Manistee Lake
Kalkaska County, T27N, 28N, R6W, Sections 3, 27, 33, 34, 35
Manistee River Watershed, last surveyed 2014

Mark A. Tonello, Fisheries Management Biologist

Environment

Manistee Lake (Figure 1) is 860 acres and located eight miles northeast of Kalkaska, in Kalkaska County, Michigan, in the northwestern Lower Peninsula. Manistee Lake is located within the Central Lake Michigan Management Unit (CLMMU) of the Fisheries Division of the Michigan Department of Natural Resources (MDNR). The maximum depth of Manistee Lake is 18 feet, the average depth is 7 feet, and approximately 95% of the lake is shallower than 15 feet. The North Branch of the Manistee River originates from Manistee Lake, flowing out of the southern end (Figure 1); there is no lake-level control structure. The shoreline is about 80% developed, with approximately 300 homes and cottages (Groves 2013). There are several human-made canals connected to the lake on the south side near the outlet and near the northeast shore of the lake. The northwestern shoreline of the lake is undeveloped cedar swamp, with one small stream flowing into the lake. There are also several other very small, intermittent streams that flow into Manistee Lake. The surrounding country is hilly and mostly forested with hardwoods and conifers, with predominately sandy soils. According to Gomez (2007) Manistee Lake is a mesotrophic lake (based on Secchi disk readings); although in some years it has been characterized as slightly eutrophic.

Public access to Manistee Lake is available at a county-owned park with a boat launch on the southwestern corner. In addition, there are several road endings on the east side of the lake where it is possible to obtain access. A significant portion of the northwestern shoreline is owned by Camp Tanuga, a residential summer camp for children and families. There are also a number of rental cottages and several small resorts located on the lake.

Two citizen-based groups are active on Manistee Lake: the Manistee Lake Association and the Manistee Lake Improvement Board (established in 2005; Groves 2013). Both organizations are very involved in lake management. They spearhead the aquatic-macrophyte control program and provide educational programs for landowners regarding proper riparian land management practices. They also assist with water quality monitoring and have provided funding to the Au Sable Institute to pay for environmental studies conducted on the lake. They have also actively participated in the fisheries management of Manistee Lake by conducting a manual sucker removal project, in cooperation with the Au Sable Institute and MDNR Fisheries Division.

Eurasian milfoil (a nonnative invasive species) was first observed in Manistee Lake in 1996 (Richards 2003). Since that discovery, there has been an ongoing effort to manage Eurasian milfoil in the lake. Instead of using chemical herbicides or other common methods of treatment, the Manistee Lake Association has successfully used milfoil weevils to biologically control the infestation. Weevils were first stocked in 1999, and have been stocked in a number of years since, including 2000, 2001, 2007, and 2010-2012.

History

Stocking and fish community

The first recorded fish stocking event for Manistee Lake occurred in 1876 when lake whitefish were stocked by the Michigan Fish Commission (Table 1). While the effort was ultimately unsuccessful in establishing a lake whitefish population, it was the first effort in a long history of fish stocking in Manistee Lake. While many records from the early 20th century were lost in a fire in Lansing, there are some records that survived (Table 1). MDNR files (Cadillac office) refer to early stocking programs conducted by MDOC (Michigan Department of Conservation, the precursor to today's MDNR), including largemouth bass, smallmouth bass, walleye, yellow perch, and bluegill stocked before 1933. There is also discussion regarding a single stocking of lake trout fry (number unknown) in 1925. Walleye were first stocked in 1905, and have been frequently stocked since then. Walleye have been the only species stocked into Manistee Lake since 1939.

Smallmouth bass and walleye were reportedly not native to Manistee Lake and were established through stockings done in the early 1900s (Table, 1; Laarman and Schneider 1986). Black crappie are also absent from early fish community records for Manistee Lake (Table 2). Over time all three species became naturalized, important components of the fish community. Walleye reproduce naturally in certain years; this species was not stocked between 1946 and 1969, yet walleye populations in Manistee Lake were reportedly robust during that time (Taube 1956; Laarman 1980; Laarman and Schneider 1986). However, between 1969 and 1983, walleye reproduction was reportedly poor (Laarman 1980; Laarman and Schneider 1986), so stocking resumed periodically to provide a fishery.

Walleye stocking has had variable success, especially when fry were used in the early and mid- 1900s. The results of an intensive research project led the investigators to conclude that stocking with large fingerling walleyes would be most suitable (Laarman 1980; Laarman and Schneider 1986). However, due to the expense and inconsistency of rearing fall fingerling walleye, MDNR has stocked only spring fingerlings (Table 1) since 1983. The spring fingerling walleye stocking program for Manistee Lake has been successful in providing a robust walleye fishery, although naturally reproduced walleye also supplement the fishery (Tonello 1999, 2004, and 2008).

Other notable changes have taken place in the fish populations of Manistee Lake. Northern pike were originally reported to have been the dominant predator species (Laarman and Schneider 1986), until being replaced by walleye in the early part of the 20th century. White suckers, which were not reported until 1955 (Table 1), became a major component of the fish community, making up 35% of the total fish biomass by the 1970s (Laarman and Schneider 1986), and an even higher percentage in the 1990s (Fisheries Division files). Black crappie were also not observed in early surveys of the lake, but have been a prominent component of the fish community since the early 1970s (Table 1). Yellow perch were described as scarce in the 1970s, but became common in the 1980s, with many exceeding twelve inches (Laarman and Schneider 1986).

MDNR/MDOC Fisheries Surveys

The first known fisheries reports for Manistee Lake were written in the 1930s (Eschmeyer 1936; 1938). They detailed creel surveys that were conducted in the winter of 1936 (Eschmeyer 1936) and the summer of 1936 and the winter of 1937 (Eschmeyer 1938). The catch from both winters consisted

of only walleye and northern pike, while the summer catch included largemouth bass, smallmouth bass, bluegill, pumpkinseed sunfish, yellow perch, rock bass, and bullhead, in addition to walleye and northern pike (Table 2). The surveys also documented that 41% of the anglers surveyed were non-residents, suggesting the importance of the Manistee Lake fishery to the tourism industry of Kalkaska County at that time.

After the 1936-37 creel surveys, Manistee Lake was not surveyed again by MDOC until 1955, when the first netting survey was conducted. In his report on the 1955 survey, Taube (1956) stated that "There are few lakes in Michigan that have as good a population of walleyes as Manistee Lake". In the 1970s and early 1980s, Manistee Lake was extensively surveyed by the Institute for Fisheries Research (Laarman 1980; Laarman and Schneider 1986). As a component of this research, population estimates for most fish species were established in Manistee Lake from 1973-1978 and from 1981-1984.

In 1993, 2002, and 2006 (Tonello 2004, 2008), fall electrofishing surveys aimed at evaluating survival of stocked walleye were conducted using the protocol outlined by Serns (1982, 1983; Table 3). Walleye were stocked in each of those three years. The age-0 walleye year class estimates ranged from 755 in 2002 to 8,115 in 2006. Catch rates ranged from 3.8 age-0 walleye per mile in 2002 to 40.3 per mile in 2006. According to Ziegler and Schneider (2000), a catch rate of less than 45 age-0/mile equals a "poor" year class. However, the fact that some age-0 walleye were caught indicates that there was at least some survival of the stocked fish.

In 1996, a general fisheries survey of the fish community was completed using fyke and inland gill nets (Tonello 1999). Healthy populations of bluegill, black crappie, and walleye were found. A total of 24 walleye ranging from 7 to 21 inches were caught. The growth index for walleye was 0.3 inches under the State of Michigan average, but slightly better than in the 1993 survey. Bluegill growth exceeded the Michigan average by 1.3 inches. Smaller numbers of yellow perch, largemouth bass, smallmouth bass, northern pike, and hybrid sunfish were observed. There were also a large number of adult white suckers captured; they represented 42.5% of the total catch by weight.

A comprehensive fisheries survey of Manistee Lake was conducted in 2004 (Tonello 2008) according to protocols developed by Wehrly et al. (2009). Gear used included large-mesh fyke nets, trap nets, experimental graded-mesh inland gill nets, maxi-mini small-mesh fyke nets, and a boom electrofishing boat. During the 2004 survey, a total of 754 fish were caught, representing 18 different species (Table 2). Robust populations of bluegill, pumpkinseed sunfish, black crappie, largemouth bass, smallmouth bass, and walleye were documented in the survey. Growth rates were above average for all species except yellow perch and walleye. Bluegill, pumpkinseed sunfish, and rock bass that would qualify for the MDNR Master Angler program were present. White suckers were also abundant, representing 47.7% of the total catch by weight.

Manual white sucker removals

According to Hayes (1990), white suckers can have a dramatic negative effect on the growth of other fish species. Although Hayes specifically studied yellow perch, the conclusion likely applies to other panfish species and juvenile walleye. According to Laarman (1980), from 1973 through 1978 the white sucker population of Manistee Lake was usually between 4,000 and 5,000 individuals except in 1973,

when the estimate was nearly 7,000. It should be noted that confidence intervals were quite large with these estimates.

In both the 1996 and 2004 netting surveys, white suckers comprised a substantial proportion of the catch biomass (42.5% in 1996 and 47.7% in 2004). For that reason, in 2006 and 2007, MDNR Fisheries personnel conducted manual removals (utilizing fyke nets) of white suckers. In 2006, 358 were removed; and 1,096 white suckers weighing 2,834.7 lbs. were removed in 2007 (Table 4). These fish were given away at the boat launch to all who wanted them. The Manistee Lake Association and the Manistee Lake Improvement Board provided assistance with this effort by publicizing the effort and providing information on good locations where spawning suckers were concentrated.

Due to staffing limitations, MDNR was unable to do any further white sucker removals after 2007. At that point, the Manistee Lake Association (MLA) stepped up and volunteered to continue the work, in cooperation with the Au Sable Institute. From 2010 to 2014, MLA volunteers conducted annual white sucker removals with fyke nets borrowed from the Au Sable Institute. Over the five year period, MLA volunteers removed a total of 3,731 white suckers weighing approximately 9,700 lbs. from Manistee Lake (Table 4).

Master Angler

Since 1996, a total of fourteen exceptional fish caught from Manistee Lake have been entered into the MDNR, Fisheries Division Master Angler program. Eleven entries were bluegill, one was a yellow perch, and two were black crappie (Table 5).

Current Status

The most recent comprehensive fish community survey of Manistee Lake was conducted by MDNR in the spring of 2014. The netting portion of the survey took place from June 2-5. Survey gear used included four trap nets (12 net-nights), one small-mesh fyke net (three net-nights), and two experimental graded-mesh inland gill nets (2 net-nights). The seining and electrofishing portion of the survey took place during the evening of July 17th. In that effort, five seine hauls were conducted, and three ten-minute transects were sampled by electrofishing. Limnological and shoreline data was collected on August 11. The primary purpose of this survey was to assess the status of all fish populations in Manistee Lake, with additional focus on the walleye population.

During the 2014 June netting survey of Manistee Lake, a total of 1,019 fish were caught, representing 15 different species (Table 6). Bluegill were the most frequently collected species, with a total of 341 caught. They represented 33.5% of the total catch by number and ranged from 1 to over 10 inches in length. Other panfish species collected included black crappie (233 from 6-13 inches), pumpkinseed sunfish (62 from 4-9 inches), rock bass (66 from 4-10 inches), and yellow perch (66 from 2-12 inches). Growth rates for all panfish species were good, with all species exceeding the State average.

Game fish species caught in the 2014 June netting survey of Manistee Lake included walleye, largemouth bass, smallmouth bass, and northern pike (Table 6). Walleye were the most numerous gamefish species caught, with 144 caught from 6 to 22 inches in length, averaging 15.3 inches. Totals of 13 largemouth and 26 smallmouth bass were caught, with largemouth bass ranging up to 17 inches

and smallmouth bass ranging up to 16 inches. The northern pike catch consisted of 8 individuals from 16 to 38 inches. As with the panfish species, all gamefish species except for walleye exhibited growth rates above the State average (Table 7).

In the July 2014 seining and electrofishing portion of the Manistee Lake survey, a total of 349 fish were caught, representing 11 species (Table 8). Yellow perch, smallmouth bass, and largemouth bass were the most commonly collected species from this portion of the survey. All species that had enough individuals collected to establish statistically significant age and growth results had growth rates that exceeded the State average (Table 9).

Fish species that were not caught in the 2014 survey of Manistee Lake but had been reported in previous surveys included black bullhead, blacknose shiner, blackchin shiner, common shiner, emerald shiner, hybrid sunfish, golden shiner, grass pickerel, hornyhead chub, mimic shiner, northern redbelly dace, and pearl dace (Table 2). New species captured in the 2014 survey included creek chub.

Shoreline data were collected on August 11, 2014 (Table 10). Manistee Lake had 24.2 docks/km, 27.9 dwellings/km, 52.3% shoreline armoring, and 26.2 submerged trees/km.

Analysis and Discussion

The 2014 MDNR fisheries survey showed that Manistee Lake has very healthy game and panfish populations. Bluegill, black crappie, and pumpkinseed sunfish populations in particular are robust, offering excellent growth and size structure, including numerous fish that exceed Master Angler standards. Numerous year classes were present in the catch, indicating consistent natural reproduction (Table 7). The bluegill and black crappie year classes produced in 2010 and 2011 were particularly abundant in the 2014 survey. According to the Schneider Index (an index used to assess the quality of bluegill populations in inland lakes), Manistee Lake ranked as "Superior", which is the highest possible rating (Table 11). While panfish may not be as numerous in Manistee Lake as some other lakes, Manistee Lake provides the opportunity for anglers to catch large panfish.

Walleye were numerous in the 2014 Manistee Lake survey. Eleven different year classes were present, from both stocked and non-stocked years. Walleye stocking has recently occurred in 2013, 2011, and 2006 (ages I, III, and VIII in Tables 7 and 9). Each of those year classes were very well-represented in the survey, indicating that stocked walleye are surviving and contributing to the Manistee Lake fishery. The presence of walleye from non-stocked years indicates that natural reproduction is occurring and that naturally reproduced walleye are also surviving and contributing to the fishery. The 2012, 2010, and 2007 natural walleye year classes (ages II, VI, and VII in Tables 7 and 9) appear to have been particularly successful.

Largemouth bass and smallmouth bass were not particularly abundant in the June netting portion of the Manistee Lake survey (Table 6). Largemouth bass and smallmouth bass (particularly juveniles) were more abundant in the July electrofishing/seining portion of the survey (Table 8). Despite the lack of large numbers of largemouth and smallmouth bass in the 2014 survey, multiple year classes were present in the catch (Tables 7 and 9), indicating consistent natural reproduction. In addition, most of the anglers that we spoke to during the 2014 survey mentioned that fishing for both largemouth and smallmouth bass was very good on Manistee Lake.

Although northern pike were not numerous in the survey (Table 6), five different year classes were present, indicating consistent natural reproduction. The lack of northern pike in the catch may also have been due to the fact that the inland gillnets were pulled after one night. Inland gillnets tend to be an effective, though lethal, gear for catching northern pike and walleye. They were pulled after one night to remove the risk of excessive mortality for those two species. Several of the northern pike caught in the survey were over 30 inches, demonstrating the capability of Manistee Lake for producing large northern pike.

Yellow perch were more numerous in the netting portion of the 2014 survey than they were in the 2004 survey. The majority of them were caught in the two inland gill nets, which were pulled after the first night. Had those nets been left in, the yellow perch catch would have likely been even higher. Six different year classes were present in the 2014 survey, with the 2011 year class exceptionally well-represented in the netting portion of the survey. Yellow perch growth appears to have improved since the 2004 survey as well. In the 2004 survey age III yellow perch averaged 6.0 inches in length, while in 2014 age III yellow perch averaged 6.6 inches.

In the previous two netting surveys of Manistee Lake (1996 and 2004), white suckers comprised a major proportion of the biomass of the catch; 42.5% in 1996 and 47.7% in 2004. However, in 2014 white suckers only comprised 7.8% of the biomass of the catch. According to Hayes (1990), large stockpiles of adult white suckers can negatively impact yellow perch through competition for food resources. Based on the results of the 1996 and 2004 surveys, it is clear that Manistee Lake had a large stockpile of adult white suckers. Therefore, the reduced white sucker catch in the 2014 survey may be a positive result of the manual removals conducted by both MDNR and the Manistee Lake Association over the past 9 years. The improved growth rates observed in yellow perch in the 2014 survey may also be a result of the white sucker removals.

Manistee Lake is heavily developed with cottages and residences along the majority of its shoreline. Only the northern lobe of the lake is relatively undeveloped, mostly due to the swampy nature of the area. Compared to other shallow, medium-sized lakes in Michigan and in the CLMMU (basically the northwestern portion of the Lower Peninsula), Manistee Lake has more docks and dwellings than most (Wehrly et al. 2015; Table 10). Manistee Lake did have more submerged trees/km than other CLMMU lakes, but not more than other medium, shallow lakes statewide (Wehrly et al. 2015).

Management Direction

The panfish and gamefish populations of Manistee Lake are extremely healthy and provide fishing opportunities far better than those found in most lakes. Large bluegill, black crappie, pumpkinseed sunfish, northern pike, and yellow perch are available. The Manistee Lake walleye population is currently very robust. Though not a "trophy" fishery, good numbers of legal walleye are available for anglers, with several year classes of sublegal fish that will recruit into the fishery. Walleye fishing on Manistee Lake should be very good for years to come. Species like smallmouth bass, largemouth bass, bluegill, pumpkinseed sunfish, black crappie, rock bass, yellow perch, and northern pike should also continue to thrive in Manistee Lake.

The quality and health of the Manistee Lake panfish and gamefish populations may be due at least in part to the white sucker removal efforts of the Manistee Lake Association. Based on the results of Hayes (1990) and growth rates from the 2014 MDNR survey we recommend that the manual sucker removals continue, as long as the Manistee Lake Association is willing and able. Continued removals of 1,000-1,200 white suckers annually should continue to relieve the competitive pressure of the adult white suckers, while not putting the overall white sucker population at risk. While suppressing the adult white sucker population is the goal of the project, eradication is not. White suckers remain a valuable component of the Manistee Lake fish community, as long as their population levels are kept at reasonable levels. With adult white sucker populations estimated at 4,000-7,000 fish (Laarman 1980); the removal of 1,000-1,200 fish annually should not jeopardize the overall white sucker population.

Although some natural reproduction occurs in most years, the Manistee Lake walleye fishery is largely dependent upon stocking. Fisheries surveys have repeatedly documented that the larger walleye year classes coincide with stocking years. Therefore, spring fingerling walleye (Muskegon River strain) should continue to be stocked into Manistee Lake, at a rate of 50/acre (or 43,000 fish) every other year, starting in 2015. Continued walleye stocking, along with supplemental natural reproduction, should continue to allow Manistee Lake to be one of the better walleye fishing lakes in the area for many years to come.

Eurasian milfoil will likely continue to require treatment, at least in some years. We commend the Manistee Lake Association and the Manistee Lake Improvement Board for making the commitment to utilize weevils instead of herbicides or other methods. The use of weevils or other methods for aquatic nuisance control will be more beneficial to the Manistee Lake ecosystem in the long run.

The remaining riparian wetlands adjacent to Manistee Lake should be protected and considered critical to the continued health of the lake's aquatic community. The Manistee Lake shoreline is already much more developed than most other CLMMU lakes. 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 basin 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 inland 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).

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Figure 1. Manistee Lake, Kalkaska County, Michigan.

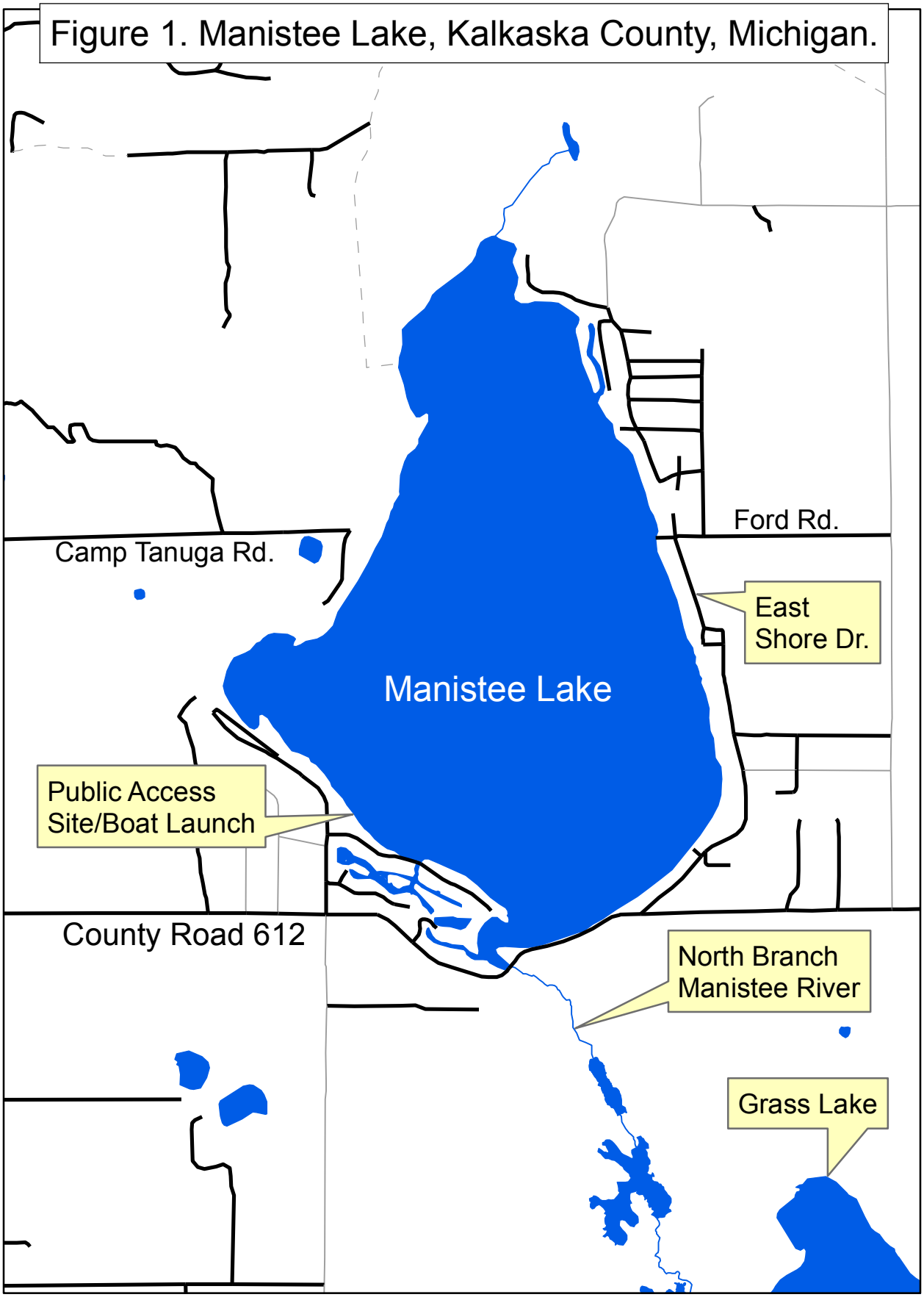

Table 1. Fish stocked in Manistee Lake, Kalkaska County, 1876-2014.

Year	Species	Number	Size	Strain
1876	Lake whitefish	20,000	fry	Detroit River
1905	Walleye	100,000	fry	
1910	Walleye	80,000	fry	
1929	Bluegill	64,000	fry	
	Largemouth bass	600	1 mo.	
1931	Bluegill	2,000	5 mo.	
1932	Bluegill	1,000	unknown	
	Largemouth bass	500	unknown	
1933	Walleye	300,000	fry	
1934	Walleye	600,000	fry	
1935	Walleye	170,000	fry	
1936	Walleye	300,000	fry	
1937	Walleye	300,000	fry	
1938	Walleye	320,000	fry	
	Yellow perch	12,000	7 mo.	
1939	Walleye	300,000	fry	
	Yellow perch	60,000	7 mo.	
1940	Walleye	160,000	fry	
1942	Walleye	300,000	fry	
1969	Walleye	1,000,000	fry	
1971	Walleye	1,015,000	fry	
1972	Walleye	1,100,000	fry	
1974	Walleye	2,781	fingerlings	
1975	Walleye	1,772	spring fingerlings	
	Walleye	6,350	fall fingerlings	
1976	Walleye	6,557	spring fingerlings	
1977	Walleye	9,427	fall fingerlings	
1978	Walleye	8,024	fall fingerlings	
1981	Walleye	6,542	spring fingerlings	
	Walleye	2,780	yearlings	
1982	Walleye	16,377	spring fingerlings	
	Walleye	1,933	yearlings	
1983	Walleye	24,150	spring fingerlings	
1985	Walleye	26,922	spring fingerlings	
1987	Walleye	22,700	spring fingerlings	
1990	Walleye	26,700	spring fingerlings	
1993	Walleye	24,386	spring fingerlings	Muskegon
1996	Walleye	39,633	spring fingerlings	Muskegon
1999	Walleye	23,931	spring fingerlings	Muskegon
2002	Walleye	17,355	spring fingerlings	Muskegon
2003	Walleye	14,690	spring fingerlings	Muskegon
2006	Walleye	34,425	spring fingerlings	Muskegon
2011	Walleye	42,850	spring fingerlings	Muskegon
2013	Walleye	147,672	spring fingerlings	Muskegon

Table 2. Presence/absence of fish species in historical fisheries surveys of Manistee Lake, Kalkaska County.

Species	1936	1955	1967	1970	1972	1973	1974	1975	1976	1977	1978	1981	1982	1983	1984	1996	2002	2004	2014
Black bullhead		x				x													
Black crappie				x		x	x	x	x	x	x	x	x	x	x	x	x	x	x
Blackchin shiner		x																	
Blacknose shiner		x			x	x													
Bluegill	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Bluntnose minnow		x				x	x											x	x
Bullhead spp.	x									x									
Creek chub																			x
Common shiner		x																	
Emerald shiner																	x		
Hybrid sunfish																x		x	
Golden shiner		x																	
Grass pickerel		x																	
Hornyhead chub		x																	
Iowa darter						x	x											x	x
Johnny darter		x				x	x											x	x
Largemouth bass	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Mimic shiner						x	x											x	
Northern pike	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
N. redbelly dace																		x	
Pearl dace																		x	
Pumpkinseed	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Rock bass	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Smallmouth bass	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Spottail shiner																	x	x	x
Walleye	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
White sucker		x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x
Yellow perch	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

Table 3. Walleye year class estimates from Manistee Lake, Kalkaska County. The estimates were established from fall electrofishing surveys conducted by MDNR according to protocols outlined by Serns (1982, 1983).

Year survey conducted	Number of age-0 walleye captured per mile of electrofishing	Estimated age-0 walleye year class
1993	8.5	1,711
2002	3.8	755
2006	40.3	8,115

Table 4. White suckers manually removed from Manistee Lake, Kalkaska County, 2007-2014.

Year	Number of white suckers removed	Party responsible for manual removal
2006	358	MDNR
2007	1,096	MDNR
2010	287	MLA/AS Institute
2011	1,004	MLA/AS Institute
2012	720	MLA/AS Institute
2013	1,197	MLA/AS Institute
2014	523	MLA/AS Institute
Total:	5,185	

Table 5. Michigan DNR Master Angler awards issued for fish caught from Manistee Lake, Kalkaska County, 1994-2014.

Species	Number of Master Angler awards issued
Bluegill	11
Black crappie	2
Yellow perch	1
Total:	14

Table 6. Number, weight, and length of fish collected from Manistee Lake with large mesh fyke nets, trap nets, small mesh fyke nets, inland gillnets, June 2-5, 2014.

Species	Number	Percent by number	Weight (pounds)	Percent by weight	Length range (inches)[1]	Average length	Percent legal size[2]
black crappie	233	22.8	112.0	17.0	6-13	9.3	97 (7")
bluegill	341	33.5	161.2	24.5	1-10	8.5	96 (6")
bluntnose minnow	1	0.1	0.0	0.0	2-2	2.5	
creek chub	1	0.1	0.0	0.0	3-3	3.5	
Iowa darter	34	3.3	0.2	0.0	2-2	2.5	
johnny darter	3	0.3	0.0	0.0	1-2	1.8	
largemouth bass	13	1.3	23.7	3.6	11-17	15.0	62 (14")
northern pike	8	0.8	41.9	6.4	16-38	26.4	50 (24")
pumpkinseed	62	6.1	30.5	4.6	4-9	8.2	97 (6")
rock bass	66	6.5	21.1	3.2	4-10	7.3	79 (6")
smallmouth bass	26	2.6	24.1	3.7	7-16	11.5	23 (14")
spottail shiner	3	0.3	0.0	0.0	2-4	3.2	
walleye	144	14.1	178.3	27.1	6-22	15.3	54 (15")
white sucker	18	1.8	51.2	7.8	10-23	18.9	
yellow perch	66	6.5	13.2	2.0	2-12	7.4	56 (7")
Total	1,019	100	657.4	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 7. Average total weighted length (inches) at age, and growth relative to the state average, for fish sampled from Manistee Lake with large mesh fyke nets, trap nets, maxi-mini fyke nets, and inland gill nets, June 2-5, 2014. Number of fish aged is given in parenthesis.

Species	Age I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Mean Growth Index
Black crappie		7.0 (14)	8.9 (20)	10.5 (17)	11.5 (4)	12.1 (3)	12.6 (4)	13.6 (2)					+1.0
Bluegill			5.9 (23)	8.0 (17)	9.1 (7)	9.1 (1)	9.7 (2)	9.8 (4)	10.3 (6)	10.2 (3)			+1.6
Largemouth bass			13.6 (2)	13.0 (3)	13.6 (1)	16.1 (3)	16.6 (2)	16.4 (2)					-
Northern pike	16.8 (2)	22.3 (1)	23.1 (1)			25.7 (1)	35.0 (3)						-
Pumpkinseed		4.3 (1)	6.5 (4)	7.3 (9)	8.7 (6)	8.4 (5)	8.5 (3)	9.1 (3)	9.6 (2)				+1.8
Rock bass		4.1 (1)	5.6 (16)	6.9 (18)	8.5 (7)	9.0 (4)	9.6 (3)	10.0 (3)	10.1 (3)				+0.6
Smallmouth bass		9.2 (13)	11.8 (3)	13.7 (7)	16.1 (2)	16.5 (1)							+0.5
Walleye	6.0 (1)	12.1 (8)	14.3 (30)	15.4 (16)	15.7 (3)		18.8 (7)	18.5 (12)	17.6 (1)	21.5 (1)	18.0 (1)	21.7 (2)	-1.1
Yellow perch		5.7 (3)	6.6 (32)	8.4 (6)	9.5 (11)		12.1 (2)						+0.4

Table 8. Number, weight, and length of fish collected from Manistee Lake with electrofishing and seining, July 17, 2014.

Species	Number	Percent by number	Weight (pounds)	Percent by weight	Length range (inches)[1]	Average length	Percent legal size[2]
bluegill	12	3.4	3.4	6.8	5-8	7.3	92
bluntnose minnow	2	0.6	0.0	0.0	2-2	2.5	
johnny darter	7	2.0	0.4	0.8	2.2	2.5	
largemouth bass	32	9.2	15.7	31.2	1-18	4.4	16
pumpkinseed	5	1.4	2.5	5.0	7-9	8.3	100
rock bass	7	2.0	2.7	5.4	6-9	7.8	100
smallmouth bass	95	27.2	7.2	14.3	1-16	2.4	1
spottail shiner	2	0.6	0.1	0.2	3-4	4.0	
walleye	14	4.0	5.5	10.9	3-16	9.3	7
white sucker	27	7.7	1.8	3.6	1-21	2.7	
yellow perch	146	41.8	11.0	21.9	1-11	5.3	18
Total	349	100	50.3	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 12=12.0 to 12.9 inches; etc.

Table 9. Average total weighted length (inches) at age, and growth relative to the state average, for fish sampled from Manistee Lake with seining and electrofishing, July 17, 2014. Number of fish aged is given in parenthesis.

	Age												
Species	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Mean Growth Index
Bluegill		6.9 (1)	6.7 (7)	7.7 (3)	8.7 (1)								+1.4
Largemouth bass			13.6 (1)			17.3 (4)							-
Pumpkinseed			7.3 (2)	8.8 (1)			8.6 (1)	9.0 (1)					-
Rock bass			6.0 (2)	7.2 (2)	8.4 (2)			9.7 (1)					-
Smallmouth bass	5.1 (1)	9.6 (5)		14.3 (2)	13.2 (1)								+0.8
Walleye	8.5 (8)	14.0 (4)											+0.3
Yellow perch	4.8 (16)	6.8 (18)	8.3 (13)	9.7 (4)									+1.1

Table 10. Shoreline data for Manistee Lake, Kalkaska County, compared with that for other medium, shallow lakes in the Central Lake Michigan Management Unit (CLMMU) and statewide (from Wehrly et al. 2015). Manistee Lake sampling was conducted by DNR Fisheries personnel on August 11, 2014.

	Total docks per km	Dwellings per km	Percent shoreline armoring	Submerged trees per km
Manistee Lake	24.2	27.9	52.3	26.2
Average for medium, shallow lakes in the CLMMU	15.3	17.5	53.5	12.0
Michigan statewide average for medium, shallow inland lakes	2.9	5.7	8.9	46.3

Table 11. Manistee Lake bluegill size structure rating using the Schneider Index (Schneider 1990). Index scores are in parentheses. Sample is from 12 trap net lifts from the June, 2014 MDNR fisheries survey. Schneider Index rankings are as follows: 1 = very poor, 2 = poor, 3 = acceptable, 4 = satisfactory, 5 = good, 6 = excellent, 7 = superior.

Sample size	340	
CPUE (#/net lift)	28.4	
		Schneider Index Score
Ave. length (in.)	8.5	(7)
% $\geq$ 6 inches	97%	(7)
% $\geq$ 7 inches	89%	(7)
% $\geq$ 8 inches	73%	(7)
	Final Rank:	7.0 (Superior)