Morrison Lake
Ionia County; T6N/R8W/S35-36
Grand River Watershed; 2023

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Environment

Morrison Lake is a 328-acre natural lake located in southwestern Ionia County in Michigan's Lower Peninsula (Figure 1). The lake is approximately 5 miles south of the village of Saranac and approximately 9 miles northwest of the village of Lake Odessa. Morrison Lake has 4.3 miles of shoreline which is predominantly occupied by residential houses. The catchment around Morrison Lake is dominated by agricultural lands (72%) interspersed with urban (11%), forested (8%), and wetland areas (8%) (Figure 2). Most of the agricultural lands are used for corn and soybean production and are tilled annually.

Morrison Lake is a relatively shallow water body with a maximum depth of 36 feet. It has one outlet, Lake Creek, which is a designated trout stream in its lower reaches. A dam on Lake Creek is used to control water surface elevations on Morrison Lake. Three small unnamed tributaries discharge into Morrison Lake. The lake has large littoral shoals that extend out from the western and southeastern shores. The drop-offs are steeper along the north-central, northeast, and south-central shorelines. Marl substrate covers most of the nearshore zone, but there are patches of sand and pulpy peat. Historically, the lake had extensive emergent and submergent aquatic vegetation beds. Over time, the lake has shifted from a vegetation dominated system to an algae dominated system with poor water clarity.

There is one public boat launch, a Michigan Department of Natural Resources (DNR) boating access site, located on the northern shore of Morrison Lake. The boating access site has a paved boat ramp, one skid pier, a pit toilet, and parking for 23 vehicles with trailers. The access site is staffed by DNR Parks and Recreation Division from Memorial Day weekend through Labor Day weekend to help with traffic control and potential issues with limited parking.

History

Morrison Lake has historically been a lake known for good panfish and bass fishing, heavy nutrient loading, semi-regular fish kills, and persistent challenges managing aquatic vegetation and algae. Fisheries surveys have been conducted on Morrison Lake since 1891 utilizing a variety of different gear types. The initial fish survey of Morrison Lake occurred on July 28-30, 1891 by an unknown investigator. The fish species documented in Morrison Lake included: "Speckled Bass" (most likely Black Crappie), Bluegill, sunfish (most likely Pumpkinseed), bullheads, and Bowfin. The first intensive fish survey of Morrison Lake was completed in 1941 by the Michigan Department of Conservation (the precursor of the present-day Michigan DNR). Gill nets and seines were used to sample the fish community. Bluegill was the most abundant fish species, but numerous other fish species were present (Table 1). In 1941, Morrison Lake was known for having good Bluegill and Largemouth Bass fishing with poor Black Crappie fishing. Bluegills, Largemouth Bass, and Yellow Perch were stocked in Morrison Lake during 1933-1941 (Table 2). Throughout the state, stocking programs for these species were discontinued after

research indicated that they were able to maintain fisheries solely through natural reproduction and supplemental stocking was not necessary (Cooper 1948).

Additional fish surveys were completed in Morrison Lake in 1959, 1961, 1968, 1969, 1978, and 1983. Bluegill continued to dominate the catch of these surveys with similar fish species caught in most years (Table 1). Bluegill population structure can be compared across years utilizing the Schneider Index. The Schneider Index provides a score for the Bluegill fishery in a lake based upon the size distribution of fish captured. The Schneider index ranges from 1 (very poor) to 7 (superior) by utilizing a standardized equation (Schneider 1990). The Schneider Index was calculated for all fish surveys completed on Morrison Lake since 1959 (Table 3). As with any metric, the Schneider Index has its own limitations and biases. It should be noted that when seines or electrofishing is the primary gear the index is typically lower than when fish are collected with trap nets and fyke nets.

In 1968, a chemical reclamation project was proposed on Morrison Lake followed by a fish restocking program. The project was slated to use rotenone to eliminate the fish population in Morrison Lake which had become overrun by Common Carp and then restock the lake with various fish species including Rainbow Trout, Brook Trout, Brown Trout, Largemouth Bass, Walleye, Muskellunge, Black Crappie, and Bluegill. The project was never completed due to opposition from lakefront property owners. In 1978, a new proposal was initiated to thin the panfish population with antimycin, but similar to the 1968 plan this proposal was not completed.

Most of the concerns which led to the treatment proposals were related to the abundant Common Carp population, the hypereutrophic nature of the lake (high in nutrients), and the poor fishing for panfish species. Several attempts were made in latter part of the 20th century to start addressing these concerns. In 1980, a sanitary sewer system was installed around the lake to improve water quality by decreasing inputs of nutrients from leaky septic systems. In 1984 and 1985, the Michigan Department of Environmental Quality (DEQ) Surface Water Quality Division studied the phosphorus amounts in Morrison Lake. Their studies concluded that phosphorus was coming from the agricultural watershed and that internal loading from the lake sediments sustained the degraded water quality (Hilt and Gustafson 1988). Following this study, a Morrison Lake Improvement Board was founded to study methods and recommend treatments to deal with the water quality problems. Initial recommendations included treating the lake with alum to reduce the release of phosphorus from the lake sediments and to bind the free-floating phosphorus to the sediments.

A DNR fisheries survey conducted in 1988 indicated that the Common Carp population density was much lower than previous years and the gamefish community was more abundant than observed during surveys completed in the 1970s and early 1980s. Rotenone proposals were abandoned following the 1988 survey and instead Walleye stocking was initiated (Table 2). Walleye were stocked annually from 1988 through 1999 (with the exception of 1995 and 1998). Surveys conducted during 1994 through 1999 showed acceptable survival and average growth of stocked Walleyes. However, Walleye stocking was discontinued in 2000 due to concerns regarding ongoing treatments (herbicide, algaecide, and alum), changes in vegetation abundance and water quality, scarcity of forage fish, and the lack of suitable coolwater habitat for Walleye during the summer months. No fish have been stocked in Morrison Lake since 1999.

Sampling conducted during late May-early June 2003 corroborated concerns regarding declining abundance of forage fish. Predators (Largemouth Bass, Walleye, and Bowfin) made up 56% of the biomass, which was above the 20-50% range recommended by Schneider (2000a). A temperature and dissolved oxygen profile completed in the deep basin of the lake on August 13, 2003 also revealed harsh conditions for Walleye, Northern Pike, and other coolwater species. The dissolved oxygen concentration remained above 6 ppm to a depth of 9 feet. At this depth, the water temperature was 77oF. By 12 feet, the temperature had only dropped to 75oF, but the dissolved oxygen concentration was below 0.5 ppm. There was very little native vegetation present. There was Chara and some Nuphar spp. of lily pads, and the rest of the vegetation consisted of very dense Curlyleaf Pondweed, an exotic species that provides poor fish habitat. Algae was also very thick. The water was green and very turbid, and the Secchi disk depth was only 2.5 feet. The total phosphorus concentration was 0.166 ppm, which is in the eutrophic (high nutrient) range.

Water quality and vegetation management continue to be difficult issues on Morrison Lake. Declining water transparency, seawall installation, colonization by invasive species, wave action from boats, and herbicide treatments have altered the vegetation community. Late summer vegetation surveys conducted by PLM Lake & Land Management Corporation during 2014-2022 have shown oscillations in native plant cumulative cover value (CCV) over time. The 2022 data indicated exceptionally low abundance of submersed plants, whereas the CCV for native emergent plants was on par with previous sampling years. Efforts to limit internal phosphorus loading from lake sediments include an alum treatment in 2008 and repeated Phoslock treatments during 2020-2023. Lakefront property owners have the ability to control nutrient runoff from their own property through installation of buffer strips with dense native vegetation, rain gardens, and proper disposal of yard waste. However, Michigan Department of Environmental Quality (2008) determined that 87% of the external phosphorus load to Morrison Lake was from agricultural land. Various programs through the Michigan Department of Agriculture and Rural Development and the Michigan Department of Environment, Great Lakes, and Energy are intended to reduce nutrient runoff from agricultural properties.

Current Status

In May 2022, Morrison Lake was surveyed utilizing a variety of gear including large-mesh fyke nets, experimental gill nets, trap nets, and nighttime electrofishing to assess the fish community (Figure 3; Table 4). The gear was deployed during the standard sampling period of the DNR's Status and Trends Program (STP). The STP utilizes standardized protocols to collect fisheries data on lakes randomly selected across the state. Although Morrison Lake was not one of the randomized lakes chosen for sampling in 2022, the gear and timing matched portions of the STP protocol to allow for comparisons to spatial and temporal trends in fish populations statewide. The second and third electrofishing transects conducted in 2022 were exceptions to STP protocols because only Largemouth Bass were targeted and collected during those sampling efforts. All fish captured in Morrison Lake were measured for total length to inch bin (i.e., 7 inch bin = 7.0-7.9 inches). Spine or scale samples for age and growth analysis were collected from the first 10 individuals per gamefish species per inch bin, and total lengths for these individuals were recorded to the nearest tenth of an inch. Weights for all species were calculated from the length-weight regression coefficients developed by Schneider et al. (2000b). Weighted mean length at age and age frequencies were calculated using the procedures developed by Schneider (2000b), and mean growth indices were derived from Schneider et al. (2000a). On August 2, 2022, water quality,

shoreline development, and nearshore habitat were assessed following methods in the STP (Wehrly et al. DRAFT).

A total of 2,339 fish were captured during the 2022 survey (Table 5). Fish were not individually marked, so there is the potential that individuals were captured more than once. Bluegills dominated the catch with 1,611 fish captured, representing nearly 69% of the catch by number and 38% of the catch by weight (Table 5). Bluegills varied in length from 3 inches to 10 inches with most of the fish in the 6- and 7-inch bins (Figure 4). Seven age classes of Bluegills were captured during the survey (ages 2-8; Figure 5). The mean growth index was +0.8 with mean lengths similar to slightly above statewide averages across all age classes (Table 6). The Schneider Index for Morrison Lake Bluegills collected in trap and fyke nets was 5.3, which is between good and excellent.

Black Crappie (n = 225) was the third most abundant species captured during the 2022 survey (Table 5). Black Crappies varied in length from 4 inches to 11 inches (Figure 6). Six age classes of Black Crappies were captured (age 2-7; Figure 7). On average Black Crappies in Morrison Lake were growing similarly to Black Crappies statewide (Table 6). Other panfish species captured included: Green Sunfish (n=1), Hybrid Sunfish (n=5), and Pumpkinseed (n=9).

Predators composed 26% of the total fish biomass. Largemouth Bass (n = 133) were the dominant predators in terms of both numbers and biomass. Eight age classes of Largemouth Bass (age 2-9) were present (Figure 8). Growth appeared to be above average, as evidenced by the mean growth index of +1.1 (Table 6). Fifty-nine percent of the Largemouth Bass were at least 14 inches in length making them legal for harvest (Figure 9).

Other gamefish species captured included Northern Pike and Yellow Perch. Seven Northern Pike were collected ranging in length from 22 inches to 33 inches. Three pike were at least 24 inches in length making them legal for harvest. Twenty-five Yellow Perch were captured, which represented three age classes (ages 3-5). Most of the Yellow Perch were over 7 inches in length making them desirable for most anglers to harvest. Mean lengths for the three age classes of Yellow Perch were similar to slightly above statewide averages (Table 6).

Nongame fish species captured during the 2022 survey included: Bluntnose Minnow, Bowfin, Common Carp, Common Shiner, Golden Shiner, White Sucker, and Yellow Bullhead. These fish species are either forage fish or commonly considered undesirable fish to catch. Most were found in low abundance in the lake with the exception of Yellow Bullhead, which were the second most abundant fish species captured with 261 individuals.

On August 2, 2022, the water quality and shoreline sampling was completed on Morrison Lake. The dissolved oxygen and temperature profile was taken in 33 feet of water. The epilimnion consisted of the top 14 feet of the water column. Water temperatures in the epilimnion were warm and varied from 78.5 °F to 77.7°F (Figure 10). Dissolved oxygen in the epilimnion was between 9.55 parts per million (ppm) to 5.11 ppm. The metalimnion (zone of thermal change) began at 15 feet and continued to the lake bottom. Water temperatures dropped from 77.3°F at 15 feet to 52.1°F at 30 feet. Dissolved oxygen concentrations declined quickly within the metalimnion, starting at 2.85 ppm at 15 feet and falling to 0.8 ppm by 17 feet. From 18 feet to the bottom, Morrison Lake was hypoxic with no dissolved oxygen present. Water chemistry sampling was completed at the same location as the temperature and dissolved

oxygen profile. Total alkalinity was 178 mg/L, total nitrogen was 0.609 mg/L, total phosphorus was 0.012 mg/L, chlorophyll a was 0.0111 mg/L, and the Secchi depth was 2.5 feet.

In addition to the temperature and dissolved oxygen profile, shoreline sampling was conducted to assess the number of dwellings, docks, submerged trees, and percentage of the shoreline that was armored. A total of 243 docks and 231 dwellings were counted on Morrison Lake in 2022. Sixty-six percent of the shoreline of Morrison Lake was armored. The estimated density of logs along the shoreline was 20.3 logs/mile.

On June 22, 2023, a one-night electrofishing survey was conducted to collect additional information regarding Bluegill year class strength in Morrison Lake. Three 10-minute transects were randomly chosen and sampled with a boat electrofishing unit. Only Bluegills were collected during this survey. All Bluegills were measured to inch bin. A total of 414 Bluegills were captured ranging in length from 1.0-7.9 inches. Bluegills in the 2-inch bin were the most numerous with 110 individuals captured (Figure 11). All inch bins between 1 and 7 had at least 10 individuals sampled. The 2023 electrofishing survey captured four age-classes of Bluegill (age 1-4; Table 7). Fifty-five percent of the Bluegills collected were age-1 and 32% of the Bluegill captured were age-4. Only 12% of the Bluegills were either age-2 or age-3. These Bluegills would have belonged to the 2020 or 2021 cohorts, respectively.

Analysis and Discussion

At the time of the 2022 water quality sampling, fish were limited to the top 14 feet of the water column. Dissolved oxygen levels were too low for zooplankton below 17 feet. The total alkalinity was indicative of a hardwater lake with substantial buffer capacity. Phosphorus and nitrogen are key nutrients that set the biological productivity of a lake. Nitrogen is the limiting nutrient when the ratio of total nitrogen to total phosphorus is <10:1, and phosphorus is the limiting nutrient when this ratio is >15:1 (Shaw et al. 2004). In Morrison Lake, the ratio of total nitrogen to total phosphorus was 51:1. Thus, phosphorus is the limiting nutrient in this system. The phosphorus concentration was within the range of a mesotrophic (moderate nutrients) lake, whereas the chlorophyll a and Secchi depth were consistent with a eutrophic (high nutrients) lake (Carlson and Simpson 1996).

Shoreline habitat variables were compared to data compiled by Kevin Wehrly (DNR - Fisheries Division) for STP surveys completed from 2002 through 2007 statewide and in SLMMU. The numbers of docks and dwellings per mile on Morrison Lake were well above the 75th percentiles for lakes statewide and lakes in SLMMU. Similarly, the percentage of shoreline armored on Morrison Lake (i.e., 66%) was well above the 75th percentiles for other lakes in SLMMU (47%) and statewide (31%). Surprisingly the density of submerged trees in Morrison Lake (20.3/mile) also was above the 75th percentile for lakes in SLMMU and between the 50th and 75th percentiles for lakes statewide. The vast majority of the submerged trees were found along the remaining areas of natural shoreline.

Compared to other lakes in SLMMU, Morrison Lake appears to have high densities of adult Bluegills based upon catch-per-unit-effort (CPUE). CPUE provides an index of relative abundance and facilitates comparisons across lakes and sampling years. Bluegill CPUE was compared to CPUE data from other STP surveys in SLMMU and statewide from 2002-2021. The Bluegill CPUE in large-mesh fyke nets in Morrison Lake in 2022 was 106 Bluegills/net night. This value was above the 75th percentiles for Bluegills per net night when compared to lakes across the state and in SLMMU. Although adult Bluegills

were abundant, zero age-1 and only three age-2 Bluegills were captured during the 2022 survey. The sampling design was at least partially responsible for the observed age distribution. Trap nets and large-mesh fyke nets do not effectively sample juvenile Bluegills. However, electrofishing is a suitable method for collecting both juveniles and adults. Only seven Bluegills smaller than 5 inches were caught during the first 10 minutes of electrofishing, and very few juvenile Bluegills were observed during the 20 minutes of targeted Largemouth Bass electrofishing effort. The apparent absence of the 2021 year class and near absence of the 2020 year class was concerning.

After the 2022 survey, SLMMU staff identified multiple plausible explanations for the observed recruitment pattern for Bluegills. In particular, poor recruitment of the 2021 and 2022 Bluegill cohort may be related to related to regional weather patterns. However, if this was the mechanism, we would have expected to find similar year class failures in other SLMMU lakes. Data from other 2022 SLMMU STP surveys did not show this pattern (Figure 12).

Alternatively, Phoslock applications may be another mechanism for Bluegill recruitment failures. Phoslock applications began on June 2, 2020, and occurred roughly every 2-3 weeks through the summer. In 2021, there were seven Phoslock treatments between May 18 and September 7. Although adult Bluegills seem to be able to tolerate exposure to the lanthanum in this product, it could be toxic to Bluegill fry. Herrmann et al. (2016) found that sensitivity to lanthanum was greater for eggs and fry than for older fish. Another possible explanation is that the columnaris disease outbreaks in Morrison Lake in 2021 were responsible for the scarcity of the 2020 and 2021 year classes of Bluegills in Morrison Lake. Columnaris can lead to mortality of all age groups, but young fish are particularly susceptible to this disease (LaFrentz et al. 2012). Black Crappies did not appear to be experiencing the same bottleneck for age-2 fish as the weighted age frequency indicated that 27% of all Black Crappies captured were age-2 (2020 year class). However, another columnaris disease outbreak occurred in late May-early June 2022 (i.e., after the fish survey), and Black Crappie was observed to be the primary species affected.

The bacteria that cause columnaris disease are ubiquitous in Michigan, but Morrison Lake seems to have unusually frequent outbreaks of this disease. The high turbidity and low dissolved oxygen levels in Morrison Lake are stressful to fish. The high nutrient concentrations also lead to algal blooms and proliferation of invasive plants such as Curlyleaf Pondweed and Eurasian Watermilfoil, followed by herbicide (used here to refer to both herbicide and algaecides) treatments to address these blooms. Toxicity effects of algaecides can include sub-lethal effects such as damage to olfactory receptors and lateral line neurons, respiratory impairments, and endocrine system disruption (DeQuattro and Karsov 2016; Kennedy et al. 2012; Linbo et al. 2006; Carreau and Pyle 2005; Henry and Atchison 1986). Indirectly, these treatments can affect fish by temporarily forcing them to leave the treatment area and through modification of vegetation beds and nearshore habitat. In combination, these sub-lethal effects of herbicides and algaecides can render fish more vulnerable to death by predators, disease, pollution, or environmental stressors.

Given the substantial investment in Phoslock applications and concerns about juvenile Bluegill capture efficiency during the 2022 survey, SLMMU staff decided to conduct the additional electrofishing sampling in 2023 to more rigorously assess Bluegill recruitment from 2020-2022.

The 2023 electrofishing results corroborated the conclusion that 2020 and 2021 were poor recruitment years for Bluegills in Morrison Lake. By contrast, the 2022 year class was relatively strong (Figure 12).

Thus, repeated Phoslock applications in a given year do not necessarily result in poor recruitment. Bluegill recruitment is influenced by a combination of factors, including water temperatures during incubation and early life stages, zooplankton abundance when fry switch from endogenous to exogenous feeding, exposure to pathogens or chemicals (such as herbicides or toxins produced by algae), turbidity, and dissolved oxygen concentrations. Although we cannot rule out effects of Phoslock treatments on Bluegill recruitment, the Morrison Lake data do not provide compelling evidence that would justify a change in management practices.

Morrison Lake has a high population density of Black Crappie, low population density for Pumpkinseeds, and an intermediate density of Yellow Perch. Black Crappie CPUE in large-mesh fyke nets in Morrison Lake in 2022 was 10 Black Crappies/net night and was above the 75th percentiles for lakes in SLMMU and statewide. Conversely, only two Pumpkinseeds were captured in large-mesh fyke nets. The low catch of Pumpkinseeds was expected as this species typically inhabits vegetated areas throughout its life cycle, and vegetation is sparse in Morrison Lake. Yellow Perch CPUE in Morrison Lake was 5.25 fish/net night in gillnets. Because Yellow Perch move offshore after spawning, gill nets are the more efficient than large mesh fyke nets for capturing this species in May. Yellow Perch CPUE was between the 50th and 75th percentiles for SLMMU lakes and lakes statewide, respectively. In terms of size structure, growth, and abundance, the Yellow Perch population in Morrison Lake is average for lakes in this region.

Largemouth Bass population density in Morrison Lake appears to be average to above average for lakes in southwest Michigan. The electrofishing CPUE (1.7 per minute of electrofishing) was near the median for SLMMU lakes, but the CPUEs with fyke nets and gill nets were above the 75th percentiles. The size structure of the Largemouth Bass population was large. While no trophy fish were captured, legal-sized individuals in the 14-17-inch range were common.

In 2016, the DNR began requiring all bass (collectively refers to Smallmouth Bass and Largemouth Bass) tournaments to register and receive a permit to conduct tournaments across the state in inland waterbodies and the Great Lakes. Since the initiation of this program, Morrison Lake has had the twelfth highest number of tournament days with 220 tournament days between 2016 and 2022. On average 31.4 tournament days are conducted on Morrison Lake annually. In comparison, Gull Lake had the highest number of tournaments registered and averaged 52.0 tournament days per year.

As part of the tournament permit, tournament directors must submit data on bass catches and angler participation. From 2018 through 2022, 168 bass tournaments occurred on Morrison Lake with an average of 23.5 anglers fishing in 12.4 boats per tournament. An average of 46 bass were weighed at each tournament. The average weight of bass weighed in at Morrison Lake tournaments was 2.09 pounds and the average heaviest bass weighed in was 3.86 pounds. All of these statistics regarding tournament size, number of fish per tournament, and fish weight fall near the average values reported for bass tournaments held in Michigan in 2022.

Northern Pike continue to be a rare species in Morrison Lake. Pike spawn in dense vegetation, which is lacking in this system. Summer habitat also appears to be limiting pike abundance in Morrison Lake. Casselman (1978) found that the optimum temperature range for growth of juvenile and adult Northern Pike was 66-70°F and that Northern Pike generally avoided water temperatures greater than 73.4°F. Although Northern Pike are capable of tolerating low oxygen concentrations (Casselman 1978),

Headrick and Carline (1993) reported that pike were rarely located in depth strata with dissolved oxygen concentrations below 3.0 ppm. During August 2022, there was no depth strata with optimal water temperatures and oxygen concentrations for Northern Pike.

Management Direction

1. Protect all remaining natural shorelines around the lake. These areas act as filters to reduce inputs of sediment, nutrients, and other pollutants. They also provide habitat for amphibians and reptiles and facilitate future recruitment of coarse woody habitat to the lake.

2. Protect native aquatic vegetation including submergent and emergent plants. Native plants serve as spawning habitat for Northern Pike and Yellow Perch, function as nurseries for a variety of fish species, stabilize sediments, and sequester nutrients. When invasive plant control is necessary, use the most selective methods available.

3. Continue working with watershed partners to reduce the amount of nutrient loading into Morrison Lake.

4. Do not stock predators (e.g., Walleye) due to the low abundance of small forage fish and lack of optimal summer habitat for coolwater fish species.

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Table 1. Fish species collected in Morrison Lake during surveys conducted from 1941 through 2022.

Species	1941	1959	1961	1968	1978	1983	1988	1994	1999	2003	2022
Black Bullhead					x						
Black Crappie	x	x	x	x	x	x	x	x	x	x	x
Bluegill	x	x	x	x	x	x	x	x	x	x	x
Bluntnose Minnow	x										x
Bowfin					x	x	x		x	x	x
Brown Bullhead					x	x	x	x	x	x	
Central Mudminnow				x							
Common Carp	x	x	x	x	x	x	x	x	x	x	x
Common Shiner	x			x						x	x
Golden Shiner	x	x	x		x	x		x		x	x
Green Sunfish											x
Hybrid Sunfish					x						x
Johnny Darter	x										
Largemouth Bass	x	x	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	x
Sand Shiner	x										
Spottail Shiner										x	
Yellow Bullhead	x			x	x			x	x		x
Yellow Perch	x	x	x	x	x	x	x	x	x	x	x
Walleye							x	x	x	x	
White Sucker		x	x	x	x	x	x	x	x	x	x

Table 2. Fish stocking in Morrison Lake from 1893 through 2023.

Year	Species	Number	Lifestage	Average Length (in.)
1893	Common Carp	40	Unknown	Unknown
1905	Walleye	75,000	Fry	Unknown
1908	Warmouth	750	Yearling	Unknown
1909	Largemouth Bass	2,000	Fingerling	Unknown
1910	Warmouth	1,150	Yearling and 2 Year Olds	Unknown
1910	Yellow Perch	75	Fingerling	Unknown
1910	Yellow Perch	100,000	Fry	Unknown
1933	Bluegill	6,000	Yearling	Unknown
1933	Largemouth Bass	8,000	1 month old	Unknown
1933	Yellow Perch	4,400	7 month old	Unknown
1934	Bluegill	5,115	4 month old	Unknown
1934	Bluegill	3,200	Yearling	Unknown
1934	Largemouth Bass	1,495	4 month old	Unknown
1934	Yellow Perch	3,250	8 month old	Unknown
1935	Bluegill	10,000	3 month	Unknown
1935	Largemouth Bass	2,320	3 month	Unknown
1935	Yellow Perch	8,700	7 month	Unknown
1936	Bluegill	8,351	5 month	Unknown
1936	Largemouth Bass	3,800	1 month	Unknown
1936	Yellow Perch	5,250	8 month	Unknown
1937	Bluegill	8,400	4 month	Unknown
1938	Bluegill	1,250	Yearling	Unknown
1938	Largemouth Bass	2,025	3 month	Unknown
1938	Yellow Perch	7,800	7 month	Unknown
1939	Bluegill	2,025	4 month	Unknown
1939	Largemouth Bass	660	4 month	Unknown
1939	Largemouth Bass	975	5 month	Unknown
1939	Yellow Perch	15,000	7 month	Unknown
1940	Bluegill	7,800	4 month	Unknown
1940	Crayfish	3,900	5 month	Unknown
1940	Largemouth Bass	200	4 month	Unknown
1940	Largemouth Bass	1,925	4 month	Unknown
1941	Bluegill	3,200	4 month	Unknown
1941	Largemouth Bass	1,575	3 month	Unknown
1988	Walleye	2,810	Fall Fingerling	4.41
1989	Walleye	139,000	Spring Fingerling	1.73
1990	Walleye	14,417	Spring Fingerling	1.83
1991	Walleye	23,172	Spring Fingerling	1.28

Table 2. Continued.

Year	Species	Number	Lifestage	Average Length (in.)
1992	Walleye	600,000	Fry	0.35
1993	Walleye	33,589	Spring Fingerling	1.30
1994	Walleye	1,150,000	Fry	0.63
1996	Walleye	34,155	Spring Fingerling	1.34
1997	Walleye	34,301	Spring Fingerling	1.66
1997	Walleye	12,022	Extended Spring Fingerling	2.01
1999	Walleye	55,211	Spring Fingerling	1.22

Table 3. Growth indices, Schneider scores, and Schneider ranks for Bluegills collected during fish surveys completed on Morrison Lake during 1959 through 2022. Schneider scores and ranks were obtained using the methods in Schneider (1990). Growth indices were calculated as described in Schneider et al. (2000a).

Month-Year	Gear Type	Growth Index	Schneider Score	Schneider Rank
May-59	Seine	-0.2	1.8	Poor
Oct-61	Seine	0.35	2.8	Poor
Sep-66	Gill nets, shocking, trap nets	-0.5	3.7	Acceptable/Satisfactory
Aug-68	Shocking	-0.5	4.0	Satisfactory
Sep-78	Fyke nets, trap nets	-0.6	2.3	Poor
May-83	Trap nets	-0.7	2.5	Poor
May-88	Trap nets	0.4	4.0	Satisfactory
Oct-94	Trap nets	N/A	5.8	Good/Excellent
May-03	Trap Nets	1.2	6.8	Excellent/Superior
May-22	Fyke nets, trap nets	0.8	5.3	Good/Excellent

Table 4. Sampling period and total effort for each gear used during the 2022 Morrison Lake fish community survey.

Sampling Period	Gear	Effort
May 2-4	Experimental Gill Net	4 net nights
May 2-4	Trap Net	2 net nights
May 2-5	Large-Mesh Fyke Net	9 net nights
May 5	Nighttime Electrofishing	30 minutes

Table 5. Numbers, calculated weights, total length ranges, and percentage legal or harvestable for all fish species collected on Morrison Lake during May 2-5, 2022.

Species	Number	Percent by Number	Weight (lb.)	Percent by Weight	Length Range (in)	Percent Legal or Harvestable Size
Black Crappie	225	9.6	57.5	6.0	4.0-11.9	70
Bluegill	1,611	68.9	367.1	38.4	3.0-10.9	85
Bluntnose Minnow	2	0.1	<0.1	<0.1	3.0-3.9	N/A
Bowfin	3	0.1	19.7	2.1	25.0-27.9	N/A
Common Carp	3	0.1	21.4	2.2	20.0-30.9	N/A
Common Shiner	1	<0.1	0.2	<0.1	7.0-7.9	N/A
White Sucker	28	1.2	68.3	7.1	7.0-20.9	N/A
Golden Shiner	25	1.1	3.9	0.4	6.0-9.9	N/A
Green Sunfish	1	<0.1	0.1	<0.1	5.0-5.9	0
Hybrid Sunfish	5	0.2	1.1	0.1	4.0-7.9	80
Largemouth Bass	133	5.7	202.3	21.2	5.0-18.9	59
Northern Pike	7	0.3	27.9	2.9	22.0-33.9	57
Pumpkinseed	9	0.4	2.0	0.2	6.0-6.9	100
Yellow Perch	25	1.1	6.8	0.7	5.0-10.9	96
Yellow Bullhead	261	11.2	178	18.6	7.0-16.9	N/A

* Harvestable size is 6 inches for Bluegill, Pumpkinseed, Green Sunfish, and hybrid sunfish, and 7 inches for Black Crappie and Yellow Perch.

Table 6. Lengths at age for Morrison Lake game fish relative to statewide averages from fish collected in 2022. Statewide average lengths and growth index equations are from Schneider et al. (2000a).

Species	Age	Number Aged	Length Range (in.)	State Average Length (in.)	Weighted Mean Length (in.)	Mean Growth Index
Black Crappie	2	21	4.8-6.2	6	6	-0.1
	3	18	6.6-8.3	7.5	7.8	
	4	7	7.8-9.8	8.6	8.3	
	5	7	8.0-10.7	9.4	9.1	
	6	4	9.5-11.2	10.2	10.6	
	7	1	11.5	10.8	N/A	
Bluegill	2	3	3.4-4.3	3.8	4	+0.8
	3	18	4.5-5.9	5	5.6	
	4	10	6.4-7.0	5.9	6.7	
	5	11	6.8-8.1	6.7	7.4	
	6	5	8.1-8.5	7.3	8.2	
	7	3	8.0-8.5	7.8	8.2	
	8	1	8.2	8.2	N/A	
Largemouth Bass	2	12	5.2-7.6	7.1	6.8	+1.1
	3	16	8.0-12.8	9.4	11.1	
	4	12	12.4-14.1	11.6	13.3	
	5	16	12.2-17.4	13.2	14.6	
	6	20	13.8-17.2	14.7	15.6	
	7	2	17.2-18.0	16.3	17.6	
	8	4	15.8-17.6	17.4	16.2	
	9	1	16.2	18.3	N/A	
Northern Pike	4	1	24.4	23.4	N/A	N/A
	5	1	22.9	25.5	N/A	
	6	1	23.9	27.3	N/A	
	7	2	23.6-25.6	29.3	N/A	
	8	2	26.0-33.7	31.2	N/A	
Yellow Perch	3	2	5.9-7.1	6.5	6.6	+0.5
	4	11	7.2-8.6	7.5	7.8	
	5	11	8.3-10.2	8.5	9.2	

Table 7. Lengths at age for Morrison Lake Bluegill relative to statewide averages from fish collected in 2023. Statewide average lengths and growth index equations are from Schneider et al. (2000a).

Species	Age	Number Aged	Length Range (in.)	State Average Length (in.)	Weighted Mean Length (in.)	Mean Growth Index
Bluegill	1	29	1.7-3.5	2.4	2.8	+0.5
	2	14	3.8-5.3	4.2	4.4	
	3	8	5.3-6.1	5.3	5.9	
	4	9	6.6-6.9	6.2	6.8	

Figure 1. Morrison Lake watershed boundary.

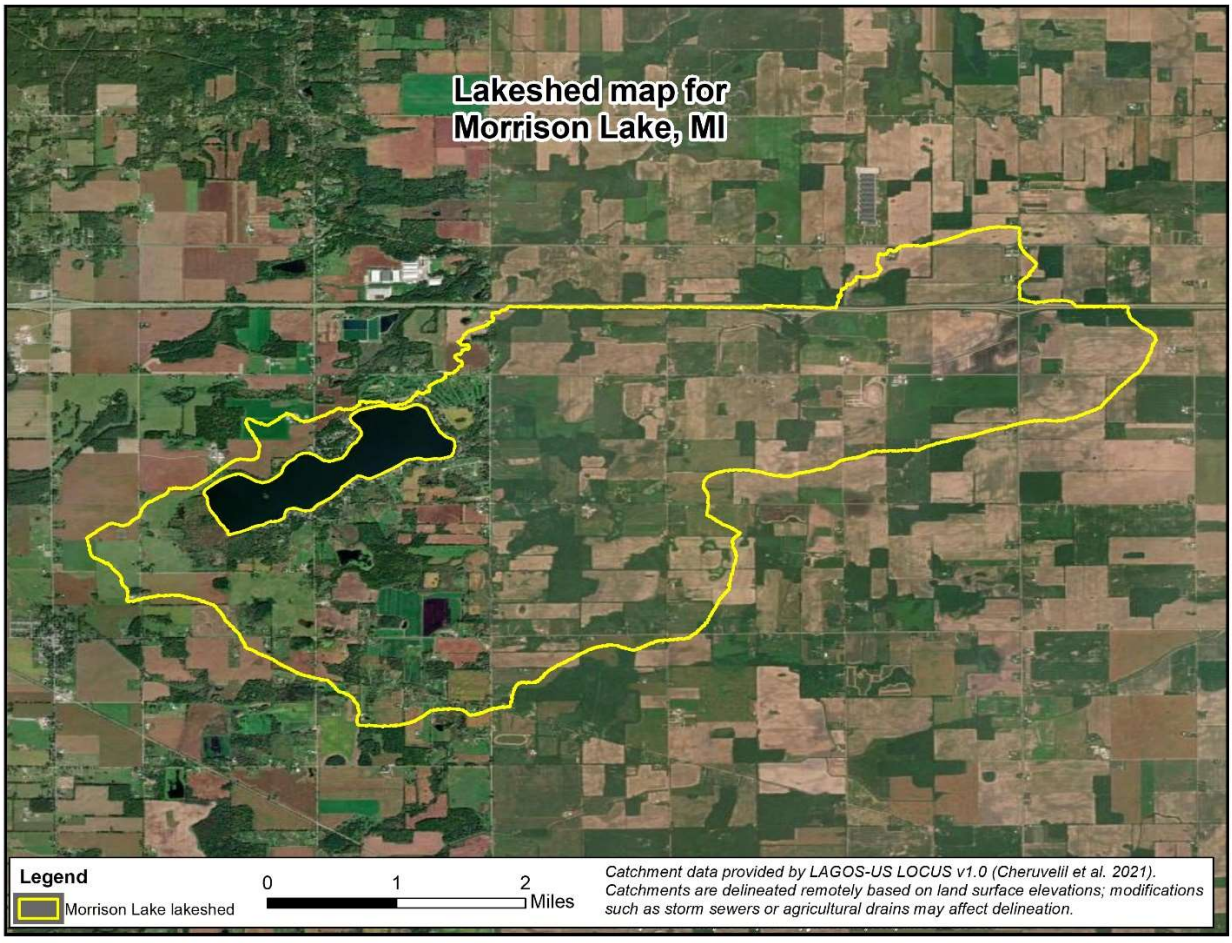

Figure 2. Land cover within the Morrison Lake catchment as of 2016.

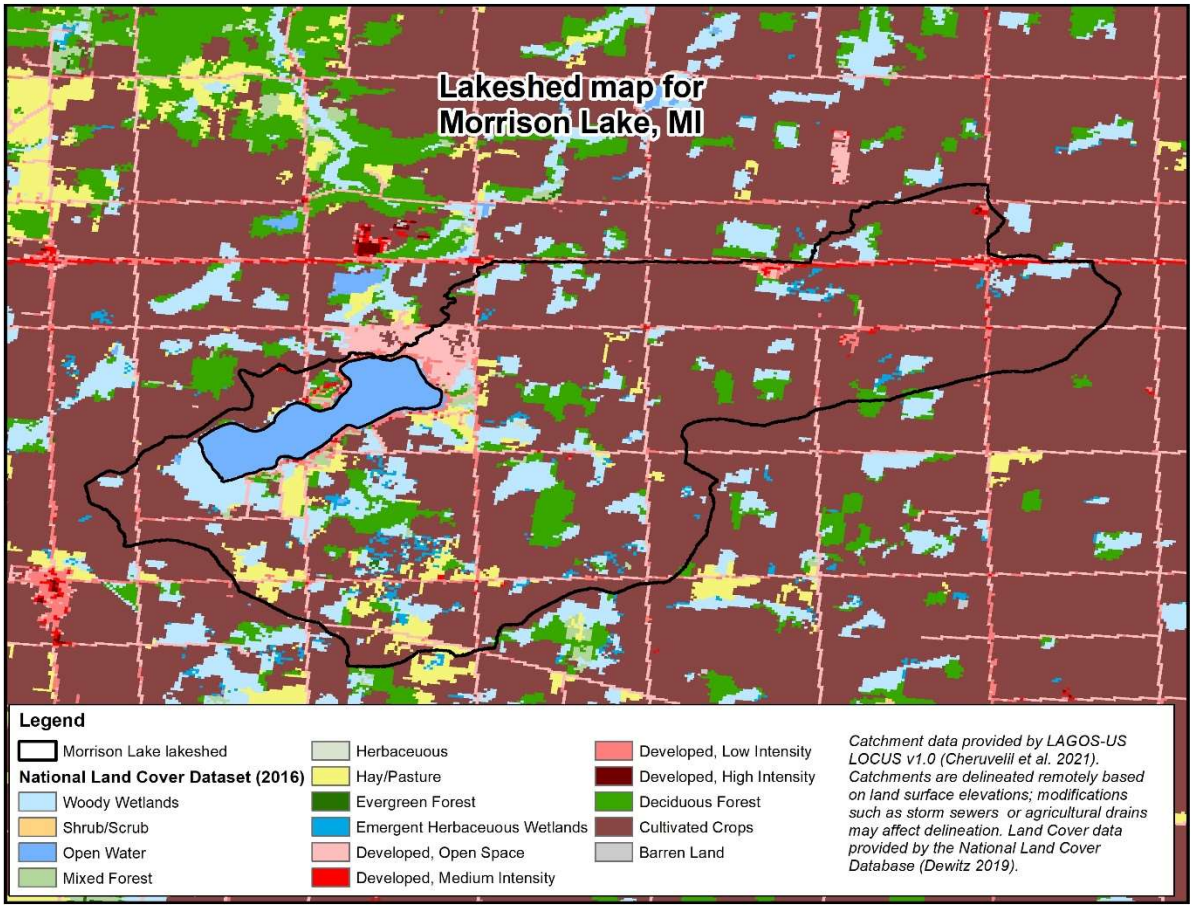

Figure 3. Map of Morrison Lake with green circles indicating locations of fyke nets, yellow lines indicating locations of gill nets, and purple lines indicating nighttime electrofishing surveys conducted during the 2022 summer survey.

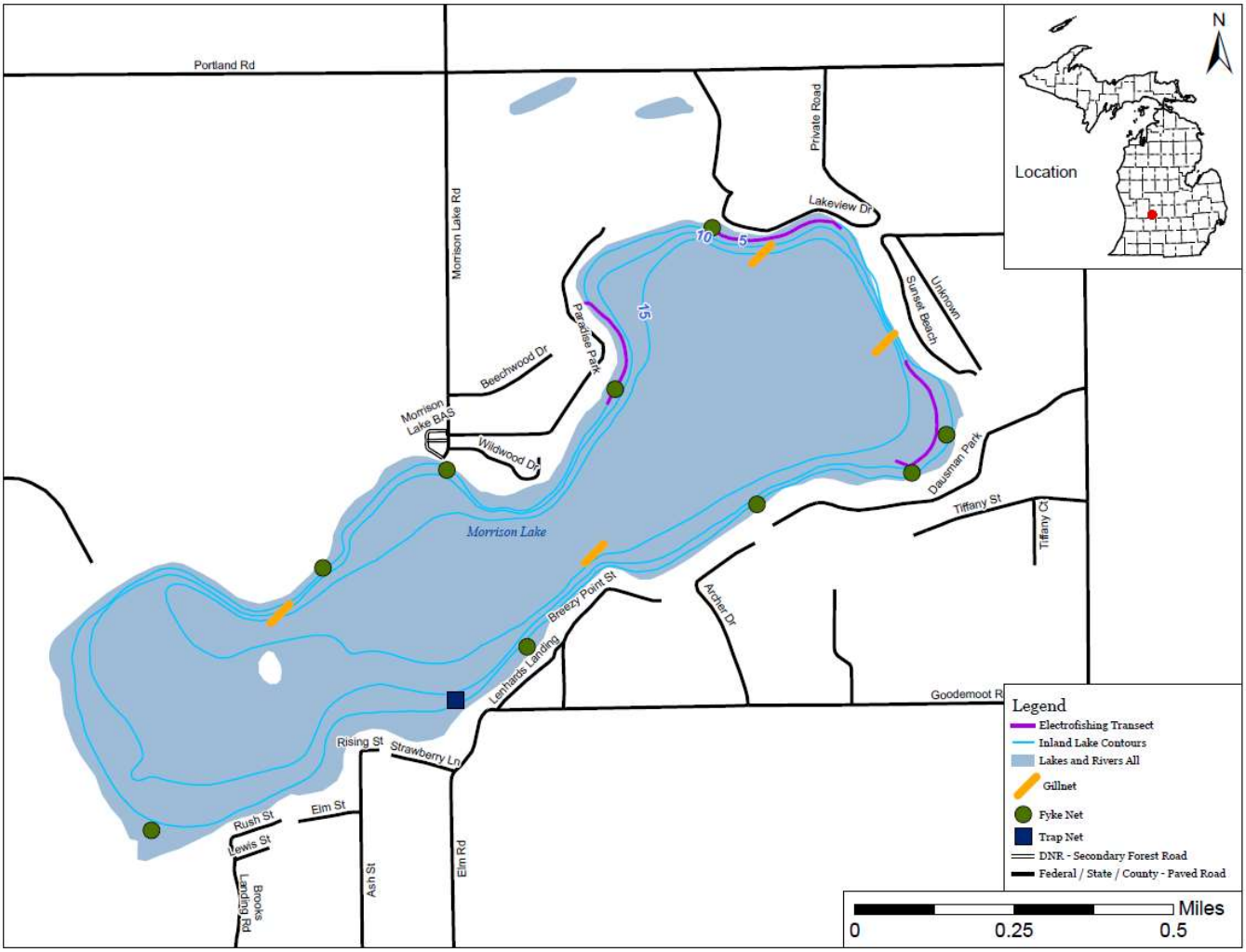

Figure 4. Length frequency distribution for Bluegills captured in Morrison Lake during May 2-5, 2022.

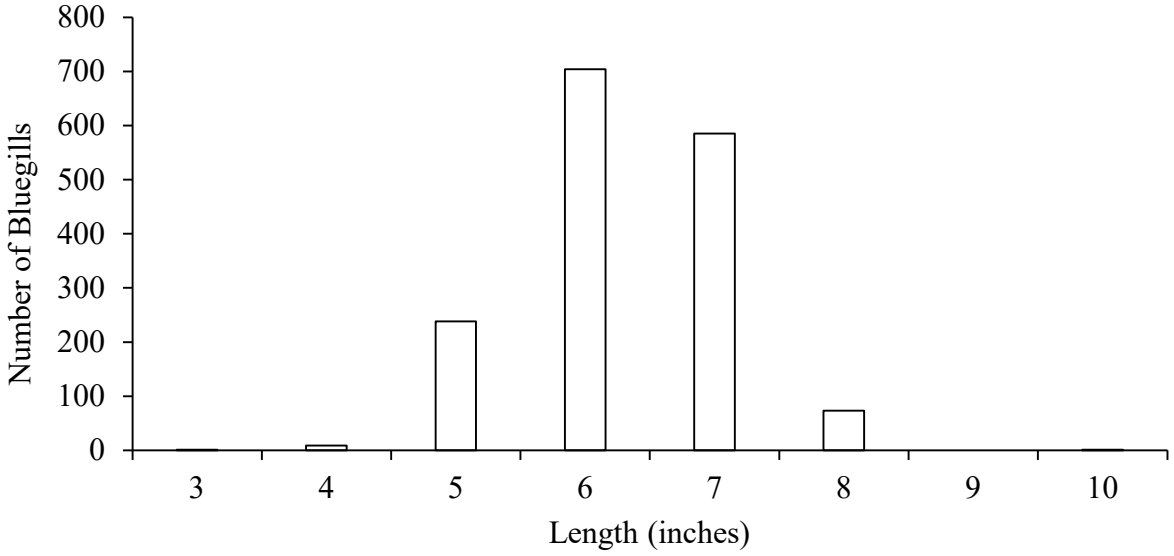

Figure 5. Age frequency distribution for Bluegills captured in Morrison Lake during May 2-5, 2022.

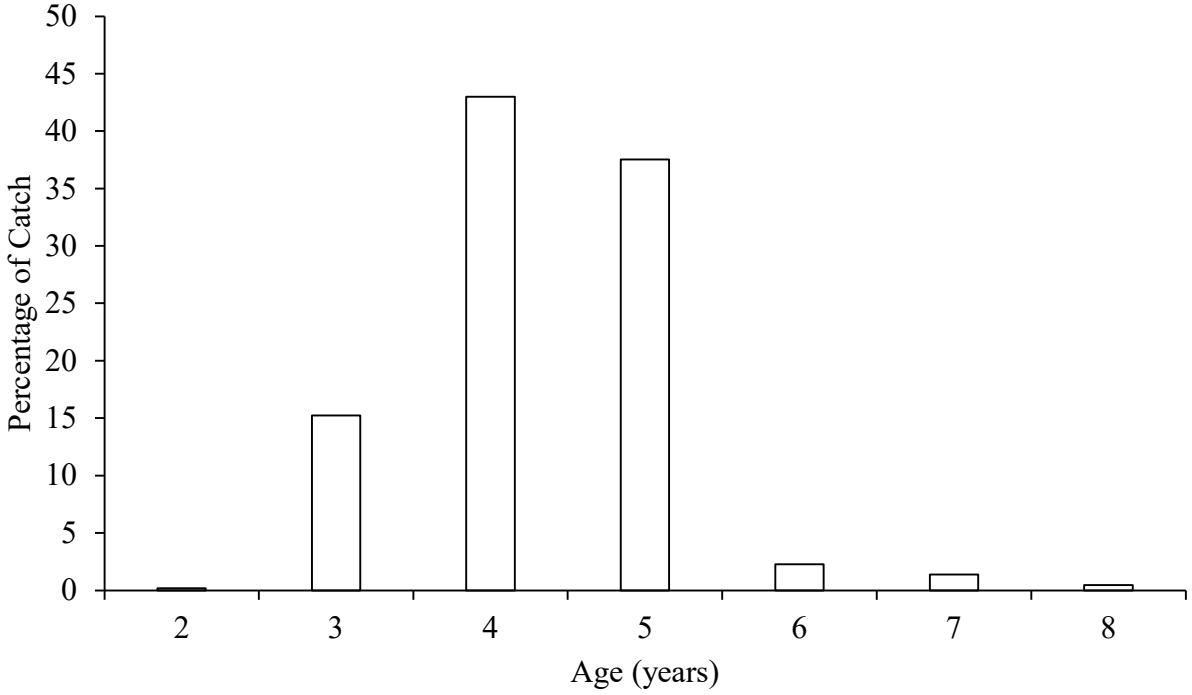

Figure 6. Length frequency distribution for Black Crappies captured in Morrison Lake during May 2-5, 2022.

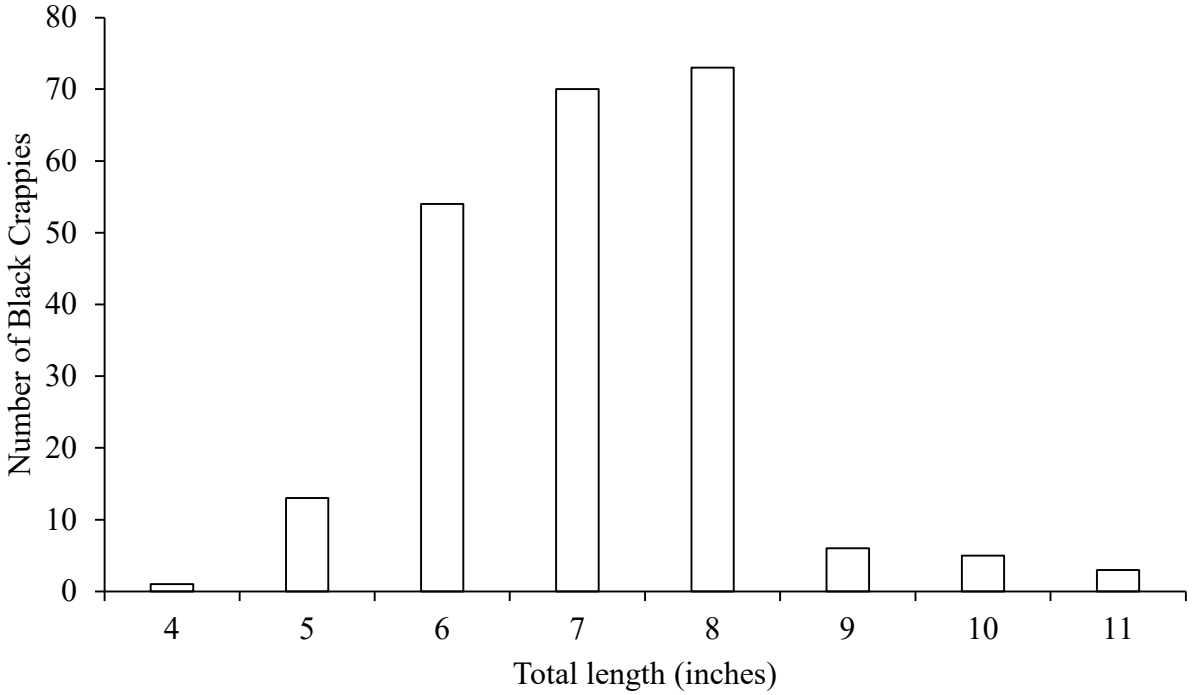

Figure 7. Age frequency distribution for Black Crappies captured in Morrison Lake during May 2-5, 2022.

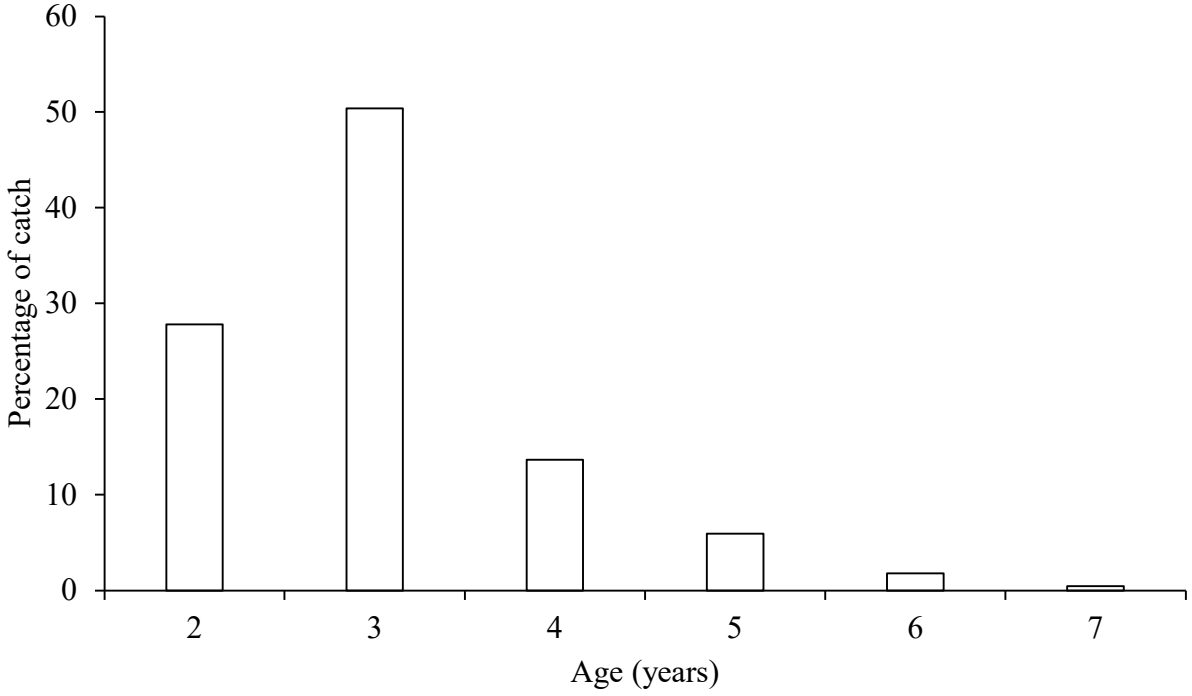

Figure 8. Age frequency distribution for Largemouth Bass captured in Morrison Lake during May 2-5, 2022.

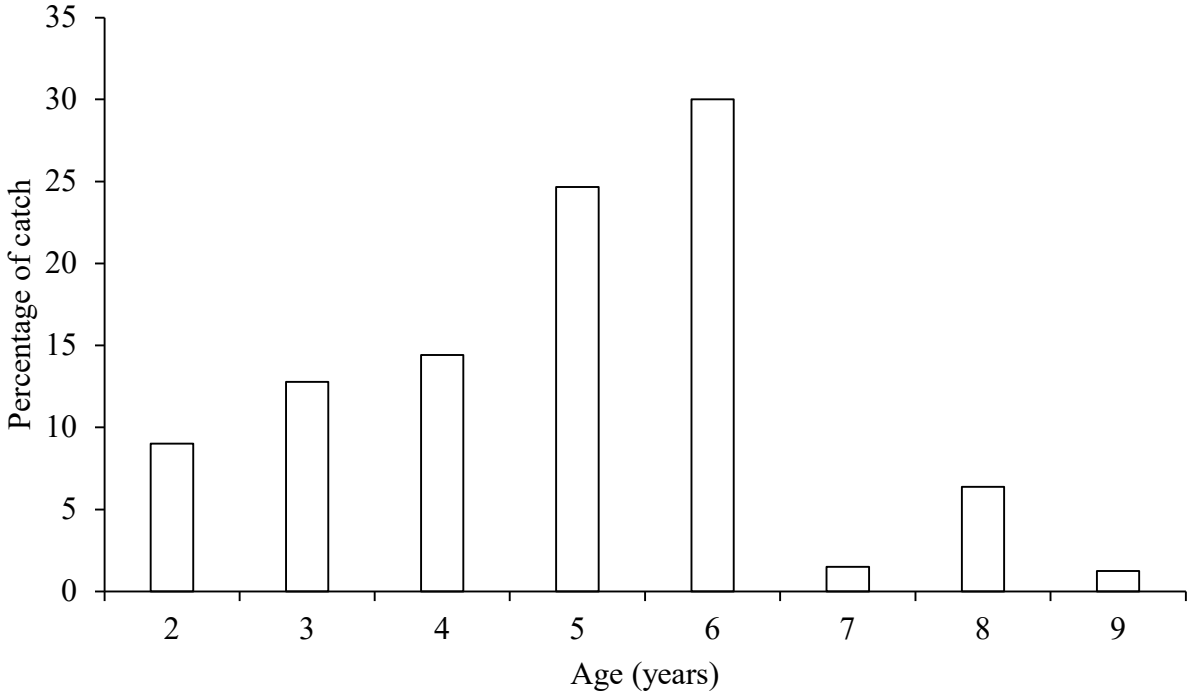

Figure 9. Length frequency distribution for Largemouth Bass captured in Morrison Lake during May 2-5, 2022.

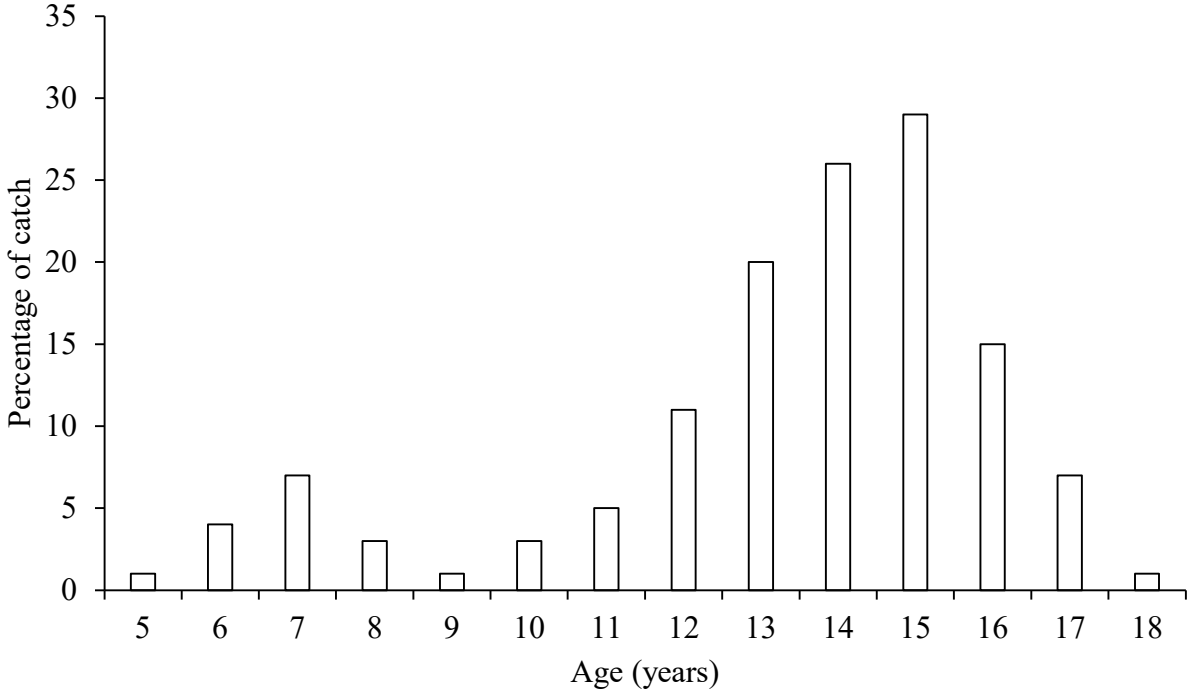

Figure 10. Water temperature and dissolved oxygen profile for the deepest basin in Morrison Lake on August 2, 2022. The hollow circles with solid line represent temperature and the solid circles with dashed line represent the dissolved oxygen concentration.

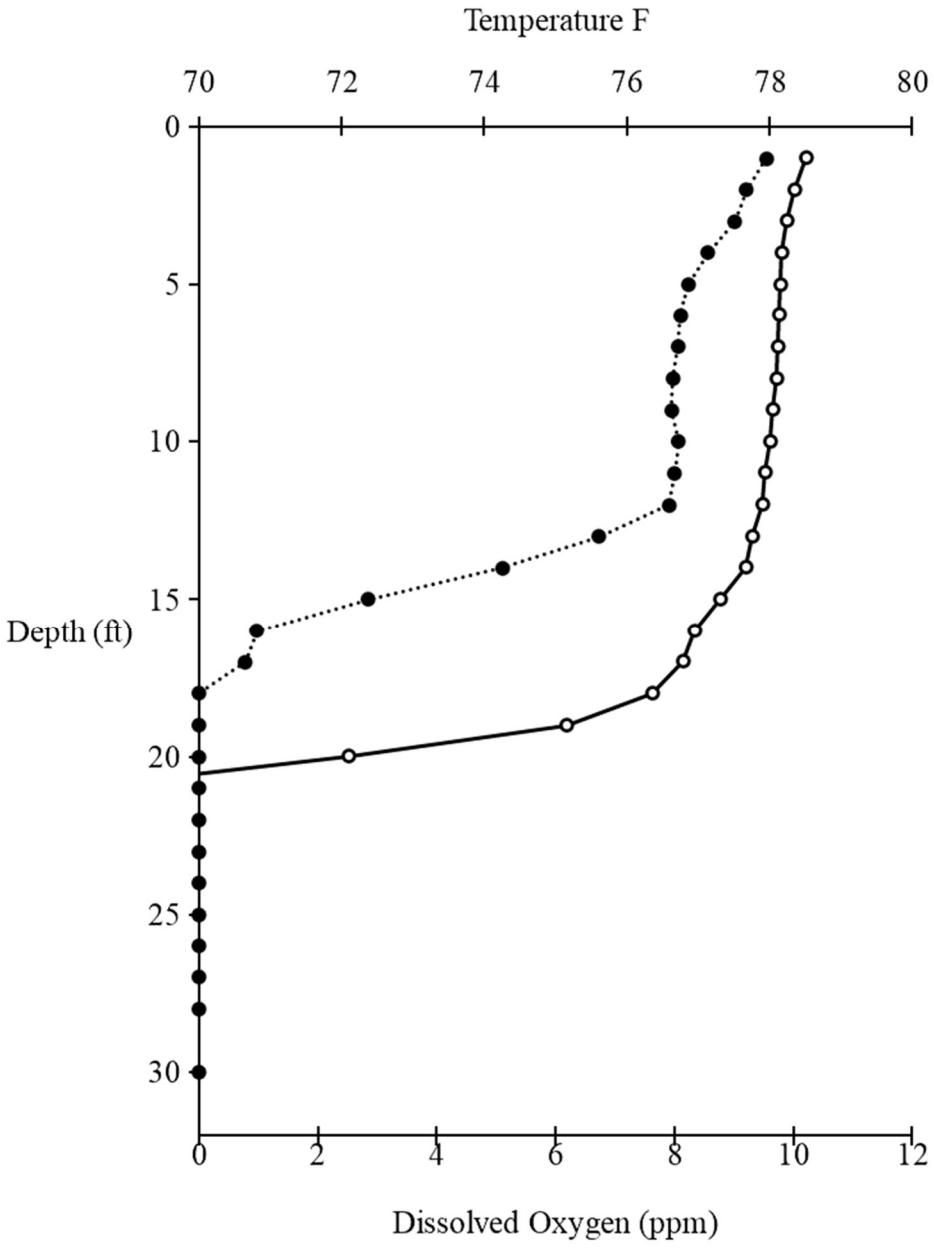

Figure 11. Length frequency distribution for Bluegills captured in Morrison Lake on June 22, 2023.

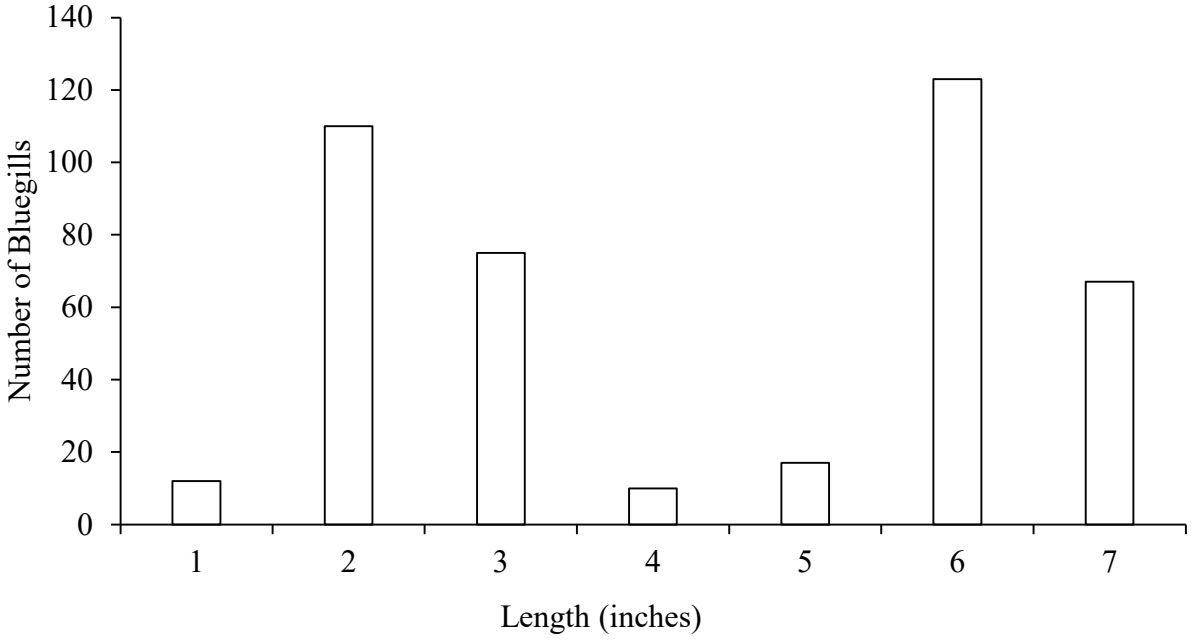

Figure 12. Age frequency distribution for Bluegills captured in all lakes surveyed in SLMMU in May 2022.