Lower Herring Lake
Benzie County, T. 25N, R 16 W.
Herring Creek Watershed, last surveyed 2015

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Environment

Lower Herring Lake (Figure 1) is a 450 acre water body located approximately five miles south of the City of Frankfort in Michigan's northwestern Lower Peninsula. The lake is within the Central Lake Michigan Management Unit (CLMMU) of the Fisheries Division of the Michigan Department of Natural Resources (MDNR). Lower Herring Lake is part of the 25 square mile Herring Lakes watershed (Harrison 2003), which is comprised of Herring Creek and its tributaries (Upper Herring Lake, and Lower Herring Lake, Figure 2). Herring Creek originates from wetlands approximately five miles west of Lower Herring Lake and flows west before entering the eastern shoreline of Upper Herring Lake (Figure 2). After exiting Upper Herring Lake, Herring Creek flows through an extensive wetlands complex, then under M-22 and into Lower Herring Lake, and finally Lake Michigan. Herring Creek is the only tributary to Lower Herring Lake and is a Designated Trout Stream with self-sustaining populations of Brook Trout, Brown Trout, Rainbow Trout (steelhead) (Walker 1993), and possibly Coho Salmon as well.

Since the early 1900s, there has been a lake-level control structure on the outlet of Lower Herring Lake, which is less than ¼ mile from Lake Michigan. The legal lake level was established in 1964 at 580.50 feet. However, during westerly wind events on Lake Michigan, a sandbar forms at the mouth of Herring Creek, often blocking the flow for periods of time and raising the water level in the lake by as much as several feet. During these times the lake level control structure is often completely inundated, allowing fish (even non-jumping species from Lake Michigan) to gain access to Lower Herring Lake. There is no lake-level control structure on Upper Herring Lake, and fish can migrate into and out of that lake unimpeded.

The maximum depth of Lower Herring Lake is 60 feet, and approximately 80% of the lake is deeper than 15 feet. It does typically stratify in the summer; however oxygen levels below the thermocline tend to be low. The predominant substrates found in Lower Herring Lake are sand and gravel and the shoreline is about 60% developed with approximately 100 homes and cottages, a number of which are offered for rent. The south shoreline of the lake is primarily owned by the Watervale Resort, while most of the western shoreline of the lake is undeveloped and consists of northern hardwood forest. Much of the surrounding country is hilly and mostly forested with hardwoods, with predominately sandy soils. Some significant wetlands complexes exist in the watershed above Upper Herring Lake. Agriculture is a prominent land use, and is discussed as one of the primary sources of pollution (nutrient enrichment and harmful bacteria) in the Herring Lakes Watershed Management Plan (Harrison 2003). Neither Upper nor Lower Herring Lake has had issues with Eurasian watermilfoil. The Benzie County Conservation District has applied for aquatic nuisance permits for the lakes in recent years, but those were for phragmites control.

Public access to Lower Herring Lake is available at an MDNR boat launch on the northeastern shore of the lake (Figure 1). The MDNR launch has a paved launch ramp and has parking space for six vehicles

with trailers. Unfortunately there is not much shore fishing opportunity at the site. There are also small gravel boat ramps along the eastern shore of the lake at the ends of White Owl and Boo Hoo View Roads (Figure 1). There is parking space for a few vehicles with trailers at each of these sites. The public can also gain access to Lower Herring Lake at several other road ends.

History

The first recorded fish stocking event for Lower Herring Lake occurred in 1930 when Bluegill were stocked by the Michigan Department of Conservation (MDOC, the precursor to today's MDNR; Table 1). Between 1930 and 1944, MDOC stocked a mix of warm and coolwater species including Bluegill, Largemouth Bass, Smallmouth Bass, Walleye, and Yellow Perch. In 1964 and 1965, Brown Trout were stocked, apparently without success. The modern Walleye stocking program for Lower Herring Lake began in 1990, and Walleye have been stocked on a regular basis since then.

Much of the Lower Herring Lake internal file correspondence from the 1950s and 1960s revolves around the outlet dam and fish passage. At that time, there was no active Walleye stocking program, and it was believed that the Walleye fishery in Lower Herring Lake resulted from Walleye migration from Lake Michigan. File reports indicate that Walleye fishing on the lake was good at times, but sporadic.

Another file entry at the Cadillac MDNR office discusses the removal of 100 old saw logs from the bottom of Lower Herring Lake sometime in the early 1960s. The logs were likely remnants from the pre-1900s logging industry.

There is also discussion regarding different fish species in Lower Herring Lake. File correspondence (again at the Cadillac MDNR office) from the 1950s reported Rainbow Smelt, Muskellunge (unconfirmed), and White Bass at or in the outlet stream or the lake itself. Apparently there was also a die-off of Cisco in 1955. File correspondence from MDNR Fisheries Biologist Ralph Hay reported Channel Catfish being caught from Lower Herring Lake in 1997. Although none have been caught in any fisheries surveys, there was a Master Angler Channel Catfish caught from Lower Herring Lake in 2000 (Table 2). Three other exceptional fish (a Freshwater Drum, Rock Bass, and Smallmouth Bass) caught in Lower Herring Lake have been entered into the MDNR Fisheries Division Master Angler program since 1994.

MDOC and MDNR Fisheries Surveys

The first known fisheries survey on Lower Herring Lake was conducted by the MDOC in 1955 (Taube 1956). The survey was accompanied by a similar survey of Upper Herring Lake. In his report on the surveys, Taube (1956) concluded that the lakes harbored a wide variety of game and non-game fish species (Table 3), but that Upper Herring Lake was more productive than Lower Herring Lake. Taube dispelled the idea that the Yellow Perch population was stunted; age and growth analysis concluded that it was simply a "young" population consisting of mostly 2 and 3 year-old fish. Finally, he concluded that Walleye stocking was not necessary in the Herring Lakes at that time, and that natural reproduction would likely be sufficient to support the fishery.

The 1955 survey marked the only instance of Cisco being caught from Lower Herring Lake in an MDOC or MDNR survey (Table 3). There have been no captures or even reports of Cisco in Lower Herring Lake since then. One Spotted Gar, which is not endemic to the area, was recorded in the 1955 survey; it is suspected that the researchers actually caught and misidentified a Longnose Gar.

Another MDOC fisheries survey was conducted in May, 1967 using only inland gill nets. Although eight species were represented in the survey (Table 3), sparse numbers of fish were caught, and no age/growth analysis was conducted. No write up or analysis of the survey was completed.

The next comprehensive survey of Lower Herring Lake was conducted by the MDNR in May, 1986. This survey consisted of large mesh fyke nets, small mesh fyke nets, and inland gill nets. Modest numbers of gamefish, including Walleye, Northern Pike, and Smallmouth Bass were caught. Yellow Perch and Rock Bass were fairly numerous, but other panfish were sparse. Large numbers of White Sucker and Brown Bullhead were present.

A general fisheries survey of the Lower Herring Lake fish community was completed in May 1996 using fyke and inland gill nets (Tonello 2000). Healthy populations of Walleye and Smallmouth Bass were found. A total of 18 Walleye ranging from 8 to 24 inches were caught. The growth index for Walleye (for ages 3 and 4) was 1.7 inches greater than the State of Michigan average. Other notable species caught in the survey included Northern Pike, Yellow Perch, Black Crappie, Rock Bass, Rainbow Trout, White Sucker, and Redhorse. Most of the Rainbow Trout were over 22 inches in length, and were likely adult steelhead from Lake Michigan that had recently spawned in Herring Creek. White Suckers were extremely abundant (343 fish) and comprised approximately 81% of the catch biomass in the survey.

Another comprehensive fisheries survey of Lower Herring Lake was conducted by the MDNR in 2004 using trap nets, experimental graded-mesh inland gill nets, a seine, and a boom electrofishing boat. During the May netting portion of the 2004 survey, a total of 235 fish were caught, representing 15 different species (Table 4). A total of 34 Walleye ranging from 12-26 inches in length were captured. Smaller numbers of Largemouth Bass, Smallmouth Bass, Northern Pike, and Rainbow Trout were caught. Growth rates for Largemouth Bass, Rock Bass, Smallmouth Bass, and Yellow Perch were near the State average, while age 2 and 3 Walleye were growing very well, exceeding the State average by 1.8 inches (Table 5).

In the July seining and electrofishing portion of the 2004 survey, 1,541 fish were caught, representing 14 species (Table 6). The vast majority of these were Spottail Shiners and Logperch captured by seine. Eight Walleye from 12-24 inches were caught, and age 2 Walleye exceeded the State average length by 1.7 inches (Table 7). Smallmouth Bass were also well-represented in the seining and electrofishing catch, with 21 fish from 3-17 inches captured. Age 2 and 3 Smallmouth Bass, and age 1-3 Yellow Perch, were growing -0.5 inches below the State average.

Current Status

The most recent comprehensive fish community survey of Lower Herring Lake was conducted by the MDNR in the spring and summer of 2015. The primary purpose of this survey was to assess the status of all fish populations in Lower Herring Lake, with additional focus on the Walleye population. The

netting portion of the survey took place from May 18-22. The survey gear included three trap nets (12 net-nights), one small-mesh fyke net (two net-nights), and two experimental graded-mesh inland gill nets (six net-nights). The seining and electrofishing portion of the survey took place during the evening of June 29. In that effort, five seine hauls were conducted and three ten-minute transects were sampled by electrofishing. Shoreline assessment data were collected on July 2 and limnological data were collected on August 13. Yet another electrofishing effort targeting juvenile Walleye was conducted on November 4. This effort targeted spring fingerling Walleye that were stocked in June of 2015, in addition to determining the extent of walleye natural reproduction from the spring of 2015.

During the May 2015 netting survey of Lower Herring Lake, a total of 5,133 fish were caught, representing 27 different species (Table 8). Mimic Shiners were the most frequently collected species, with a total of 4,371 caught in the small mesh fyke nets. Gamefish species caught included Brown Trout, juvenile Coho Salmon, Largemouth Bass, Northern Pike, Rainbow Trout, Smallmouth Bass, and Walleye. A total of 45 Walleye from 10-23 inches were captured in this portion of the survey. A total of 21 Smallmouth Bass from 10-18 inches were also caught. Smallmouth Bass and Walleye both exhibited good growth rates (Table 9). Age 3-5 Smallmouth Bass were growing 1.3 inches above the State average, while age 2-5 Walleye were growing 0.6 inches above the State average.

Panfish numbers were relatively low, with 11 Black Crappie and 27 Bluegill caught. Rock Bass were common, with some individuals as large as 12 inches. Yellow Perch were common as well, although most were small. All panfish species exhibited good growth rates (Table 9). For example, age 5 Black Crappie were growing 2.3 inches above the State Average, Rock Bass (six different age groups) were growing 1.4 inches above the State average, and age 4 Yellow Perch exceeded the State average by 0.9 inches.

In the June 2015 seining and electrofishing portion of the Lower Herring Lake survey, a total of 448 fish were caught, representing 17 species (Table 10). Yellow Perch, Rock Bass, and Round Goby were the most commonly collected species from this portion of the survey. This survey showed relatively slow growth of yearling Walleye, as the average length of Age 1 fish was 1.1 inches below the State average (Table 11).

In the November electrofishing effort the only species captured was Walleye. A total of 152 Walleye from 4 to 20 inches were caught (Table 12); the majority were Age 0 fish that had been stocked in 2015 or were the result of natural reproduction. Six other year classes were also represented. Age 0 and Age 1 Walleye from this portion of the survey were growing 0.5 inches below the State average. The Walleye that were stocked in Lower Herring Lake in 2015 were marked with oxytetracycline, which leaves a mark on bony structures of the fish, allowing researchers to determine whether a fish is stocked or of wild origin. Approximately 43% of the age 0 Walleye caught in the November 2015 effort were marked and presumably stocked. The remainder were unmarked and presumably of wild origin.

Fish species that were not caught in the 2015 survey of Lower Herring Lake but had been reported in previous surveys included Alewife, Black Bullhead, Cisco, Emerald Shiner, Gizzard Shad, Longear Sunfish, Sand Shiner, Trout Perch, and White Bass (Table 3). New species captured in the 2015 survey included Coho Salmon, Common Carp, Round Goby, and Silver Redhorse.

Shoreline data were collected on July 2, 2015 (Table 13). Lower Herring Lake had 13.0 docks/km, 16.2 dwellings/km, 6.3% shoreline armoring, and 25.1 submerged trees/km. A limnological profile of Lower Herring Lake was conducted on August 13, 2015 (Table 14). The thermocline was located below 27 feet. From the surface to that point, the water temperature held steady, near 74°F. However, at 28 feet, the temperature dropped to 67.1°F, and then continued to drop steadily from there to the bottom (51 feet). The thermocline also showed a major break in dissolved oxygen levels. After holding steady near 10-11 ppm, dissolved oxygen dropped from 9.8 ppm at 27 feet to 3.9 ppm at 28 feet. Dissolved oxygen continued to drop steadily in the deeper water. At a depth of 42 feet, the dissolved oxygen was 0.3 ppm, well below the levels needed for fish to survive. Secchi depth was recorded as 13.0 feet, indicating relatively clear water. These limnological readings are similar to the results produced from previous limnology surveys of Lower Herring Lake.

Lower Herring Lake is moderately-developed with cottages and residences along much of its shoreline. Compared to other deep, medium-sized lakes in Michigan and in the CLMMU (basically the northwestern portion of the Lower Peninsula), Lower Herring Lake has an average number of docks and dwellings (Wehrly et al. 2015; Table 13). Lower Herring Lake did have more submerged trees/km than other CLMMU lakes, and more than other medium, deep lakes statewide (Wehrly et al. 2015).

Analysis and Discussion

The 2015 MDNR fisheries survey showed that Lower Herring Lake has a relatively diverse fish community. Because of its (sometimes) direct connection to Lake Michigan, it hosts many species not commonly found in many inland lakes in Michigan. However, due to its physical characteristics including habitat, substrate, depth, productivity, and oxygen levels, many species popular in other inland Michigan lakes do not thrive in Lower Herring Lake. For example, Lower Herring Lake will likely never host great sport fisheries for species such as Bluegill, Black Crappie, and Largemouth Bass because it does not have enough of the proper habitat for those species. A few individuals of those species will be present, and even occasionally grow to large size. In contrast, species like Rock Bass, Walleye, and Smallmouth Bass do thrive in Lower Herring Lake and should continue to provide good sport fisheries for the foreseeable future.

Walleye were numerous in both the 2004 and 2015 fisheries surveys of Lower Herring Lake. In the 2015 survey, eleven different year classes were present, from both stocked and non-stocked years. Walleye stocking has recently occurred in 2015, 2012, 2008, and 2005 (ages 0, 3, 7, and 10 in Tables 9, 11, and 12). Each of those year classes were represented in the survey, indicating that stocked Walleye are surviving and contributing to the Lower Herring Lake fishery. In particular, the 2012 and 2015 Walleye year classes were strong. Walleye were stocked into Upper Herring Lake in the same years that Lower Herring Lake was stocked, with additional Walleye stocked into Upper Herring Lake in 2009 and 2010 (Tonello 2016). Both of those year classes (ages 5 and 6) were also well-represented in the Lower Herring Lake survey catch. It is likely that Walleye migrate from Upper Herring Lake into Lower Herring Lake, and vice-versa.

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. It is very likely that the historical Walleye fishery in both Upper and Lower Herring Lake was based on natural reproduction within the watershed and not on Walleye migrating from Lake Michigan. If Walleye

stocking were to be discontinued on the Herring Lakes, walleye would likely persist in the lakes, but at lower levels that do not provide the level of sport fishery desired by the public.

Management Direction

The 2015 survey showed that Lower Herring Lake has a relatively healthy and diverse fish community. Species like Largemouth Bass, Bluegill, Black Crappie, Yellow Perch, and Northern Pike will continue to be present and provide some fishing opportunities without direct management. Species like Smallmouth Bass and Rock Bass will continue to provide excellent fisheries opportunities without direct management. Salmonids like Brown Trout, Rainbow Trout (steelhead), and possibly Coho Salmon will provide seasonal fisheries during migration periods, particularly when the water body is accessible to Lake Michigan. The lack of dissolved oxygen below the thermocline of Lower Herring Lake precludes the management of the lake for coldwater species such as trout.

Both the 2004 and 2015 fisheries surveys of Lower Herring Lake showed robust Walleye populations. 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 within a few years. Based on the results of the fall 2015 electrofishing survey, the 2015 stocking event was successful. Stocking clearly plays a role in the Lower Herring Lake Walleye fishery, and should continue. Lower Herring Lake has consistently seen low levels of natural reproduction as well, and this will supplement the stocked fish. The stocking regime should include stocking 16,000 (35.6 fish/acre) spring fingerling Walleye on a three year rotation, with the next stocking event occurring in 2018.

Any fisheries management planning for Lower Herring Lake should also include discussion about Upper Herring Lake (Tonello 2016). The two lakes are connected by a stream without barriers to fish passage. Because fish can freely move between both lakes, management actions or stocking strategies considered for one of the lakes could certainly impact the other. Herring Creek has not been sampled by the MDNR in many years. Electrofishing surveys of this stream should be conducted as soon as possible at multiple locations. Such a survey effort would complement the recent surveys of the two lakes and would provide a more complete picture of the Herring Lakes watershed. While Brown Trout, Brook Trout, and Rainbow Trout (steelhead) have been documented in historical surveys of Herring Creek (MDNR files, Cadillac), the presence of Coho Salmon in the 2015 Lower Herring Lake survey indicates that they are most likely reproducing in Herring Creek as well. To verify this, at least several locations between the two lakes should be surveyed, in addition to as many locations as possible upstream of Upper Herring Lake.

Cisco were not caught in the 2004 or 2015 survey of Lower Herring Lake, and they have not been caught in any MDOC/MDNR survey of the lake since 1955. It is likely that they are no longer present in the lake. Oxygen levels below the thermocline in Lower Herring Lake tend to be low and not conducive for coldwater species. Not enough historical limnological data exists to determine if this has changed over time and has caused the extirpation of the Cisco, which are listed as a State-threatened species in Michigan.

The presence of woody debris in the form of submerged trees likely contributes to the health of the overall Lower Herring Lake ecosystem, including its fish community. Woody debris provides many ecological benefits for many species. Aquatic insects feed on the wood and the algae that grows on the

wood. Many fish species use submerged wood for cover, and both Largemouth and Smallmouth Bass spawn in nests protected by woody debris. Mammals, birds, reptiles, and amphibians also use woody debris for basking, perching, and hunting. Therefore, all efforts should be made to protect the woody cover that currently exists in Lower Herring Lake particularly considering the amount of shoreline development that has already taken place.

The remaining undeveloped shoreline of Lower Herring Lake should be protected and considered 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 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).

References

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Figure 1. Lower Herring Lake, Benzie County, Michigan.

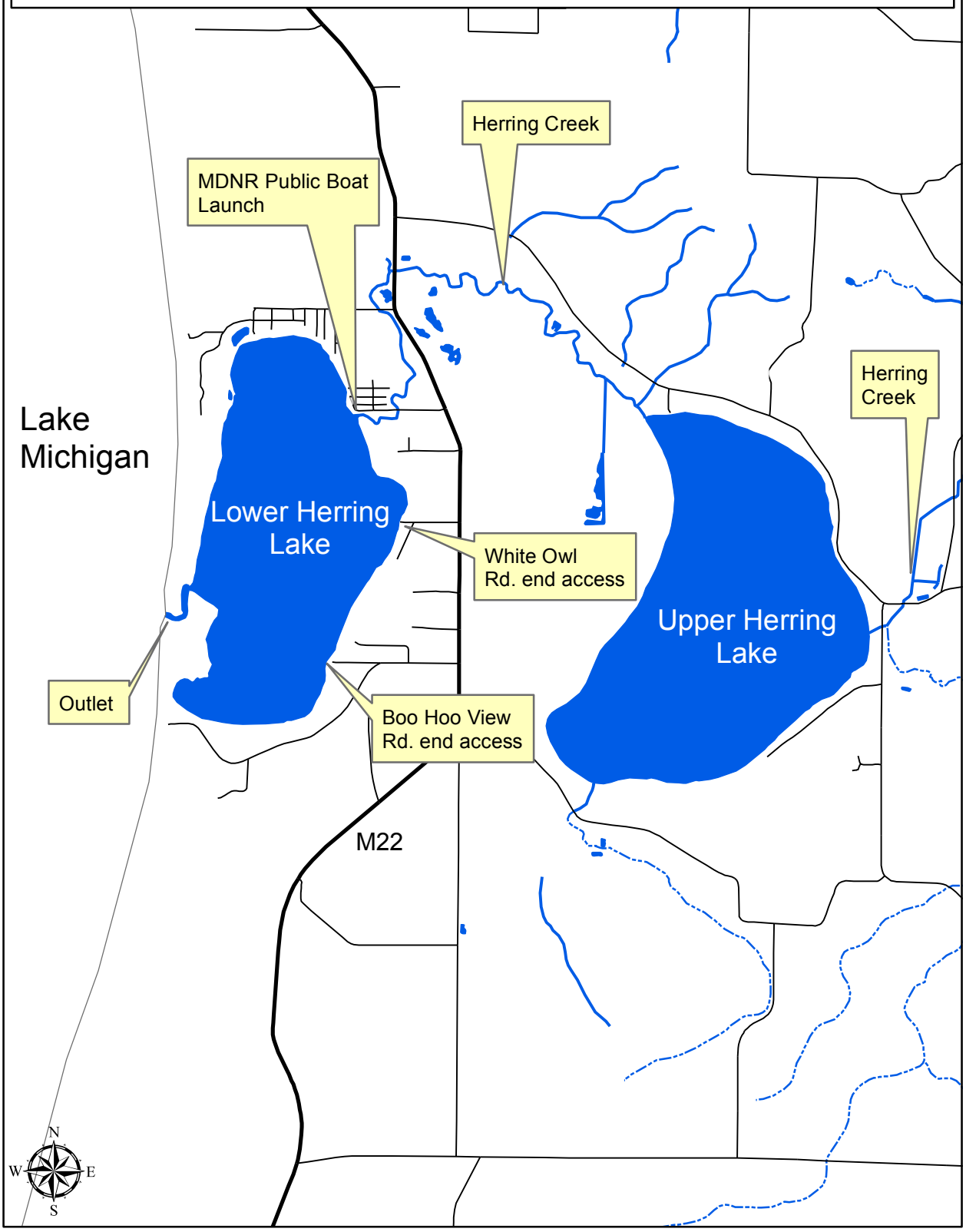

Figure 2. Herring Lakes watershed, Benzie County, Michigan.

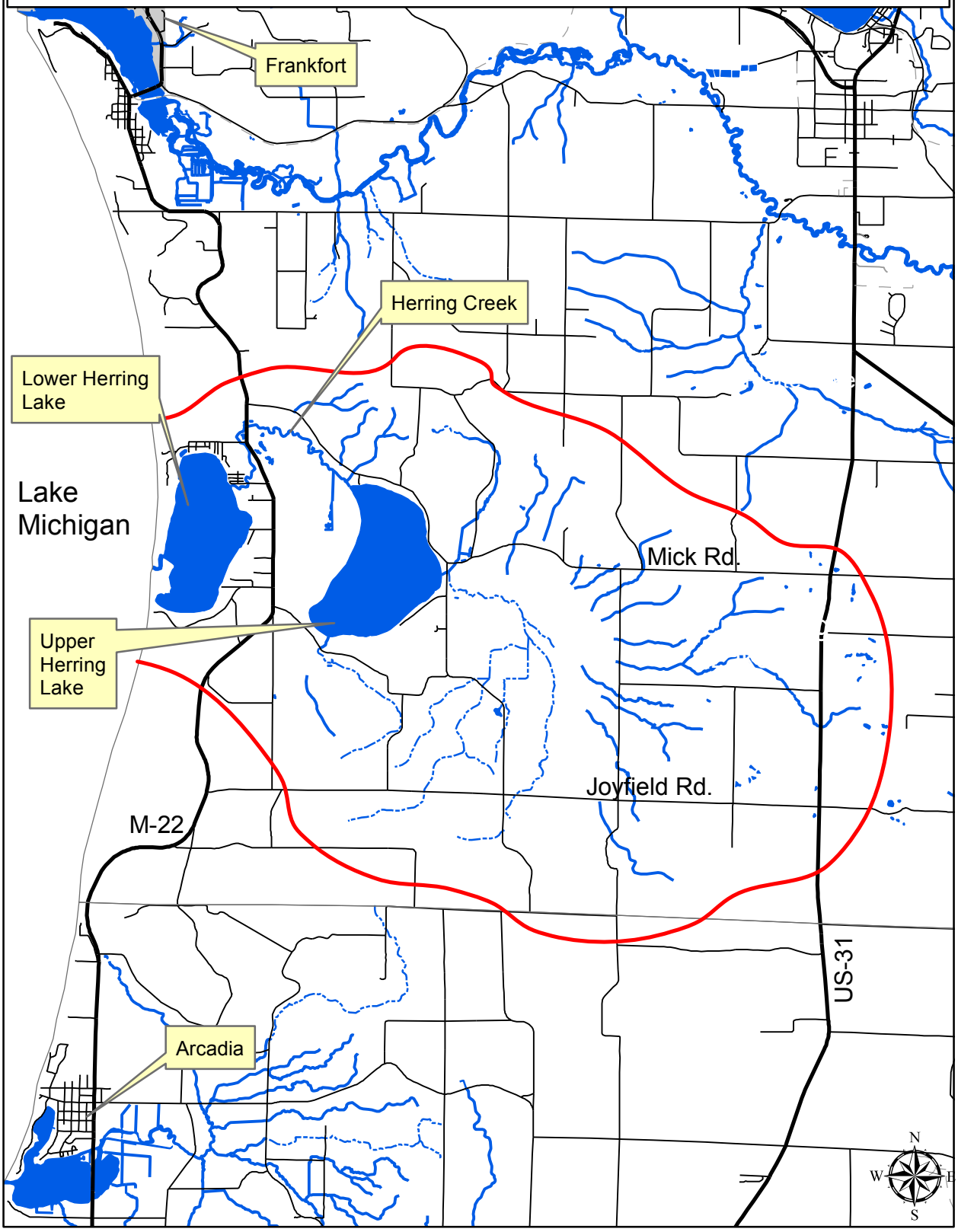

Table 1. Fish stocked in Lower Herring Lake, Benzie County, 1930-2015.

Year	Species	Number	Size	Strain
1930	Bluegill	350	yearlings	
1938	Bluegill	15,000	3-5 mo.	
	Largemouth Bass	500	3 mo.	
	Smallmouth Bass	2,000	5 mo.	
	Yellow perch	20,000	7 mo.	
1939	Bluegill	20,000	4 mo.	
	Smallmouth Bass	800	5 mo.	
	Walleye	180,000	fry	
1940	Bluegill	34,260	4 mo.	
	Smallmouth Bass	500	4 mo.	
	Walleye	80,000	fry	
1941	Bluegill	23,000	4 mo.	
	Largemouth Bass	1,000	4 mo.	
1942	Bluegill	15,000	4 mo.	
	Smallmouth Bass	600	4 mo.	
	Walleye	100,000	fry	
1943	Bluegill	600	yearlings	
	Largemouth Bass	700	4 mo.	
	Smallmouth Bass	200	4 mo.	
1944	Bluegill	500	yearlings	
	Largemouth Bass	500	3 mo,	
1964	Brown Trout	5,000	legal	
1965	Brown Trout	15,000	sublegal	
1990	Walleye	3,501	spring fingerlings	Bay De Noc
		7,507	spring fingerlings	Muskegon
1991	Walleye	3,868	spring fingerlings	Muskegon
1992	Walleye	4,183	spring fingerlings	Bay De Noc
1993	Walleye	12,992	spring fingerlings	Bay De Noc
1996	Walleye	18,005	spring fingerlings	Bay De Noc
1998	Walleye	1,000	fall fingerlings	unknown
1999	Walleye	16,095	spring fingerlings	Muskegon
2002	Walleye	18,898	spring fingerlings	Muskegon
2005	Walleye	20,539	spring fingerlings	Muskegon
2008	Walleye	25,066	spring fingerlings	Muskegon
2012	Walleye	22,428	spring fingerlings	Muskegon
2015	Walleye	16,158	spring fingerlings	Muskegon

Table 2. Michigan DNR Master Angler awards issued for fish caught from Lower Herring Lake, Benzie County, 1994-2015.

Species	Number of Master Angler awards issued
Rock Bass	1
Channel Catfish	1
Smallmouth Bass	1
Freshwater Drum	1
Total:	4

Table 3. Presence/absence of fish species in historical fisheries surveys of Lower Herring Lake, Benzie County.

Species	1955	1967	1986	1996	2004	2015
Alewife		x*		x*		
Banded Killifish	x					x
Black Bullhead			x			
Black Crappie	x			x		x
Bluegill	x		x		x	x
Bluntnose Minnow	x					x
Bowfin			x	x	x	x
Brown Bullhead	x		x	x	x	x
Brown Trout		x	x			x
Cisco (Lake Herring)	x					
Coho Salmon						x
Common Carp						x
Common Shiner	x					x
Creek Chub	x				x	
Emerald Shiner	x					
Freshwater Drum					x	x
Gizzard Shad			x			
Iowa Darter	x				x	x
Johnny Darter	x					x
Largemouth Bass					x	x
Logperch	x				x	x
Longear Sunfish	x					
Longnose Gar			x		x	x
Mimic Shiner	x					x
Northern Pike	x	x	x	x	x	x
Pumpkinseed	x				x	x
Quillback					x	x
Rainbow Trout			x	x	x	x
Redhorse spp.	x	x	x			
Rock Bass	x	x	x	x	x	x
Round Goby						x
Sand Shiner	x					
Shorthead Redhorse				x	x	x
Silver Redhorse						x
Smallmouth Bass	x	x	x	x	x	x
Spottail Shiner	x			x	x	x
Spotted Gar	x**					
Trout Perch	x					
Walleye	x	x	x	x	x	x
White Bass	x					
White Sucker	x	x	x	x	x	x
Yellow Bullhead	x		x		x	x
Yellow Perch	x	x	x	x	x	x

*Observed but not collected

**Was likely a mis-identified Longnose Gar

Table 4. Number, weight, and length of fish collected from Lower Herring Lake with trap nets and inland gillnets, May 24-27, 2004.

Species	Number	Percent by number	Weight (pounds)	Percent by weight	Length range (inches)[1]	Average length	Percent legal size[2]
Bluegill	1	0.4	0.3	0.1	7-7	7.5	100 (7")
Bowfin	3	1.3	17.3	3.7	19-28	24.8	
Brown Bullhead	58	24.7	50.4	10.8	10-14	12.3	100 (7")
Freshwater Drum	1	0.4	3.3	0.7	19-19	19.5	
Largemouth Bass	12	5.1	17.3	3.7	11-16	13.9	42 (14")
Longnose Gar	1	0.4	4.8	1.0	26-36	31.5	
Northern Pike	9	3.8	48.5	10.4	24-33	28.5	100 (24")
Quillback	1	0.4	1.7	0.4	15-15	15.5	
Rainbow Trout	3	1.3	22.0	4.7	25-29	27.2	100 (8")
Rock Bass	23	9.8	7.9	1.7	4-10	7.3	59 (6")
Shorthead Redhorse	30	12.8	148.4	31.8	12-26	22.9	
Smallmouth Bass	19	8.1	33.7	7.2	7-18	14.6	68 (14")
Walleye	34	14.5	55.8	12.0	12-26	16.0	35 (15")
White Sucker	22	9.4	51.6	11.1	12-21	17.8	
Yellow Perch	18	7.7	3.5	0.8	5-11	7.5	72 (7")
Total	235	100	466.5	100			

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

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

Table 5. Average total weighted length (inches) at age, and growth relative to the state average, for fish sampled from Lower Herring Lake with trap nets and inland gill nets, May 24-27, 2004. Number of fish aged is given in parenthesis.

Species	Age I	II	III	IV	V	VI	VII	VIII	IX	X	Mean Growth Index
Bluegill					7.5 (1)						--
Largemouth Bass				11.9 (2)	13.9 (8)	15.4 (3)					+0.7
Northern Pike			24.2 (2)	27.8 (4)	30.1 (2)	33.0 (1)					--
Rainbow Trout				27.2 (3)							--
Rock Bass				5.0 (7)	6.9 (7)	8.3 (9)	9.8 (3)	10.5 (1)			-0.3
Smallmouth Bass		7.6 (1)	10.9 (2)	12.4 (5)	15.7 (3)	16.2 (8)	17.7 (1)	18.1 (1)			+0.4
Walleye		12.8 (17)	15.1 (5)	18.6 (2)	19.4 (2)	21.3 (3)	21.9 (1)	21.4 (1)	23.7 (2)	26.4 (1)	+1.8
Yellow Perch			6.6 (9)	7.4 (9)	8.8 (2)			11.0 (1)			0.0

Table 6. Number, weight, and length of fish collected from Lower Herring Lake with electrofishing and seining, July, 1, 2004.

Species	Number	Percent by number	Weight (pounds)	Percent by weight	Length range (inches)[1]	Average length	Percent legal size[2]
Creek Chub	18	1.17	0.5	0.6	3-4	4.1	
Johnny Darter	1	0.06	0.0	0.0	2-2	2.5	
Largemouth Bass	2	0.13	0.8	1.0	7-10	9.0	0 (14")
Logperch	177	11.49	3.1	3.9	2-4	3.6	
Longnose Gar	1	0.06	1.6	2.0	26-26	26.5	
Pumpkinseed	1	0.06	0.1	0.1	6-6	6.5	100 (6")
Rock Bass	3	0.19	2.0	2.5	8-10	9.5	100 (6")
Shorthead Redhorse	9	0.58	23.0	28.9	16-23	18.3	
Smallmouth Bass	21	1.36	18.3	23.0	3-17	10.8	19 (14")
Spottail Shiner	1,172	76.05	5.4	6.8	1-4	2.1	
Walleye	8	0.52	9.9	12.5	12-24	14.5	13 (15")
White Sucker	16	1.04	9.9	12.5	1-21	6.4	
Yellow Bullhead	2	0.13	1.7	2.1	10-13	12.0	100 (7")
Yellow Perch	110	7.14	3.2	4.0	1-9	3.5	4 (7")
Total	1,541	100	79.5	100			

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

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

Table 7. Average total weighted length (inches) at age, and growth relative to the state average, for fish sampled from Lower Herring Lake with seining and electrofishing, July 1, 2004. Number of fish aged is given in parenthesis.

	Age									
Species	I	II	III	IV	V	VI	VII	VIII	IX	Mean Growth Index
Largemouth Bass		7.4 (1)	10.2 (1)							--
Pumpkinseed			6.0 (1)							--
Rock Bass						9.0 (2)	10.0 (1)			--
Smallmouth Bass	3.2 (2)	7.7 (5)	11.3 (9)		14.2 (2)	17.0 (1)	15.6 (1)			-0.5
Walleye		13.1 (7)							24.1 (1)	+1.7
Yellow Perch	3.5 (15)	4.7 (12)	6.7 (6)	8.2 (1)	9.5 (1)					-0.5

Table 8. Number, weight, and length of fish collected from Lower Herring Lake with trap nets, small mesh fyke nets, and inland gillnets, May 18-22, 2015.

Species	Number	Percent by number	Weight (pounds)	Percent by weight	Length range (inches)[1]	Average length	Percent legal size[2]
Black Crappie	11	0.21	11.4	2.1	10-13	12.0	100 (7")
Bluegill	27	0.53	1.0	0.2	1-8	2.6	7 (6")
Bluntnose Minnow	4	0.08	0.1	0.0	2-3	3.0	
Bowfin	1	0.02	3.5	0.6	21-21	21.5	
Brown Bullhead	16	0.31	13.8	2.5	6-13	12.2	94 (7")
Brown Trout	1	0.02	3.2	0.6	19-19	19.5	100 (8")
Coho Salmon	7	0.14	0.0	0.0	1-1	1.5	0 (8")
Common Shiner	3	0.06	0.1	0.0	1-4	3.2	
Freshwater Drum	1	0.02	12.6	2.3	29-29	29.5	
Iowa Darter	23	0.45	0.0	0.0	1-2	1.6	
Johnny Darter	10	0.19	0.1	0.0	2-2	2.5	
Largemouth Bass	10	0.19	17.9	3.3	13-16	15.0	90 (14")
Longnose Gar	6	0.12	15.5	2.9	27-31	30.5	
Mimic Shiner	4,371	85.15	78.4	14.4	1-2	1.5	
Northern Pike	13	0.25	47	8.7	11-36	23.7	38 (24")
Quillback	1	0.02	4.6	0.8	21-21	21.5	
Rainbow Trout	2	0.04	9.5	1.7	21-25	23.5	100 (8")
Rock Bass	219	4.27	114.3	21.0	1-12	8.2	79 (6")
Round Goby	163	3.18			1-2	2.2	
Shorthead Redhorse	1	0.02	1.2	0.2	14-14	14.5	
Silver Redhorse	4	0.08	23.1	4.3	26-27	26.8	
Smallmouth Bass	21	0.41	37.6	6.9	10-18	15.0	86 (14")
Spottail Shiner	1	0.02	0.0	0.0	4-4	4.5	
Walleye	45	0.88	62.4	11.5	10-23	15.7	62 (15")
White Sucker	26	0.51	80.2	14.8	2-22	19.4	
Yellow Bullhead	2	0.04	1.3	0.2	10-11	11.0	100 (7")
Yellow Perch	144	2.81	4.4	0.8	1-12	2.6	7 (7")
Total	5,133	100	543.2	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 9. Average total weighted length (inches) at age, and growth relative to the state average, for fish sampled from Lower Herring Lake with trap nets and inland gill nets, May 18-22, 2015. Number of fish aged is given in parenthesis.

Species	Age I	II	III	IV	V	VI	VII	VIII	IX	X	XII	Mean Growth Index
Black Crappie					11.7 (8)	12.1 (1)			13.7 (2)			+2.3
Bluegill		3.5 (1)	3.7 (2)	7.9 (2)								--
Brown Trout				19.1 (1)								--
Largemouth Bass				14.5 (4)	14.8 (4)	16.5 (2)						--
Northern Pike	11.0 (1)	18.0 (2)	21.8 (4)		24.3 (4)	36.2 (1)		30.6 (2)				--
Rainbow Trout			24.1 (3)									--
Rock Bass			5.2 (21)	7.0 (14)	8.6 (13)	9.7 (12)	10.8 (9)	10.4 (1)	11.1 (5)	12.1 (2)	11.8 (1)	+1.4
Smallmouth Bass			14.3 (2)	13.6 (9)	15.9 (10)							+1.3
Walleye		11.4 (5)	13.8 (15)	16.4 (6)	18.5 (10)	18.3 (4)	20.9 (1)	19.8 (1)		19.2 (2)		+0.6
Yellow Perch	3.1 (1)	4.4 (1)	7.6 (3)	8.4 (5)	10.0 (2)	12.1 (1)						+0.9

Table 10. Number, weight, and length of fish collected from Lower Herring Lake with electrofishing and seining, June 29, 2015.

Species	Number	Percent by number	Weight (pounds)	Percent by weight	Length range (inches)[1]	Average length	Percent legal size[2]
Banded Killifish	7	1.56	0.0	0.0	1-2	2.2	
Bluegill	6	1.34	0.2	0.4	1-4	3.7	0 (6")
Common Carp	1	0.22	8.5	17.1	26-26	26.5	
Iowa Darter	3	0.67	0.0	0.0	1-2	1.8	
Largemouth Bass	1	0.22	1.6	3.2	14-14	14.5	100 (14")
Logperch	26	5.80	0.4	0.8	2-3	3.5	
Longnose Gar	1	0.22	3.6	7.2	33-33	33.5	
Mimic Shiner	15	3.35	0.2	0.4	1-2	2.3	
Northern Pike	1	0.22	1.6	3.2	19-19	19.5	0 (24")
Pumpkinseed	1	0.22	0.0	0.0	2-2	2.5	0 (6")
Rock Bass	52	11.61	16.8	33.7	2-11	6.5	54 (6")
Round Goby	44	9.82			1-2	2.1	
Smallmouth Bass	2	0.45	2.5	5.0	13-13	13.5	0 (14")
Walleye	22	4.91	9.1	18.3	5-16	9.9	5 (15")
White Sucker	16	3.57	0.0	0.0	1-1	1.5	
Yellow Bullhead	1	0.22	0.6	1.2	10-10	10.5	100 (7")
Yellow Perch	249	55.58	4.7	9.4	1-9	3.0	3 (7")
Total	448	100	49.8	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 11. Average total weighted length (inches) at age, and growth relative to the state average, for fish sampled from Lower Herring Lake with seining and electrofishing, June 29, 2015. Number of fish aged is given in parenthesis.

Species	Age I	II	III	IV	V	VI	VII	VIII	IX	Mean Growth Index
Bluegill		3.1 (2)	3.5 (3)							--
Largemouth Bass				14.7 (1)						--
Northern Pike		19.6 (1)								--
Rock Bass		3.5 (6)	5.9 (14)	7.8 (12)	8.9 (2)	10.0 (3)	11.0 (4)		11.1 (1)	+0.4
Smallmouth Bass			13.2 (1)	13.3 (1)						--
Walleye	7.1 (13)	11.5 (2)	13.1 (4)	15.1 (3)						-1.1
Yellow Perch	3.3 (12)	4.6 (8)	6.2 (11)	7.8 (6)	8.4 (1)					-0.8

Table 12. Results of a fall electrofishing effort targeting Walleye on Lower Herring Lake on November 4, 2015, Benzie County, Michigan.

Lower Herring Lake acreage:	450
Miles of shoreline sampled:	4.01
Hours of electrofishing:	1.9
Water temperature:	54.3

Year Class	Age	# Walleye captured	Catch Rate (# Walleye/mile of shoreline sampled)	Catch Rate (# Walleye/hour of electrofishing
2015*	0	132	32.92	69.47
2014	I	8	2.00	4.2
2013	II	3	0.75	1.6
2012*	III	4	1.00	2.1
2010	V	3	0.75	1.6
2008*	VII	1	0.25	0.5
2003	XII	1	0.25	0.5

*stocked year class

Table 13. Shoreline data for Lower Herring Lake, Benzie County, compared with that for other medium, deep lakes in the Central Lake Michigan Management Unit (CLMMU) and statewide (from Wehrly et al. 2015). Lower Herring Lake sampling was conducted by MDNR Fisheries personnel on July 2, 2015.

	Total docks per km	Dwellings per km	Percent shoreline armoring	Submerged trees per km
Lower Herring Lake	13.0	16.2	6.3	25.1
Average for medium, deep lakes in the CLMMU	10.5	16.3	19.2	4.9
Michigan statewide average for medium, deep inland lakes	12.7	16.7	25.3	14.5

Table 14. Water temperature, dissolved oxygen and pH profile for Lower Herring Lake, Benzie County, August 13, 2015.

Depth (ft)	Temperature (°F)	Dissolved oxygen (ppm)	pH
0	74.2	10.4	8.6
3	74.2	11.0	8.7
6	74.2	11.1	8.7
9	74.2	11.1	8.8
12	74.2	11.0	8.8
15	74.2	10.9	8.8
18	74.2	10.1	8.8
21	74.2	10.6	8.8
24	74.2	10.4	8.8
27	74.1	9.8	8.8
28	67.1	3.9	8.5
29	65.7	3.5	8.2
30	64.3	3.5	8.2
31	63.3	3.2	8.1
32	62.6	2.9	8.1
33	61.4	2.4	8.0
34	60.6	2.1	8.0
35	58.9	1.9	8.0
36	58.3	2.0	8.0
37	57.6	1.9	7.9
38	56.0	1.6	7.9
39	55.1	1.3	7.9
42	52.6	0.3	8.2
45	51.2	0.2	8.1
48	50.4	0.2	8.1
51	50.2	0.2	8.1