Union Lake
Branch County; T5S/R8W/Sec 11, 12, 14 and T5S/R7W/Sec 6, 7
Saint Joseph River Watershed, Surveyed May 3 - 6, 2021

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Environment

Union Lake lies in northwestern Branch County, 1.4 miles southwest of Union City in Sherwood and Union Townships. Union Lake is located just downstream of the confluence of the Upper Saint Joseph River and the Coldwater River. The lake is an impoundment on the Saint Joseph River that was created by the construction of the Riley Dam in 1923. The Riley Dam was constructed for hydropower for the Village of Union City. It is the most upstream large reservoir (544 acres) on the Saint Joseph River with a maximum depth of 16 feet. Forty five percent of the lake (by surface area) is between 5 and 10 feet in depth and 19% is deeper than 10 feet (Figure 1). The upper section of the lake is depositional with sediments from the Saint Joseph River resulting in a depth of less than 3 feet. Typical of large river impoundments, the lake is long (2.5 miles) and narrow (1/3 mile). The watershed is large, draining 310,568 acres, which includes parts of Branch, Calhoun, and Hillsdale Counties. The watershed geology is split between coarse-textured glacial till and end moraines of coarse-textured till (49%) and glacial outwash sand and gravel and postglacial alluvium (50%). The watershed land use is primarily agricultural (60.6%), with some wetland (14.9%), forest (11.7%), and urban land use (9.8%) and small amounts of water (2.2%), grassland (0.5%), and barren land (0.2%) (USGS 2014; Figure 2). Basin substrates are composed almost entirely of sand and organic material. Some gravel is evident in a few shallow areas. Submerged tree stumps are scattered throughout the basin, but most are concentrated in the shallow northeast end. The land near the shores of Union Lake is gently rolling (0 to 6% slopes) and composed mostly of sandy loam soils. However, there are some steep slopes to the water's edge along the immediate shoreline. The Midwest Glacial Lakes Partnership planner reports 53% of the shoreline of Union Lake is disturbed. This is primarily due to residential shoreline development, but the upland beyond is heavily farmed. A Michigan Department of Natural Resources (DNR) access site with concrete boat launch allows year-around public access and can easily accommodate pontoon boats and boats up to 20 feet. The boating access site is located on the northern shore and has parking for at least 10 vehicles with trailers.

History

Riley Dam was constructed, and Union Lake was filled for the first time in 1923. The original construction of Riley Dam included a fish ladder, but correspondence in the Plainwell DNR Office files states that the ladder never successfully passed fish from the Saint Joseph River below the dam into Union Lake. Fish stocking began shortly after the reservoir was formed. Yellow Perch, Bluegills, Largemouth Bass, Smallmouth Bass, and Walleyes were stocked at various times from 1922 through the mid-1940s (Tables 1 and 2). Bluegills and Largemouth Bass were the most frequently species stocked during this period. Northern Pike, Tiger Muskellunge, Walleyes, Largemouth Bass, Channel Catfish, Redear Sunfish, and Bluegills have subsequently all been stocked in Union Lake. Walleye have been stocked since 2005 from a mixture of a privately operated lake side rearing pond and DNR production ponds (Table 2). Currently spring fingerling Walleye are stocked in alternating years at a rate of 50 fish per acre (26,250 fish) in Union Lake as part of the upper Saint Joseph River stocking strategy. The

rearing pond continues to operate but stocking has not been reported to DNR and records are not available.

As is common with newly created reservoirs, the Union Lake fishery was excellent in early years and the lake became a popular fishing destination drawing local anglers as well as anglers from other states. There was a perception of overharvest based on the high angler effort, which prompted the early stocking program. The DNR files indicate there was a belief that stocking exceeded natural recruitment. In addition to stocking, some of the first portable fish passage techniques were explored at Union Lake because of the inability of the original fish ladder to pass fish. A Warner Bower fish conveyor was installed and operated from May 16 through June 16, 1936, to facilitate fish passage (Bower 1936). It was the first working model of this type. DNR Fisheries files indicate the conveyor was operated at least one additional year in 1941. A DNR observer was present from May 27 through June 7, but observed only a few fish that successfully passed upstream of the dam. The system was removed after a short demonstration duration. A rearing pond was also created below the dam to assist in fish rearing and stocking efforts. By the 1940s, Union Lake appeared to be overpopulated with fish and growth rates and size structure declined. Rearing pond use was discontinued, and the pond fell into disrepair. A seine survey was conducted on August 6, 1948. Small Bluegills were abundant, ranging from 1 to 7 inches. Largemouth Bass, Pumpkinseeds, and Black Crappies were also caught. An angler creel census was conducted from 1944 through 1953. The results indicated that fishing for Bluegill, Largemouth Bass, Pumpkinseed, Black Crappie, Yellow Perch, and Northern Pike was considered good. Bluegills made up 83% of the total catch.

The boating access site (BAS) was purchased in 1956, and the lake bathymetry was mapped May 27-29, 1963. From the late 1950s through the 1960s the Union Lake fishery was perceived to be declining by local homeowners and anglers. Several strategies for improving the fishery were discussed including a fish ladder, netting and lifting fish over the dam, and resuming operation of the rearing pond. The rearing pond was refurbished and operated by a combination of the Union City Betterment Association and the Union Lake Fisherman's League. The pond was stocked with angler caught adult Bluegills that were allowed to spawn in the ponds. The first year of operation reported a yield 500,000 fingerlings. The pond was operated through the 1960s, but poor records were kept until the late 1970s. Channel Catfish were also stocked by the Union Lake Fisherman's League from an outside source in 1967 to enhance the fishery.

A seine survey was conducted on September 14 and 15, 1960. The survey was difficult due to snagging on the abundant wood in Union Lake, resulting in below average catches. Age-1 Bluegills and Pumpkinseeds were the bulk of the catch and were growing above the state average. Black Crappies, Largemouth Bass, Yellow Perch, Common Shiner, Common Carp, redhorse spp., Green Sunfish, and Lake Chubsuckers were also caught in low numbers. A trap and fyke net survey was conducted on July 17-19, 1962 (36 net nights). A total of 581 fish were captured and Black Crappie were the most abundant species (n = 246) collected, followed by Bluegill (n = 162). Mean lengths for Bluegills and Black Crappies were 6.9 inches and 7.9 inches, respectively, which was above the statewide average growth for both species. Black Crappies over 10 inches were abundant. Bluegills reached 8 inches by age-4 with good numbers of fish over 8 inches and the largest fish measuring 9.1 inches. Redhorse, White Suckers, and Common Carp dominated the biomass due to the large size of these species that were captured. Thirteen Northern Pike over 20 inches were also caught that were growing above the statewide average.

A gill net survey was conducted on September 27, 1971. Black Crappies dominated the catch by number and individuals as large as 12 inches were caught. Seven Northern Pike were captured that were all over 22 inches. Two Channel Catfish were caught (6 and 10 inches), indicating potential survival of stocked fish or immigration from the Saint Joseph River. Anglers reported catching Channel Catfish ranging from 3 to 5 pounds. Only 16 Bluegills were captured and 50% were greater than 8 inches in length. An electrofishing and fyke net survey was completed on July 19, 1972. The survey was conducted as part of the Saint Joseph River Inventory and was not an intensive survey of Union Lake (20 minutes electrofishing; 2 net lifts). Few fish were captured, but similar species and sizes were observed as in past surveys.

Common Carp tournaments (aka rodeos) had been conducted sporadically on Union Lake since the impoundment was created. The Union Lake Association began sponsoring the Annual Union Lake Carp Rodeo in the early 1980s. The rodeo consisted of a weekend festival where teams competed to catch the highest number of Common Carp using hook and line, spear, and/or bow-and-arrow. As many as 2,000 Common Carp were removed during a rodeo in a year, but average catch was approximately 300 Common Carp. The rodeo was conducted until 2003.

Union Lake historically was highly vegetated. In the early 1980s, vegetation declined to the point that it was nearly absent. Residents pointed to pollution as the likely cause as there were several industries operating upstream of Union Lake. Extensive investigations and water quality analysis did not identify a chemical source suggesting that was not the cause of the decline. Common Carp were identified as one potential cause of decreased vegetation because their benthic feeding behaviors uproot vegetation and increase turbidity.

A weeklong trap net survey was conducted from June 6-9, 1983 (total of 12 net nights) to assess any changes in the fish population that may have occurred. Catch rates for all species was lower than observed in other regional lakes. Bluegill catch per unit effort (CPUE) was only 18.7 fish per net night. Bluegills averaged 7.1 inches, and 87% were 6 inches or longer. Growth rates of all sport fish except Black Crappies were above the statewide average. There was an abundance of small Black Crappies due to a strong year class that was experiencing slower growth, but older fish growth was above the statewide average rate. Channel Catfish (n = 11) collected had a mean length of 17.9 inches, maximum length of 21 inches, and were reported as being in good condition. The sportfish community size structure was reported as good. Management goals were to begin using a Northern Pike marsh on the southern shore and stock Walleye fry. Abundance of prey species such as suckers and minnows were expected to support the additional predator stocking. Common Carp, redhorse spp., and White Suckers made up 44% of the catch by weight. Only 20 Common Carp were captured. Managers did not believe this density of Common Carp would be the cause of lake-wide reductions in vegetation. Common Carp may have been more abundant than measured as they may have left the lake for the river seasonally or the survey gear did not efficiently trap Common Carp. This hypothesis is supported by the fact that over 600 Common Carp were reported captured during the Annual Union Lake Carp Rodeo in 1983. Common Carp likely contributed to the reduced vegetation density, but it was unclear why a significant shift occurred in the early 1980s.

The DNR conducted another fish survey on September 29-30, 1987, using trap and gill nets. Rough fish made up 48% of the trap net catch by weight. Union Lake continued to support a quality sportfish

community as evidenced by the panfish size structure. Bluegill average size was 7.2 inches, and the mean growth index score was +2.4. Both of these metrics were well above the statewide average. However, Bluegill abundance was reported as low with only 66 fish (trap net CPUE = 8.3 fish per net night) caught. Black Crappies were captured in higher numbers (n = 485) and mean size was 9.2 inches. The observed size structure was likely due to the strong year class observed in 1983 resulting in an abundance of larger fish in 1987. Twenty Largemouth Bass were caught that ranged in length from 4.7 to 19.3 inches. Growth rates were above average with a growth index of +1.4. Yellow Perch were abundant and averaged 7 inches. Twenty-one Channel Catfish were captured ranging in size from 9 to 24 inches. Anglers also reported catching Channel Catfish in the Saint Joseph River below the dam.

The Union Lake Community Association received a grant from the inland Fisheries Cooperative Grant Program to dredge the rearing pond one additional foot in 1988. They entered into an agreement to allow DNR to raise game fish in the Union Lake rearing pond for 10 years. Union Lake was drawn down 40 inches during the winter of 1990-1991 to attempt to cut stumps that were creating a navigational hazard (Permit 89-13-0400). During the drawdown, residents had issues with wells running dry and the impoundment was brought to normal pool. The recommendation was to conduct stump cutting during the next dam maintenance that required drawdown. It is unclear after reviewing the historic records if or when this activity occurred.

A comprehensive fish survey was conducted on June 11 and 12, 1991 that included trap and gill netting (Towns 1992). Catch rates for Bluegills continued to be low (trap net CPUE = 14.8 per net night), but size structure was excellent with a mean length of 7.7 inches and a growth index of +0.8. The Black Crappie population was reported as one of the best in Southern Michigan with an average length of 9.9 inches, which was driven by an abundance of age-5 individuals. Only four Largemouth Bass were captured ranging from 10 to 17 inches. The Channel Catfish population remained strong with 53 fish ranging from 4 to 18 inches. Some natural reproduction was determined to be occurring. Anglers were also reporting increased catch of Channel Catfish of good size. Only five Northern Pike (15.5 to 25 inches) and no Walleyes were captured. The Saint Joseph River continued to influence the species present with Common Carp, redhorse spp., and White Suckers making up 32% of the trap net catch and 67% of the gill net catch by weight.

Spring fingerling Walleyes from the Jackson rearing ponds were stocked in Union Lake by the DNR in 1986, 1987, 1991, 1993, 1994 and 1995. Walleyes historically were evaluated using the Serns index to estimate the number of fish per acre from CPUE from shoreline electrofishing surveys (Serns 1982, Serns 1983, Ziegler and Schneider 2000). Walleye Serns electrofishing surveys were conducted on September 24, 1994, September 25, 1995, and September 18, 1997, to evaluate spring fingerling stocking. Two miles of shoreline were electrofished (2 hours) each survey. Total catches were 25 Walleyes in 1994, 15 Walleyes in 1995, and 8 Walleyes in 1997. Young-of-year Walleye CPUE was 2.9 fish per acre in 1994. CPUE of young-of-year and yearling Walleye in 1995 was 0.6 and 1.0 fish per acre respectively. Condition of fish was reported as excellent, but poor return rates resulted in the decision to discontinue DNR stocking. The Branch County Conservation and Sportsman's Club raised 17,000 spring fingerling Walleye in 1997 and stocked them in Union Lake in an attempt to continue Walleye management. The CPUE of young-of-year Walleyes in the 1997 survey was 0.9 fish per acre and stocking was not recommended unless larger fingerlings became available.

Private stocking continued with the release of fall fingerling Walleyes in 1998 and spring fingerling Walleyes in 1999 and 2000. The DNR conducted a trap and gill net survey during May 24-26, 1999, followed by an electrofishing survey the night of June 16, 1999. The purpose of the survey was to evaluate survival of stocked Walleyes. No Walleyes were collected, and stocking was discontinued in 2000. Twenty-one other species were collected in the 1999 survey. Black Crappie was the most abundant species and ranged from 4-12 inches in length with 61% being larger than 10 inches. The Black Crappie population was primarily composed of a strong age-5 year class (9.7 to 10.7 inches) making up 67% of the total Black Crappie catch. Bluegill, Largemouth Bass, redhorse spp., and Yellow Perch populations were also reported as good. Bluegill growth was excellent at 1.6 inches above the state average and a size structure index score of 4.5 (satisfactory/good; Schneider 1990). Largemouth Bass growth was also above average (growth index +1.4), but only 8% were of legal size (>14 inches). Five Northern Pike were caught ranging from 20.3 to 32.5 inches. All fish were growing at or above the state average, and Union Lake was reported to be a healthy impoundment.

Additional sampling was completed in Union Lake on July 1, 2002, to collect Largemouth Bass to be tested for the Largemouth Bass Virus (LMBV). LMBV was first confirmed in Michigan by the fish health lab at Wolf Lake State Fish Hatchery in 2000. Union Lake was tested prior to any reports of LMBV related fish kills. During this survey, Largemouth Bass were collected using a boom shocker electrofishing unit. Thirty-six fish were collected ranging in size from 9.9 to 17.3 inches. Largemouth Bass collected in this sample represented fish from ages 3, 4, and 7. Test results were negative for LMBV in the Largemouth Bass examined from Union Lake at the Michigan State University laboratory.

Repair work was conducted on the Riley Dam in 2018 to address issues identified during dam inspections. A drawdown to a maximum of 7 feet (Michigan Department of Environment, Great Lakes, and Energy [EGLE] permit WRP008406) was conducted as part of the construction. During the drawdown, the surface area of the impoundment was significantly reduced and stump and tree cutting was performed to remove boating and navigation hazards. This resulted in a reduction in fish cover. Additional maintenance drawdowns of 3 feet have been permitted periodically for dam inspections and repairs. Local anglers conducted a wood habitat addition in 2020 using three-tree brush bundles (up to 24 structures permitted) along the southern shoreline of Union Lake to offset impacts of tree cutting on fish habitat (EGLE WRP020335). Despite intentional removal of woody habitat, stumps and trees are still present in Union Lake and provide the primary habitat as vegetation is limited. Aquatic vegetation treatments have been conducted in the past decade. The treatments have focused on small areas in coves and in the shallows at the upstream end of the lake to control established invasive species (e.g., Eurasian Watermilfoil and Curlyleaf Pondweed) and algae.

The Union Lake rearing pond has been operated through recent years. During 2012-2016, the DNR provided Walleye fry for the rearing pond. Volunteers from the Union Lake Community Association (ULCA) maintained the pond, harvested the fish as spring fingerlings, and stocked them into Union Lake. Walleye production in the pond was low, and spring fingerlings from the DNR's Jackson Prison rearing pond were used to supplement stocking numbers. Although Walleye production in the Union Lake rearing pond ceased after 2016, the DNR stocked spring fingerling Walleyes in the lake in 2018 and 2022, as part of the upper Saint Joseph River Walleye management program. The ULCA has continued to operate the Union Lake rearing pond. However, communication between ULCA and the DNR has been sporadic since 2016 and detailed stocking records are lacking. The available records indicate that ULCA has stocked a variety of warmwater species including Bluegill, Largemouth Bass,

Black Crappie, and Northern Pike. The pond was dredged and graded in 2018 to restore the original depth and facilitate draining.

Current Status

Methods

Union Lake was surveyed in 2021 as part a DNR discretionary survey. Methods followed those of the DNR Status and Trends program (Wehrly et al. In Revision). Netting efforts took place during May 3-6, 2021. Two gill net sets were conducted overnight for two days (total of 4 net nights). Four large-mesh fyke nets were set for three overnight sets for a total of 12 net nights. Two small-mesh fyke nets were set for two nights for a total of 4 net nights. Three 10-minute electrofishing transects were performed on May 6, 2021, for a total of 30 minutes of electrofishing. One additional 10-minute electrofishing transect targeted Largemouth Bass and Smallmouth Bass only to collect additional growth structures. All fish were identified, counted, and measured for total length, and aging structures were collected from 10 fish in each inch class for Largemouth Bass, Smallmouth Bass, Northern Pike, and Walleye. Weights for all fish species were calculated using the length-weight regression equations compiled by Schneider et al. (2000).

The relative stock density for each fish species was assessed using CPUE calculated as the number of fish caught per net night (gill, fyke, and trap nets), per hour of electrofishing (boomshocker), or per seine haul. CPUE data from this survey were compared to a summary of CPUE data from lakes surveyed in the Status and Trend Program from 2001 through 2022 on a statewide and regional level for the Southern Lake Michigan Management Unit (SLMMU). Weighted age compositions using length and age keys for each game fish species were calculated as described by Schneider (2000b). A growth index for each age class was calculated by subtracting the state average mean length from the mean length-at-age from the 2021 Union Lake survey. Growth indices for age classes represented by a minimum of five fish were averaged to provide a mean index of fish growth (Schneider et al. 2000a). Growth index scores between +1 and -1 are considered similar to the state average while scores less than -1 and greater than +1 are considered below or above the state average, respectively. Bluegill size structure was rated using an index based on the mean length and the proportion of fish >6 inches, >7 inches, and >8 inches collected using specific gear types (Schneider 2000a, Schneider 1990).

Results

A total of 2,552 fish (584.8 pounds) were caught in the 2021 fish survey on Union Lake. Thirty-one species were observed (Table 3). Bluegill was the most abundant species with 1,559 fish collected making up 61% of the total catch. A strong 2020 year class appeared to be present as 70% of the Bluegills caught were 1-2 inches in length (Figure 3). The CPUE of Bluegill in small-mesh fyke nets was 265.8 fish per net night, which is above the 75th percentiles for SLMMU (72.0 fish per net night) and statewide lakes (46.0 fish per net night) and is considered very high. Adult Bluegills were less abundant. Bluegill CPUE in large-mesh fyke nets was 27.4 fish per net night, which is just above the 25th percentile for SLMMU lakes (22.1 fish per net night) but above the median for statewide lakes (13.4 fish per net night). Bluegills in the 7-inch and 8-inch size bins inches made up the majority of the large-mesh fyke net catch (49% and 27% of total catch respectively) indicating good numbers of fish of preferred size for harvest.

Bluegill size structure index scores were 5.8 (good) for large-mesh fyke nets, but scored 3.0 (acceptable) for electrofishing. Electrofishing captured the abundant 1-2-inch fish, which resulted in a low proportion of larger fish in the catch and drove down the index score. Large-mesh fyke nets targeted larger fish and the 1-2-inch fish were not recruited to the gear, resulting in higher index scores that were based on abundance of catchable-sized fish.

Black Crappie was the second most abundant panfish species with 70 fish caught across all gears. Black Crappies ranged from 2 to 13 inches with 29% over 10 inches in length (Figure 4). The CPUE of Black Crappies in large-mesh fyke nets was 1.2 fish per net night, which is below the 25th percentiles for SLMMU and statewide lakes (2.5 and 1.5 fish per net night respectively). Black Crappies that were 11 inches were the most abundant size class and made up 36% of the total catch. Small-mesh fyke nets caught higher numbers of Black Crappie with a CPUE of 7.3 fish per net night, which is above the 75th percentiles for SLMMU and statewide lakes (2.0 and 2.2 fish per net night respectively). All Black Crappies captured in small-mesh fyke nets were 2-3 inches in length.

Fifty Yellow Perch were caught ranging from 2-13 inches. Gill net CPUE was 3.5 fish per net night, which is average and close to the median for SLMMU and statewide lakes (3.4 and 2.8 fish per net night, respectively). Eight- and 9-inch fish were the most common size classes composing 54% of the total catch by number. Fish over 10 inches made up 14% of the Yellow Perch catch. Low numbers of Redear Sunfish (n = 2), Pumpkinseeds (n = 13), and Rock Bass (n = 10) were also collected.

Largemouth Bass composed a significant portion of the total survey catch with 136 fish caught ranging from 2 to 19 inches. Nine age classes were captured with the oldest Largemouth Bass being a 9-year-old fish that measured 19.6 inches. Growth rates were good with mean length-at-age of Largemouth Bass caught in Union Lake being slightly above the statewide average for all but one year class (Figure 5). Growth index was +0.8, which is slightly above the average. Only 9% of Largemouth Bass captured in electrofishing were over the 14-inch legal length limit, 58% of the large-mesh fyke net catch, and 13% of Largemouth Bass across all gears were over 14 inches (Figure 6). Electrofishing CPUE was 2.8 fish per minute, which is higher than the 75th percentiles for SLMMU (2.5 fish per minute) and statewide lakes (1.7 fish per minute). Smallmouth Bass were also present in Union Lake. Twenty-five were caught ranging from 4 to 18 inches. Mean length-at-age for Union Lake Smallmouth Bass generally were near or above the statewide averages (Figure 7). Only the age-5 cohort met the minimum sample size of five fish for inclusion in the mean growth index calculation. The growth index for the age-5 cohort was -0.3. The CPUE of Smallmouth Bass with electrofishing was 0.5 fish per minute.

Union Lake is a popular bass tournament destination. All bass fishing tournaments are required to register with the Michigan DNR Fishing Tournament Registration System (https://www.mcgi.state.mi.us/fishingtournaments/). A total of 127 registered bass tournaments were held on Union Lake from 2016 through 2022, and catch data were reported for 109 of these tournaments (Table 4). An average of 15.6 tournaments are held on Union Lake each year. Tournament effort has increased from 2016 through 2022 with 20 tournaments being held in 2021 and 2022. Union Lake was tied for the 32nd most tournaments statewide in 2022 and ranks 34th based on average tournaments per year from 2016 through 2022. Union Lake receives above average tournament pressure compared to the statewide annual average of 8.6 tournaments per lake and 7.5 tournaments per medium sized lake (100-1000 acres). The average number of tournaments per year is also higher than the average for SLMMU lakes that had at least one registered tournament in 2022 (10.2 tournaments per year) and is ranked 21st

highest tournament pressure of SLMMU lakes. Bass tournaments averaged 11.9 boats and 40.5 fish weighed per tournament. Union Lake tournaments were smaller than statewide lakes (average 13.2 boats per tournament) and caught fewer bass (statewide average 46.1 fish per tournament). Largemouth Bass made up 91% of the fish weighed, but Smallmouth Bass were also weighed at most tournaments. The "biggest fish" caught in tournaments averaged 3.0 pounds from 2016 - 2022, slightly lower than the statewide average of 3.9 pounds in 2022. The biggest fish caught in Union Lake each year averaged 4.3 pounds from 2016 to 2022.

Largemouth and Smallmouth Bass were the primary predators in Union Lake. Two Walleyes were also caught that presumably originated from spring fingerling stocking, a 20.9-inch age-5 fish and a 20.8-inch age-6 fish. Both fish were above the statewide average length-at-age (17.6 for age 5 and 19.2 for age 6), but adult Walleyes caught in impoundments are difficult to age and ages are approximate. Four Northern Pike were caught during the 2021 Union Lake survey ranging from 20 to 36 inches. Too few Northern Pike were captured in each age class to rigorously evaluate growth, but all four fish were larger than the statewide average for their age class. Additional predators captured included Longnose Gar (n = 1) and Spotted Gar (n = 14). Catfish species were also present in Union Lake. A total of 10 large Channel Catfish were captured ranging from 22 to 30 inches. Catfish can contribute to predation but are more omnivorous eating a variety of food sources. Predators (Largemouth Bass, Longnose Gar, Smallmouth Bass, Spotted Gar, and Walleye) made up 25% of the total estimated biomass which is within the range of 20-50% recommended by Schneider (2000).

Minnows were abundant with 459 fish of six species (Bluntnose Minnow, Brook Silverside, Common Shiner, Golden Shiner, Sand Shiner, and Striped Shiner) captured. Low numbers of darters were also caught including Iowa Darter (n = 1), Johnny Darter (n = 3), and Logperch (n = 3). Large-bodied nongame species included Shorthead Redhorse (n = 36), Golden Redhorse (n = 35), White Sucker (n = 10), and Common Carp (n = 1). Yellow Bullhead (n = 54) and Brown Bullhead (n = 1) were also collected.

Analysis and Discussion

During the 2021 survey on Union Lake, the CPUE for juvenile Bluegills was above average, whereas the CPUE for adult Bluegills was near the lower end of the average range for SLMMU lakes. There are three potential explanations (which are not mutually exclusive) that could have contributed to the observed length frequency distribution. The impoundment size was substantially reduced during the 2018 drawdown. It is likely that some fish emigrated from the impoundment during the drawdown. For fish remaining in the impoundment, mortality from predation likely was high due to the concentration of fish into a smaller area. Another potential explanation for the skewed size structure is that there was unusually strong natural recruitment of Bluegills in 2020 due to favorable environmental conditions. Bluegills were also stocked from the Union Lake rearing pond at some unknown date in the last 8 years (personal communication with ULCA members) and if stocked in 2020, could have contributed to the high catch of age-1 fish in 2021. Bluegill growth was not specifically evaluated during the 2021 survey; however, the size structure index score based on the large-mesh fyke net catch indicates that the Bluegills in Union Lake are not stunted. Union Lake continues to support a quality Bluegill fishery with good numbers of seven- to nine-inch fish available and good recruitment to maintain the population. Bluegill stocking is not recommended as the population is self-sustaining and high densities can impact growth by increasing competition.

The Black Crappie population in Union Lake appears to support a low-density fishery with large fish available to harvest. The population may have been dominated by a strong year class given the prevalence of 11-inch fish. Black Crappie populations are often cyclical based on variable recruitment success (Swingle and Swingle 1967; Guy and Willis 1995). A Black Crappie fishery is often driven by episodic strong year classes, and as a result fishing success varies as the year class grows and is harvested. In 2021, good numbers of fish over 10 inches were observed, but very few fish ranging from 4-10 inches. Catch rates of two- to three-inch fish were extremely high during the 2021 survey indicating another strong recruitment class (presumably the 2020 cohort). As these fish grow, the fishery in Union Lake will improve. Recruitment variability in Black Crappie populations is often tied to water level variation and environmental conditions during spawning and early life history (Maceina and Stimpert 1998; Sammons et al. 2002; Maceina 2003; Siepker and Michaletz 2013). Black Crappies utilize wood structure as habitat. The abundance of coarse woody habitat in Union Lake has fluctuated in recent years due to the 2018 drawdown and associated removal of wood through stump cutting, followed by the addition of wood habitat structures in 2020.

Several other species are present in lower numbers in Union Lake. Yellow Perch provide an acceptable fishery. Catch rates were average with 8- and 9-inch fish being the most available for harvest and fish up to 13 inches present. Very few additional panfish species are contributing to the fishery. Bullheads and redhorse species are also abundant and likely are targeted by some anglers. The 2021 survey results do not accurately reflect the abundance of Common Carp in Union Lake. Although only one Common Carp was captured in the 2021 survey, it is important to recognize that standard lake survey methods tend to underestimate relative abundance of this species. Bow anglers still frequently target Common Carp in this reservoir. In addition, carp abundance within Union Lake may change seasonally as fish move between the impoundment and the Saint Joseph River. Despite these caveats, it seems clear that Common Carp are not present at densities that would be expected to impact sport fish.

The Largemouth Bass and Smallmouth Bass populations in Union Lake are in excellent condition. Catch rates were high and good growth rates were observed. Legal-sized fish were present in good numbers. Tournaments report an average catch of legal bass at 1.8 fish per angler or a team catch of 3.4 fish per boat. Several year classes of smaller fish were present that will continue to contribute to the fishery. The Smallmouth Bass population is less dense than Largemouth Bass, but good numbers were present compared to other SLMMU lakes. Smallmouth Bass fishing opportunities are limited on inland lakes in Southern Michigan. Union Lake is an exception. The Saint Joseph River is known for quality Smallmouth Bass populations. The connection to the Saint Joseph River is likely providing additional feeding and spawning habitat that enhances the reservoir fishery. The river connection also provides thermal refuge in July and August when habitat is limited in Union Lake.

Union Lake is a popular destination for bass tournament anglers. Bass tournament pressure is higher in southern Michigan due to proximity to population centers and the quality bass fisheries present. Union Lake receives higher than average tournament pressure because it meets several criteria. For example, it has a quality bass fishery and both Largemouth and Smallmouth Bass can be targeted. Union Lake also has a public BAS and is large enough to allow anglers to spread out across the lake. The DNR supports bass tournament angling as part of our strategy to provide diverse fishing opportunities. Bass tournaments practice catch, retain, and release practices, and fish are kept in aerated live wells, weighed, and released. Some mortality has been attributed to tournament weigh-ins, but most fish are released

alive. New technology and handling techniques have greatly improved live well conditions, decreased handling stress during weigh-in, and reduced the associated mortality (Ostrand et al. 2011; Allen et al. 2008). Temperature has been directly linked to the mortality observed in live-release tournaments as it increases stress of fish caught (Wilde 1998; Kwak and Henry 1995; Schramm et al. 1987). Water and air temperatures in Michigan are moderate compared to more southern reservoirs where high tournament mortality has been observed. Significant research has been conducted to monitor bass populations to determine if tournament pressure can result in impacts to the fish population. There is little evidence that live-release tournaments impact fish populations (Allen et al. 2004; Diana and Wahl 2015; Sylvia and Weber 2022). Recent analysis of statewide data in Michigan found no bass population impacts associated with tournament pressure (Herbst et. al unpublished data). Union Lake has supported a quality bass fishery as well as sustained tournament pressure. There are no indications that above average bass tournament pressure has had any negative impacts on the fishery. Best management practices for tournaments include maintaining cool oxygenated water in live wells and weigh-in holding tanks. Reducing the amount of air fish are exposed to during capture, handling, weigh-in, pictures, and release will also limit fish stress and mortality. If release boats are used, water quality in tanks should be maintained and fish should not be crowded in tanks for extended periods of time. DNR will continue to manage Union Lake as a quality bass fishery that supports bass fishing tournaments.

Union Lake has a BAS that can accommodate an average tournament of 10 boats. The site is not ideal for larger tournaments because of the parking limitation yet several tournaments that exceed the parking capacity were reported. As a result, tournaments and associated crowding have created some conflict at the BAS requiring additional enforcement, especially during weekends and popular boating times. The DNR Parks and Recreation Division manages the site and indicated that more than 10 vehicles with trailers can park in the lot if done in an organized fashion and they have not received complaints regarding the Union Lake BAS. The DNR operates boating access sites on a first-come first-serve basis. Tournament anglers have as much right to the BAS as other recreational anglers and boaters. All users must adhere to BAS rules and once the lot is full, must find alternative legal parking or refrain from using the site. Tournament directors are encouraged to plan ahead for larger tournaments and determine if additional site access permits are required when exceeding capacity. Best practices can be employed to avoid user conflicts.

Walleye prefer cool oxygenated water at depth in Michigan inland lakes. Union Lake is shallow and as a result does not provide optimal Walleye habitat year-round. As a result, only two Walleye were observed in the survey indicating the population density is low. Past management recommendations recommended stocking larger fingerlings (e.g. 8-inch fall fingerlings) to increase the possibility they would remain in the impoundment. Fall fingerlings are more costly to produce, and the demand for fall fingerlings greatly exceeds the current supply. Past attempts to rear fall fingerling Walleyes in the Union Lake rearing pond produced few fish.

ULCA members report that Walleye fishing activity in Union Lake is minimal. Similarly, SLMMU has not received reports of anglers targeting Walleyes in the Saint Joseph River upstream of Union Lake. By contrast, anglers are known to target Walleyes in the Saint Joseph River immediately downstream of Riley Dam. Gunderman (2017) documented downstream movement of stocked Walleyes over several dams in the lower Saint Joseph River. It is possible that some of the Walleyes caught below Riley Dam were stocked in Union Lake. However, Walleyes also are stocked downstream of the dam at Arney

Road and at Sturgeon Lake. No recent electrofishing or creel survey data are available for the river between Sturgeon Lake and Riley Dam.

Northern Pike were also captured in low numbers during the 2021 survey. Similar to Walleye, Northern Pike population estimates are conducted immediately after ice out during spawning and are only sparsely captured in gill nets during May and June. Northern Pike are abundant in the Saint Joseph River in areas where wetland spawning habitat is present. The Northern Pike that were captured in Union Lake were growing well, resulting in a low density population with a high percentage of preferred size fish.

Longnose Gar and Spotted Gar also were collected during the 2021 sampling efforts. Spotted Gar are protected from harvest due to their special concern status. Spotted Gar populations in Michigan are isolated to the southwestern part of the state (Diana and Goniea In Press). Because this population is at the northern fringe of the species' distribution, genetics have been shown to be unique (David 2012). Gar are important native predators that can control panfish from becoming overpopulated.

Overall, predator growth rates were average to above average. The predator to prey ratio is relatively low but still within the target range proposed by Schneider (2000a). Due to the river connectivity and associated influx of fish and nutrients, predators have a plentiful supply of forage fish. However, the panfish populations are not overabundant or stunted. Thus, predator stocking is not needed as an intervention to improve panfish size structure.

The DNR's Master Angler Program is a voluntary angler incentive program that rewards anglers by providing special patches if they catch and report fish meeting a species-specific minimum length criteria. Several Master Angler fish have been caught and reported on Union Lake. One Largemouth Bass was reported at 23.5 inches in 2014. Two Channel Catfish were reported at 10.38 pounds in 2009 and 27.2 inches in 2001. Two Bluegills, both measuring 10.2 inches were caught in 1996 and 2013. A 12.2-inch Rock Bass was caught in 2007, a 9.0-inch Pumpkinseed in 2022, and two Redear Sunfish measuring 10.4 and 11.5 inches were caught in 2019 and 2020 respectively. Union Lake appears to be providing opportunities to catch Master Angler class fish of several species.

Fish habitat in Union Lake has changed over the course of the history of the impoundment. Reports indicate that Union Lake was heavily vegetated until a shift in stable state occurred in the 1980s. Currently, Union Lake has limited vegetation with some pockets of invasive Eurasian Watermilfoil and Curly-leaf Pondweed in coves and along the shoreline. As noted previously, stumps and trees were removed from Union Lake in at least one effort to improve navigation. Despite these efforts, Union Lake retains a good amount of woody habitat. Wood habitat structure additions in 2020 have also increased fish habitat availability in the lake. Wood is critical considering the amount of shoreline hardening that has occurred through installation of seawalls and revetments. Fish nursery habitat is especially limiting in Union Lake. Natural shorelines with wetland fringe and native vegetation are vital habitats for juvenile fish. Vegetation and woody habitat have been shown to be directly related to growth rates of Bluegills and Largemouth Bass (Schindler et al. 2000). Shoreline development results in increased angling pressure, decreased water quality, and decreased woody habitat. Both Largemouth Bass and Bluegill production decreases when vegetation is absent, or densities are too low (Wiley et al. 1984; Savino at al. 1992). Largemouth Bass recruitment has also been shown to decline when vegetation coverage is low (Durocher et al 1984; Miranda and Pugh 1997). Presence of vegetation and woody habitat increase survival of young-of-year Largemouth Bass by providing refuge from predation and

access to quality prey. The remaining woody habitat in Union Lake should be protected and future removal efforts should not be considered. Vegetation treatments should be limited to target only nuisance invasive vegetation while emphasizing protection of native plant species. To improve nearshore habitat for fish and increase lake to upland connectivity for frogs and turtles, soft natural shoreline protection techniques should be considered in areas where erosion is occurring (O'Neal and Soulliere 2006; see https://www.shorelinepartnership.org/ for more information).

The rearing pond has been operated to produce supplemental fish that have been stocked in Union Lake for decades. Many different species have been produced over the history of operating the pond. There is no local interest in producing Walleyes as it has been demonstrated that they do not create a significant fishery in Union Lake. Fall fingerling Walleyes were more expensive and only limited numbers could be produced. DNR has discontinued the practice of stocking warmwater species in lakes (e.g. Bluegill, Largemouth Bass, etc.) because stocking does not contribute to the fishery, these species are rarely recruitment limited, and overcrowding and stunting are common concerns (Cooper 1948). Because warmwater fish species are prolific and found at high densities in lakes (demonstrated in this survey by Bluegills dominating the catch) it is also difficult to stock enough fish to significantly contribute to the fishery. Stocked Largemouth Bass rarely contribute to a fishery and only in limited proportions (Nannini et al. 2014; Diana and Wahl 2008; Diana and Wahl 2009). Largemouth Bass catch rates in this survey were high, indicating that supplementation is not needed and could have adverse impacts by increasing competition for resources. As a result, DNR does not recommend stocking Bluegills or Largemouth Bass in Union Lake. Black Crappies have significant variation in spawning success and fisheries are often carried by a few strong year classes. Stocking Black Crappies could supplement low recruitment years and contribute to a more stable fishery. Yellow Perch spawn by laying stranded eggs on top of vegetation. Yellow Perch populations could be depressed in Union Lake due to the lack of vegetation in early spring. Stocking Yellow Perch potentially could contribute to the fishery. If ULCA wants to continue operating the rearing pond, DNR recommends rearing Black Crappies and Yellow Perch. The source fish for the pond should come from Union Lake to avoid the risk of bringing in pathogens or invasive species from other water bodies. As required by law, all stocking should be performed under a valid permit issued by the DNR and final stocking numbers should be reported to the DNR for record keeping. Unpermitted stocking and lack of reporting limit the ability of DNR staff to manage Union Lake and interpret survey results.

Management Direction

Union Lake currently has moderate density sportfish populations with good growth and size structure. The DNR will continue to monitor angler reports to determine if significant changes in the fishery are occurring.

The DNR will discontinue spring fingerling Walleye stocking in Union Lake. Stocking has been attempted several times and has failed to create a significant fishery in Union Lake. Union Lake is a type 1 lake and the Walleye Management Plan does not recommend spring fingerling stocking in type 1 lakes. Downstream stocking at Arney Road will continue to support the popular fishery in the Saint Joseph River below the reservoir.

SLMMU staff will work with the ULCA to assist in permitting and reporting of rearing pond operations. Communication was lacking over the past 10 years and efforts have been made to reestablish

collaboration. As required by law, all fish stocking from the rearing pond must be done under permit and through communication with the DNR to ensure that the proposed actions do not conflict with fisheries management goals.

Habitat protection will continue to be an important component of fisheries management on Union Lake. This objective will be achieved in part by reviewing EGLE permit applications for potential impacts to the aquatic resources of Union Lake. The DNR also will promote natural shoreline techniques for erosion control and suggest best management practices to reduce impacts. If there is interest from ULCA or other angler groups, SLMMU staff will provide advice regarding design and location of coarse woody habitat structures to support suitable habitat for Black Crappie and bass populations. In addition, DNR biologists will continue to review and comment on proposals for aquatic nuisance control treatments to promote practices that will limit impacts on fish and native vegetation.

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Table 1. Stocking history of Bluegill, Largemouth Bass, Northern Pike, Tiger Muskellunge, and Yellow Perch in Union Lake, Branch County.

Species	Year	Number	Age / Length (inches)
Yellow Perch	1922	3,500	
Bluegill	1923	4,250	
Smallmouth Bass	1923	1,400	
Largemouth Bass	1923	1,000	
Yellow Perch	1929	3,600	
Bluegill	1929	15,250	
Largemouth Bass	1929	480	
Bluegill	1930	7,980	
Bluegill	1931	8,500	
Yellow Perch	1931	21,000	
Bluegill	1935	20,000	4 month
Bluegill	1936	5,000	4 month
Bluegill	1937	15,000	4 month
Bluegill	1938	25,000	4 month
Bluegill	1939	126,000	4 month
Bluegill	1939	17,267	Adults
Largemouth Bass	1939	359	4 month
Bluegill	1940	25,000	4 month
Bluegill	1940	2,500	Yearling
Largemouth Bass	1940	1,000	4 month
Largemouth Bass	1940	2,500	Yearling
Yellow Perch	1940	3,500	Yearling
Bluegill	1941	100,000	4 month
Largemouth Bass	1941	1,000	4 month
Bluegill	1942	29,000	4 month
Largemouth Bass	1942	2,500	4 month
Bluegill	1944	25,000	4 month
Largemouth Bass	1944	5,000	3.5 month
Bluegill	1945	20,000	3 month
Largemouth Bass	1945	6,650	3 month
Largemouth Bass	1950	800	
Channel Catfish	1967	7,500	
Bluegill	1972	350,000	Fingerling

Table 1 Continued.

Species	Year	Number	Age / Length (inches)
Northern Pike	1974	115	Fingerling
Northern Pike	1976	554	Spring fingerling
Northern Pike	1977	1,679	Fingerling
Northern Pike	1978	1,248	Spring fingerling
Northern Pike	1979	1,346	0
Tiger Muskellunge	1980	1,100	7.6
Northern Pike	1981	216,184	0.5
Northern Pike	1984	3,280	3.2
Northern Pike	1985	2,302	4.0
Largemouth Bass	1986	3,000	1.7
Channel Catfish	1987	9,000	4.4
Northern Pike	1987	2,000	5.5
Channel Catfish	1988	10,000	3.2
Northern Pike	1988	64,611	1.9
Channel Catfish	1989	3,300	4.1
Northern Pike	1989	2,500	4.5
Redear sunfish	1989	7,278	1.3
Bluegill	1990	35,100	2.2
Channel Catfish	1990	10,000	3.7
Northern Pike	1990	3,100	4.0
Redear sunfish	1990	6,000	1.8
Channel Catfish	1991	12,000	3.9
Northern Pike	1991	5,700	2.5
Channel Catfish	1992	5,450	4.3
Bluegill	1993	100,000	1.0
Channel Catfish	1995	15,271	4.3
Channel Catfish	1996	4,500	8.4
Channel Catfish	1997	6,000	7.2
Channel Catfish	1998	4,922	9.5
Northern Pike	1998	3,040	3.3
Channel Catfish	1999	10,030	8.8
Northern Pike	1999	4,136	3.8
Channel Catfish	2000	4,435	7.5
Channel Catfish	2001	6,355	9.1
Channel Catfish	2002	7,877	7.8
Channel Catfish	2003	5,250	8.8
Northern Pike	2003	4,700	4.5
Channel Catfish	2004	7,376	3.2
Channel Catfish	2005	7,673	8.3

Table 2. Stocking history of Walleye in Union Lake, Branch County.

Species	Year	Number	Age / Length (inches)
Walleye	1933	280,000	Swim-up fry
Walleye	1981	500,000	0.3
Walleye	1983	600,000	0.4
Walleye	1984	1,000,000	0.0
Walleye	1986	1,000	1.8
Walleye	1987	30,000	1.4
Walleye	1987	18,700	2.8
Walleye	1988	1,200	2.0
Walleye	1993	800	4.5
Walleye	1994	175,000	0.6
Walleye	1994	52,500	1.0
Walleye	1995	52,500	1.2
Walleye	1997	11,900	1.5
Walleye	1997	850	1.8
Walleye	1997	16,770	1.5
Walleye	1998	9,295	6.3
Walleye	1999	46,754	1.7
Walleye	2000	31,295	1.8
Walleye	2012	8,200	0.9
Walleye	2013	11,750	1.8
Walleye	2014	500	1.3
Walleye	2015	19,877	1.4
Walleye	2015	750	1.3
Walleye	2016	1,000	1.2
Walleye	2018	26,314	1.5
Walleye	2022	26,176	1.0

Table 3. Fish captured in the 2021 fish survey of Union Lake, Branch County.

Species	Number	Total Weight (lbs)	Average Length (inches)	Length Range (inches)
Black Crappie	70	20.8	6.1	2 - 13
Bluegill	1,559	115.8	3.2	1 - 9
Bluntnose Minnow	273	2.5	2.8	1 - 3
Brook Silverside	110	-	2.8	1 - 3
Brown Bullhead	1	1.4	14.5	14 - 14
Channel Catfish	10	66.5	26.8	22 - 30
Chestnut Lamprey	5	0.1	6.9	5 - 8
Common Carp	1	9.4	27.5	27 - 27
Common Shiner	18	0.4	3.4	2 - 5
Golden Redhorse	35	24.1	10.7	2 - 19
Golden Shiner	46	1.9	4.4	2 - 8
Hybrid Sunfish	27	7.2	7.0	5 - 8
Iowa Darter	1	0.0	1.5	1 - 1
Johnny Darter	3	0.0	2.5	2 - 2
Largemouth Bass	135	86.1	9.1	2 - 19
Logperch	3	0.0	2.5	2 - 2
Longnose Gar	1	2.3	29.5	29 - 29
Northern Pike	4	22.9	28.0	20 - 36
Pumpkinseed	13	3.2	6.5	4 - 7
Redear Sunfish	2	0.6	7.5	7 - 7
Rock Bass	10	1.5	5.7	3 - 7
Sand Shiner	11	0.1	2.5	2 - 2
Shorthead Redhorse	36	77.2	17.1	5 - 21
Smallmouth Bass	25	32.8	12.9	4 - 18
Spotted Gar	14	20.3	22.3	19 - 30
Striped Shiner	1	0.0	3.5	3 - 3
Walleye	2	5.6	20.5	20 - 20
Warmouth	22	6.9	7.2	5 - 8
White Sucker	10	21.9	16.9	6 - 20
Yellow Bullhead	54	38.7	11.4	8 - 13
Yellow Perch	50	14.7	8.2	3 - 13
Grand Total	**2,552**	**584.8**	**4.6**	**1 - 36**

Table 4. Summary of bass tournaments reported to the Michigan Fisheries Tournament Information System for Union Lake from 2015 through 2023.

Year	Number of Tournaments	Average Number of Boats	Average Number of Largemouth Bass Weighed	Average Number of Smallmouth Bass Weighed	Heaviest Bass Reported Annually (lbs.)
2016	7	8.6	15.7	0.4	4.7
2017	17	11.2	36.7	3.1	4.0
2018	17	12.9	46.8	3.3	4.0
2019	13	14.8	40.6	5.3	4.3
2020	15	11.9	35.5	3.1	3.8
2021	20	12.4	34.6	4.0	4.2
2022	20	11.8	42.5	5.8	4.9
Average	15.6	11.9	36.0	3.6	4.3

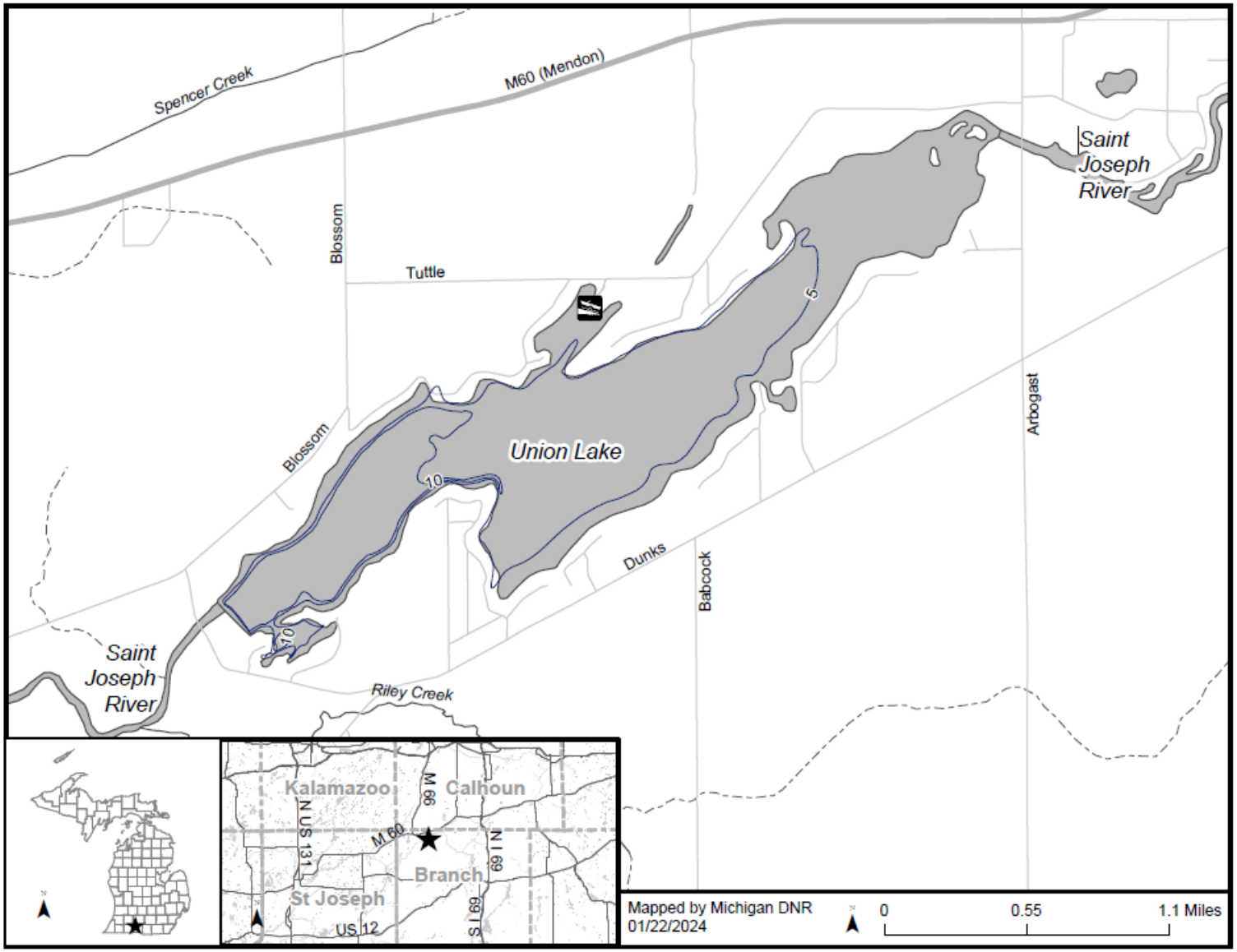

Figure 1. Map of Union Lake in Branch County

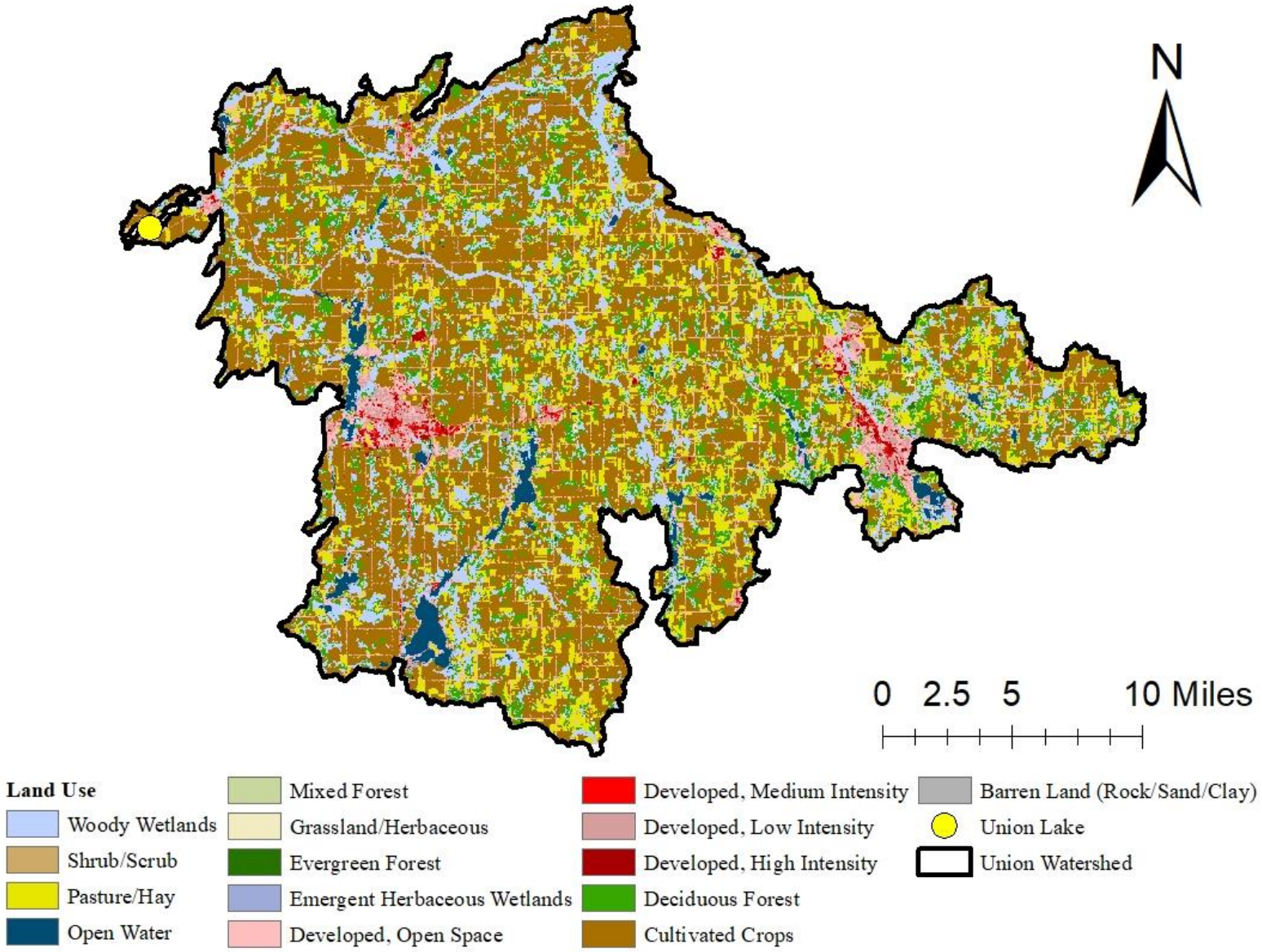

Figure 2. Land use map of the Union Lake watershed based on 2011 National Land Cover Database (USGS 2014). The Union Lake watershed was obtained from LAGOS delineation (Smith et al. 2021).

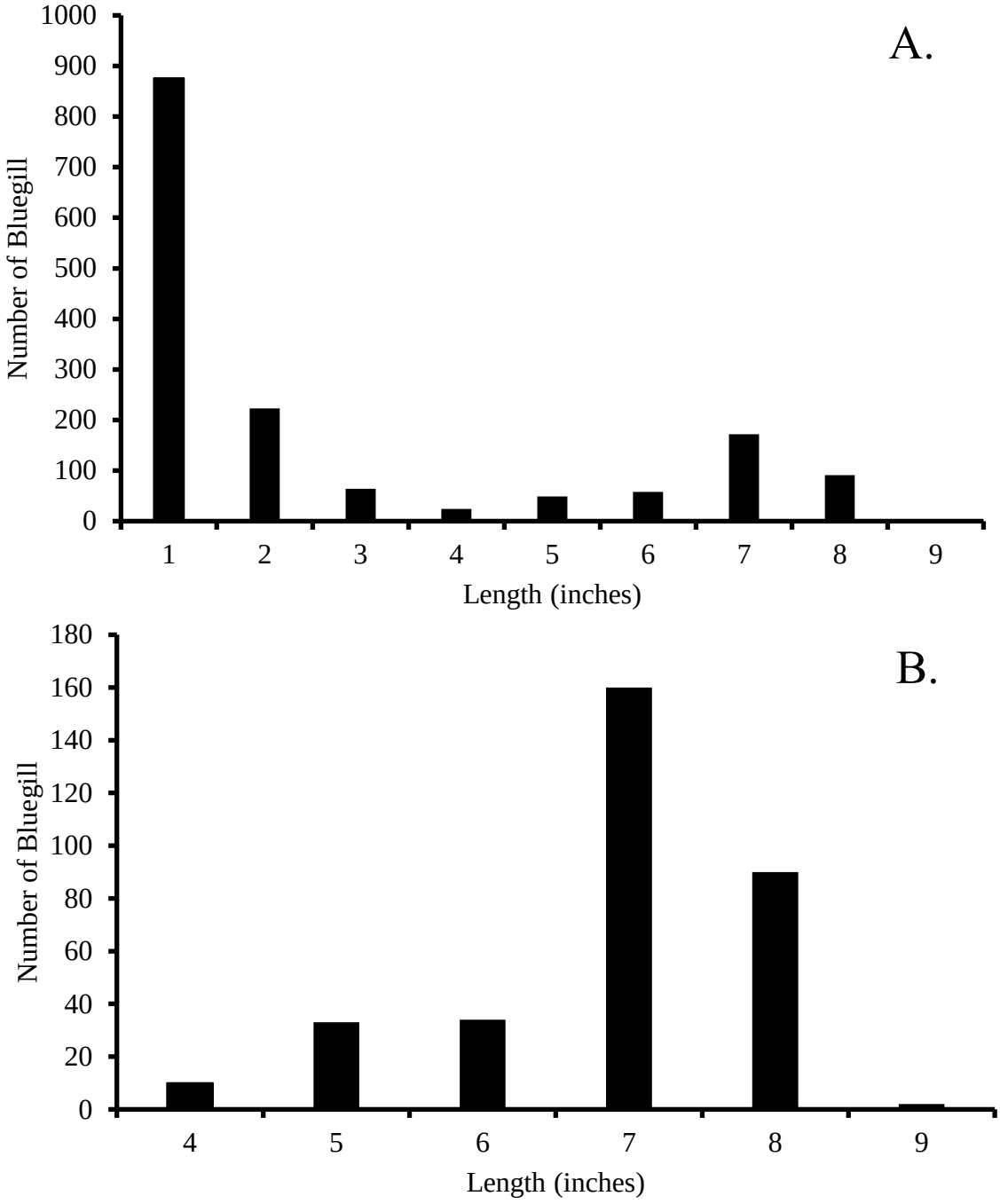

Figure 3. Length frequency distribution of Bluegills caught across all gears (A) and in large-mesh fyke nets (B) during the 2021 fish survey of Union Lake.

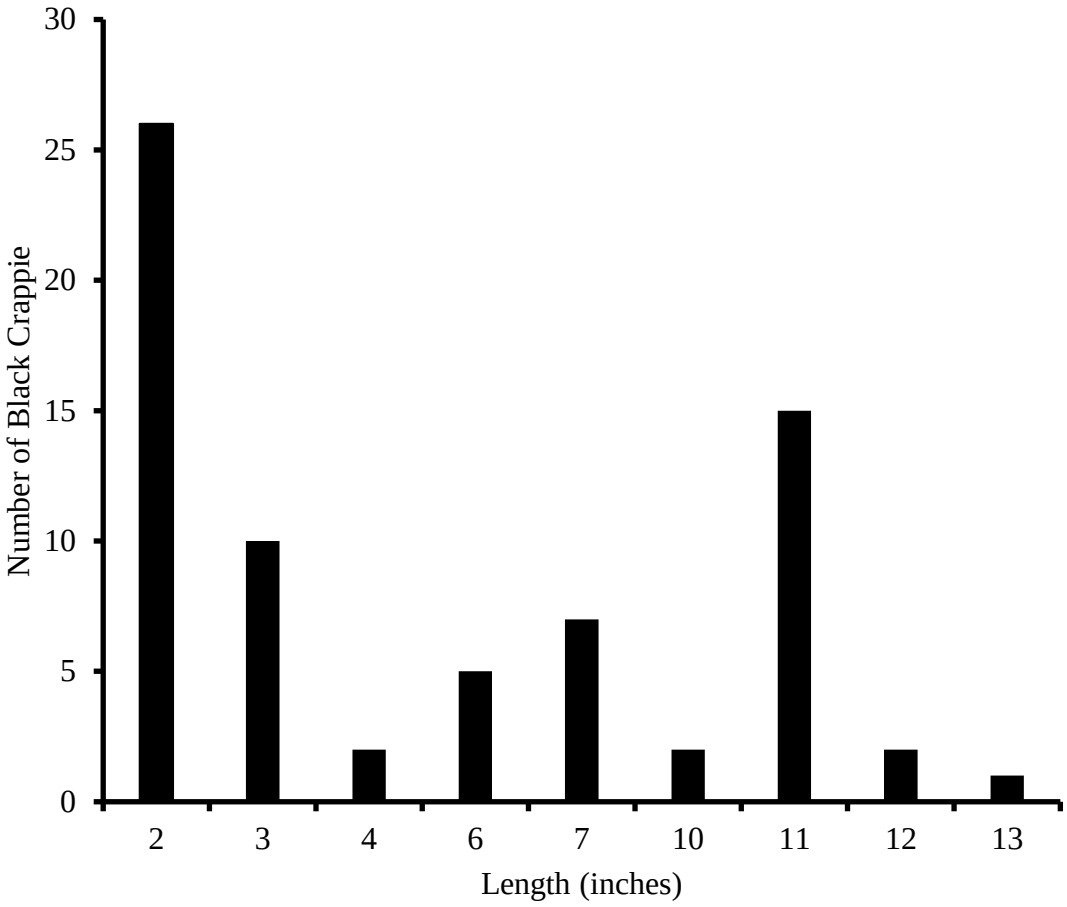

Figure 4. Length frequency distribution of Black Crappies captured across all gears in the 2021 fish survey of Union Lake.

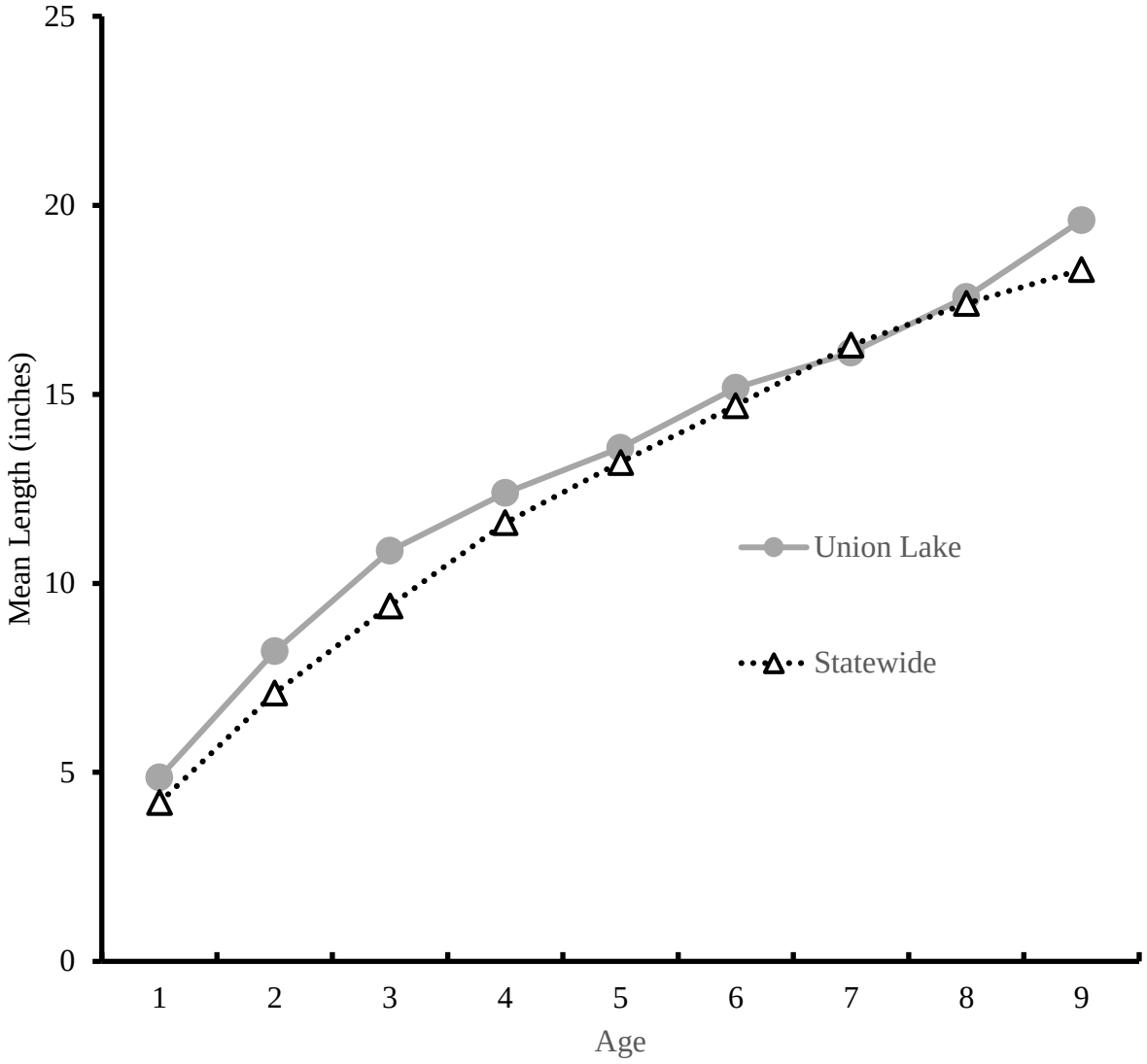

Figure 5. Mean lengths at age for Largemouth Bass captured in the 2021 fish survey on Union Lake compared to the statewide average lengths at age from Schneider et al. (2000a).

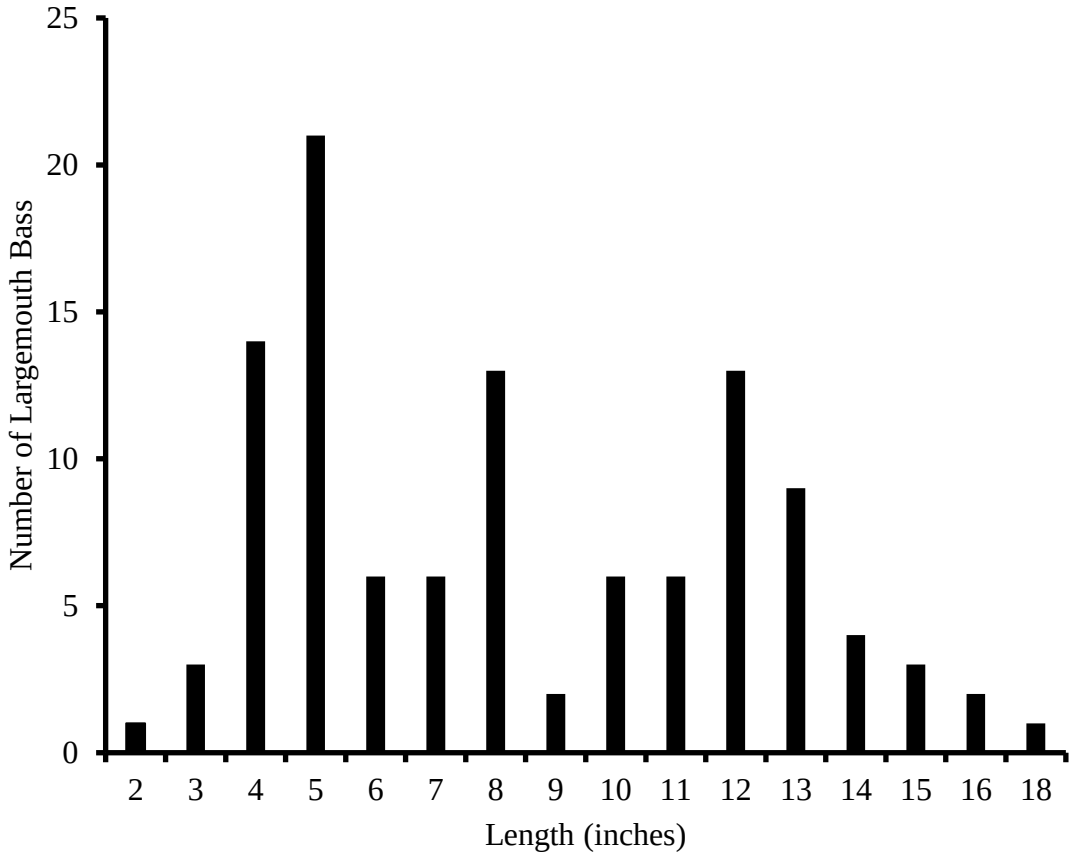

Figure 6. Length frequency distribution of Largemouth Bass caught in Union Lake during the nighttime electrofishing survey on May 6, 2021.

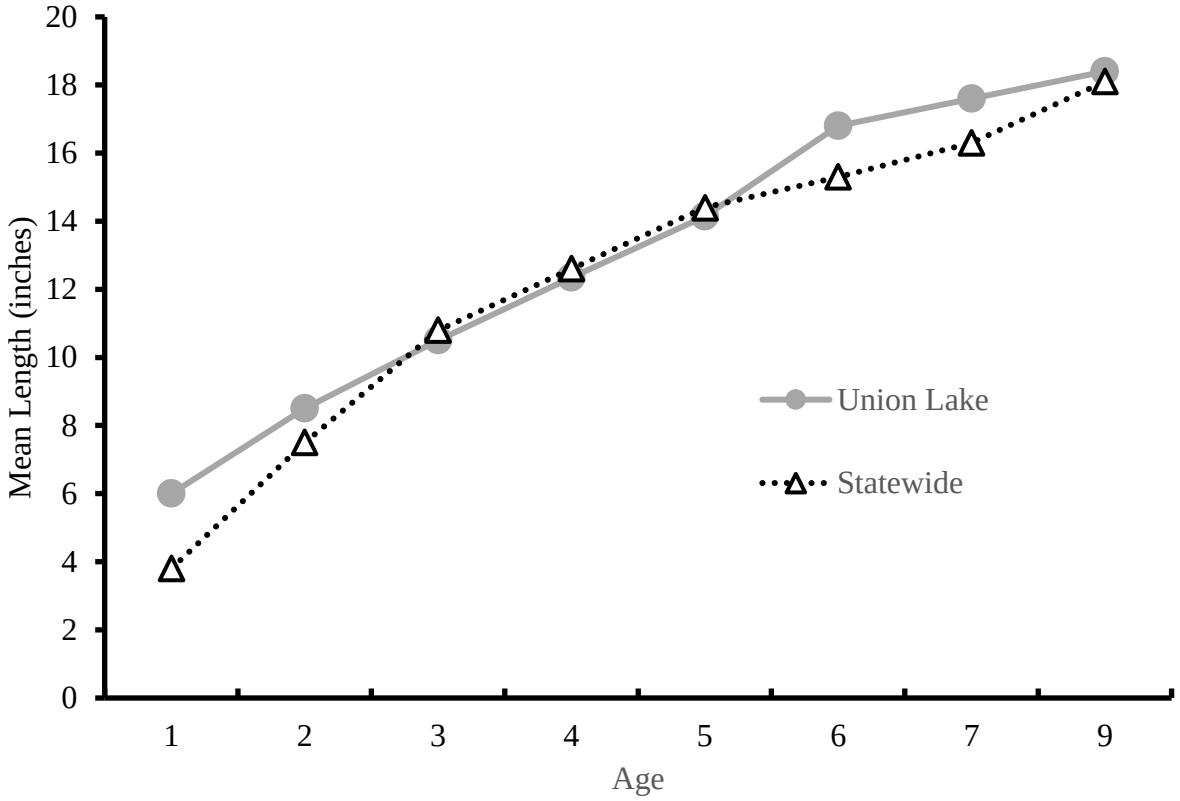

Figure 7. Mean lengths at age for Smallmouth Bass captured in the 2021 fish survey on Union Lake compared to the statewide average lengths at age from Schneider et al. (2000a). Only the age-5 cohort met the minimum requirement of five fish for inclusion in calculation of the mean growth index.