Manistee Lake

Manistee County; 21N, 16W, 17W, Sections 1, 12, 13, 6, 7, 17, 18, 19, 20
Manistee River Watershed; last surveyed May, 2008

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Environment

Manistee Lake (Figure 1) is located in Manistee County, Michigan, in the northwestern Lower Peninsula. It is classified as a drowned river mouth lake due to its proximity to Lake Michigan and its location at the downstream end of the Manistee and Little Manistee Rivers. Manistee Lake serves as the confluence for the 2052.5 square mile Manistee River watershed (Grant 1977) and the 227 square mile Little Manistee River watershed (Wicklund and Dean 1957). Manistee Lake drains into the Manistee Harbor of Lake Michigan via a 1.5 mile-long channel. The channel is routinely dredged to allow for freighter traffic, as is Manistee Lake from the channel outlet to the T. E. S. Filer City Station coal-fired power plant.

Manistee Lake is approximately five miles in length and ½ mile wide or less in most spots, although some discrepancies exist about its total size. According to Taube (1958) Manistee Lake is 930 acres in size; while Grant (1977) states that its size is 929 acres. Other sources state that Manistee Lake is as large as 1,062 acres. These discrepancies most likely occur because the size of Manistee Lake increases and decreases based on the rise and fall of Lake Michigan water levels. Although a contour map of Manistee Lake is not available, most of its waters are deeper than 15 feet, with a maximum depth of about 50 feet. The southern and northern ends of the lake are mostly shallow while the long, narrow, middle portion is the deepest.

Two significant river systems enter Manistee Lake; the Manistee River in the northeastern portion and the Little Manistee River at the south end. The Manistee River watershed is predominantly forested, with both deciduous and coniferous forests present (Rozich 1998). Agriculture is another common land use in the Manistee River watershed, but much of the agriculture is in the form of Christmas tree plantations. The Little Manistee River watershed is also heavily forested, with more than half of the watershed land in public ownership, either by the State of Michigan as State forest land or by the U. S. Department of Agriculture as the Manistee National Forest (Tonello 2005).

Soils in the Manistee Lake area are typically sandy, consisting of Grayling, Graycalm, Rubicon, and Kalkaska type soils, although in the wetland areas around Manistee Lake wetland complex soils are likely present, including mucks, organics, sands, clay, and loams.

The Manistee Lake shoreline is predominantly developed with heavy industry. Development started in the mid-1800s with the establishment of the City of Manistee and the village of Eastlake (located along the eastern shore) and the villages of Filer City and Stronach (located on the southern shore) when the Manistee and Little Manistee River watersheds were being logged. The destination for many of the harvested logs was Manistee Lake. According to Manisteedowntown.com (accessed 12/3/10), in 1885 there were 40 different sawmills operating near the City of Manistee. Presumably, most of these would have been on Manistee Lake. Forest products are still processed on the shores of Manistee Lake at the Packaging Corporation of America (PCA) plant on the south end of Manistee Lake near Stronach. Salt

mining began in the City of Manistee in the 1880s, and there are currently two salt production plants on the shores of Manistee Lake. Other industries currently on Manistee Lake include a Martin Marrietta magnesia chemicals plant, the T. E. S. Filer City Station coal-fired power plant, operated by the Tondu Corporation, and the Manistee Drop Forge Corporation. The Martin Marrietta plant is on the eastern shore of Manistee Lake just south of Eastlake, while the T.E.S Filer City Station power plant, the salt production facilities, and Manistee Drop Forge are all located on the western shore. Development along the northwestern shore of Manistee Lake consists of marinas and condominium developments.

Due to its industrialized nature, Manistee Lake has a history of degraded water quality in certain areas. Historic fish kills have been documented in Manistee Lake, with the most serious in 1950 (Taube 1958). These fish kills were likely the result of dissolved oxygen depletion resulting from point-source pollution. According to Rediske et al. (2001), Manistee Lake contains a variety of sedimentary pollutants, including polycyclic aromatic hydrocarbons (PAH) and other oils, brines, and resin acids. A historic Superfund site (a Federal designation prioritizing funds and resources to clean-up and control a hazardous waste site) was located in the southeastern end of the lake near PCA. Kraft black liquor (toxic byproduct of wood pulp production) was discharged into Manistee Lake via contaminated groundwater. By 1993, it was determined that most of the black liquor had already vented to Manistee Lake through groundwater (USEPA 1993). No further remedial action was recommended at the site, although long term monitoring continues.

There are also a number of locations around Manistee Lake where groundwater that is contaminated with brine is discharging into the lake. According to Suppnick (2000), a number of samples taken in a 1999 water quality survey of Manistee Lake did not meet the minimum standards for a coldwater lake. The water quality of Manistee Lake is also threatened by groundwater that is contaminated with the following substances: arsenic, mercury and other heavy metals, and petroleum compounds (Nick Swiger, Michigan Department of Environmental Quality [DEQ], personal communication). The result of the contaminated groundwater discharging to the lake is that much of Manistee Lake is "characterized by depauperate benthic communities and sediments impacted by the presence of oils and PAHs" (Rediske et al. 2001). The areas off the mouths of the Manistee and Little Manistee Rivers are not as adversely affected by the anthropogenic contaminants as are other areas of the lake, primarily due to the dilution and cleansing effects provided by the flows of the rivers.

According to the Michigan Department of Community Health (MDCH 2010), black crappie, bluegill, largemouth bass, smallmouth bass, and walleye from Manistee Lake all have consumption restrictions, due to mercury and PCB (Polychlorinated Biphenyl) contamination. For women and children under 15 years old, MDCH recommends eating only one meal per month of black crappie larger than 8 inches, largemouth and smallmouth bass larger than 14 inches, and walleye larger than 15 inches; and only one meal per week of bluegill larger than 6 inches and black crappie between 6 and 8 inches in length. For the general population, MDCH recommends eating only one meal per week of black crappie larger than 8 inches, largemouth and smallmouth bass larger than 14 inches, and walleye larger than 15 inches in length.

Despite the fact that large portions of the Manistee Lake shoreline are heavily developed, some areas of natural riparian wetlands remain intact, including large cattail marshes located near the inlets of both the Manistee and Little Manistee Rivers. The Manistee State Game Area (MSGA), just upstream of

Manistee Lake on the Manistee River consists of 6,237 acres of state-owned land (Earle 2003), much of which is emergent wetland. Also located within the MSGA is Peter's Bayou, which is a diked area adjacent to Manistee Lake that can be filled with water to allow for waterfowl nesting in the spring and waterfowl hunting in the fall.

There are four public access sites (all have boat launches) on Manistee Lake and one on the channel just upstream from Lake Michigan (Figure 2). Two of the access sites have recently been upgraded through the efforts of the Manistee County Community Foundation "Explore the Shores" program; one on the south end of the lake in Stronach (maintained by the Michigan Department of Natural Resources [DNR]) and the other on Arthur Street in Manistee (maintained by the City of Manistee). Universally accessible fishing piers have been added at both locations, along with upgrades to the boat launches and restroom facilities. The 9th Street access site is on property owned by T. E. S. Filer near the power plant and leased to the City of Manistee. The Eastlake Village Park access site (which includes a campground) is located on the eastern shore of Manistee Lake. The First Street access site, on the channel just upstream from Manistee Harbor and Lake Michigan, is a large City of Manistee operated facility designed to handle heavy traffic and is used mostly by Lake Michigan boaters and anglers. A total of 16 launch ramps, parking for nearly 300 vehicles, and a fish cleaning station are available at this site.

Manistee Lake is managed by the DNR as a Type F trout lake. It is open to year-round fishing with a year-round possession season for all trout and salmon species, except for lake trout, which may only be possessed from May 1 through Labor Day. The size limit for all trout and salmon species is 10 inches.

History

Manistee Lake is somewhat unique among Michigan lakes in that according to DNR records, it has never been stocked with fish. Its tributaries, the Manistee River (Tonello 2004) and the Little Manistee River (Tonello 2005) have been heavily stocked with fish (particularly migratory salmonids) over the years. Manistee Lake anglers benefit from these stocking efforts, as many adult salmon and steelhead move through Manistee Lake as they ascend the Manistee and Little Manistee Rivers for their annual spawning runs. Additionally, the Manistee harbor area has been routinely stocked, particularly with brown trout in recent years. It is likely that the stocked brown trout also inhabit Manistee Lake at certain times of the year.

The first known fisheries survey of Manistee Lake was conducted in 1957 (Taube 1958). The survey had two efforts. The first effort was conducted in June and was an attempt to determine whether or not rainbow trout, which had recently been stocked upstream in the Manistee and Little Manistee Rivers, were entering Manistee Lake en route to Lake Michigan. Gill nets and seines were set off the mouths of the Manistee and Little Manistee Rivers to collect fish. At that time, it was suspected that smolting rainbow trout were not entering Manistee Lake because of the pollution there. The second effort of the 1957 survey was conducted in late August, and was a routine fisheries inventory of the lake using gill nets set throughout the lake.

In the June 1957 survey effort, a total of 706 fish were collected, including 388 alewives (5.6-10.1 inches), 159 yellow perch (5.6 to 9.9 inches), 49 rock bass (3.3 to 8.5 inches), 36 pumpkinseed sunfish (3.3 to 6.8 inches), 11 black crappie (5.0 to 9.4 inches), 11 white suckers (6.4 to 13.6 inches), 10

northern pike (13.1 to 29.1 inches), 9 redhorse (6.2 to 18.7 inches), 8 rainbow trout (6.9 to 9.4 inches), 6 bowfin (18.5 to 27.0 inches), one brown trout (22.9 inches), one brown bullhead (11.8 inches), one carp (10.3 inches), and one common shiner (5.9 inches).

In the August 1957 survey effort a total of 349 fish were collected, including 140 bluegill (3.8 to 8.6 inches) 55 yellow perch (5.6 to 9.9 inches), 38 rock bass (3.6 to 9.3 inches), 31 pumpkinseed sunfish (4.1 to 6.8 inches), 25 redhorse (11.6 to 18.6 inches), 18 northern pike (14.5 to 30.6 inches), 12 hybrid bluegill (4.5-7.1 inches), 7 black crappie (4.8 to 10.3 inches), 5 white suckers (13.0 to 18.5 inches), 4 walleye (14.3 to 21.5 inches), 4 smallmouth bass (9.9 to 13.5 inches), 3 bowfin (19.6 to 29.3 inches), 3 largemouth bass (10.0 to 13.5 inches), 2 brown bullhead (10.7 to 12.8 inches), and 1 yellow bullhead (9.6 inches). Forage species noted, but not counted, were bluntnose minnow and banded killifish.

Other species that were noted as being present in Manistee Lake during the 1957 surveys included lake herring, rainbow smelt, muskellunge, white bass, warmouth, sea lamprey, emerald shiner, common shiner, brook silverside, and Johnny darter.

According to Taube (1958), the U. S. Fish and Wildlife Service operated a weir in the Little Manistee River for the purpose of blocking sea lamprey during the spring and summer of 1958. It was located less than ¼ mile upstream of Manistee Lake, and captured fish swimming upstream. Many different fish species were captured at the weir. Species that had not been seen in the 1957 surveys but were captured at the weir included brook trout, longnose sucker, logperch, creek chub, sculpin, golden shiner, rainbow smelt, and central mudminnow.

A DNR fisheries survey of Manistee Lake was conducted in 1970. It was a four-hour boomshocker run, with the goal of collecting fish to be analyzed for a mercury contamination study. In the 1970 survey, a total of 97 fish were collected, representing 13 different species. Bluegill, pumpkinseed sunfish, walleye, alewife, and rock bass were the most commonly collected species. The walleye catch in particular was notable, with 14 fish collected, all larger than 16 inches. Gizzard shad were also collected in the 1970 survey. This was the first documentation of gizzard shad in Manistee Lake.

From the late 1990s through the mid-2000s, fisheries surveys were conducted on Manistee Lake by Central Michigan University (CMU) graduate students attempting to enumerate and study the lake sturgeon population of Manistee Lake and the lower Manistee River (Gunderman 2001, Yeomans 2002, Lallaman 2003, and Damstra 2007). Lake sturgeon are listed as a threatened species in Michigan. Prior to this research, very little was known about the Manistee Lake/Manistee River lake sturgeon population. The CMU studies estimated spawning runs of less than 100 fish in each year, with the majority of fish in each run being males. Ages of lake sturgeon captured during the CMU studies ranged from age 0 to age 55, with 25 different year classes represented.

These studies documented that adult lake sturgeon use Manistee Lake as a staging area for spawning runs. Damstra (2007) also documented that non-spawning lake sturgeon inhabit Manistee Lake and that post-spawn adults also inhabit Manistee Lake. These facts, along with the presence of juvenile lake sturgeon in Manistee Lake, indicate that Manistee Lake is critical habitat for lake sturgeon. Lallaman (2003) and Damstra (2007) documented that lake sturgeon in Manistee Lake preferred the north basin of the lake near the mouth of the Manistee River. Damstra (2007) hypothesized that this was likely due to higher invertebrate densities and favorable temperature regimes. He also suggested

that pollution in Manistee Lake may play a role in habitat selection by lake sturgeon, although this was not directly studied.

Since 2004, Fisheries staff from the Little River Band of Ottawa Indians have operated a streamside lake sturgeon rearing facility on the Manistee River (Mann 2008). They collect either eggs or larvae from the Manistee River in the spring. The eggs or larvae are reared in the streamside facility until they are 8-10 inches in length, and released back into the Manistee River in the fall. It is hoped that this will give the lake sturgeon a better chance of survival to adulthood. This practice has the potential for enhancing the lake sturgeon population of Manistee Lake, the Manistee River, and Lake Michigan.

DNR file information indicates that creel surveys were conducted on Manistee Lake prior to 1957 (Taube 1958), but the data could not be located. An airplane count was conducted on April 6, 1968 and revealed 150 anglers and 46 boats, 32 of which were off the mouth of the Little Manistee River (Fisheries Division records). The most recent creel survey of Manistee Lake was conducted from 1999-2004 (Table 1). During the years of 1999-2001, the creel surveys took place from March through December. In those years, the most common species harvested were yellow perch, bluegill, pumpkinseed sunfish, black crappie, and rock bass. Chinook salmon and rainbow trout (steelhead) also had relatively high harvest estimates in some years. During the years of 2002-2004, the creel surveys took place from March through May, and from September through December. This resulted in lower harvest estimates for panfish species, while estimates for steelhead and Chinook salmon remained higher.

From 1994-2010, a total of 155 exceptional fish caught from Manistee Lake by anglers have been entered into the MDNR Fisheries Division Master Angler program (Table 2). Of those 155 fish, 22 different species were represented. Rock bass, channel catfish, freshwater drum, Chinook salmon, bluegill, and bowfin were the most commonly represented species, with at least ten entries per species. The large number of Master Angler entries for Manistee Lake exemplifies the quality of Manistee Lake fish populations and the popularity of Manistee Lake with anglers.

Current Status

The most recent comprehensive fisheries survey of Manistee Lake was conducted in 2008. Status and trends netting protocols (Wehrly et al. 2009) were used for the survey. The survey occurred from May 12 through May 15, 2008. Gear used included large-mesh fyke nets (9 net-nights), trap nets (9 net-nights), and experimental graded-mesh inland gill nets (9 net-nights). No small mesh netting, seining, or electrofishing took place, so smaller, forage species were not sampled in the 2008 survey. The purpose of the survey was to investigate the status of the fisheries community in the lake, since Manistee Lake had not been comprehensively surveyed since 1957 (Taube 1958).

During the 2008 survey, a total of 665 fish were collected, representing 20 different species (Table 3). Bluegill, rock bass, and yellow perch were the most frequently collected species. A total of 128 bluegill from 4.3 to 8.3 inches were collected, representing 18.3% of the catch by number. Of those, 84% exceeded 6 inches in length. A total of 157 rock bass ranging from 3.8 to 9.9 inches were collected, representing 22.5% of the catch by number. Sixty-eight percent of the rock bass were over 6 inches. A total of 109 yellow perch ranging from 5.5 to 12.2 inches were collected, representing 15.6 percent of the catch by number. Only 29% of the yellow perch were over 7 inches. Other panfish

species present in the catch included black crappie (31 collected from 6.3 to 12.0 inches) and pumpkinseed sunfish (71 collected from 3.9 to 7.5 inches).

Larger game fish species collected were largemouth bass, smallmouth bass, northern pike, and walleye (Table 3). A total of 19 largemouth bass were collected, from 7.0 to 17.2 inches. Nearly half of the largemouth bass were over 14 inches. Ten smallmouth bass from 9.1 to 17.6 inches were collected, with 5 of them exceeding 14 inches. Thirty-one northern pike were collected, ranging from 12.8 to 38.1 inches. Of those, 55% exceeded 24 inches. Northern pike comprised 23.3% of the total survey catch by weight. Walleye were represented in the catch by four individuals, ranging from 18.9 to 27.3 inches. Other game species present in the catch included brown trout (one fish, 8.7 inches) and rainbow trout (11 fish from 6 to 24 inches).

Other species collected in the 2008 survey (Table 3) included alewife, bowfin, brown bullhead, white sucker, gizzard shad, longnose gar, quillback, shorthead redhorse, and silver redhorse.

Panfish species collected in 2008 showed average growth (Table 4). Age-3 black crappie were growing 0.5 inches slower than the State of Michigan average length at age. Age-3, -6, and -7 bluegill were growing 0.4 inches slower than the state average. Age-3 through -7 pumpkinseed sunfish were growing 0.2 inches slower than the state average. Rock bass ages -3 through -8 were growing 0.7 inches slower than the state average. Yellow perch ages -3 through -5 were growing at the state average. Of the larger game fish species, only enough (more than five per age class) northern pike and largemouth bass from any one age class were collected to make statistical inferences regarding age and growth. Northern pike were growing exceptionally well, at 4.1 inches faster than the state average for fish aged -2 through -4. Largemouth bass aged -3 and -6 were growing 1.4 inches faster than the state average.

Species that had been reported in previous surveys or Master Angler records but were not collected in the 2008 survey included lake herring, channel catfish, common carp, flathead catfish, freshwater drum, Chinook salmon, coho salmon, brook trout, muskellunge, warmouth, white bass, sea lamprey, rainbow smelt, yellow bullhead, emerald shiner, common shiner, bluntnose minnow, banded killifish, brook silverside, and Johnny darter. Although muskellunge were not collected in the 2008 survey, one was captured by an angler fishing through the ice in February 2007. The muskellunge was tagged, and had been stocked in Sturgeon Bay, off the coast of Wisconsin, by the Wisconsin DNR. Although white bass were not collected in the 2008 survey, they were observed in Manistee Lake by DNR Fisheries personnel in Manistee Lake in the summer of 2010 (DNR files, Cadillac). Species that were collected in 2008 that had not been previously recorded for Manistee Lake included longnose gar and quillback. Although round gobies were not collected in the 2008 survey, it is highly likely that they are present in large numbers in Manistee Lake. They are commonly caught by anglers off the piers that form Manistee Harbor, and they have been found to be prominent members of the fish communities of other drowned rivermouth lakes in Michigan (DNR unpublished data).

Limnological data was not collected by DNR in the 2008 survey. However, limnological sampling of Manistee Lake was conducted by the U. S. Geological Survey (USGS) in August 2004 (USGS 2010, Table 5). In the August, 2004 USGS survey effort, secchi depth was measured at 8.9 feet, total phosphorus was measured at 24 and 18 micrograms/liter, and total nitrogen was measured at 400 and 300 micrograms/liter.

Analysis and Discussion

The 2008 DNR fisheries survey showed that Manistee Lake has healthy game fish populations. Although relatively few largemouth and smallmouth bass were collected in the 2008 survey, the populations appear to be well balanced, with multiple year classes represented and many individuals of both species exceeding the minimum legal-size limit of 14 inches. Another indicator of robust bass populations in Manistee Lake is the number of bass fishing tournaments that are held each summer on Manistee Lake. Northern pike in particular are numerous and are a keystone predator. The 31 individuals collected in the 2008 survey represented 6 different year classes and were growing extremely well. Also, Master Angler records indicate that Manistee Lake is capable of producing large, trophy-sized northern pike. Although only four walleye were collected in the 2008 survey, Manistee Lake has a reputation as providing a good walleye fishery, including fish of large, trophy size. It is likely that Manistee Lake walleye run into the Manistee River to spawn, and they may also migrate into Lake Michigan after spawning to forage. A shore fishery develops in late May and early April on the piers that form Manistee harbor, and many anglers troll Manistee Lake, the channel, the harbor, and the pierheads seeking large, post-spawn walleye. No walleye are stocked in Manistee Lake, so the fish present are either naturally reproduced or migrants from other areas. The excellent growth shown by predatory fish from Manistee Lake is likely due to the connection of Manistee Lake with Lake Michigan, and the plentiful forage that Lake Michigan provides in the form of alewives, rainbow smelt, and round goby, and juvenile salmonids migrating to Lake Michigan.

The panfish populations of Manistee Lake also appear to be healthy. Individuals were present in the catch of the 2008 survey from a number of different year classes, indicating consistent natural reproduction. Master Angler catches have been recorded in recent years for rock bass, black crappie, and bluegill. Although growth rates for panfish were not above State average, they are clearly good enough to provide good numbers of "catchable" panfish. Master Angler yellow perch have also been caught by anglers in recent years, although it is possible that they were migrants from Lake Michigan. It is well-known that yellow perch migrate into Manistee Lake from Lake Michigan, particularly during the winter in preparation for spawning.

One of the primary values of Manistee Lake from a fisheries perspective is its use as a staging ground for spawning runs by Chinook salmon, coho salmon, steelhead. Staging salmon and steelhead in Manistee Lake provide popular fisheries that generate many thousands of angler hours each year.

Manistee Lake also provides critical habitat for lake sturgeon, a state-threatened species. Adult lake sturgeon utilize Manistee Lake as a staging area for spawning runs, and both adults and juvenile lake sturgeon live and feed in Manistee Lake at different times of the year (Damstra 2007). The Manistee River/Manistee Lake population of lake sturgeon is one of the largest found on the eastern shore of Lake Michigan.

Although a complete limnological survey of Manistee Lake was not conducted in conjunction with this survey, limnological data is available from a number of other sources (Suppnick 2000; Rediske et al. 2001; USGS 2010 [Table 5]). The secchi depth reading from the 2004 USGS effort (USGS 2010) was 8.9 feet, indicating that Manistee Lake water at that time was slightly more clear than the average (7.9 feet) for medium, shallow lakes in Michigan (Wehrly et al. 2010). Total phosphorous readings for Manistee Lake (24 µg/liter at a depth of 3 feet and 18 µg/liter at a depth of 18 feet) were also about

average (22 µg/liter) for medium, shallow lakes in Michigan (Wehrly et al. 2010). Total nitrogen readings for Manistee Lake (400 µg/liter at 3 feet and 300 µg/liter at 18 feet) were somewhat below average (814 µg/liter) for medium, shallow lakes in Michigan (Wehrly et al. 2010).

Management Direction

Native species like smallmouth bass, largemouth bass, bluegill, pumpkinseed sunfish, black crappie, rock bass, northern pike, and walleye should continue to thrive in Manistee Lake. Another general netting survey should be conducted within the next 10 years with the goal of examining the general fish populations of Manistee Lake. In the next survey, electrofishing and seining should be included in order to learn about the smaller non-game and forage fish populations of Manistee Lake. Also, a full limnological sampling effort should be included in the next survey effort. Serns fall walleye electrofishing efforts should also be conducted on Manistee Lake. Although Manistee Lake is not stocked with walleye, such surveys can help determine the extent of walleye natural reproduction. Monitoring of the lake sturgeon population of Manistee Lake should also continue.

Past land-use practices and industries along the shores of Manistee Lake have degraded the water quality of certain areas of Manistee Lake. Major pollution issues remain in Manistee Lake, as is evidenced by the fish consumption advisory for Manistee Lake that was issued by the Michigan Department of Community Health (MDCH 2010). While industry is important to the local economy of the Manistee area, fishing is also an important component of that economy. In recent years, development along the shores of Manistee Lake has shifted from being purely industrial to residential/recreational. This is evidenced by the large number of condominiums that have been developed on the west shore of Manistee Lake. Therefore, it should be a goal for Manistee Lake to have healthy fish populations that can be consumed by the public without risk of PCB or mercury contamination.

All remaining riparian wetlands adjacent to Manistee Lake should be protected as they are critical to the continued health of the lake's aquatic community. Future unwise riparian development and wetland loss may result in deterioration of the water quality and aquatic habitat. Healthy biological communities in inland lakes require suitable natural habitat. Human development within the lake watershed, along the shoreline, and in the lake proper has a tendency to change and diminish natural habitat. Appropriate watershed management is necessary to sustain healthy biological communities, including fish, invertebrates, amphibians, reptiles, birds and aquatic mammals. Generally for lakes this includes maintenance of good water quality, especially for nutrients; preservation of natural shorelines, especially shore contours and vegetation; and preservation of bottom contours, vegetation, and wood structure within a lake. Guidelines for protecting fisheries habitat in inland lakes can be found in Fisheries Division Special Report 38 (O'Neal and Soulliere 2006).

The efforts of Manistee County's "Explore the Shores" program should be supported by the MDNR. These efforts have already enhanced the ability of anglers of all persuasions to access the outstanding fisheries that Manistee Lake has to offer. Hopefully these efforts will continue, and even more universal access will be provided in the future.

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Figure 1. Manistee Lake, Manistee County.

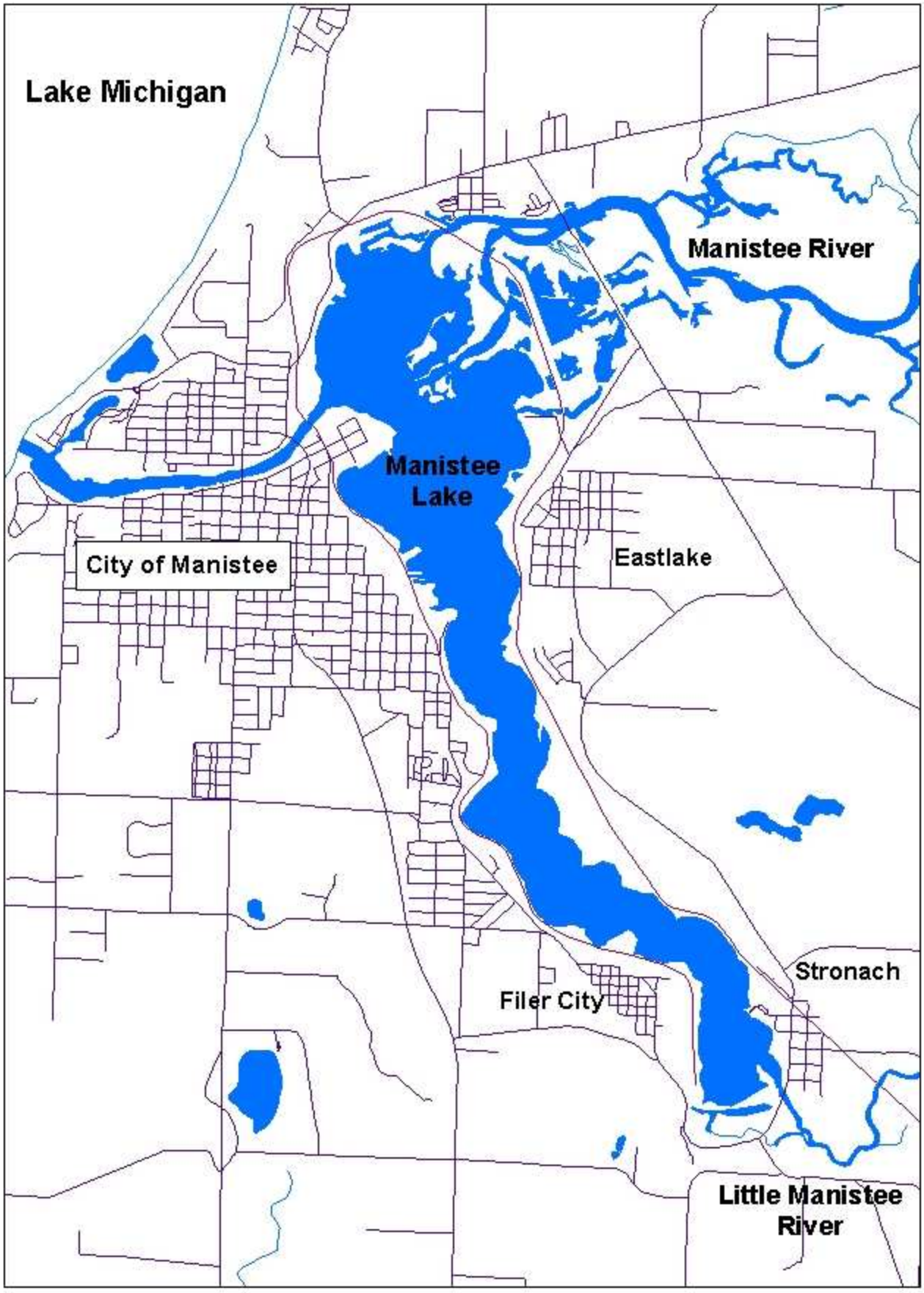

Figure 2. Public access boat launch facilities on Manistee Lake, Manistee County.

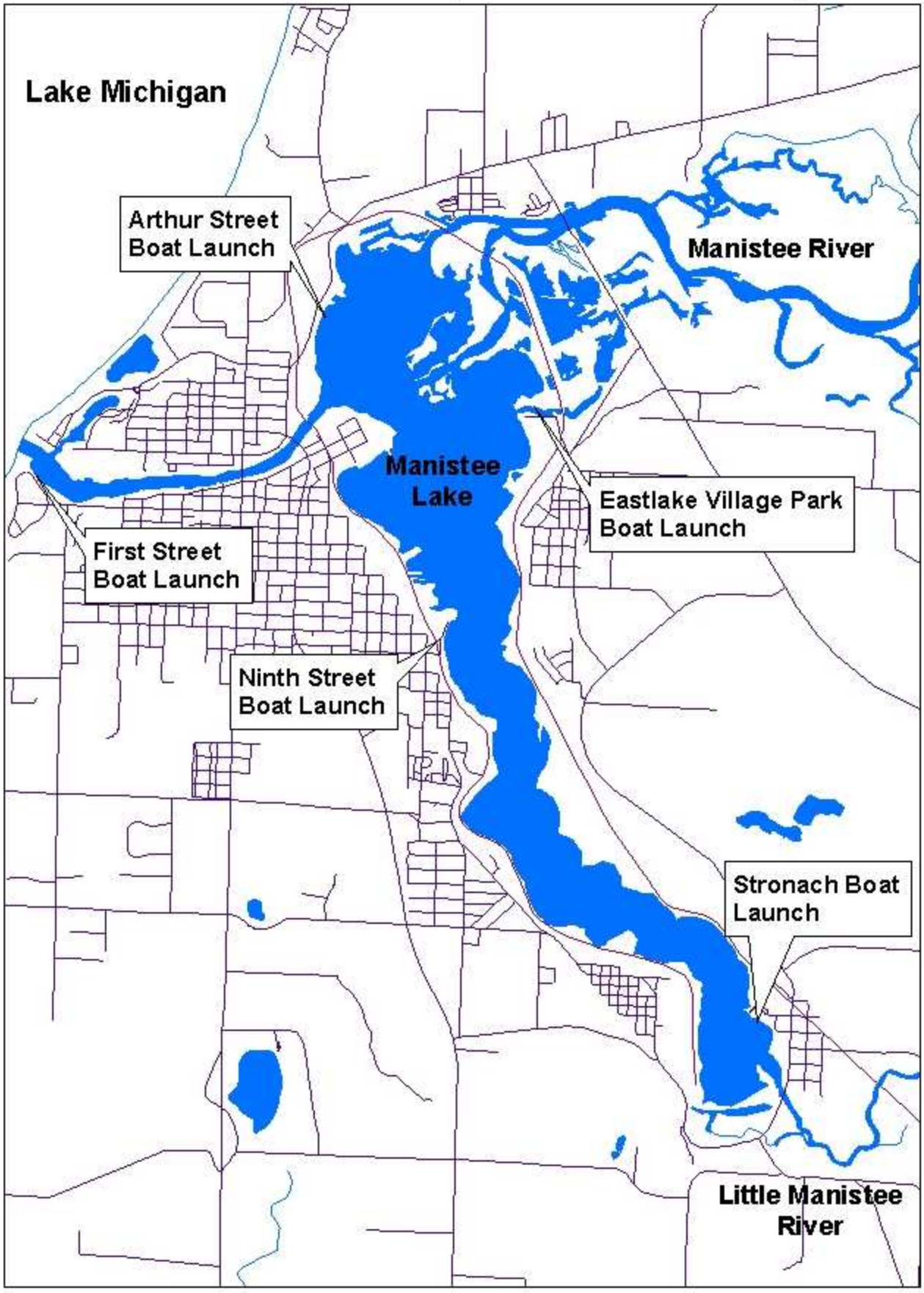

Table 1. MDNR creel census data for Manistee Lake, 1999-2004.

Year	Estimated Angler trips	Estimated angler days	Estimated angler hours
1999*	20,378	16,723	73,787
2000*	15,563	12,299	59,098
2001*	17,221	14,766	63,116
2002**	7,054	5,758	20,030
2003**	7,620	7,620	27,663
2004**	8,504	7,504	29,393

*The creel surveys in 1999-2001 took place from March through December.

**The creel surveys in 2002-2004 took place from March through May, and September through December.

Table 2. MDNR Master Angler awards issued for fish caught from Manistee Lake, Manistee County, 1994-2010.

Species	Number of Master Angler awards issued
Black crappie	5
Bluegill	12
Bowfin	10
Brook trout	1
Brown trout	1
Carp	5
Channel catfish	15
Chinook salmon	13
Coho salmon	5
Flathead catfish	4
Freshwater drum	14
Largemouth bass	2
Northern pike	3
Pumpkinseed sunfish	1
Rainbow trout	6
Redhorse	5
Rock bass	31
Smallmouth bass	2
Walleye	9
White bass	1
White sucker	7
Yellow perch	3
Total:	155

Table 3. Number, weight, and length of fish collected from Manistee Lake with fyke nets, trap nets, and inland gillnets, on May 13-15, 2008.

Species	Number	Percent by number	Weight (Pounds)	Percent by weight	Length range (inches)[1]	Average length	Percent legal size[2]
alewife	1	0.2	0.1	0.0	6-6	6.5	
black crappie	31	4.7	13.2	2.4	6-12	8.7	65 (7")
bluegill	128	19.2	27.5	5.0	4-8	6.7	84 (6")
brown trout	1	0.2	0.3	0.1	8-8	8.7	0 (10")
bowfin	19	2.9	117.8	21.5	20-31	25.6	
brown bullhead	11	1.7	4.8	0.9	7-12	9.5	
gizzard shad	17	2.6	23.8	4.3	12-19	15.2	
largemouth bass	19	2.9	25.2	4.6	7-17	13.1	42 (14")
longnose gar	3	0.5	5.7	1.0	16-31	26.2	
northern pike	31	4.7	127.4	23.3	12-38	25.3	55 (24")
pumpkinseed sunfish	71	10.7	14.2	2.6	3-7	6.1	65 (6")
quillback	3	0.5	4.9	0.9	12-16	15.2	
rainbow trout	11	1.7	7.5	1.4	6-24	10.0	9 (10")
rock bass	157	23.6	41.7	7.6	3-9	6.8	68 (6")
shorthead redhorse	4	0.6	5.3	1.0	13-17	14.8	
silver redhorse	18	2.7	30.5	5.6	7-24	16.1	
smallmouth bass	10	1.5	14.8	2.7	9-17	13.7	12 (14")
walleye	4	0.6	17.5	3.2	18-27	23.0	100 (15")
white sucker	17	2.6	49.1	9.0	12-22	19.1	
yellow perch	109	16.4	16.5	3.0	5-12	7.0	29 (7")
Total	665	100	547.8	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 4. Average total weighted length (inches) at age, and growth relative to the state average, for fish sampled from Manistee Lake with trap nets, fyke nets, and inland gill nets, May 13-15, 2008. 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											
Species	I	II	III	IV	V	VI	VII	VIII	IX	X	XIII	Mean Growth Index
Black crappie			7.0 (18)	8.8 (3)	10.2 (3)	11.2 (2)	11.4 (4)	12.0 (2)				-0.5
Bluegill			4.8 (5)	6.3 (3)	5.3 (4)	6.7 (15)	7.4 (12)	8.2 (2)	8.3 (1)			-0.4
Brown trout	8.7 (1)											
Largemouth bass		8.5 (1)	11.3 (5)	12.3 (4)		15.6 (5)	16.3 (3)					+1.4
Northern pike	11.7 (1)	20.2 (7)	24.6 (11)	29.3 (9)	29.1 (3)			38.1 (1)				+4.1
Pumpkinseed sunfish			4.3 (7)	5.3 (4)	6.1 (12)	6.4 (11)	7.2 (5)	7.4 (2)				-0.2
Rainbow trout	9.5 (2)	8.6 (2)	24.1 (1)									
Rock bass			4.5 (16)	5.2 (7)	6.2 (7)	7.1 (13)	7.9 (9)	8.5 (7)		9.3 (4)		-0.7
Smallmouth bass			10.6 (4)	13.8 (1)	15.7 (3)	16.5 (2)						
Walleye			19.3 (2)					26.9 (1)			27.3 (1)	
Yellow perch		5.7 (1)	6.5 (5)	7.0 (24)	8.2 (16)	10.7 (16)	11.5 (9)	12.9 (4)	13.0 (5)	14.1 (2)		+0.6

Table 5. Total phosphorous, total nitrogen, secchi depth, and chlorophyll for Manistee Lake, Manistee County. Sampling was conducted by the U. S. Geological Survey on August 11, 2004.

Depth (ft)	Total phosphorous µg/l	Total nitrogen µg/l	Chlorophyll A µg/l
3	24	400	
18	18	300	
22			4

Secchi depth = 8.9 feet