

Rose Lake
Osceola County
Pine River Subwatershed, Manistee River Watershed, Last Surveyed 2017

Mark A. Tonello, Fisheries Management Biologist

Environment

Rose Lake is a 370-acre natural lake in northwestern Osceola County, near Leroy, Michigan. It is the largest lake in Osceola County. Rose Lake has two main basins and a small, weedy bay. Maximum depths in the basins are around 30 feet, and in the bay around 10 feet. The substrate present in the lake is mostly sand, with silty sand and detritus in the weedy shoreline areas. The shoreline is highly developed with many homes surrounding the lake, with only a few scattered parcels of undeveloped land. Rose Lake Park (operated by Osceola County Parks and Recreation) is located on the north side of the lake. Rose Lake Park has a campground, boat launch, and a fishing pier. The Rose Lake Youth Camp is adjacent to Rose Lake Park. The closest municipalities to Rose Lake are the villages of Tustin (5 miles to the northwest) and Leroy (4 miles to the southwest).

Rose Lake is in the Pine River subwatershed of the Manistee River watershed. The Rose Lake outlet is a Designated Trout Stream and flows into the East Branch of the Pine River. A lake-level control structure on the outlet was originally installed in 1957 and was replaced in the summer of 2017. The outlet flows intermittently and does not flow at all during times of drought. The elevation of Rose Lake is 1,253 feet, making it one of the more "elevated" lakes in Michigan. The geography surrounding Rose Lake is hilly and forested, with predominantly sandy soils. There are some agricultural lands to the east of Rose Lake. There are four small, unnamed tributary streams that flow into Rose Lake. Two of the tributaries begin in wetlands to the northeast of the lake, while the other two flow from the agricultural lands to the east of the lake. Satellite photo scrutiny indicates that several of these tributaries were likely dredged/ditched at one time.

Because it is a relatively shallow lake, Rose Lake has an abundance of aquatic vegetation. In the past, there have been problems with Eurasian milfoil and other nuisance aquatic vegetation. The first mention of chemical control for nuisance aquatic plants is dated from 1960 (Michigan Department of Natural Resources (MDNR) files, Cadillac). Since the first chemical control, the Michigan Department of Environmental Quality (MDEQ) has issued permits over many years for control of aquatic nuisance vegetation. The most recent permit from MDEQ for chemical treatment of aquatic nuisance macrophytes (issued in 2015 and typically in effect for five years) called for the treatment of 100 acres or less of Eurasian milfoil or curlyleaf pondweed (including some native plant control) with herbicides in any given year. In 2016 and 2017, Eurasian milfoil was at relatively low levels, requiring treatment of less than 40 acres in each year. Excessive Eurasian milfoil can lead to several fisheries problems including poor growth and stunting for a number of important species.

The primary citizen group for Rose Lake is the Rose Lake Property Owner's Association (RLPOA). There is also a Rose Lake Special Assessment Advisory Board that oversees the fund created by taxes on lakefront landowners. The funds are used primarily for chemical control of aquatic nuisance weeds.

History

The first recorded fish stocking of Rose Lake took place in 1876, when Lake Whitefish were stocked by the Michigan Fishery Commission (Table 1). Common Carp were also recorded as being stocked in 1894. Neither of those species survived, as no subsequent reports of either species were ever recorded. Walleye fry were first stocked in 1910. In the 1930s and early 1940s, various stockings of Bluegill, Largemouth Bass, Walleye, and Yellow Perch were conducted by the Michigan Department of Conservation (MDOC; the precursor to today's MDNR). A Northern Pike spawning marsh was operated between 1957 and 1962, with some juvenile Northern Pike released into Rose Lake as a result. A more consistent Walleye stocking program was initiated in 1985. Since then, Walleye fingerlings have been stocked consistently on two or three-year intervals, except for the period from 2006-2011 when no Walleye were stocked due to fears of infecting the lake with Viral Hemorrhagic Septicemia (VHS). While most recent stockings of Walleye into Rose Lake had consisted of spring fingerlings, 1,503 fall fingerling Walleye were stocked in the fall of 2018 (in addition to the 27,045 spring fingerlings that were stocked in June). This was the first time fall fingerling Walleye had been stocked into Rose Lake since 2006.

File information indicates that Rose Lake may be prone to fish kills. A substantial 1938 winter kill is discussed by Brown (1940), and fish kills were observed in June of 1972 and June of 1981. In the June fish kills, the primary victims were small Bluegill, but small numbers of other species were noted as well. The most likely cause of both summer fish kills on Rose Lake was oxygen depletion caused by algae blooms. No major fish kills of note have occurred on Rose Lake in recent years.

Other management activities on Rose Lake include the installation of 45 Brush shelters in 1949 and the operation of a Northern Pike rearing marsh in the late 1950s and early 1960s. The project ceased when ownership changed on the parcel where the dam creating the marsh was constructed, and the new landowner was not in favor of the project. While some Northern Pike were stocked into Rose Lake because of the marsh project, it eventually became apparent that the Northern Pike population is entirely capable of sustaining itself without the marsh. Also, in the mid-1960s, spearing of Northern Pike was banned on Rose Lake for several years. It was eventually re-instated due to public outcry. Another management action aimed at increasing Northern Pike harvest occurred in 2003, when due to angler complaints regarding overabundant small Northern Pike and poor growth rates, managers removed the minimum size limit on Northern Pike and changed the bag limit to five per day.

The first fisheries survey of Rose Lake was conducted by MDOC personnel in 1938 (Brown, 1940; Table 2). The catch was recorded as being very poor, which was attributed to a recent severe winterkill that occurred during the previous winter. After that, Rose Lake was sampled by MDOC Fisheries personnel on a fairly regular basis throughout the latter half of the 20th century. MDOC personnel again surveyed Rose Lake in 1958 (Table 2). In that survey, which utilized a 100' cotton seine, Bluegill, Pumpkinseed Sunfish, Yellow Perch, Black Crappie, Largemouth Bass, Rock Bass, Northern Pike, Walleye and Golden Shiners were captured. Follow up seine surveys were also done in 1959, 1960, and 1961. The only new species captured was a lone Bullhead (not identified to species) in 1959. A thorough fisheries survey done in 1966 found a large population of small Bluegill, with very slow growth noted for the Bluegill, as well as for Northern Pike and Yellow Perch. The next survey, conducted in 1975, also confirmed slow growth in Bluegill and Northern Pike. The 1975 survey did find exceptional populations of Black Crappie and Largemouth Bass but was limited by only utilizing gill nets as the gear type for the survey.

While no Smallmouth Bass have ever been captured from Rose Lake in any fisheries surveys, a file note indicates that a 22.5", 5.5 lb specimen was reported as caught from Rose Lake in 1980. The fish was aged as being 12 years old. It is possible that this fish was transplanted illegally into Rose Lake by an angler.

A 1984 netting survey that utilized trap and gill nets found that Bluegill seemed to be growing slightly better, and again noted a good population of Black Crappie. While Walleye had been present in small numbers in most of the earlier surveys, fifteen adult Walleye from 18" to almost 27" were caught in the 1984 survey. Baker (1989) noted that the Walleye did not seem to be reproducing, but that they were surviving when stocked and growing very well. Unfortunately, an electroshocking survey completed in 1985 did not turn up any Walleye but did catch some Northern Pike and Largemouth Bass. Baker also noted that nearly all species, both predator and panfish, were exhibiting slow growth rates.

Rose Lake was again surveyed by MDNR in 1994, using small mesh fyke nets, large mesh fyke nets, and gill nets. The Bluegill were again observed to be growing very slowly, and very few over 6" were caught. The Black Crappie population was again fair, as was the Pumpkinseed Sunfish population, although both were growing slowly. The Largemouth Bass population was good, with individuals up to 18 inches, although they were growing very slowly. Northern Pike were very numerous, and similar to the other species, they too were growing very slowly. Individuals up to 26" were caught. A total of 19 Walleye were caught in the 1994 survey, ranging from 20-27" in length. It is likely that the Walleye captured in this survey came from the 1985 and 1988 plants. None were small enough to have come from the 1991 plant. Even so, the stocked Walleye were obviously surviving and creating a fishery in Rose Lake.

The 2002 survey was a general fisheries survey of Rose Lake involving gill nets, trap nets, fyke nets, and electrofishing (Tonello, 2002). This survey had similar results to the previous netting surveys, with slow growth noted in both gamefish and panfish species. Only two Walleye were caught, both from the 1999-year class. One management recommendation from the report was to continue the Walleye stocking program; mostly due to positive angler catch reports.

In 2004 and 2006, fall electrofishing surveys targeting juvenile Walleye that had been stocked the previous spring were conducted on Rose Lake. The surveys followed protocols outlined in Ziegler and Schneider (2000). In the 2004 survey, a total of 7 walleye were caught, from 8 to 11 inches in length, representing the 2003 and 2004-year classes (both of which were stocked). Only one Walleye, 23 inches in length, was caught in the 2006 survey.

Since 1994, a total of 12 exceptional fish caught from Rose Lake have been entered in the MDNR Fisheries Division Master Angler program. Master Angler species caught from Rose Lake have included Bluegill, Largemouth Bass, Pumpkinseed Sunfish, Rock Bass, and Yellow Perch (Table 3). Rock Bass was the most numerous species entered, with 8 entries.

Current Status

The most recent comprehensive fisheries survey of Rose Lake was conducted in 2017. Fish sampling was conducted with trap nets, large-mesh fyke nets, small-mesh fyke nets, inland gill nets, minnow seines, and electrofishing gear. The netting portion of the survey occurred from June 12 through June

15, and the electrofishing and seining portion was completed on June 29. Another electrofishing survey (targeting juvenile Walleye) was conducted during the evening of October 15, 2018.

A total of 3,373 fish, representing 17 different species, were caught in the 2017 survey (Table 4). Bluegill were the most frequently collected panfish species in the survey. A total of 2,129 Bluegill from 1 to 8 inches were caught, representing 63.1% of the catch by number. Other panfish species caught included Black Crappie (72 individuals ranging from 3 to 12 inches), Pumpkinseed Sunfish (120 caught ranging from 2 to 8 inches in length), Rock Bass (159 caught ranging from 2 to 11 inches), and Yellow Perch (237 caught ranging from 1 to 9 inches). Largemouth Bass were the most numerous predator species caught in the survey, with 94 individuals ranging from 1 to 20 inches in size. Northern Pike ranged from 13-27 inches length, with 14 individuals caught. Ten adult Walleye were also caught, ranging from 20 to 28 inches in length. One juvenile Walleye (one inch in length) was also caught in a small mesh fyke net. Yellow Bullhead were also very abundant in the 2017 survey, with 255 individuals caught, representing approximately 27% of the catch by weight.

Bluegill, and Largemouth Bass captured during the 2017 survey (Table 5) were growing substantially slower (-0.9 and -1.1 inches, respectively) than the state average length at age. Pumpkinseed Sunfish and Rock Bass were growing slightly slower (-0.4 and -0.2 inches, respectively) than the state average, while Black Crappie (+0.3 inches) and Yellow Perch (+0.1 inches) were growing faster than the state average. There were not enough Northern Pike or Walleye collected during the 2017 survey to make inferences regarding age and growth.

The final component of the most recent Rose Lake fisheries survey effort was a fall 2018 electrofishing effort targeting juvenile Walleye. This effort was similar to the previous fall Walleye surveys conducted in 2004 and 2006 (Tonello 2004 and 2006) and was conducted using methods established by Ziegler and Schneider (2000). In this survey, a total of 7 Walleye were caught, all of which were either 6 or 7 inches in length, and age-0.

Shoreline data were collected on August 31, 2017 (Table 6). Rose Lake had 20.5 docks/km, 21.9 dwellings/km, 39.1% shoreline armoring, and 1.1 submerged trees/km. Rose Lake is heavily-developed with cottages and residences along most of its shoreline. Compared to other shallow, medium-sized lakes in Michigan and in the Central Lake Michigan Management Unit (CLMMU; basically, the northwestern portion of the Lower Peninsula), Rose Lake has an above-average number of docks and dwellings (Wehrly et al. 2015; Table 6), although it did have a slightly lower percent of shoreline armoring than other shallow, medium sized lakes in the CLMMU.

Analysis and Discussion

The 2017 MDNR fisheries survey of Rose Lake showed similar results to other surveys conducted on Rose Lake over the years. Very abundant panfish populations, relatively slow growth of prominent panfish and predator species, and abundant Yellow Bullhead populations have been recurring themes in Rose Lake surveys in the latter half of the 1900s and the early 2000s.

However, there were several interesting results of the 2017 survey. The Walleye population of Rose Lake seems to be more robust than in the past, with fish living many years and attaining lengths that are rare in many inland lakes. Natural reproduction of Walleye was documented for the first time in the 2017 survey (albeit just one one-inch Walleye), although it is questionable whether the fish would be

able to survive the "predator gauntlet" of the numerous panfish species. Six of the 10 adult Walleye caught in the 2017 survey came from 2006-year class, a year in which both spring fingerlings and fall fingerlings were stocked. This is noteworthy- it is suspected that the excellent survival of the 2006-year class was from the fall fingerlings. Spring fingerling Walleye are typically stocked at an average length of 1.5 inches, which makes them vulnerable to predation by many different species of fish, including panfish. Rose Lake clearly has very abundant panfish populations, and it is likely that they prey heavily on the spring fingerling Walleye. If fall fingerling Walleye were available on a consistent basis, they might be a better stocking option for Rose Lake than spring fingerlings. In late October 2018, the first fall fingerling Walleye were stocked into Rose Lake since 2006. These Walleye were stocked after the electrofishing survey was conducted, so the Walleye caught in that survey were likely from the spring fingerlings that were stocked in early June 2018.

The Northern Pike and Largemouth Bass populations of Rose Lake remain strong and are a major draw for anglers. Although the Largemouth Bass were growing slowly, large individuals approaching the 20-inch class are present. Largemouth Bass fishing is good enough on Rose Lake that there are a number of bass tournaments held on the lake each summer. Although not enough Northern Pike were caught to make inferences regarding growth, several larger individuals were caught. Angler reports for both species remain positive. In particular, Northern Pike are pursued in the winter through the ice by spear fishers and anglers fishing with tip ups.

The Bluegill population of Rose Lake also seems to have improved slightly since the most recent comprehensive survey in 2002. According to the Schneider Index (Schneider 1990) the Bluegill population of Big Star Lake ranked as "very poor" in 2002 but improved to "acceptable" in 2017 (Table 7). This improvement in the Bluegill population of Rose Lake may be at least in part due to the Walleye population. Schneider and Lockwood (1997) found that even relatively low densities of adult Walleye in inland lakes improved Bluegill size structure and growth. Bluegill should continue to provide good fishing opportunities on Rose Lake, as well as being an excellent forage base for predators like Walleye and Largemouth Bass. Continued Walleye stocking (preferably fall fingerlings) should help to keep the Bluegill population from stunting.

The Black Crappie, Pumpkinseed Sunfish, and Yellow Perch populations also appear healthy, although they are not as numerous as Bluegill. In the 2017 survey, "keeper" sized fish of all three species were caught. Angler reports remain very positive for the Rose Lake panfish fishery, particularly for Black Crappie and occasionally Yellow Perch through the ice.

One other possible explanation for the slow fish growth observed in some fish species in Rose Lake is low productivity. Rose Lake sits very high in the Pine River watershed, and past limnological surveys have shown that Rose Lake has a very low Alkalinity. This is a common phenomenon seen in other inland lakes that sit high in their respective watersheds in the northwestern lower peninsula of Michigan.

Management Direction

The Walleye fishery of Rose Lake is extremely popular with riparian landowners and local anglers. In addition, the stocked Walleye are likely helping to keep the Bluegill population in good condition for anglers. Therefore, Walleye fingerlings should continue to be stocked into Rose Lake to maintain the Walleye fishery. While a few fish from unstocked years were present in the 2017 survey catch, the

bulk of the catch came from stocked years. The previous management regime called for stocking 27,750 spring fingerling Walleye (75/acre) every other year. However, the 2017 survey results indicate that Rose Lake is capable of supporting more Walleye, and that having more adult Walleye in the lake might benefit the growth and size structure of the panfish populations. It is unlikely that better Walleye population densities will be reached by stocking spring fingerlings, due to intense predation from panfish. Therefore, we will request that 7,400 (20/acre) fall fingerling Walleye be stocked on an every-other year basis. If fall fingerling Walleye are not available, then 37,000 spring fingerlings (100/acre) should be stocked, also on an every-other year basis. Rose Lake was most recently stocked in 2017 and 2018, so the next stocking event should occur in 2020.

Another comprehensive fisheries survey should be conducted within the next ten years to monitor the fish populations of Rose Lake. In particular, the Walleye population should be targeted to assess the effectiveness of the Walleye stocking program. In addition, fall electrofishing surveys following the protocols outline by Ziegler and Schneider (2000) should be conducted in years when Walleye are stocked into Rose Lake. Other goals of future fisheries surveys should include further scrutiny of the panfish, Largemouth Bass, and Northern Pike populations.

Eurasian milfoil will likely continue to require treatment, at least in some years. We recommend continued small-scale spot chemical treatments for dealing with the Eurasian milfoil, but only when absolutely necessary. We also recommend that native plants not be treated. A healthy aquatic plant community is critical to healthy fish communities. Many of the desired fish species in Rose Lake, including Walleye, Northern Pike, Largemouth Bass, Bluegill, Black Crappie, Pumpkinseed Sunfish, and Yellow Perch require healthy native aquatic plant communities.

The remaining riparian wetlands adjacent to Rose Lake should be protected and considered critical to the continued health of the lake's aquatic community. The Rose Lake shoreline is already more developed than most other lakes in Michigan. Future unwise riparian development and wetland loss may result in further 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). Also, 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 Rose Lake.

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Table 1. Fish stocked in Rose Lake, Osceola County, 1876-2018.

Year	Species	Number	Size	Strain
1876	Lake Whitefish	25,000	fry	Detroit River
1894	Common Carp	150	unknown	
1910	Walleye	75,000	fry	
1934	Bluegill	4,000	adult	
	Largemouth Bass	150	4 months	
1935	Yellow Perch	20,000	8 months	
1936	Largemouth Bass	500	yearling	
1937	Bluegill	55,000	4-5 months	
	Walleye	450,000	fry	
1938	Bluegill	14,000	3 months	
	Walleye	440,000	fry	
1939	Bluegill	14,000	3 months	
	Largemouth Bass	500	3 months	
	Walleye	440,000	fry	
	Yellow Perch	7,500	7 months	
1940	Bluegill	6,000	4 months	
	Largemouth Bass	400	3 months	
	Walleye	350,000	fry	
1941	Bluegill	5,000	3 months	
	Largemouth Bass	500	3 months	
1942	Bluegill	7,706	4 months	
	Walleye	200,000	fry	
1954	Walleye	10,000	spring fingerlings	
1957	Northern pike	40,000	spring fingerlings	
1958	Northern pike	4,197	spring fingerlings	
1959	Northern pike	1,000	spring fingerlings	
	Walleye	1,400	sublegal	
1960	Northern pike	26,000	spring fingerlings	
1961	Northern pike	4,134	spring fingerlings	
1976	Walleye	6,000	spring fingerlings	
1978	Walleye	1,107	spring fingerlings	
1979	Walleye	2,042	spring fingerlings	
1985	Walleye	30,672	fall fingerlings	
1988	Walleye	15,533	fall fingerlings	
1991	Walleye	15,249	spring fingerlings	
1994	Walleye	20,366	spring fingerlings	
	Walleye	790	fall fingerlings	
1995	Walleye	1,786	fall fingerlings	
1997	Walleye	20,951	spring fingerlings	Muskegon
1999	Walleye	18,501	spring fingerlings	Muskegon
2001	Walleye	22,075	spring fingerlings	Muskegon
2003	Walleye	2,645	spring fingerlings	Muskegon
2004	Walleye	39,025	spring fingerlings	Muskegon
2006	Walleye	41,498	spring fingerlings	Muskegon
	Walleye	10,662	fall fingerlings	Muskegon
2011	Walleye	27,250	spring fingerlings	Muskegon
2013	Walleye	32,446	spring fingerlings	Muskegon

Table 1. continued

2015	Walleye	27,538	spring fingerlings	Muskegon
2017	Walleye	27,037	spring fingerlings	Muskegon
2018	Walleye	27,045	spring fingerlings	Tittabawassee
	Walleye	1,503	fall fingerlings	Muskegon

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

Species	1938	1958	1959	1960	1961	1966	1975	1984	2002	2004	2017
Banded Killifish											X
Black Bullhead	X								X		X
Black Crappie	X	X	X	X	X	X		X	X		X
Blackstripe Topminnow									X		
Bluegill	X	X	X	X	X	X	X	X	X		X
Bluntnose Minnow									X		X
Bowfin							X				
Brown Bullhead						X					
Bullhead spp.			X					X			
Common Shiner	X									X	
Golden Shiner		X			X	X			X		X
Hybrid Sunfish						X					X
Iowa Darter											X
Largemouth Bass		X	X	X	X	X	X	X	X		X
Northern Pike	X	X	X	X	X	X	X	X	X		X
Pumpkinseed		X	X	X	X	X	X	X	X	X	X
Rock Bass	X	X	X	X	X	X	X	X	X	X	X
Sand Shiner									X		X
Walleye		X			X	X	X	X	X	X	X
White Sucker	X				X		X		X	X	X
Yellow Bullhead	X					X			X	X	
Yellow Perch	X	X	X	X	X	X	X	X	X	X	X

Table 3. Michigan DNR Master Angler awards issued for fish caught from Rose Lake, Osceola County, Michigan, 1994-2018.

Species	Number of Master Angler awards issued
Rock Bass	8
Bluegill	1
Pumpkinseed Sunfish	1
Yellow Perch	1
Largemouth Bass	1
Total:	12

Table 4. Number, weight, and length of fish collected from Rose Lake with trap nets, large mesh fyke nets, small mesh fyke nets, inland gillnets, seining, and electrofishing, June 12-15, and June 29, 2017.

Species	Number	Percent by number	Weight (pounds)	Percent by weight	Length range (inches) ¹	Average length	Percent legal size ²
Banded Killifish	13	0.4	0.1	0.0	1-2	2.1	
Black Bullhead	1	0.0	0.1	0.0	5-5	5.5	0 (7")
Black Crappie	72	2.1	37.0	4.9	3-12	8.5	93 (7")
Bluegill	2,129	63.1	247.6	32.8	1-8	5.1	26 (6")
Bluntnose Minnow	91	2.7	0.5	0.1	1-2	2.5	
Golden Shiner	1	0.0	0.0	0.0	3-3	3.5	
Hybrid Sunfish	25	0.7	3.0	0.4	3-7	5.2	28 (7")
Iowa Darter	1	0.0	0.0	0.0	2-2	2.5	
Largemouth Bass	94	2.8	70.4	9.3	1-20	8.8	23 (14")
Northern Pike	14	0.4	30.4	4.0	13-27	19.7	14 (24")
Pumpkinseed Sunfish	120	3.6	23.0	3.0	2-8	5.7	47 (6")
Rock Bass	159	4.7	72.1	9.5	2-11	7.2	74 (6")
Sand Shiner	148	4.4	0.5	0.1	1-2	2.2	
Walleye	11	0.3	50.7	6.7	1-28	22.0	91 (15")
White Sucker	2	0.1	1.9	0.3	13-13	13.5	
Yellow Bullhead	255	7.6	200.3	26.5	6-14	11.1	100 (7")
Yellow Perch	237	7.0	18.0	2.4	1-9	5.3	9 (7")
Total	3,373	100	755.6	95			

¹Note 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.

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

Table 6. Shoreline data for Rose Lake, Osceola County, compared with that for other medium-sized, shallow depth lakes in the Central Lake Michigan Management Unit (CLMMU) and statewide (from Wehrly et al. 2015). Sampling was conducted by MDNR Fisheries personnel on August 31, 2017.

	Total docks per km	Dwellings per km	Percent shoreline armoring	Submerged trees per km
Rose Lake	20.5	21.9	39.1	1.1
Average for medium-sized, shallow depth lakes in the CLMMU	15.3	17.5	53.5	12.0
Michigan statewide average for medium-sized, shallow depth inland lakes	2.9	5.7	8.9	46.3