Lake LeAnn 2018 Fish Survey

June 21, 2018

Prepared for:

Lake LeAnn Property Owners Association

Prepared by:
ADVANCED ECOLOGICAL MANAGEMENT
22071 7 Mile Road
Reed City, MI 49677

Table of Contents

1.0 INTRODUCTION

Lake LeAnn is a man-made private lake that is comprised of two major basins totaling approximately 470 acres in size. The north basin is approximately 185 acres and the south basin is approximately 285 acres, with both basins managed by the Lake LeAnn Property Owners Association (LLPOA).

The south basin is located approximately 900 feet north of United States Highway 12 and the north basin is located approximately 600 feet south of Vicary Road in Somerset Township, 5 South, Range 1 West in Sections 3, 4, 5, 8, 9, and 10 of Hillsdale County, Michigan (Figure 1-1). The lake is predominantly characterized as a shallow (less than 15 feet deep, with the south basin containing two small areas that are approximately 30-40 feet deep and the north basin containing several small areas that are approximately 20 feet deep. The lake is characterized as a warmwater fish community and has been actively managed by the LLPOA to control aquatic weed growth and to promote a healthy fishery.

Lake LeAnn has been historically stocked by the LLPOA with a variety of fish, including smallmouth bass (*Micropterus dolomieu*), walleye (*Sander vitreus*), yellow perch (*Perca flavescens*), channel catfish (*Ictalurus punctatus*), black crappie (*Pomoxis nigromaculatus*), northern pike (*Esox Lucius*), and fathead minnows (*Pimphales promelas*). Although the MDNR no longer conducts fisheries surveys for private lakes, the LLPOA was interested in gaining a better understanding of the Lake LeAnn fish community and contracted with Advanced Ecological Management, LLC (AEM) to conduct an electrofishing survey of the lake in May 2018. The objectives of this survey were to identify fish species that were present within the lake and determine their relative abundances. Where possible, AEM has provided recommendations for fisheries management strategies that are consistent with the insight gained from this survey. The management recommendations are intended to improve and/or maintain the current fish community characteristics.

2.0 STUDY SITE

Lake LeAnn is a man-made all sports lake that is located within the Grand River Watershed. The lake is surrounded by forest, seasonal cottages, permanent residences, and portions of the shoreline of the lake are vegetated with a variety of emergent, submerged and floating aquatic vegetation, including pondweeds (*Potamogeton* sp.) and

cattails (*Typha* sp.) that contribute to habitat complexity, and are an important fish habitat component. Invasive aquatic vegetation species are also abundant in numerous locations throughout each basin, and include curly-leaf pondweed (*Potamogeton crispus*) and Eurasian watermilfoil (*Myriophyllum spicatum*).

3.0 METHODS

The fish community of Lake LeAnn was surveyed using boat-mounted electrofishing gear to collect fish in shallow water and near-shore areas around the lake, and Fyke nets were placed in five locations around each major basin. A minnow seine was also used around the shoreline of the islands located in each basin. (Figure 1-2).

Pulsed direct current was used during the survey to minimize trauma to the fish. Electroshocking duration was automatically recorded as the total seconds of electricity that was discharged from the electrofisher for each transect. Electrofishing was conducted in the evening, which is more effective than shocking during daylight hours (Smith-Root 2005).

Fyke nets were fished overnight (one night of net deployment = one net night per net). The Fyke nets were placed along the shoreline in locations where drop-offs (i.e., access to deeper water) were typically located close to the shoreline. Three Fyke nets were constructed of two-inch stretch mesh and the hoop diameter measured four feet with a 50-foot long center lead, and two 6-foot by 25-foot wing leads. Two additional Fyke nets were constructed of 0.125-inch "Ace"-type nylon mesh coated with green latex net dip. The lead was 15 feet-long and 2-feet high. The frame and the cab were 10-feet long when fully extended. The frame section is formed by two rectangular spring-steel frames that are 2-feet high by 4-feet wide. The cab was constructed of two 2-feet diameter steel hoops.

Catch-per-unit-effort (CPUE) is used as an index of fish abundance. Fish sampling efforts were standardized to units consistent with the Michigan Department of Natural Resources sampling protocol (Schneider et al. 2000[a]). CPUE for electroshocking was estimated as follows:

CPUE = $\frac{N}{t}$

Where,

N = number of fish caught

t = duration of electricity discharge in minutes, or minutes of Fyke net soak time.

The species, length in millimeters (converted to inches), weight in grams (converted to ounces or pounds), and number of fish captured were recorded for all fish collected by AEM. Fish were returned alive to the system following collection and identification. Fish were identified to species using various taxonomic references (Bailey et al., 2003; Coon, 2001; Pflieger, 1997; Becker, 1983).

Weight-length regressions were evaluated for selected fish species and the data were compared to state average length and weight values to evaluate the condition of the fish. Condition (robustness) sometimes reflects food availability and growth within the weeks prior to sampling (Schneider et al. 2000[b]). The weight-length relationship was expressed on a logarithmic (base 10) scale as follows:

$$\log W = \log a + b \log L$$

Where,

W = total weight

L = total length

log a = intercept of regression equation

b = slope of regression equation.

Water temperature, pH, conductivity, and dissolved oxygen were measured as part of the fish survey. These water quality parameters were measured at one or two-foot depth intervals in each major basin of the lake using a Yellow Springs Instrument Professional Plus water quality meter (Figure 1-2). Secchi depth was recorded in the same location where other water quality parameters were collected.

Although no formal survey of aquatic vegetation was conducted during the fish survey, AEM personnel noted the general conditions of the lake at the time of the survey, including aquatic vegetation, structure, and morphology that contributes to fish habitat complexity. Photographs were collected to depict conditions of the lake at the time of the survey.

4.0 RESULTS

Electrofishing was conducted during the evenings of May 7 and 8, 2018 in five transects along the shoreline of each basin. The total shocking time was 10,462 seconds of electricity discharge into the water for both basins, with a total of 4,474 seconds in the south basin and 6,012 seconds in the north basin. Five Fyke nets were deployed for a total of five net nights in the north basin from May 7 through May 8, 2018, and for a total of five net nights in the south basin from May 8 through May 9, 2018.

4.1 Fish Community

A total of 806 fish were captured by AEM from the north (sample size; *n* = 305 fish) and south basins (*n* = 501 fish), and included at least 14 species of fish that were predominantly comprised of warmwater species (Table 4-1). Largemouth bass (*Micropterus salmoides*) and bluegills (*Lepomis macrochirus*) were the most frequently collected fish, with largemouth bass and bluegills comprising 79% of the total catch among both basins (Table 4-1). Baitfish, including a Central mudminnow (*Umbra limi*), bluntnose minnows (*Pimephales notatus*), fathead minnows (*Pimephales promelas*), and spotfin shiners (*Cyprinella spiloptera*) were also collected during the electrofishing survey. Spotfin shiners and bluntnose minnows were the most abundant species among the minnow species and were observed to be numerous around the small islands of each basin and in shallow nearshore areas with aquatic vegetation or woody debris nearby.

The catch rate using electrofishing gear for all species was 5.7 fish per minute of electrofishing in the south basin and 2.6 fish per minute of electrofishing in the north basin. Although more fish were collected in the south basin per minute of effort, the total weight of fish collected was greater in the north basin, with a total of 280.5 pounds compared to the south basin, where a total of 235.1 pounds of fish were collected among all survey gear.

Most of the fish were collected using electrofishing gear. The Fyke nets were effective at catching black crappie, minnows, a few northern pike (*Esox lucius*) and walleye (*Sander vitreus*; Table 4-1). The seines were only fished around the shoreline of the islands in each basin and were effective at catching minnow species and juvenile bluegill (Table 4-1).

Largemouth bass

Largemouth bass comprised 42% of the fish collected among all fish collected by AEM during the 2018 survey. A total of 340 largemouth bass were captured in Lake LeAnn, with 214 collected from the south basin and 126 collected from the north basin (Table 4-1). Largemouth bass in the south basin ranged in length from 5.8 to 19.4 inches (average $\bar{x}$ = 10.4 inches; standard deviation *s* = 2.2 inches; sample size *n* = 214), and ranged in weight from 0.1 to 3.1 pounds ($\bar{x}$ = 0.5 pounds, *s* = 0.4 pounds, *n* = 214). Largemouth bass in the north basin ranged in length from 5.4 to 20.4 inches, with a larger average length of 14.1 inches (*s* = 2.4 inches; sample size *n* = 126), and ranged in weight from 0.03 to 3.8 pounds, with a larger average weight of 1.3 pounds (*s* = 0.7 pounds, *n* = 126).

Approximately 97% of the largemouth bass from the south basin ranged in size from 8 to 14 inches, and approximately 81% of the largemouth bass from the north basin ranged in size from 14 to 18 inches (Figure 4-1). The 12-inch size class was the most abundant among all lengths in the south basin and the 16-inch size class was the most abundant among all lengths in the north basin. The size of largemouth bass in both basins was close or slightly smaller than the state average weight-length relationship for Michigan largemouth bass (Figure 4-2).

Bluegills

A total of 294 bluegills were captured in Lake LeAnn, with 172 collected from the south basin and 122 collected from the north basin (Table 4-1). Bluegills in the south basin ranged in length from 1.0 to 8.1 inches ($\bar{x}$ = 6.0 inches; *s* = 1.7 inches; sample size *n* = 172), and ranged in weight from 0.01 to 6.0 ounces ($\bar{x}$ = 2.6 ounces, *s* = 1.1 ounces, *n* = 172). Bluegills in the north basin ranged in length from 1.4 to 8.6 inches, with a smaller average length of 4.8 inches (*s* = 1.8 inches; sample size *n* = 120), and ranged in weight from 0.01 to 6.8 ounces, with a smaller average weight of 1.4 ounces (*s* = 1.4 ounces, *n* = 120).

Approximately 85% of the bluegills from the south basin ranged in size from six to eight inches, and approximately 53% of the largemouth bass from the north basin ranged in size from four to six inches (Figure 4-3). The seven-inch size class was the most abundant among all lengths in the south basin and the four and six-inch size classes were the most abundant among all lengths in the north basin. The size of bluegills in both

basins was close or slightly smaller than the state average weight-length relationship for Michigan bluegills (Figure 4-4).

Black crappie

A total of 23 black crappie (*Pomoxis nigromaculatus*) were captured in Lake LeAnn in 2018, with seven collected in the south basin and 16 collected in the north basin (Table 4-1). Among both basins, black crappie ranged in length from 7.4 to 14.6 inches ($\bar{x}$ = 9.7 inches; *s* = 1.7 inches), and ranged in weight from 3.1 to 29.2 ounces ($\bar{x}$ = 8.4 ounces, *s* = 5.6 ounces).

Pumpkinseed

A total of 15 pumpkinseeds (*Lepomis gibbosus*) were captured in Lake LeAnn (Table 4-1). It should be noted that two to three of these fish may have been incorrectly identified as pumpkinseeds and may have been redear sunfish (*Lepomis microlophus*), which have been introduced in the southern three tiers of Michigan counties (Bailey et al., 2003). According to Pflieger (1997), the rear margin of the gill cover is stiff, the soft dorsal rays are spotted, and the cheek is distinguished by wavy blue lines in pumpkinseeds, where the rear margin of the gill cover is thin and flexible, the soft dorsal is without distinct spots, and the cheek is without wavy blue lines in redear sunfish.

Pumpkinseeds (and a few redear sunfish) ranged in length from 3.2 to 7.8 inches ($\bar{x}$ = 6.5 inches; *s* = 1.5 inches), and ranged in weight from 0.3 to 5.9 ounces ($\bar{x}$ = 3.8 ounces, *s* = 1.8 ounces).

Walleye

A total of 11 walleye were captured in Lake LeAnn in 2018, with eight collected in the south basin and three collected in the north basin (Table 4-1). Among both basins, walleye ranged in length from 16.3 to 25.4 inches ($\bar{x}$ = 20.1 inches; *s* = 2.9 inches), and ranged in weight from 1.6 to 6.4 pounds ($\bar{x}$ = 2.9 pounds, *s* = 1.5 pounds).

Common carp

A total of 23 common carp (*Cyprinus carpio*) were captured in Lake LeAnn in 2018, with 16 collected in the south basin and seven collected in the north basin (Table 4-1). Among both basins, common carp ranged in length from 15.2 to 29.9 inches ($\bar{x}$ = 20.7 inches; *s*

= 4.2 inches), and ranged in weight from 2.0 to 14.2 pounds ($\bar{x}$ = 5.0 pounds, *s* = 2.9 pounds).

4.2 Water Quality and Habitat

It did not appear that the south or north basins had thermally stratified at the time of the 2018 aquatic survey. Water temperature was consistent from the surface to 17 feet in the south basin and declined a total of 2.8°C from surface to 17 feet (Table 4-2). Similarly, water temperature was consistent from the surface to 14 feet in the north basin and declined a total of 2.1°C from surface to 14 feet. Conductivity was slightly higher in the south basin ($\bar{x}$ = 419.1 micro Siemens per centimeter) compared to the north basin ($\bar{x}$ = 388.3 micro Siemens per centimeter). Dissolved oxygen was generally consistent from the surface to the substrate and was high enough to support aquatic life throughout the water column in both basins. The pH of the water ranged from 8.48 to 8.24 throughout the water column in the south basin and from 8.04 to 7.84 throughout the water column in the north basin, which is well within the "normal" range for most Michigan lakes (Table 4-2). The Secchi depth was 12.8 feet in the south basin and 16.2 feet in the north basin at the time of the survey, which likely indicates Lake LeAnn would be classified as a mesotrophic lake (Fuller et al. 2004).

Much of the shoreline of both basins of Lake LeAnn at the time of the survey was modified with hard armoring, including steel sheet piling and rock riprap (Figure 4-5). Small portions of the shoreline of both basins naturally transitioned from woody vegetation to lake, where emergent vegetation and large woody debris could provide valuable hiding cover and spawning habitat for fish (Figure 4-6). Although it was early in the growing season at the time of the aquatic survey, AEM noted the presence of invasive of Eurasian watermilfoil, curly-leaf pondweed, and filamentous green algae. AEM understands that an active aquatic vegetation management program is continually implemented by the LLPOA to minimize the occurrence and abundance of these aggressive species.

5.0 SUMMARY and DISCUSSION

Both basins of Lake LeAnn are comprised of a predominance of warmwater species including panfish, such as bluegills, pumpkinseeds, black crappie, and largemouth bass. A total of 14 species of fish were observed, and largemouth bass and bluegills were the most abundant, comprising 79% of the total catch (bluegill = 37% and largemouth bass = 42% of the total catch). Although a few baitfish were collected as part of the aquatic

survey, baitfish were observed to be abundant along the shoreline of both basins. Baitfish species predominantly included spotfin shiners and bluntnose minnows, with a few fathead minnows observed in the south basin.

Fish were more abundant in the south basin where 62% of the total catch was collected. Similarly, catch per unit of effort was also higher in the south basin (5.7 fish per minute of electrofishing) compared to only 2.6 fish per minute of electrofishing in the north basin. Although more fish were found in the south basin, the north basin had a greater biomass of fish (280.5 total pounds of fish collected compared to 235.1 pounds of fish in the south basin) indicating the fish were generally larger than fish found in the south basin.

The largemouth bass length frequency distribution indicated the south basin had a smaller sized and more abundant population of bass (*n* = 214 fish), where the 12-inch size class was the most frequently observed size (Figure 4-1). Although the north basin had fewer bass (*n* = 126 fish), there were more representatives of larger fish, where the 16-inch size class was the most frequently observed size (Figure 4-1). The size of largemouth bass in both basins was only slightly lower than the average size experienced by largemouth bass in other Michigan waters (Figure 4-2), which likely indicates there are few or no problems affecting the growth of these fish.

The length frequency distribution of bluegills in the north basin indicated multiple size classes were represented in the population, but none were dominant representatives of the total population (Figure 4-3). Larger bluegills ranging from six to eight inches were the most frequently collected length classes in the south basin. However, few bluegills in the four to five-inch size class were collected in the south basin, which may be indicative of poor reproductive success for bluegill that comprised those sizes. Few bluegills larger than eight inches were collected from the north or south basins, which may be indicative of fishing pressure resulting in the reduction of the larger bluegills (Figure 4-3). The size of bluegills in Lake LeAnn is generally consistent to the size experienced by bluegill in other Michigan waters (Figure 4-4).

Walleye have been periodically stocked in Lake LeAnn. AEM only collected larger walleye as indicated by an average size of 20.1 inches. Based on the observed larger sizes of walleye and the apparent absence of smaller, or juvenile walleye, it is unlikely that Lake

LeAnn supports walleye reproduction. However, walleye stockings are regularly conducted in many of Michigan's inland lakes as a means to assist in the control of abundant populations of juvenile panfish and/or to create a put-and-take walleye fishery.

Water quality at the time of the survey appeared to be adequate to support fish, with evidence of sufficient dissolved oxygen throughout the water column of each basin (Table 4-3). Thermal stratification was not apparent in either basin at the time of the survey (Table 4-3). Although the conductivity of the south basin was slightly higher than the north basin, the conductivity of both basins was consistent with other lakes in the vicinity of Lake LeAnn (Fuller and Taricska; 2012).

Both basins of Lake LeAnn are managed by the LLPOA to control the invasive aquatic vegetation. Aquatic vegetation, including small patches of invasive species, appeared to be abundant in both basins of Lake LeAnn, with portions of the north basin known for containing dense stands of Eurasian milfoil and filamentous green algae (personal communication, LLPOA members).

Fish tend to identify with large woody debris as important locations for feeding and hiding from predators. Few large woody debris complexes were observed in either basin of the lake, with most of the wood debris complexes observed in a few locations around the islands in each basin.

Management Considerations

The LLPOA has stocked a variety of fish in each basin in recent years to improve and manage the fishery. Some of the stocking efforts have likely been conducted in vain based on 2018 fish survey observations by AEM. For example, it appears smallmouth bass (*Micropterus dolomieu*) were stocked in the lake in 2003, 2012, and recently, in 2016. No smallmouth bass were collected by AEM during the survey and it is likely that Lake LeAnn does not support smallmouth bass based on the abundance of other predators within each basin. Similarly, yellow perch were stocked in 2014 and only seven yellow perch were collected by AEM.

It also appears largemouth bass may have been stocked, or were considered for stocking in 2017. Both basins have abundant populations of largemouth bass and should not require supplemental stocking.

AEM observed three notable features about the fish communities in each basin of Lake LeAnn:

1. Largemouth bass are the most abundant species in both basins, and the south basin appears to be overpopulated with numerous bass that are 12 inches and smaller.
2. Bluegills are abundant in both basins, but not overpopulated. However, large bluegills (greater than eight inches) are rare in both basins, and it appears there may have been one poor year class (lower reproductive success) of bluegills that was recently produced in the south basin.
3. It appears that both basins of Lake LeAnn have a well-developed batifish community with an abundance of spotfish shiners and bluntnose minnows.

Largemouth bass

The large predatory fish are responsible for naturally controlling populations of smaller sized fish in most lakes. The south basin of Lake LeAnn lacks adequate numbers of larger predatory fish and additional stocking efforts are unlikely to significantly affect the overpopulation of small bass in the south basin. Implementing a basin-specific size limit may be helpful in reducing the number of smaller sized bass. Lowering the size limit on largemouth bass to 12 inches is a technique that is being utilized in some Michigan Lakes by the Michigan Department of Natural Resources (MDNR) as a means to reduce the population size of small bass. AEM recommends the LLPOA considering adopting this strategy in cooperation with the MDNR regional fisheries biologist as a means to encourage anglers to harvest the smaller bass, thereby creating favorable conditions that allow more bass to achieve a larger size.

Bluegills (and black crappie)

The bass-bluegill relationship is often tenuous to manage in most lakes. If a lack of larger sized predators exists (i.e. bass), it is possible for bluegill reproduction to overrun the aquatic system and result in an overpopulation of stunted (i.e., small sized) bluegills. It appears that largemouth bass and other predators, such as walleye, northern pike, and

catfish are effectively keeping the bluegill populations in both basins in check from becoming stunted. However, it appears that a combination of fishing pressure and a lack of habitat complexity (i.e., large woody debris complexes) may limit the bluegill population (and black crappies) from achieving a greater abundance of larger fish in both basins.

AEM recommends the LLPOA consider the placement of whole trees in a few locations in each basin that would effectively link shallower spawning and rearing habitat for bluegills to deeper water. Whole trees are typically placed with the trunk anchored to the shore and the canopy submerged in the water, where the leafless branches provide valuable hiding and feeding cover for panfish and minnow species. These woody debris complexes often house larger panfish that can hide from larger predators until they grow large enough to escape or minimize predation.

Continuing to encourage the presence of larger bass and other predators, should result in a natural control of smaller bluegills and ultimately result in a higher abundance of larger bluegills. Larger bluegills and black crappie may also be encouraged through a volunteer catch-and-release program, where anglers are encouraged to keep fewer larger panfish.

Fathead minnows and other minnow species

The LLPOA has stocked fathead minnows in 2005, 2014, and 2015. The stocking of minnow species is often valuable to supplement a poor forage base, encourage the establishment of additional minnow species in a lake, or to provide a temporary forage for a recently stocked predatory fish species.

Lake LeAnn appears to have an abundance of minnow species in both basins. Supplementing the basins by stocking additional minnows would likely be more effective if coupled with the addition of complex cover to allow hiding and potentially reproductive habitat to the fathead minnows.

Placing stacks of wooden pallets and alternating the alignment of each pallet in the stack 90 degrees would provide a complex woody debris structure that would serve as hiding cover and spawning habitat for fathead minnows. Furthermore, placing the wooden pallet structures next to other natural complex cover would allow the fathead minnows to

successfully foray away from the pallet structures and possibly expand their range within the lake.

Future stocking efforts

AEM recommends future stocking efforts should not include largemouth bass, smallmouth bass, or possibly, yellow perch. Periodic stocking of walleye or other predatory species, such as channel catfish will continue to serve as a put-and-take fishery (walleye) and as a natural predatory control to avoid stunted bluegills. The periodic stocking of black crappie may provide expanded angling opportunities for panfish. However, it remains unclear if the black crappie are successfully reproducing in either basin of Lake LeAnn. The stocking of minnows will likely be more successful if they are coupled with the placement of woody structures that enhance hiding and reproduction for these fish.

Finally, AEM recommends that the LLPOA consult with the Michigan Department of Natural Resources regional fisheries biologist prior to implementing any fisheries management strategy. Specifically, the stocking of fish in waters of the state, or private lakes that were previously stocked with fish from the State of Michigan, such as Lake LeAnn, requires permit approval from the State of Michigan.

To summarize, AEM recommends LLPOA consider the following strategies to improve the fish community size structure and composition of Lake LeAnn:

- Implement a 12-inch minimum size limit on largemouth bass in the south basin.
- Add submerged wood pallets and whole trees to provide hiding and spawning cover for fathead minnows should they be stocked, and to provide hiding and feeding cover for bluegills so that larger-sized bluegills become more abundant within each basin.
- Encourage the catch and release of larger bass and panfish to allow these larger fish to grow larger and provide better natural control of smaller more abundant sizes.

6.0 REFERENCES

Bailey, R. M., W. C. Latta, and G. R. Smith. 2003. An atlas of Michigan fishes with keys and illustrations for their identification. Miscellaneous Publications, Museum of Zoology, No. 192, University of Michigan, Ann Arbor, MI.

Becker, G. C. 1983. Fishes of Wisconsin. The University of Wisconsin Press, Madison, WI.

Coon, T. G. 2001. Key to the fishes of Michigan. Michigan State University. East Lansing, MI.

Fuller, L.M., and Taricska, C.K., 2012. Water-quality characteristics of Michigan's inland lakes, 2001–10: U.S. Geological Survey Scientific Investigations Report 2011–5233, 53 p., plus CD–ROM.

Fuller, L. M., Aichele, S. S., & Minnerick, R.J., 2004. Predicting water quality by relating secchi-disk transparency and chlorophyll-measurements to satellite imagery for Michigan inland lakes, August 2002: U. S. Geological Survey Scientific Investigations Report, 5086.

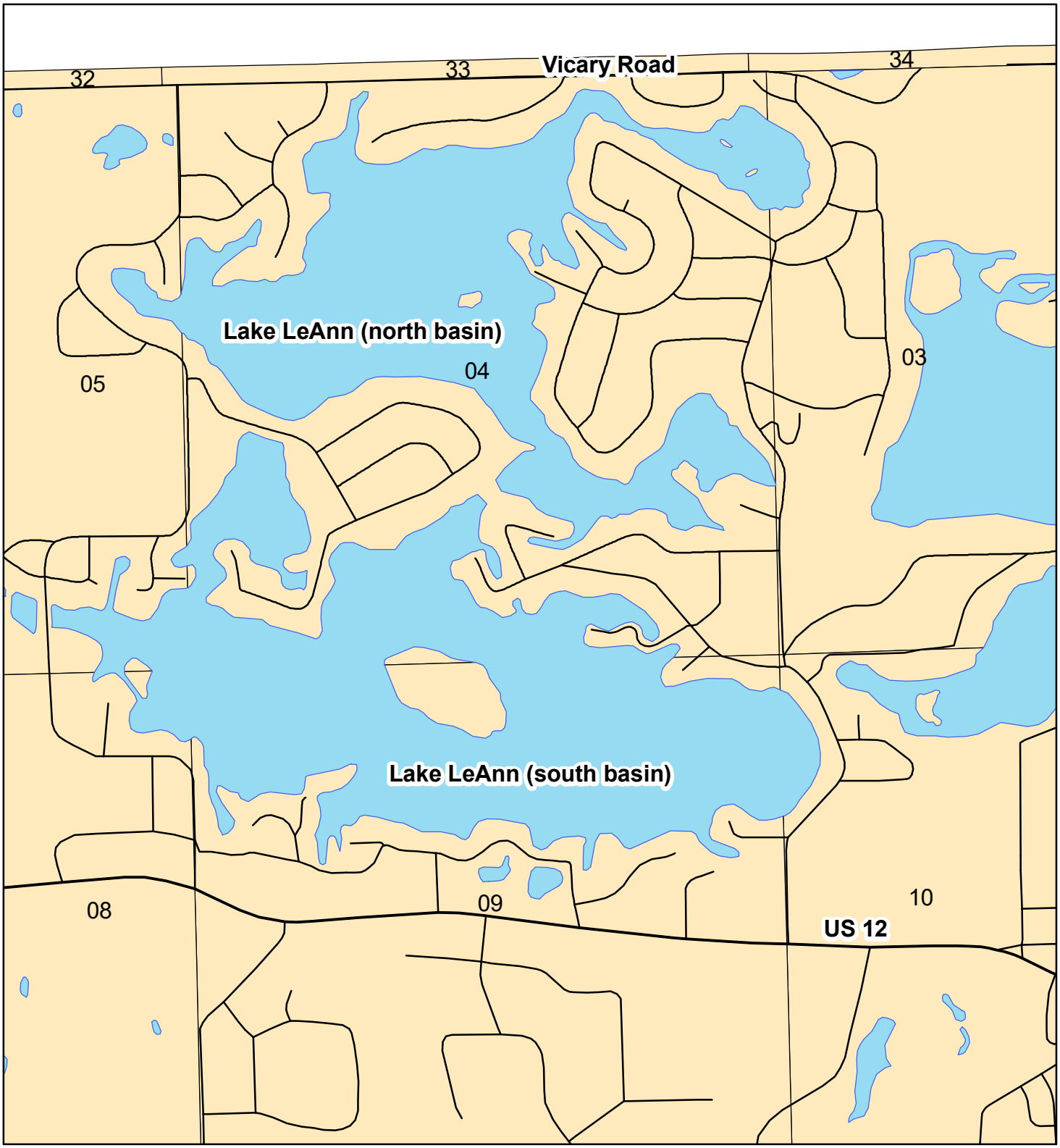
Pflieger, W. L. 1997. The Fishes of Missouri. 372 pp. Publisher information; Missouri Department of Conservation Jefferson City, Missouri.

[a]Schneider, J. C., G. R. Alexander, and J. W. Merna. 2000. Modules for lake and stream surveys. Chapter 2 *in* Schneider, J. C., editor, Manual of fisheries survey methods II: with periodic updates. Michigan Department of Natural Resources, Fisheries Special Report 25, Ann Arbor.

[b]Schneider, J. C., P. W. Laarman, and H. Gowing. 2000. Length-weight relationships. Chapter 17 *in* Schneider, J. C. editor, Manual of fisheries survey methods II: with periodic updates. Michigan Department of Natural Resources, Fisheries Special Report 25, Ann Arbor.

Smith-Root, Inc. 2004. Portable Electrofishers. Vancouver, WA.

7.0 FIGURES



Legend

State Roads

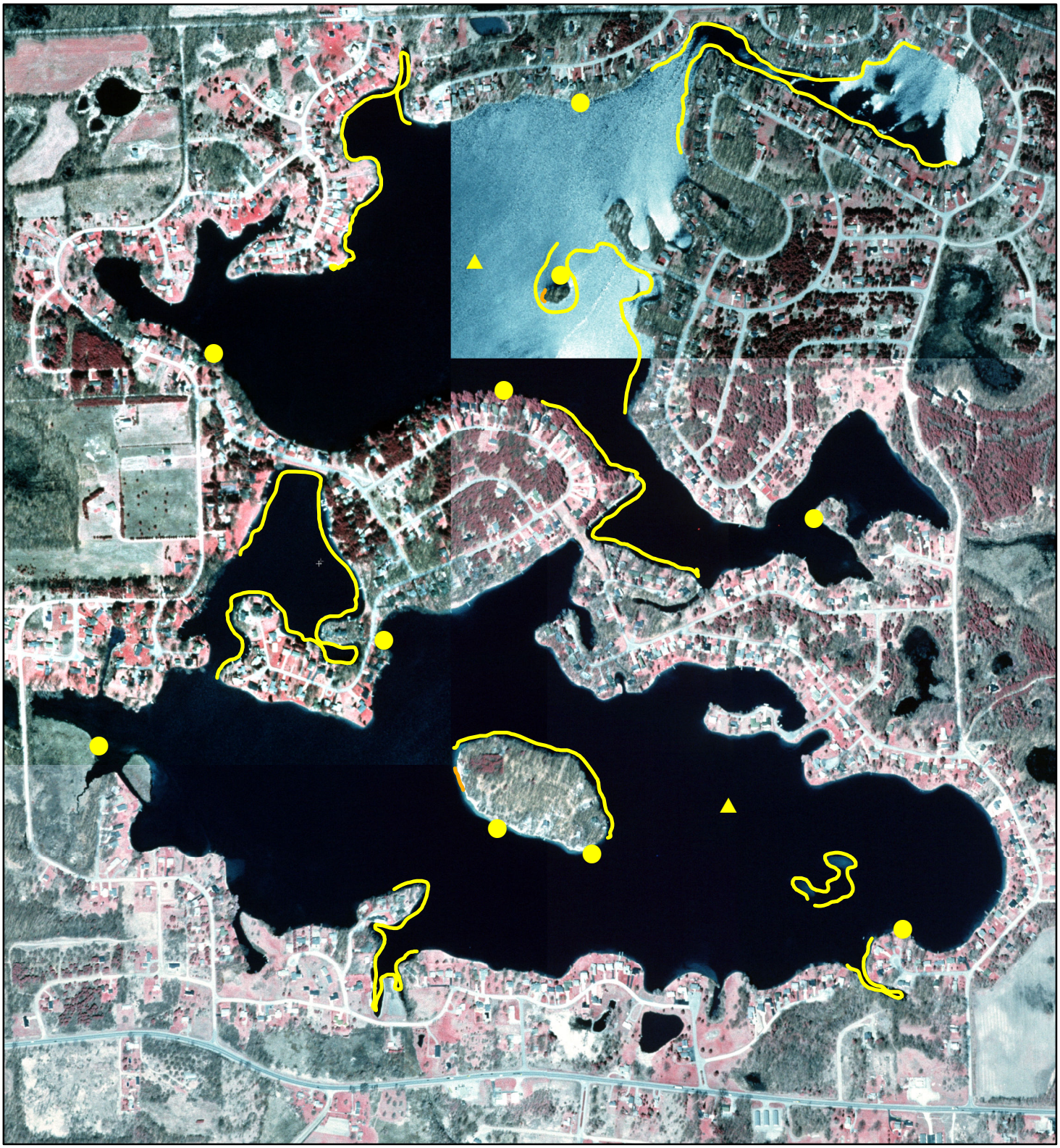
Sections

N

0 462.5 925 1,850 2,775 3,700 Feet

AeM ADVANCED ECOLOGICAL MANAGEMENT

PROJECT	2018 Lake LeAnn Fisheries Survey
TITLE	Project Location
FIGURE	1-1



Legend

- Water Quality Measurement
- Fyke Net Locations
- Seine Locations
- Electrofishing Transects

N

0 360 720 1,440 2,160 2,880 Feet

AeM ADVANCED ECOLOGICAL MANAGEMENT

PROJECT	2018 Lake LeAnn Fisheries Survey
TITLE	Survey Gear Locations
FIGURE	1-2

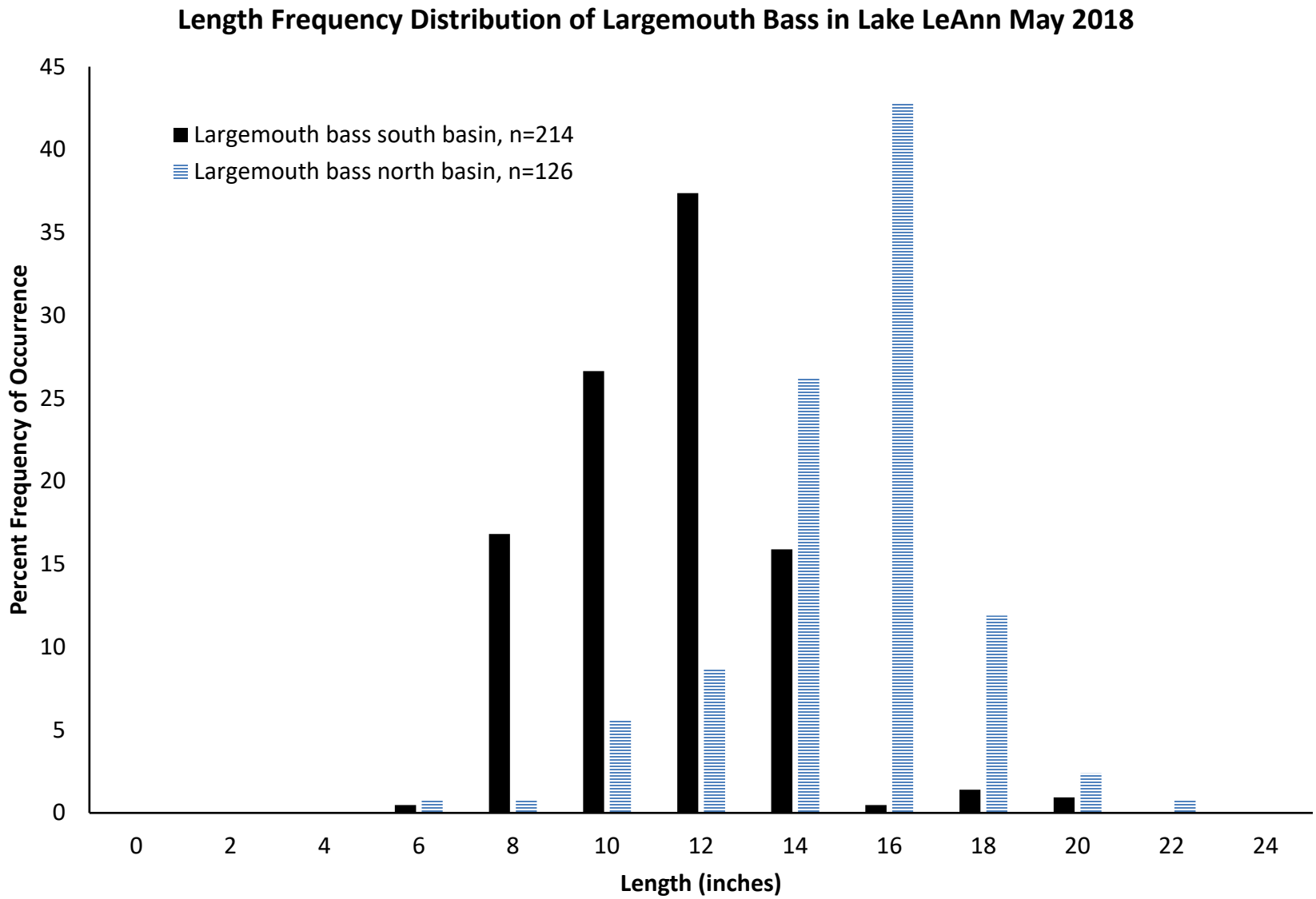


Figure 4-1. Length frequency distribution of Lake LeAnn largemouth bass (*Micropterus salmoides*), May 2018.

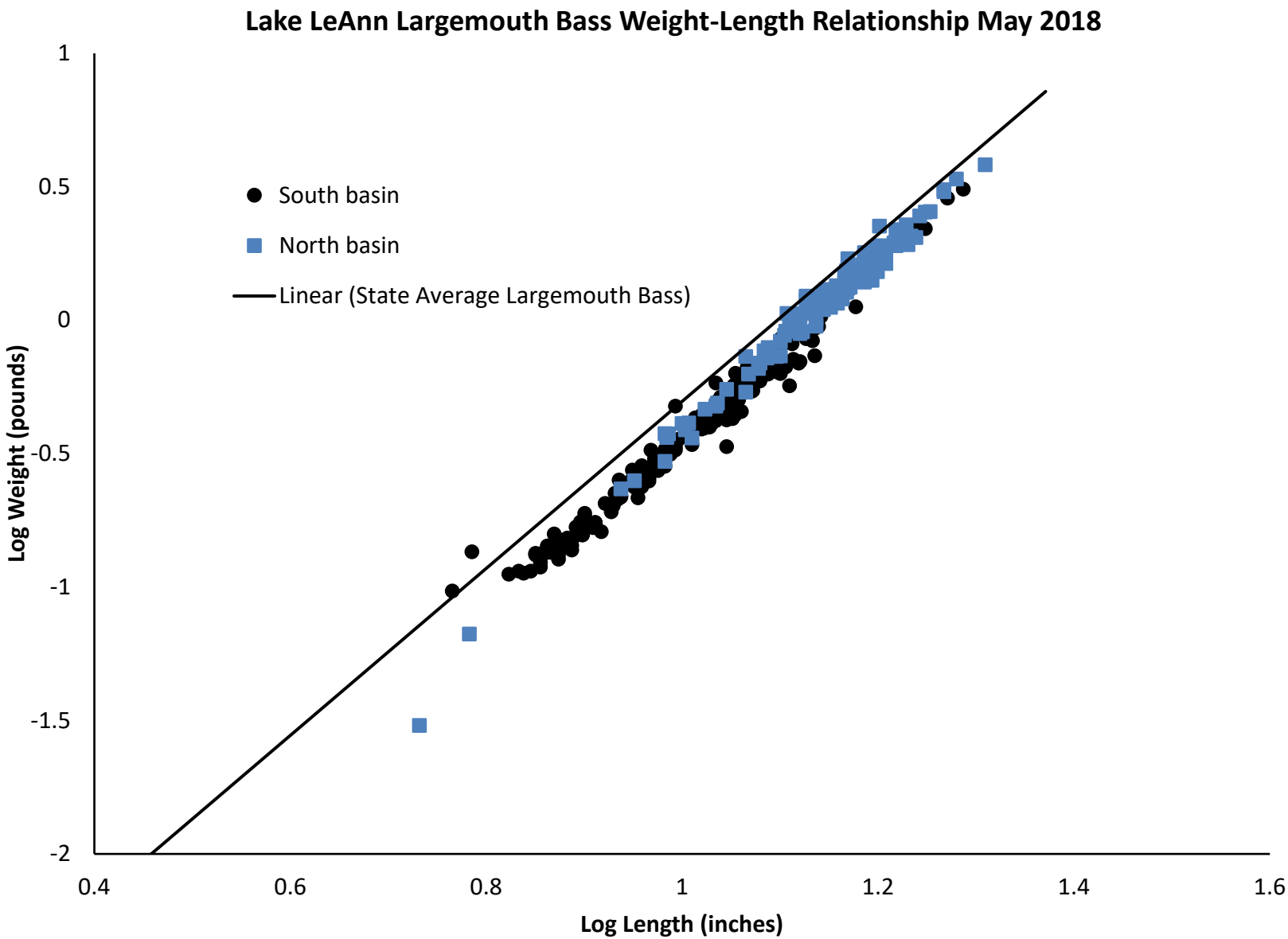


Figure 4-2. Largemouth bass length-weight regression for Lake LeAnn during May 2018, and state average weight-length relationship for Michigan largemouth bass (Schneider et al. 2000[b]).

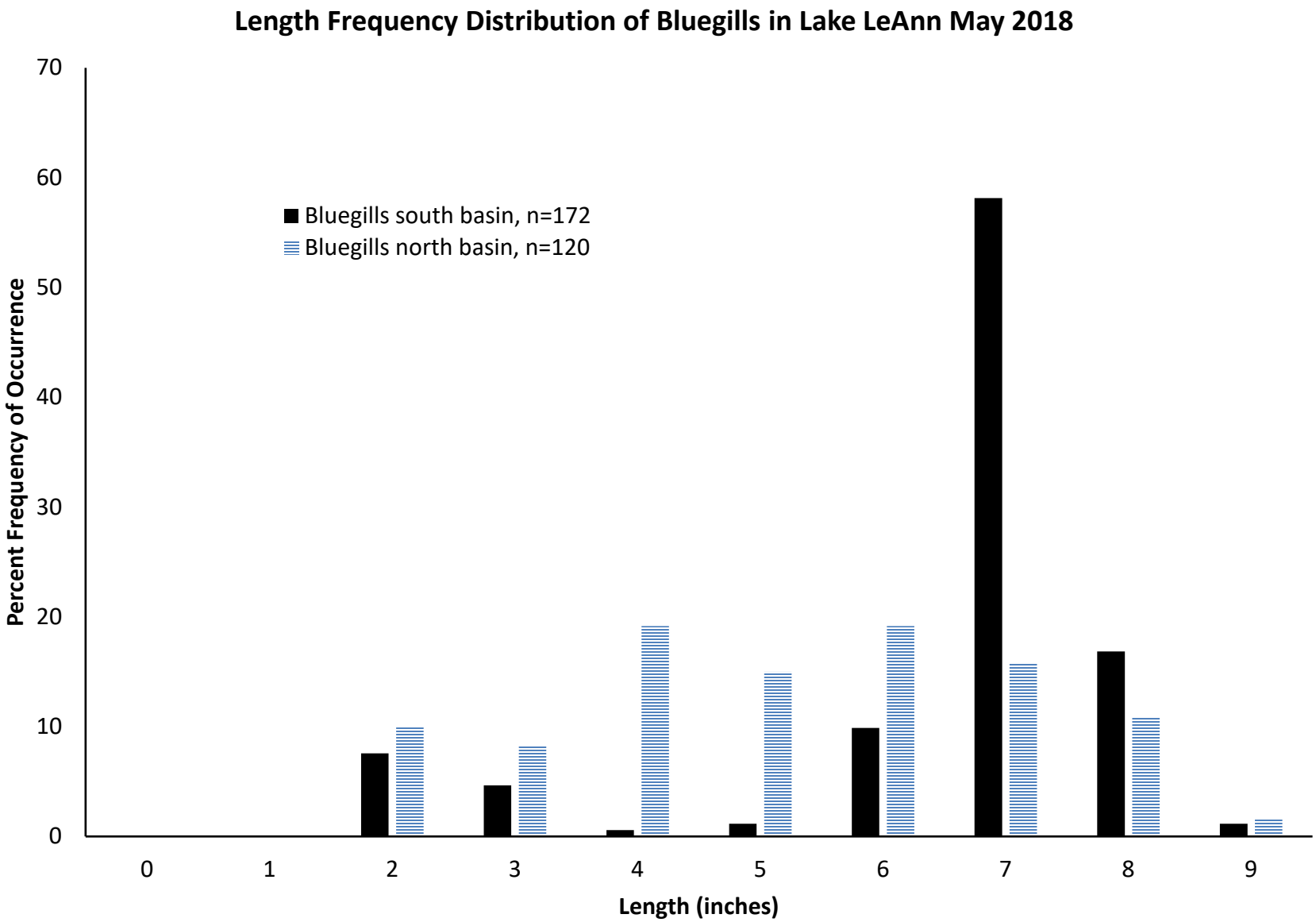


Figure 4-3. Length frequency distribution of Lake LeAnn bluegills (*Lepomis macrochirus*), May 2018.

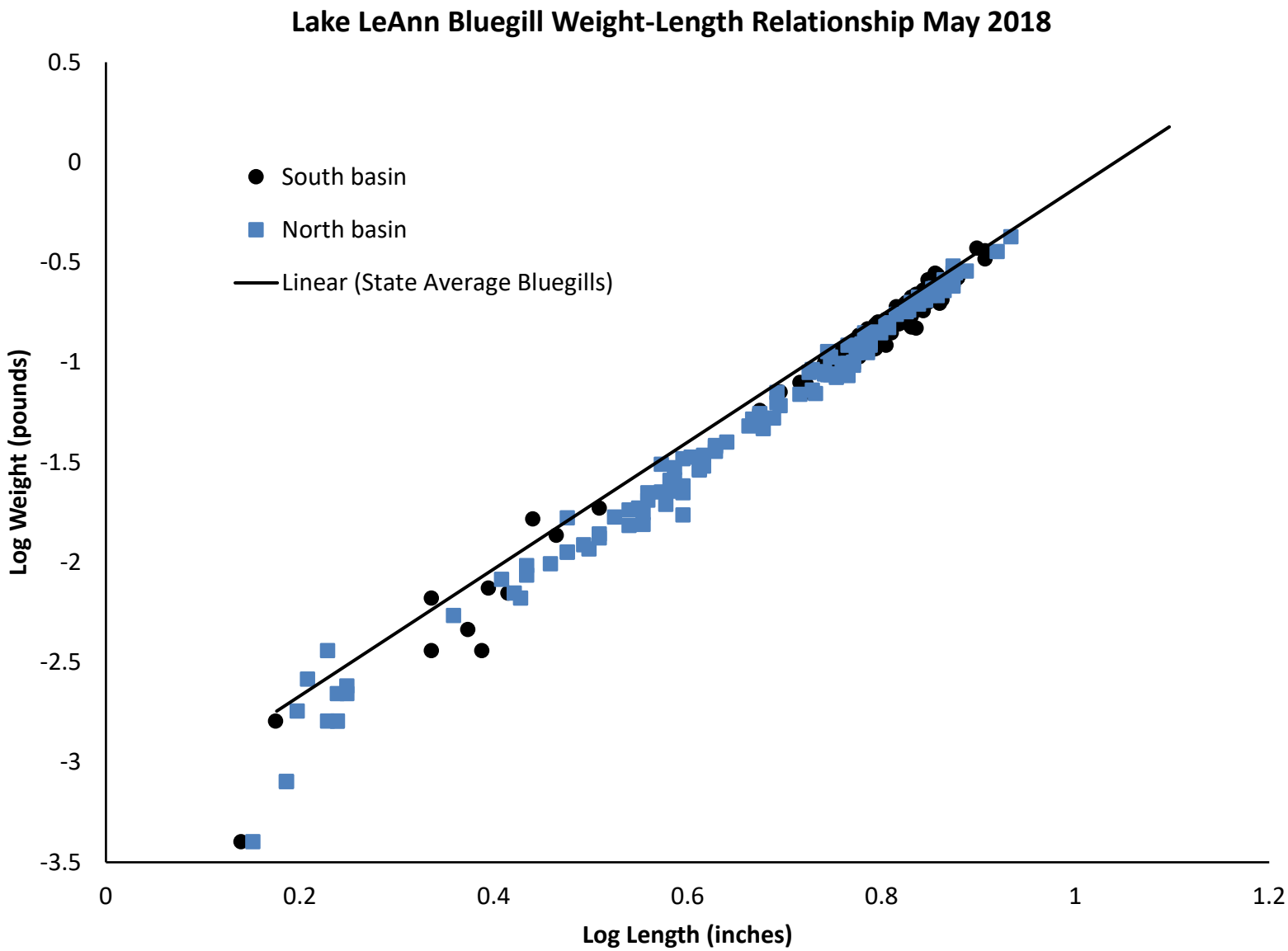


Figure 4-4. Bluegill length-weight regression for Lake LeAnn during May 2018, and state average weight-length relationship for Michigan bluegills (Schneider et al. 2000[b]).

Figure 4-5. Photograph of hard armored shoreline of south basin of Lake LeAnn. Photograph collected by AEM.

Figure 4-6. Natural shoreline of island located in south basin of Lake LeAnn. Photograph collected by AEM.

8.0 TABLES

Table 4-1. List of fish species by sample gear that were collected by AEM from Lake LeAnn during May 2018.

		South basin			North basin		
Common Name	**Scientific Name**	**Electrofishing**	**Fyke**	**Seine**	**Electrofishing**	**Fyke**	**Seine**
Black crappie	*Pomoxis nigromaculatus*	3	4		7	9	
Bluegill	*Lepomis macrochirus*	162	10		101	19	2
Bluntnose minnow	*Pimephales notatus*	4	9	6		1	
Central mud minnow	*Umbra limi*	1					
Common carp	*Cyprinus carpio*	16			7		
Fathead minnow	*Pimephales promelas*	5					
Largemouth bass	*Micropterus salmoides*	211	3		126		
Northern pike	*Esox lucius*				2	3	
Pumpkinseed	*Lepomis gibbosus*	9	2		2	2	
Spotfin shiner	*Cyprinella spiloptera*	6	12	22	10		5
Walleye	*Sander vitreus*	4	4		1	2	
Warmouth	*Lepomis gulosus*				1		
Yellow bullhead	*Ameiurus natalis*	2	1			3	
Yellow perch	*Perca flavescens*	5			2		
	Total Number Collected	**428**	**45**	**28**	**259**	**39**	**7**

Table 4-2. Water quality parameters measured in the south basin of Lake LeAnn at two-foot intervals on May 9, 2018, and in the north basin at one-foot intervals on May 8, 2018.

Depth feet	Temperature °C	Conductivity µSiemens/cm	%DO	DO mg O_2/L	pH
South basin					
0	19.1	426.4	95.2	8.8	8.48
2	19.1	426.5	95.0	8.8	8.47
4	19.0	425.9	95.1	8.8	8.46
6	19.0	425.7	94.7	8.8	8.45
8	19.0	425.7	94.4	8.7	8.44
10	19.0	425.5	93.5	8.7	8.44
12	19.0	425.2	93.6	8.7	8.43
14	17.4	409.1	91.2	8.7	8.37
16	16.7	401.3	80.5	7.8	8.29
17	16.3	399.4	73.1	7.2	8.24
North basin					
0	19.0	397.9	97.4	9.0	8.04
1	18.9	396.1	96.6	9.0	8.05
2	18.7	394.6	96.6	9.0	8.05
3	18.4	391.8	95.4	8.9	8.05
4	18.3	390.2	94.8	8.9	8.05
5	18.2	389.4	93.3	8.8	8.05
6	18.2	389.2	94.3	8.9	8.05
7	18.2	389.1	93.9	8.8	8.06
8	18.1	388.8	94.5	8.9	8.06
9	18.1	388.2	94.2	8.9	8.07
10	17.7	384.3	94.9	9.0	8.07
11	17.4	381.4	93.6	9.0	8.06
12	17.1	379.7	90.6	8.7	8.03
13	16.9	380.0	84.6	8.1	7.96
14	16.9	383.9	70.6	6.8	7.84

DO – dissolved oxygen