, Silver Redhorse, and Trout-Perch (Table 3).

For gamefish species, scale or spine samples were collected from up to ten fish per inch group. Age and growth analysis was conducted by counting growth rings present in cross sections of spines or scales. Weighted age compositions of gamefish populations were calculated as described by Schneider (2000b). Mean length at age was used to obtain a growth index by calculating the difference from the state average length (Schneider et al. 2000a). The mean growth indices for a given gamefish species was generated by averaging the growth indices for each age class that was represented by at least five fish. Positive growth rates were observed for the five species that had enough samples to make statistical inferences (Table 11).

Shoreline data were collected on White Lake by MDNR Fisheries personnel on August 1, 2023, according to protocols outlined in Wehrly et al. (2009). Data collected included the number of docks, submerged trees, and houses observed per kilometer of shoreline, as well as how much of the shoreline is armored or hardened with seawalls or riprap to prevent erosion. White Lake averaged 15.4 docks, 11.3 submerged trees and 16.4 houses per kilometer of shoreline. Armoring structures and materials were present along 51.3% of the lake shoreline (Table 7). A temperature/dissolved oxygen profile was also collected on August 1, 2023. The profile was taken in the deepest part of the lake. Oxygen levels suitable for fish were found to a depth of 24 feet (Table 12).

Analysis and Discussion

The 2023 MDNR fisheries survey of White Lake was extremely successful in that it provided current information on the fish populations of White Lake, and particularly those species that anglers like to pursue. Direct comparison between the 2007 and 2023 surveys is imperfect due to differences in gear utilized and the 2007 survey having been conducted in mid-June, while the 2023 survey was conducted in mid-May. However, some differences can be noted. Growth rates for all species were improved in 2023, rather dramatically in some cases (Tables 6 and 11). Nearly all species were growing slower than the state average in 2007, while the opposite was true in 2023.

The panfish populations, in particular Bluegill and Pumpkinseed, have improved dramatically since the 2007 survey. In 2007, the Bluegill growth rate was -1.0 inches below the state average, and the Pumpkinseed growth rate was -0.7 inches below the state average (Table 6). However, in 2023, the Bluegill growth rate was +1.0 inches greater than the state average, while the Pumpkinseed growth rate was +0.7 inches greater than the state average (Table 11). In the 2007 survey, no Bluegill or Pumpkinseed were in the 8-inch class, and only a few were in the 7-inch class. However, in 2023, many Bluegill and Pumpkinseed were in the 7-inch class, with some also reaching the 8-inch class. According to the Schneider Index, a tool which examines Bluegill size structure and growth rates to provide a score for the Bluegill population of a lake (Schneider 1990), the 2023 Bluegill catch for White Lake rated as "Good", while the 2007 catch rated as "Very Poor" (Table 13). The reason(s) for the dramatic improvement in the Bluegill and Pumpkinseed populations shown in the 2023 survey are unclear. Anglers have certainly taken note, as we observed numerous anglers out targeting and catching panfish while we conducted the survey.

While Largemouth Bass were not overly numerous in either the 2007 or 2023 surveys (the majority of those observed in the 2023 survey were juveniles caught while seining), they are clearly an important component of the White Lake fish community. One indication of the health of the Largemouth Bass population of White Lake is the popularity of the lake for bass tournament anglers, with over 19,000

Largemouth Bass caught in 208 bass tournaments from 2016-2022. One curiosity of both the 2007 and 2023 surveys was the lack of Smallmouth Bass in the catch. While Largemouth Bass clearly outnumber Smallmouth Bass in White Lake, Smallmouth Bass are an important component of the White Lake fish community. The lack of Smallmouth Bass in these surveys may be a geographical issue. Smallmouth Bass are known to inhabit the channel and pierhead areas, where it is not possible to set nets. Also, the White River is known to host a summer fishery for Smallmouth Bass. While it is possible or even likely that most of these fish are migrants from White Lake, this run/population has never been studied.

Some anglers believe that the White Lake Smallmouth Bass fishery population has declined dramatically over the last few decades. They attribute this to the physical changes that have taken place in the lake over that time, including zebra mussel presence, greater water clarity, and changes in abundance and composition of the aquatic plant community due to aggressive chemical treatments for nuisance aquatic plants. A warming climate could also favor Largemouth Bass over species like Smallmouth Bass and Walleye. Reductions in Smallmouth Bass abundance accompanied by increases in Largemouth Bass abundance has been observed in recent years in other northern Lower Peninsula lakes, including Lake Cadillac (Tonello 2012), and Fife Lake (Tonello 2014).

Other gamefish species like Channel Catfish and Northern Pike were present in the 2023 survey. While the catch was not overly numerous for either species, multiple size classes were present for both species (Table 10). Consistent year classes were present for Northern Pike (Table 11), indicating that natural reproduction for these species is occurring in most or even all years. Growth rates for Northern Pike were good as well. White Lake is known as an excellent fishing lake for Northern Pike, particularly through the ice in the winter.

Black Crappie, Rock Bass, and Yellow Perch were also present in the 2023 survey catch. Black Crappie were not overly numerous in the survey catch, but we talked to anglers who told us they do target them successfully. The anglers told us that most of the fishing for Black Crappie occurs in the spring, and that large individuals are sometimes caught. White Lake has long had a reputation as an excellent fishing lake for Yellow Perch. There are likely two different metapopulations of Yellow Perch in White Lake-those that are year-round residents, and those that are migrants from Lake Michigan (Schneider et al. 2007; Chorak et al. 2019). The migratory Yellow Perch enter White Lake (and other drowned river mouth lakes along the eastern shore of Lake Michigan) for spawning and foraging purposes. The Lake Michigan migrant Yellow Perch tend to be larger and paler in coloration, and anglers take note when they show up in White Lake. During the 2023 survey, we observed anglers targeting and catching what were likely Lake Michigan migrant Yellow Perch just inside the channel to Lake Michigan. Our survey gear also caught Yellow Perch in that area, including some larger, paler individuals that were likely migrants from Lake Michigan.

The Walleye catch in the 2023 survey was disappointing, with only 9 caught, ranging from 6 to 27 inches in length (Table 9). Although 7 different year classes were represented (Table 11), only one year class (2022) was represented by more than one fish. The Walleye catch in the 2023 survey represented a marked decline from the 2007 catch, in which 54 Walleye representing nine-year classes were caught. Of those, all but one fish came from stocked year classes. Despite a large annual Walleye spawning run in the White River, O'Neal (2017) surmised that Walleye natural reproduction in the system was very low, since very few age-0 Walleye were ever caught in fall electrofishing surveys in years in which Walleye were not stocked (Table 8). Recent discussions with local anglers, members of WLASA, and

several local fishing guides also lead to the conclusion that the Walleye population of White Lake has diminished in recent years. This is despite consistent stocking efforts by MDNR (Table 1). For unknown reasons, in recent years, the stocked Walleye do not seem to be surviving like they did in the past. Walleye stockings in the 1997-2005 period were more numerous on a per-acre basis than those in recent years.

An 18-inch Lake Sturgeon was caught in a gill net during the 2023 survey. This marked the first time that a Lake Sturgeon has been caught in a White Lake fisheries survey. Although no aging structures were taken from the fish, it was likely age-3 or age-4 (Ed Baker, MDNR Fisheries Division personal communication). The White Lake/White River Lake Sturgeon population has not been studied to this point. Although rare sightings of Lake Sturgeon in the White River have been reported, it is likely that the population does not rival that of other, larger watersheds, including the Muskegon and Manistee. Although the Lake Sturgeon was captured in a gill net, it was only lightly caught, and we were able to release it alive.

One disappointment of the 2023 White Lake survey was the lack of any Muskellunge in the catch. However, the survey was not specifically designed to target Muskellunge, so this is not surprising. Reports and pictures from anglers confirm that at least some of the stocked Muskellunge are surviving and creating a fishery for those who are willing to invest the time and effort into pursuing them. There should be plenty of soft-rayed forage available for the Muskellunge in White Lake, and growth rates of other predator species were very good in the 2023 survey (Table 11). Northern Pike, which prefer similar prey, were growing particularly well, at +1.6 inches greater than the state average.

Compared to other large, deep lakes in Michigan, White Lake has more docks and dwelling density (Table 7; Wehrly et al. 2015). White Lake did have slightly more submerged woody habitat than other large, deep lakes in Michigan. White Lake had nearly double the amount of shoreline armoring than other large, deep Michigan lakes. The White Lake shoreline is clearly heavily developed and natural, undeveloped shoreline is lacking. In addition, White Lake water levels (and subsequent shoreline impacts) will always be heavily dependent on Lake Michigan water levels.

Management Direction

Based on the 2023 fisheries survey catch and reports from anglers, the Walleye population of White Lake is likely much lower than it has been in the past. Walleye are a very important species for anglers on White Lake. The recent stocking regime of 130k spring fingerlings (approximately 50/acre) on an every-other year basis does not seem to be creating the desired fishery. Therefore, the Walleye stocking rate should be increased to 75/acre (approximately 200k spring fingerlings) on an every-other year basis. Also, in recent years, the spring fingerling Walleye have been stocked at the Montague Municipal Boat Launch. This area hosts dense populations of panfish and juvenile Largemouth Bass, which are potential predators on the stocked spring fingerling Walleye. Alternate stocking locations, including the road-end at Nestrom Road, and the Scenic Road boat launch should be utilized instead. Since the most recent Walleye stocking occurred in 2022, Walleye should be stocked into White Lake in 2024. The 2024 Walleye stocking effort should be followed up with a fall electrofishing effort targeting juvenile Walleye that follows protocols outlined by Ziegler and Schneider (2000) and Serns (1982 and 1983).

Although no Muskellunge were caught in the 2023 survey, we have received Muskellunge catch reports from anglers. Clearly, at least some of the stocked Muskellunge are surviving and being caught by anglers. White Lake provides excellent habitat and forage for Muskellunge. Therefore, Muskellunge (Great Lakes strain) stocking should continue in White Lake. The stocking rate should be 1.5/acre fall fingerlings (3,857 fish) stocked on an every-other-year basis. Since Muskellunge have not been stocked into White Lake since 2021, they should be stocked in 2024.

Lake Sturgeon are designated as a State-threatened species in Michigan. Their status in the White Lake/White River system has never been studied, and population levels are unknown. The catch of a young Lake Sturgeon in the 2023 White Lake survey is encouraging and may suggest that the White River/White Lake system is capable of producing Lake Sturgeon. Therefore, a study designed to evaluate the current Lake Sturgeon population in White Lake and the lower White River should be undertaken. Depending on the results of that study, the White Lake/White River system could be considered a candidate for Lake Sturgeon restoration, possibly through stocking.

Improved shoreline management would benefit the fish populations and the overall ecosystem of White Lake. Seawalls, developed shorelines, and manicured lawns do not provide the appropriate habitat for the White Lake ecosystem. Any development projects on or near White Lake should consider the fluctuations in Lake Michigan water levels over time and the impacts of higher or lower water levels. The Michigan Natural Shoreline Partnership, an organization dedicated to promoting natural shoreline landscaping to protect Michigan's inland lakes (http://www.mishorelinepartnership.org/), can provide guidance and training on how best to manage the land/water interface for the benefit of White Lake. Also, downed trees in the shallows of the lake provide excellent habitat for numerous popular species, including Largemouth Bass, Smallmouth Bass, and panfish. Any trees that fall into the lake should be left alone as fisheries habitat. In addition, trees could be intentionally placed in appropriate shallow water areas of White Lake to provide cover and habitat for desirable fish species.

A healthy aquatic plant community is critical for the fish community of White Lake, particularly for species like Bluegill, Pumpkinseed, Largemouth Bass, and many others. In recent years on White Lake, chemical aquatic nuisance plant treatments have been only conducted on relatively small areas, mostly on the upper part of the lake near marinas and other developed areas. These treatments have typically been spot-treatments in places where Eurasian milfoil, curly-leaf pondweed, and a few other species have reached unacceptable densities. We recommend that this strategy continue. Aquatic plants, both native and non-native, should only be chemically treated when they are actually creating a nuisance to recreation or navigation. This will result in lower expenses for White Lake riparian landowners, and a healthier White Lake ecosystem. Copper sulfate should not be used under any circumstances, as it is known to be extremely harmful to aquatic insect populations, especially mayflies.

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Figure 1. White Lake, Muskegon County, Michigan.

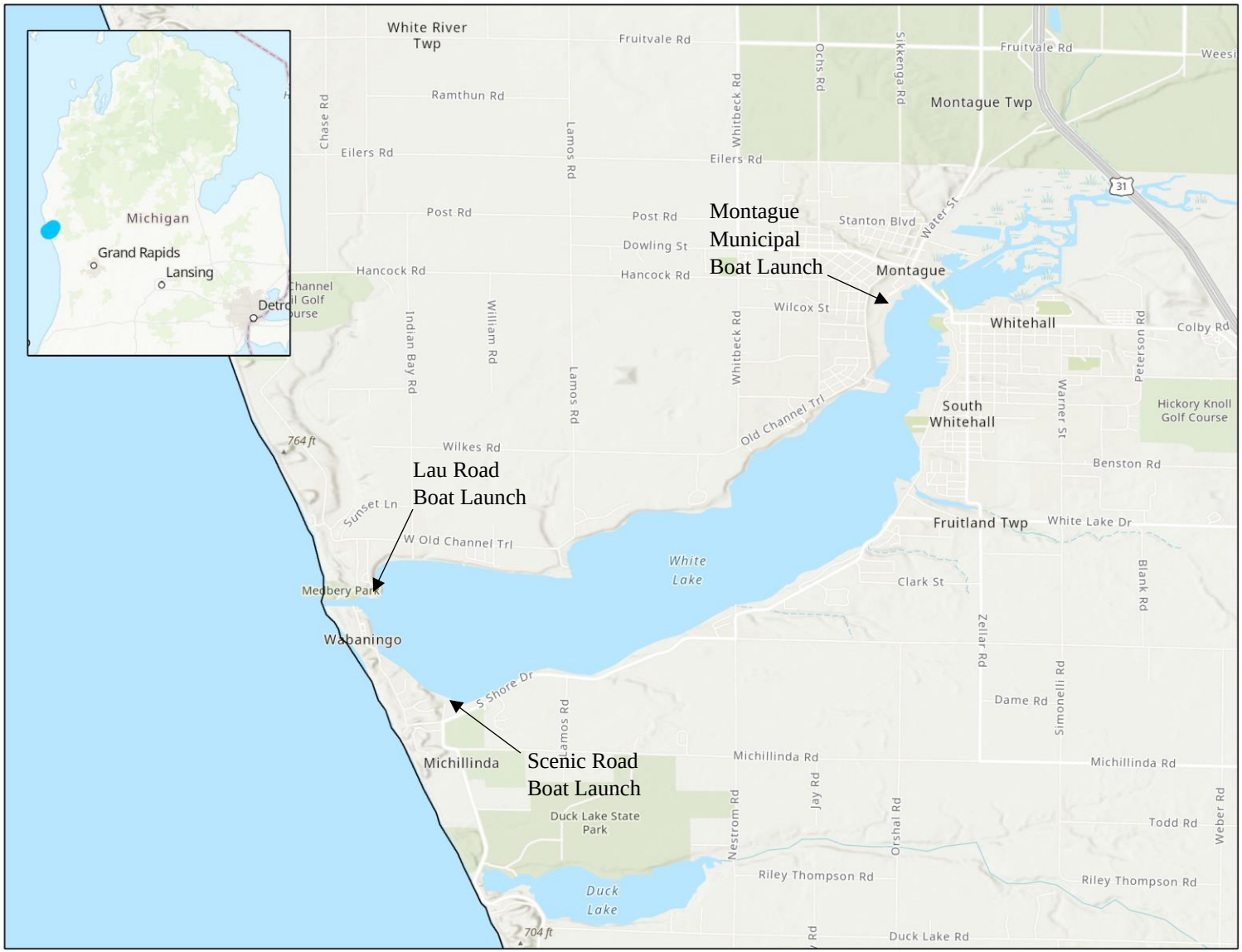

Figure 2. Lakeshed map for White Lake, Muskegon County, MI.

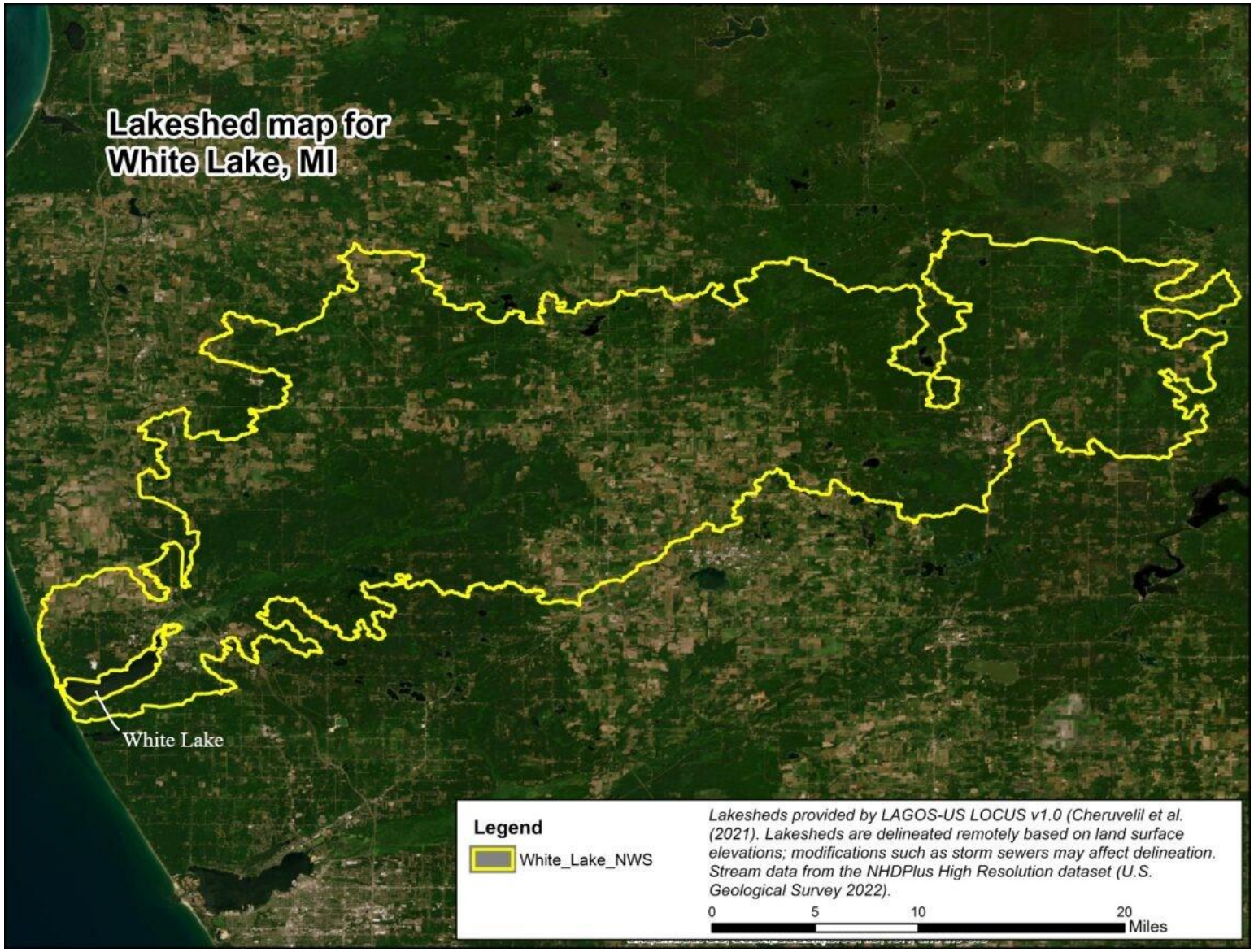

Figure 3. Lakeshed landcover map for White Lake, Muskegon County, MI.

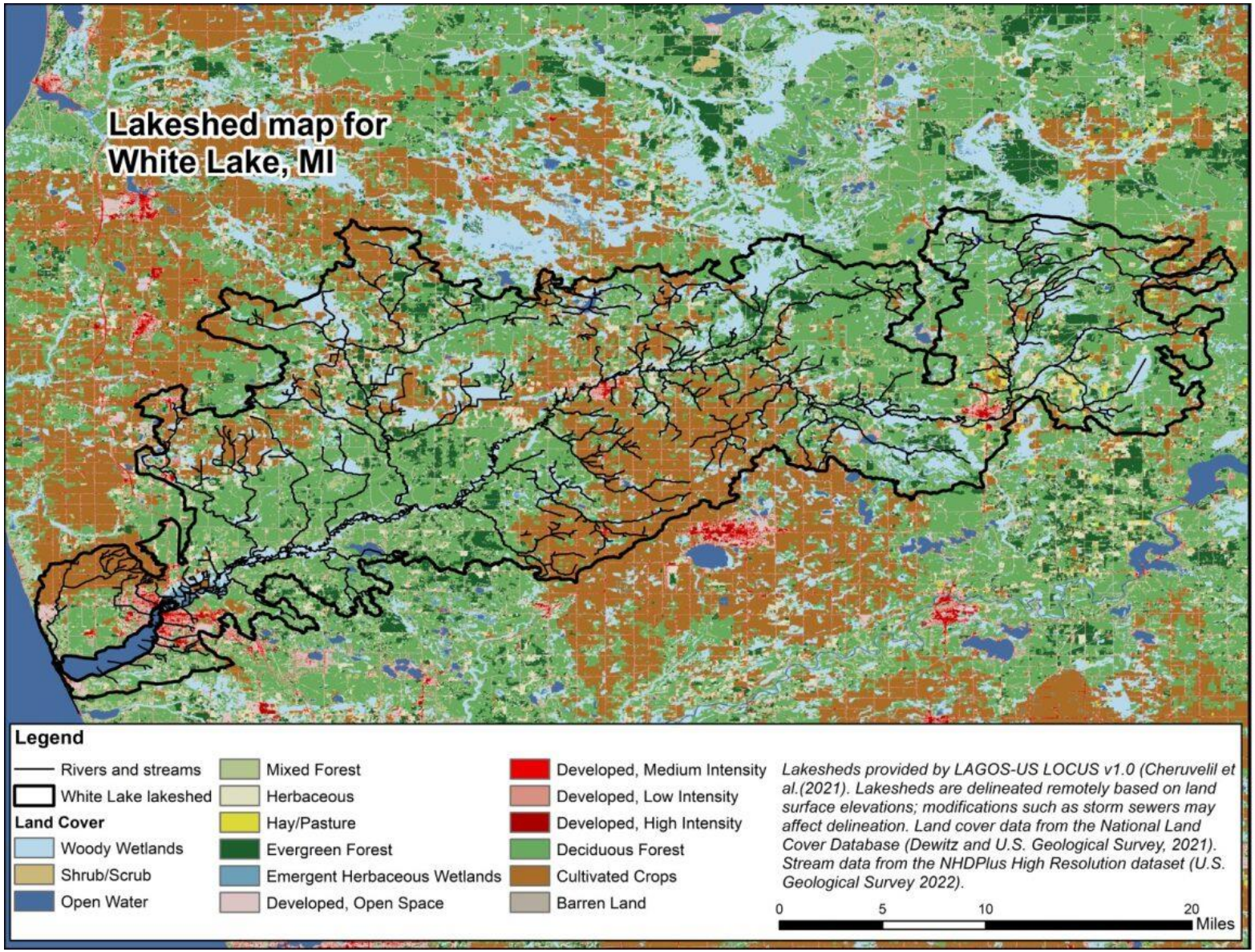

Table 1. Fish stocked in White Lake, Muskegon County, 1886-2023.

Year	Species	Number	Size	Strain
1886	Lake Whitefish	3,150,000	fry	
1903	Largemouth Bass	4,000	fry	
1904	Largemouth Bass	4,000	fry	
	Walleye	200,000	fry	
1905	Largemouth Bass	3,000	advanced fingerlings	
	Walleye	200,000	fry	
1906	Lake Trout	51,000		
	Largemouth Bass	300	yearlings	
	Walleye	200,000	fry	
1907	Lake Trout	30,000		
	Walleye	240,000	fry	
1909	Walleye	200,000	fry	
1911	Smallmouth Bass	4,000	fingerlings	
	Walleye	100,000	fry	
1912	Largemouth Bass	10,000	advanced fry	
	Smallmouth Bass	6,000	advanced fry	
1913	Walleye	300,000	fry	
1918	Walleye	306,000	fry	
1919	Walleye	200,000	fry	
1920	Smallmouth Bass	20,000	fry	
1921	Walleye	180,000	fry	
1924	Smallmouth Bass	375		
1925	Smallmouth Bass	5,000	fingerlings	
1926	Smallmouth Bass	6,000	fingerlings	
1927	Bluegill	600	3 mo.	
1928	Smallmouth Bass	400	5 mo.	
1934	Walleye	1,000,000	fry	
1935	Walleye	850,000	fry	
1936	Walleye	855,000	fry	
1937	Walleye	750,000	fry	
1938	Walleye	900,000	fry	
1939	Walleye	1,000,000	fry	
1973	Rainbow Trout	10,000	yearlings	
1974	Rainbow Trout	15,260	yearlings	
1981	Walleye	2,000	spring fingerlings	
1982	Walleye	16,584	spring fingerlings	
1983	White Bass	615	adults	Detroit River

Table 1, continued

1984	Walleye	1,004	fall fingerlings	
	White Bass	1,674	adults	Detroit River
1985	Walleye	5,325	fall fingerlings	Muskegon
1986	Walleye	120,675	spring fingerlings	Muskegon
1987	Walleye	960,000	fry	Muskegon
	Walleye	31,038	spring fingerlings	Muskegon
	Walleye	4,900	fall fingerlings	Muskegon
1988	Walleye	290,000	fry	Muskegon
	Walleye	36,000	spring fingerlings	Muskegon
	Walleye	17,569	fall fingerlings	Muskegon
1989	Walleye	421,000	fry	Muskegon
	Walleye	49,709	spring fingerlings	Muskegon
	Walleye	4,251	fall fingerlings	Muskegon
1990	Walleye	202,000	fry	Muskegon
	Walleye	41,287	spring fingerlings	Muskegon
1992	Walleye	403,600	fry	Muskegon
	Walleye	262,797	spring fingerlings	Muskegon
	Walleye	2,361	fall fingerlings	Muskegon
1993	Walleye	15,900	spring fingerlings	Muskegon
	Walleye	19,423	fall fingerlings	Muskegon
1994	Walleye	720,000	fry	Muskegon
	Walleye	49,264	spring fingerlings	Muskegon
	Walleye	120	fall fingerlings	Muskegon
1995	Walleye	43	fall fingerlings	Muskegon
1996	Walleye	971,000	fry	Muskegon
	Walleye	7,850	spring fingerlings	Muskegon
	Walleye	9,837	fall fingerlings	Muskegon
1997	Walleye	156,923	spring fingerlings	Muskegon
1998	Walleye	195,670	spring fingerlings	Muskegon
1999	Walleye	307,970	spring fingerlings	Muskegon
2000	Walleye	249,997	spring fingerlings	Muskegon
2001	Walleye	257,100	spring fingerlings	Muskegon
2003	Walleye	250,007	spring fingerlings	Muskegon
2005	Walleye	226,273	spring fingerlings	Muskegon
2009	Walleye	138,314	spring fingerlings	Muskegon
2011	Walleye	133,110	spring fingerlings	Muskegon
2013	Muskellunge	3,854	fall fingerlings	Great Lakes
	Walleye	108,896	spring fingerlings	Muskegon

Table 1, continued

2014	Muskellunge	3,853	fall fingerlings	Great Lakes
	Rainbow Trout	100	yearlings	Private
2015	Walleye	128,357	spring fingerlings	Muskegon
2016	Muskellunge	3,818	fall fingerlings	Great Lakes
	Walleye	6,787,500	fry	Muskegon
2017	Walleye	129,333	spring fingerlings	Muskegon
2019	Walleye	150,811	spring fingerlings	Muskegon
2021	Muskellunge	3,800	fall fingerlings	Great Lakes
2022	Walleye	112,695	spring fingerlings	Muskegon

Table 2. Michigan DNR Master Angler awards issued for fish caught from White Lake, Muskegon County, Michigan, 1994-2023.

Species	Number of Master Angler awards issued
Freshwater Drum	56
Channel Catfish	30
Bowfin	24
Walleye	23
Common Carp	13
Northern Pike	8
White Perch	7
Lake Whitefish	6
Longnose Gar	6
Black Crappie	5
Cisco	5
Redhorse Spp.	5
Smallmouth Bass	5
Pumpkinseed	4
Quillback	4
Largemouth Bass	3
Yellow Perch	3
Bluegill	2
Brown Trout	2
Bullhead Spp.	2
Chinook Salmon	2
Burbot	1
Muskellunge	1
Rock Bass	1
White Sucker	1
Total:	219

Table 3. Presence/absence of fish species in historical fisheries surveys of White Lake, Muskegon County.

Species	1892	1965	1976	1978	1979	1988	1989	1994	2007	2023
Alewife		x	x		x				x	x
Banded Killifish										x
Black Bullhead								x	x	
Black Crappie	x	x		x			x	x	x	x
Bluegill	x	x	x				x	x	x	x
Bluntnose Minnow										x
Bowfin	x	x	x		x	x	x	x	x	x
Brook Silverside										x
Brown Bullhead			x	x	x			x	x	x
Brown Trout				x				x		x
Bullhead spp.		x								
Channel Catfish		x	x	x	x		x	x	x	x
Cetnral Mudminnow									x	
Coho Salmon				x						x
Common Carp		x					x	x	x	x
Common Shiner								x		
Emerald Shiner										x
Flathead Catfish		x								
Freshwater Drum	x	x					x		x	x
Golden Redhorse										x
Golden Shiner				x	x	x		x	x	x
Gizzard Shad		x	x		x	x	x	x	x	x
Hybrid Sunfish										x
Johnny Darter								x		
Lake Sturgeon										x
Lake Trout				x						
Largemouth Bass	x	x	x			x	x	x	x	x
Longnose Gar		x						x	x	
Northern Pike		x	x		x		x	x	x	x
Mimic Shiner										x
Pumpkinseed		x	x			x	x	x	x	x
Quillback								x	x	x
Rainbow Trout				x				x		
Redhorse spp.		x	x	x	x	x	x	x	x	
Rock Bass		x	x		x	x	x	x	x	x
Round Goby									x	x
Sand Shiner										x
Shorthead Redhorse										x
Silver Redhorse										x
Smallmouth Bass	x	x	x		x	x	x	x		x
Spottail Shiner								x	x	x
Trout-perch										x
Walleye		x					x	x	x	x
Warmouth									x	
White Bass	x	x						x		
White Perch									x	x
White Sucker		x	x	x				x	x	x
Yellow Bullhead			x						x	x
Yellow Perch	x	x	x	x	x	x	x	x	x	x

Table 4. Number, weight, and length of fish collected from White Lake, Muskegon County, with trap nets, inland gillnets, seining, and electrofishing , June 2007.

Species	Number	Percent by number	Weight (pounds)	Percent by weight	Length range (inches)[1]	Average length	Percent legal size[2]
Alewife	92	4.6	5.9	0.4	4-7	6.2	
Black Bullhead	1	0.1	0.6	0.0	10-10	10.5	100 (7")
Black Crappie	22	1.1	4.0	0.3	5-11	6.5	14 (7")
Bluegill	768	38.7	113.1	8.4	4-7	5.9	46 (6")
Bowfin	27	1.4	178.4	13.2	22-33	26.4	
Brown Bullhead	88	4.4	66.3	4.9	7-13	11.7	100 (7")
Common Carp	7	0.4	74.3	5.5	22-30	28.5	
Channel Catfish	12	0.6	59.4	4.4	14-36	22.6	100 (12")
Freshwater Drum	6	0.3	26.3	2.0	11-28	19.2	
Golden Shiner	1	0.1	0.1	0.0	5-5	5.5	
Gizzard Shad	41	2.1	57.7	4.3	10-20	14.8	
Largemouth Bass	40	2.0	46.7	3.5	1-18	11.4	45 (14")
Longnose Gar	35	1.8	109.6	8.1	24-40	31.5	
Northern Pike	28	1.4	124.5	9.2	18-35	26.4	68 (24")
Pumpkinseed	199	10.0	37.0	2.7	3-7	6.0	55 (6")
Quillback	1	0.1	3.9	0.3	20-20	20.5	
Redhorse spp.	147	7.4	233.2	17.3	2-26	15.9	
Rock Bass	112	5.6	28.1	2.1	3-9	6.8	65 (6")
Round Goby	28	1.4	0.0	0.0	1-3	2.5	
Spottail Shiner	60	3.0	0.1	0.0	0-4	2.1	
Walleye	54	2.7	73.9	5.5	9-26	14.8	24 (15")
White Perch	41	2.1	12.4	0.9	6-12	8.0	46 (7")
White Sucker	8	0.4	14.9	1.1	8-19	16.0	
Yellow Bullhead	97	4.9	70.0	5.2	8-14	11.5	100 (7")
Yellow Perch	72	3.6	7.9	0.6	1-12	5.6	22 (7")
Total	1,987	100	1348.3	100			

[1]Note some fish were measured to 0.1 inch, others to inch group: e.g., "5"=5.0 to 5.9 inch, "12"=12.0 to 12.9 inches; etc.

[2]Percent legal size or acceptable size for angling. Legal size or acceptable size for angling is given in parentheses.

Table 5. Length frequency distribution for fish species caught from White Lake, Muskegon County, with trap nets, inland gillnets, seining, and electrofishing, June 2007.

Inch Class	Alewife	Black Bullhead	Black Crappie	Bluegill	Bowfin	Brown Bullhead	Common Carp	Channel Catfish	Fresh-water Drum
1									
2									
3									
4	2			31					
5	37		11	387					
6	39		8	331					
7	14		1	19		1			
8									
9						3			
10		1				12			
11			2			38			2
12						31			
13						3			
14								1	
15								1	
16								1	
17									1
18								1	
19								2	
20									
21								1	1
22					2		1		
23								1	
24					4				1
25					8			1	
26					4				
27					6				
28					1		1		1
29							4	1	
30							1	1	
31									
32					1				
33					1				
34									
35									
36								1	
38									
39									
40									
Total	92	1	22	768	27	88	7	12	6

Table 5, continued

Golden Shiner	Gizzard Shad	Large-mouth Bass	Long-nose Gar	Northern Pike	Pumpkin-seed	Quill-back	Redhorse spp.	Rock Bass	Round Goby
		6							5
							1		18
					2			1	5
					21			9	
1					67			29	
					93			14	
		2			16			42	
		1						16	
		3					3	1	
	4	4					2		
	11	2					4		
	3	1					20		
		3					15		
	1	10					14		
	5	3					18		
	4	1					14		
	3	3					23		
	5	1		1			13		
	4						8		
	1			1		1	2		
				2			3		
				2			4		
				3			1		
			1	4					
			3				1		
			2	5			1		
			3						
			6	1					
				3					
			4	2					
			1	2					
			2						
				1					
			8	1					
			2						
			1						
			1						
			1						
1	41	40	35	28	199	1	147	112	28

Table 5, continued

Spottail Shiner	Walleye	White Perch	White Sucker	Yellow Perch	Yellow Bullhead
3				2	
54					
1				4	
2				37	
				4	
		22		9	
		6		6	
		3	1	4	1
	2	1		3	8
	1	1		1	21
	7	7	1	1	39
	14	1		1	20
	9				7
	8		1		1
	3				
	1				
			1		
			2		
			2		
	2				
	1				
	1				
	1				
	1				
	3				
60	54	41	8	72	97

Table 6. Average total weighted length (inches) at age, and growth relative to the state average, for fish sampled from White Lake, Muskegon County, with trap nets, inland gill nets, seining, and electrofishing, June 2007. Number of fish aged is given in parenthesis. A minimum of five fish per age group is statistically necessary for calculating a Mean Growth Index, which is a comparison to the State of Michigan average.

	Age												Mean Growth
Species	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Index
Black Crappie		5.9	6.1				11.8	11.6					-0.6
		(15)	(4)				(1)	(1)					
Bluegill			4.7	5.2	5.9	6.5	7.2	7.2	7.6				-1.0
			(2)	(7)	(16)	(11)	(4)	(1)	(1)				
Largemouth		8.5	10.4	10.8	14.1	14.7		15.1		17.4	18.6		-1.0
Bass		(3)	(7)	(4)	(4)	(7)		(6)		(2)	(1)		
Northern Pike				22.1	22.7	27.5	28.4	35.1					-1.8
				(1)	(10)	(9)	(6)	(2)					
Pumpkinseed		3.8	4.4	4.6	5.8	6.1	6.5	6.4					-0.7
		(3)	(6)	(2)	(12)	(7)	(11)	(3)					
Rock Bass		4.3	5.2	6.5	7.1	7.7	8.1	8.4					-0.3
		(4)	(12)	(9)	(9)	(7)	(5)	(3)					
Walleye		11.4	13.3	13.0		15.1	20.4		22.1	21.6	26.0	26.2	-2.6
		(13)	(1)	(21)		(10)	(1)		(2)	(2)	(3)	(1)	
White Perch*	6.0	6.6	8.1		11.4	11.7							--
	(1)	(13)	(6)		(5)	(1)							
Yellow Perch		4.7	5.5	9.1	8.4	8.2	8.1	11.1					-1.2
		(18)	(11)	(2)	(4)	(4)	(1)	(3)					

*No State of Michigan average growth rates have been developed for White Perch.

Table 7. Shoreline data for White Lake, Muskegon County, compared with that for other large, deep depth lakes in Michigan (from Wehrly et al. 2015). Sampling was conducted by MDNR Fisheries personnel on August 21, 2007, and on August 1, 2023.

	Total docks per km	Dwellings per km	Percent shoreline armoring	Submerged trees per km
White Lake 2007	12.3	18.9	43.7	12.4
White Lake 2023	15.4	16.4	51.3	11.3
Michigan statewide average for large, deep depth inland lakes	4.3	9.2	24.2	8.4

Table 8. Results of fall electrofishing surveys conducted on White Lake targeting juvenile Walleye. The surveys were conducted according to protocols described by Ziegler and Schneider (2000). Asterisk indicates a stocked year-class.

Year survey was conducted	Age 0 Walleye #/mile of electrofishing	Age 1 Walleye #/mile of electrofishing
1999*	2	0.2
2000*	4	2.7
2001*	7.2	3.2
2003*	0	0
2005*	55.2	0
2006	0	20
2007	0	0
2008	0.2	0
2009*	0.2	0
2011*	18.7	0
2012	0	1
2013*	8.4	0
2015*	5.8	0.3
2016*	1.5	0.8
2017*	0	0
2019*	0	0
2022*	Incomplete	Incomplete
Average:	6.5	1.8

Table 9. Number, weight, and length of fish collected from White Lake, Muskegon County, with trap nets, large mesh fyke nets, small mesh fyke nets, inland gill nets, seining, and electrofishing, May 15- June 28, 2023.

Species	Number	Percent by number	Weight (pounds)	Percent by weight	Length range (inches)[1]	Average length	Percent legal size[2]
Alewife	14	0.5	0.5	0.0	4-7	5.1	
Banded Killifish	35	1.3	0.3	0.0	1-3	2.7	
Black Crappie	8	0.3	4.8	0.3	6-11	10.0	100 (7")
Bluegill	588	21.0	129.1	8.4	2-8	6.7	84 (6")
Bluntnose Minnow	5	0.2	0.1	0.0	2-3	2.9	
Bowfin	36	1.3	161.1	10.5	18-28	23.1	
Brook Silverside	1	0.0	0.0	0.0	3-3	3.5	
Brown Bullhead	78	2.8	66.6	4.3	10-13	12.2	100 (7")
Brown Trout	4	0.1	0.3	0.0	2-8	4.0	0 (10")
Channel Catfish	16	0.6	114.4	7.5	16-33	27.0	100 (12")
Coho Salmon	1	0.0	0.0	0.0	2-2	2.5	0 (10")
Common Carp	1	0.0	4.7	0.3	21-21	21.5	
Emerald Shiner	1	0.0	0.0	0.0	2-2	2.5	
Freshwater Drum	14	0.5	52.7	3.4	12-28	18.4	
Golden Redhorse	42	1.5	47.5	3.1	8-19	13.7	
Golden Shiner	1	0.0	0.2	0.0	8-8	8.5	
Gizzard Shad	2	0.1	2.6	0.2	14-15	15.0	
Hybrid Sunfish	2	0.1	0.4	0.0	4-7	6.0	50 (6")
Lake Sturgeon	1	0.0	1.3	0.1	18-18	18.5	
Largemouth Bass	216	7.7	106.3	6.9	1-20	5.3	19 (14")
Mimic Shiner	8	0.3	0.0	0.0	1-2	2.4	
Northern Pike	39	1.4	145.4	9.5	12-31	24.8	64 (24")
Pumpkinseed	478	17.1	156.4	10.2	3-8	7.2	94 (6")
Quillback	18	0.6	68.6	4.5	17-22	20.3	
Rock Bass	139	5.0	35.7	2.3	3-10	6.7	63 (6")
Round Goby	39	1.4	0.0	0.0	1-4	2.6	
Sand Shiner	85	3.0	0.4	0.0	1-3	2.4	
Shorthead Redhorse	13	0.5	32.8	2.1	15-20	18.4	
Silver Redhorse	17	0.6	59.4	3.9	16-26	21.9	
Smallmouth Bass	1	0.0	2.8	0.2	17-17	17.5	100 (14")
Spottail Shiner	193	6.9	0.3	0.0	1-3	1.6	
Trout-perch	3	0.1	0.0	0.0	1-1	1.5	
Walleye	9	0.3	26.2	1.7	6-27	17.7	67 (15")
White Perch	69	2.0	20.6	1.3	6-11	8.4	90 (7")
White Sucker	62	2.2	120.2	7.8	8-21	16.2	
Yellow Bullhead	89	3.2	65.8	4.3	5-14	11.5	99 (7")
Yellow Perch	467	16.7	107.0	7.0	3-12	7.8	61 (7")
Total	2,795	100	1534.5	100			

[1]Note some fish were measured to 0.1 inch, others to inch group: e.g., "5"=5.0 to 5.9 inch, "12"=12.0 to 12.9 inches, etc.

[2]Percent legal size or acceptable size for angling. Legal size or acceptable size for angling is given in parentheses.

Table 10. Length frequency distribution for fish species caught from White Lake, Muskegon County with trap nets, fyke nets, inland gillnets, seining, and electrofishing, May and June 2023.

Inch Class	Alewife	Banded Killifish	Black Crappie	Bluegill	Bluntnose Minnow	Bowfin	Brook Silverside	Brown Bullhead	Brown Trout
1		3							
2		22		4	3				3
3		10		3	2		1		
4	8			20					
5	5			68					
6			1	266					
7	1			210					
8				17					1
9			3						
10			1					6	
11			3					19	
12								44	
13								9	
14									
15									
16									
17									
18						2			
19						1			
20						5			
21						6			
22						4			
23						7			
24						2			
25						4			
26						2			
27						2			
28						1			
29									
30									
31									
32									
33									
34									
35									
36									
38									
39									
40									
Total	14	35	8	588	5	36	1	78	4

Table 10, continued

Common Carp	Coho Salmon	Emerald Shiner	Fresh-water Drum	Golden Redhorse	Golden Shiner	Gizzard Shad	Hybrid Sunfish	Lake Sturgeon	Large-mouth Bass
									151
	1	1							
									1
							1		1
							1		1
				8	1				1
				10					2
									5
			3						5
			3	1					9
				6		1			11
				3		1			17
			2	1					9
				5					
				4				1	1
				4					1
									1
1			2						
			1						
			1						
			1						
			1						
1	1	1	14	42	1	2	2	1	216

Table 10, continued

Mimic Shiner	Northern Pike	Pumpkin-seed	Quill-back	Rock Bass	Round Goby	Sand Shiner	Shorthead Redhorse	Silver Redhorse
1					2	12		
7					33	72		
		3		3	3	1		
		5		7	1			
		23		41				
		107		25				
		297		37				
		43		18				
				7				
				1				
	2							
	1							
							1	
							1	2
			1				4	1
			1				1	1
			6				4	
	1		6				2	3
	5		2					2
	2		2					1
	3							
	5							3
	3							3
	2							1
	5							
	3							
	4							
	2							
	1							
8	39	478	18	139	39	85	13	17

Table 10, continued

Smallmouth Bass	Spottail Shiner	Trout-Perch	Walleye	White Perch	White Sucker	Yellow Bullhead	Yellow Perch
	181	3					
	6						
	6						8
							10
						1	59
			1	7			107
				15		1	79
			1	31	2	1	103
			1	13	2	7	49
				2	5	14	26
				1	4	29	20
					2	30	6
					4	5	
					2	1	
			1		4		
			1		5		
1					7		
					5		
					8		
					10		
					2		
			1				
			1				
			2				
1	193	3	9	69	62	89	467

Table 11. Average total weighted length (inches) at age, and growth relative to the state average, for fish sampled from White Lake with trap nets, large mesh fyke nets, small mesh fyke nets, inland gill nets, electrofishing, and seining, May 15-June 28, 2023. Number of fish aged is given in parenthesis. A minimum of five fish per age group is statistically necessary for calculating a Mean Growth Index, which is a comparison to the State of Michigan average.

	Age											Mean Growth
Species	I	II	III	IV	V	VI	VII	VIII	IX	X	XV	Index
Black Crappie		6.8	9.8	10.5	11.6							--
		(1)	(3)	(2)	(2)							
Bluegill		4.2	5.4	6.7	7.2	7.3	7.6	8.2	8.8	8.5		+0.1
		(1)	(31)	(18)	(10)	(2)	(5)	(1)	(1)	(1)		
Largemouth Bass	4.8	8.2	11.0	12.9	13.7	15.5	15.7	16.9	19.0		20.1	+0.2
	(1)	(2)	(6)	(7)	(15)	(18)	(12)	(1)	(1)		(1)	
Northern Pike	13.0	20.9	22.3	25.6	27.9	28.4						+1.6
	(4)	(2)	(4)	(20)	(9)	(2)						
Pumpkinseed		4.3	5.5	7.2	7.4	8.3						+0.7
		(5)	(19)	(18)	(17)	(4)						
Smallmouth Bass					17.2							--
					(1)							
Walleye	(8.3)			15.2	16.2		22.9	25.3	27.8	27.3		--
	(3)			(1)	(1)		(1)	(1)	(1)	(1)		
Yellow Perch	4.2	5.3	6.5	7.5	9.0	10.9	11.7	12.1				+0.1
	(9)	(9)	(14)	(16)	(21)	(14)	(4)	(3)				

Table 12. Temperature and dissolved oxygen profile for White Lake, Muskegon County, on 8/1/2023.

Depth (feet)	Temperature (F)	O2 (ppm)
0	77.7	9.61
3	77.0	9.63
6	76.9	9.57
9	76.5	9.41
12	76.4	9.23
15	76.3	9.04
18	74.7	6.54
21	71.8	5.15
24	68.1	4.49
27	63.9	2.88
30	62.9	0.00
33	60.8	0.00
36	59.6	0.00
42	57.1	0.00
45	56.9	0.00
48	56.9	0.00
51	56.6	0.00
54	56.5	0.00
57	56.4	0.00
60	56.3	0.00

Table 13. White Lake Bluegill size structure rating using the Schneider Index (Schneider 1990). Schneider Index rankings are as follows: 1 = very poor, 2 = poor, 3 = acceptable, 4 = satisfactory, 5 = good, 6 = excellent, 7 = superior.

Year Surveyed	Trap net/large mesh fyke net catch average length (in.)	%>6 in.	%>7 in.	%>8 in.	Growth Index	Schneider Index
2007 Metrics	5.4	46.0	2.4	0.0	-1.1	
2007 Rankings	2	3	2	1	1	1.8 (Very Poor)
2023 Metrics	6.8	89.8	41.7	3.1	+0.1	
2023 Rankings	5	6	5	5	4	5 (Good)