

Investigation of the Fish Community of Portage Lake in Manistee County, Michigan, 2023

Prepared for

Portage Lake Invasive Plant Control Program

Onkama Township

PO Box 458

Onkama, Michigan, 49675

Prepared by:

ADVANCED ECOLOGICAL MANAGEMENT

22071 7 Mile Road

Reed City, MI 49677

AeM

ADVANCED
ECOLOGICAL
MANAGEMENT

1.0 INTRODUCTION

Portage Lake is a public access lake that is approximately 2,110 acres in size and is located Onekama Township, 23 North, Range 16 West, in Sections 22, 25, 26, 27, 28, 33, 34, 35, and 36 of Manistee County, Michigan (Figure 1-1). The fish community of Portage Lake has been historically surveyed by the Michigan Department of Natural Resources (MDNR), and more recently by the Little River Band of Ottawa Indians (LRBOI) and Onekama Township.

Prior to this survey, the most recent comprehensive survey of the lake was conducted by the MDNR in 2009 and included the use of a variety of capture methods, including electrofishing and a variety of nets (Seites, 2009). Recently, some citizen groups have expressed concern that the panfish community of Portage Lake has been experiencing a decreased abundance of catchable sized bluegills (*Lepomis macrochirus*) and yellow perch (*Perca flavescens*). In addition, it had been approximately 14 years since a comprehensive fish survey had been conducted within the lake. Onekama Township contracted with Advanced Ecological Management, LLC (AEM) in 2023 to conduct a fisheries survey of Portage Lake to evaluate the current conditions of the fisheries community. The objectives of this survey were to identify fish species that were present within the lake and determine their relative abundances.

2.0 STUDY AREA

Portage Lake is a natural lake that is a drowned river mouth lake as a result of a historical connection to Lake Michigan via Portage Creek, which no longer exists (Seites, 2009). The lake is up to 60 feet deep and has shoal areas (less than 20 feet deep) that account for approximately 65% of the lake surface area (Tonello, 2000).

Much of the shoreline along the east end of the lake contains submergent and emergent weed beds. Large portions of the shoreline include bulrushes and cattails (*Typha* sp.) along with pondweeds and coontail (*Ceratophyllum* sp.), and native chara (*Chara* sp.) in the submerged weed beds. Similarly, the peninsula of land that includes the MDNR boat launch along the north shore contained notable patches of submergent and emergent weed beds.

3.0 METHODS

Prior to conducting the survey, AEM consulted with MDNR fisheries biologists to identify suitable survey locations and methodologies to maximize survey success. Fish were collected in Portage Lake using a combination of a boat-mounted electrofisher, large and small mesh fyke nets, gill nets, and a seine. A boat-mounted electrofishing unit and generator (electroshocker) were used to collect fish in shallow water (six feet or less), near-shore areas of the lake (Figure 3-1). 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 electroshocker in each transect. Electroshocking was conducted at night to minimize fish avoidance of the electrofishing gear (Smith-Root, 2004).

Three 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 3-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 3-feet high 4-feet wide. The cab is constructed of two 3-foot diameter steel hoops. Two large-mesh fyke nets were also placed in the lake and fished overnight for approximately 24 hours (Figure 3-1). The large-mesh fyke nets were constructed of two-inch stretch mesh and the hoop diameter measured four feet with a 50-foot-long center lead. The fyke nets were distributed along the shoreline of the lake and were fished overnight for approximately 24 hours (Figure 3-1).

Two multiple panel monofilament gill nets of varying mesh size were fished in four locations throughout Portage Lake (Figure 3-1). Each gill net consisted of five, 6- by 25-foot panels ranging from 1.5- to 6-inch stretch mesh. The gill nets were set overnight and were fished for approximately 12 hours.

A seine was fished in wadable areas along the shoreline in the vicinity of the MDNR boat ramp along the north shore. Several hauls were attempted as part of the survey.

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). CPUE for the following gear was estimated as follows:

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

Where,

- N = number of fish caught
- t = sample duration in hours (boom shocker), or
- t = sample duration in net nights (gill net), or
- t = sample duration in net nights (fyke net).

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.

As part of the enumeration process, the species, length, weight, and number of fish captured were recorded. Fish were identified to species using various taxonomic references (Bailey et al., 2003; Becker, 1983).

Water temperature, pH, conductivity, and dissolved oxygen were measured in two locations in Portage Lake as part of the fish survey (Figure 3-1). These water quality parameters were measured at two-foot depth increments using a Yellow Springs Instrument Professional Plus water quality meter. Secchi depth was also measured at each water quality sample location.

4.0 RESULTS

The fisheries survey of Portage Lake was conducted from June 19 through June 23, 2023. Fyke nets were set along the shoreline during the evenings of June 19th through the 22nd, gill nets were set during the evenings of June 19th and June 20th, and electrofishing was conducted throughout the lake during the evenings of June 19th and June 21st (Figure 3-1). Water quality data were collected during the afternoon (from 13:24 to 14:37pm) of June 23, 2023.

A total of 1,130 fish were collected from Portage Lake by AEM in 2023 representing 28 different taxa (Table 4-1). Rockbass (*Ambloplites rupestris*), round gobies (*Neogobius melanostomus*), alewives (*Alosa pseudoharengus*), largemouth bass (*Micropterus salmoides*), and yellow perch (*Perca flavescens*) were the most frequently collected species in Portage Lake (Table 4-1). A total of 390 fish were collected using electrofishing gear for a Catch Per Unit of Effort (CPUE) of 3.7 fish per minute of electricity discharge into the lake. Fyke net CPUE varied from zero fish per hour of net soak time to a maximum of 7.4 fish per hour of soak time. Gill net CPUE varied from 0.1 fish per hour of net soak time to a maximum of 3.2 fish per hour of soak time.

Rockbass

Rockbass ranged in length from 1.5 inches to 13.0 inches, with an average length of 7.9 inches (standard deviation = 2.7 inches, sample size = 267 fish), and ranged in weight from 0.1 ounces to 23.7 ounces, with an average weight of 8.2 ounces (standard deviation = 5.3 ounces). Eight to 12-inch fish were the most frequently observed lengths of rockbass in Portage Lake (Figure 4-1). The Portage Lake juvenile rockbass sizes were slightly larger than the state average sized rockbass and the larger sized rockbass were consistent with state average sized rockbass (Figure 4-2). Rockbass collected by AEM in 2023 represented approximately 23.6 percent of the total number of fish collected. Rockbass represented approximately 24.8 percent of the total number of fish collected by the MDNR in the 2009 survey of Portage Lake (Seites, 2009), and 28.3 percent of the total number of fish collected by the MDNR in 1999 (Tonello, 2000).

Round goby

A total of 235 round gobies were collected by AEM during the Portage Lake survey (Table 4-1). Round gobies ranged in length from 0.6 inches to 3.0 inches, with an average length of 2.1 inches (standard deviation = 0.6 inches, sample size = 16 fish). Most of the round gobies collected by AEM were caught in the shallow set fyke nets that were set in water four feet deep or less. Round gobies collected by AEM in 2023 represented approximately 20.8 percent of the total number of fish collected. Round gobies represented approximately 1.1 percent of the total number of fish collected by the MDNR in the 2009 survey of Portage Lake (Seites, 2009), and they were not collected by the MDNR in the 1999 survey (Tonello, 2000).

Alewife

Alewives ranged in length from 4.6 inches to 7.9 inches, with an average length of 5.9 inches (standard deviation = 0.7 inches, sample size = 145 fish), and ranged in weight from 0.03 ounces to 0.1 ounces, with an average weight of 0.9 ounces (standard deviation = 0.3 ounces). Six and seven-inch fish were the most frequently observed lengths of alewives in Portage Lake (Figure 4-3). The size of alewives in Portage Lake was consistent with state average sized alewives (Figure 4-4). Most of the alewives were caught in the locations where AEM conducted electrofishing (Figure 3-1).

Largemouth bass

Most of the largemouth bass collected by AEM (125 of the 136 total largemouth) were young-of-the-year fish that were collected in fyke nets located in the east end of Portage Lake. These young-of-the-year fishes were all less than one inch long and were too small to have their weight recorded. Of the largemouth bass that were large enough to be measured, they ranged in length from 11.3 inches to 18.7

inches, with an average length of 11.3 inches (standard deviation = 6.5 inches, sample size = 11 fish), and ranged in weight from 0.3 ounces to 58.2 ounces, with an average weight of 26.5 ounces (standard deviation = 17.9 ounces).

Yellow perch

Yellow perch ranged in length from 1.0 inches to 13.4 inches, with an average length of 5.7 inches (standard deviation = 1.9 inches, sample size = 129 fish), and ranged in weight from 0.2 ounces to 19.2 ounces, with an average weight of 1.7 ounces (standard deviation = 2.4 ounces). Five to seven-inch fish were the most frequently observed lengths of yellow perch in Portage Lake (Figure 4-5). Similar to the rockbass, the juvenile yellow perch were slightly larger than the state of Michigan average sized yellow perch and the larger yellow perch were consistent with the state of Michigan average sized yellow perch (Figure 4-6). Yellow perch collected by AEM in 2023 represented approximately 12.0 percent of the total number of fish collected. Yellow perch represented approximately 3.7 percent of the total number of fish collected by the MDNR in the 2009 survey of Portage Lake (Seites, 2009), and 23.4 percent of the total number of fish collected by the MDNR in 1999 (Tonello, 2000).

Bluegill

A total of nine bluegills were collected by AEM during the Portage Lake fish survey. Bluegills ranged in length from 2.2 inches to 8.0 inches, with an average length of 5.4 inches (standard deviation = 2.3 inches, sample size = 9 fish), and ranged in weight from 0.1 ounces to 8.1 ounces, with an average weight of 3.2 ounces (standard deviation = 2.8 ounces). Bluegills collected by AEM in 2023 represented approximately 0.8 percent of the total number of fish collected. Bluegills represented approximately 2.1 percent of the total number of fish collected by the MDNR in the 2009 survey of Portage Lake (Seites, 2009), and 9.9 percent of the total number of fish collected by the MDNR in 1999 (Tonello, 2000).

Pumpkinseed sunfish

Pumpkinseed sunfish ranged in length from 3.7 inches to 7.9 inches, with an average length of 6.6 inches (standard deviation = 1.3 inches, sample size = 19 fish), and ranged in weight from 0.7 ounces to 7.8 ounces, with an average weight of 4.7 ounces (standard deviation = 2.2 ounces). Eight-inch fish were the most frequently observed lengths of pumpkinseed sunfish in Portage Lake (Figure 4-7). The Portage Lake pumpkinseed sunfish sizes were consistent with state average sized pumpkinseed sunfishes (Figure 4-8). Pumpkinseed sunfish collected by AEM in 2023 represented approximately 1.6 percent of the total number of fish collected. Pumpkinseed sunfish represented approximately 0.4 percent of the total number of fish

collected by the MDNR in the 2009 survey of Portage Lake (Seites, 2009), and 8.6 percent of the total number of fish collected by the MDNR in 1999 (Tonello, 2000).

Smallmouth bass

Smallmouth bass ranged in length from 3.7 inches to 22.0 inches, with an average length of 12.8 inches (standard deviation = 4.6 inches, sample size = 33 fish), and ranged in weight from 0.4 ounces to 96.0 ounces, with an average weight of 24.9 ounces (standard deviation = 22.4 ounces). Ten to 16-inch fish were the most frequently observed lengths of smallmouth bass in Portage Lake (Figure 4-9). The Portage Lake smallmouth bass sizes were consistent with state average sized smallmouth bass (Figure 4-10).

Northern pike

Northern pike ranged in length from 16.2 inches to 31.1 inches, with an average length of 24.1 inches (standard deviation = 4.1 inches, sample size = 27 fish), and ranged in weight from 13.4 ounces to 114.6 ounces (7.2 pounds), with an average weight of 58.0 ounces (3.6 pounds; standard deviation = 29.3 ounces). Northern pike in the 22-inch length class were the most frequently observed length of northern pike in Portage Lake (Figure 4-11). The Portage Lake northern pike sizes were consistent with state average sized northern pike (Figure 4-12).

Walleye

A total of nine walleye were collected by AEM in gill nets during the Portage Lake survey (Table 4-1). Walleye ranged in length from 14.8 inches to 29.7 inches, with an average length of 23.8 inches (standard deviation = 4.7 inches, sample size = 9 fish), and ranged in weight from 19.4 ounces to 166.7 ounces (10.4 pounds), with an average weight of 86.6 ounces (5.4 pounds; standard deviation = 44.0 ounces).

Water quality

Water quality data were collected in one location in the west portion of Portage Lake, where one of the gill nets was placed, and near the east portion of the basin (Figure 3-1). Water quality data were collected from the surface to the substrate in the western sample location and data were collected to the maximum reach of the recording equipment in the eastern sample location. Water temperature in the west survey location ranged from a minimum of 10.5 °C (50.9 °F) at a depth of 20 feet to a maximum of 21.2 °C (70.2 °F) at the surface (Table 4-2). Dissolved oxygen ranged from a minimum of 9.6 milligrams of oxygen per Liter at the surface to a maximum of 13.7 milligrams of oxygen per Liter at a depth of 21 feet. Dissolved oxygen was adequate to support life at all depths measured by AEM in the west sample location. Conductivity ranged from a minimum of 213 micro-Siemens per centimeter, to a maximum of 309 micro-

Siemens per centimeter, and pH ranged from a minimum of 6.2 to a maximum of 8.4 in the west sample location (Table 4-2).

Water temperature in the east survey location ranged from a minimum of 11.7 °C (53.1 °F) at a depth of 36 feet to a maximum of 21.4 °C (70.5 °F) at the surface (Table 4-2). Dissolved oxygen ranged from a minimum of 9.0 milligrams of oxygen per Liter at the surface to a maximum of 12.6 milligrams of oxygen per Liter at a depth of 20 feet. Dissolved oxygen was adequate to support life at all depths measured by AEM in the east sample location. Conductivity ranged from a minimum of 228 micro-Siemens per centimeter, to a maximum of 312 micro-Siemens per centimeter, and pH ranged from a minimum of 8.0 to a maximum of 8.5 in the east sample location (Table 4-2). Secchi depth was 12.7 feet in the west sample location and was 13.3 feet in the east sample location (Table 4-2).

5.0 SUMMARY

Portage Lake supports a diverse and healthy fish community, with a total of 1,130 fish and a total of 28 species of fish that were observed by AEM during the survey. The lack of catchable sized panfish was a concern raised by the Invasive species committee and was also an impetus for this survey. Panfish, such as bluegill and pumpkinseed sunfish were low in abundance among all the panfish that were collected during the survey. Among panfish, the rockbass, was the most abundant species collected by AEM and the relative abundance of rockbass has remained consistent among the 2000 and 2009 MDNR surveys, and 2023 AEM surveys.

Although bluegills and pumpkinseed sunfish were low in abundance in this survey, they did not appear to be suffering from poor growth. The size of all fish collected by AEM that were compared to their state average sized respective species was consistent or slightly better than the state average sized fish. The relative abundance of bluegills has declined from the 2000 and 2009 MDNR surveys through the 2023 AEM survey of Portage Lake. The relative abundance of pumpkinseed sunfish has remained low among the 2000, 2009 and 2023 surveys, and the relative percentage of pumpkinseed sunfish caught has varied among survey years. Juvenile bluegills and pumpkinseed sunfish were notably absent in shallow-water locations where fyke nets were placed. Round gobies were also notably abundant in those same locations where juvenile panfish were expected to be caught. It is possible that juvenile and egg predation from gobies could be contributing to the lower abundances of bluegills and pumpkinseed sunfish.

Another desirable panfish, the yellow perch, comprised approximately 12 percent of the total catch during the 2023 Portage Lake survey. The relative abundance of yellow perch has varied among the two most

recent surveys conducted by the MDNR and this survey. Consistent with the size of the other species evaluated by AEM, yellow perch sizes were consistent with state of Michigan average sized yellow perch. Approximately 17 percent of the total yellow perch catch (22 fish) was eight inches or larger. The abundance of larger catchable sized yellow perch could be a combination of factors, including production within Portage Lake and of the seasonal movement of larger yellow perch from Lake Michigan in and out of Portage Lake (Seites, 2009).

Smallmouth bass and largemouth bass appeared to be actively or recently spawning in portions of the lake during the survey. Largemouth bass young-of-the-year were abundant in the emergent aquatic vegetation located in the east end of the lake and smallmouth bass were observed to be defending spawning beds around the emergent vegetation located in the northwest portion of the lake near the MDNR boat ramp at the time of the survey.

Several anglers encountered during the survey indicated that Portage Lake contained an abundance of smaller sized northern pike. Most of the northern pike collected by AEM during the survey were collected in gill nets. Several smaller northern pike were also collected in fyke nets and during the electrofishing portion of the survey. Although smaller pike may be abundant in Portage Lake, northern pike size was consistent with state of Michigan average sized northern pike, which could indicate Portage Lake northern pike are not experiencing growth difficulties.

Walleye are a popular gamefish in Portage Lake and the MDNR and LRBOI have frequently surveyed the walleye throughout the lake. Walleye were only collected by AEM in the gill net sets. Gill nets were used sparingly to minimize fish mortality experienced during the survey. Walleye could have moved to the deeper portions of the lake prior to the survey, which would indicate why no walleye were collected during electrofishing activities.

The baitfish community is diverse and abundant within Portage Lake. Alewives were the third most abundant species collected by AEM during the Portage Lake survey (Table 4-1). In addition to the alewives, nine other species of baitfish were collected by AEM.

Members of the Invasive species committee asked AEM to consider aquatic habitat as a potential bottleneck to panfish development within Portage Lake. Although AEM did not conduct a formal aquatic vegetation survey as part of this survey, AEM collected cursory water quality data and observed aquatic vegetation diversity and density throughout the lake while conducting the fish survey. Water quality data indicate the dissolved oxygen is adequate to support life throughout much of the water column within the

lake. The conductivity is consistent with most inland lakes throughout the Lower Peninsula of Michigan and the pH was reasonably consistent throughout the water column and was adequate to support life in the lake. Most of the aquatic vegetation, particularly most of the emergent vegetation along the shoreline, is comprised of native species and occurred at densities that provided great habitat complexity for feeding and hiding cover for fish species that may use those areas. In addition, much of the visible submerged aquatic vegetation did not appear to be particularly dense during the survey. A high density of aquatic vegetation could lead to problems with low dissolved oxygen later in the summer.

Managing the poor panfish abundance appears to largely be an issue of gaining a better understanding of the declining bluegill abundance as both rockbass and pumpkinseed sunfish abundances have remained comparatively consistent over the same period. In addition, although yellow perch abundance has varied from 2000 through 2023, their success may be strongly influenced by seasonal variation from Lake Michigan fish moving in and out of Portage Lake.

It is likely that most anglers currently pursuing panfish find a high rate of success in catching rockbass in Portage Lake as rockbass have remained consistently abundant within Portage Lake from 2000 through 2023. Anglers focusing on shallow waters (three to five feet) to catch bluegill are probably finding poor success based on the survey results of this study. It is also possible that larger bluegill had migrated to deeper water during the time of the survey, which could explain the low catch using electrofishing gear. AEM expected to find juvenile bluegills in shallow water habitat and did not, which indicates that something is affecting their abundance in those shallow areas. Round gobies could be a significant source of bluegill loss based on predation of eggs and possibly young-of-the-year fish.

Evaluating the diet of round gobies in Portage Lake could provide more insight regarding their potential influence on bluegills. Specifically, identifying bluegill spawning habitat and focusing round goby sampling efforts in those locations during ongoing bluegill spawning activities could provide more information regarding the likelihood of their negative influence on bluegills in Portage Lake.

Several photos of fish collected during this 2023 Portage Lake fish survey are included at the end of the report. The photos are provided to illustrate some of the fish that were collected as part of this survey.

6.0 REFERENCES

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

^aSchneider, 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.

^bSchneider, 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.

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Table 4-1. Fish collected by gear from Portage Lake by AEM during June 2023.

Common Name	Electroshocker	Fyke Net	Gill Net	Seine	Grand Total
Alewife	137		8		145
Banded killifish	3				3
Black crappie		1			1
Blacknose shiner	1				1
Bluegill	7	2			9
Bluntnose minnow		1			1
Bowfin	4	2			6
Brook silverside	1				1
Brown bullhead	11	2	2		15
Chinook salmon	2	1			3
Emerald shiner				2	2
Four-spine stickleback		1			1
Golden redhorse	7	1			8
Golden shiner	1				1
Johnny darter				1	1
Largemouth bass	6	128	2		136
Longnose gar	1	6			7
Northern pike	2	3	23		28
Pumpkinseed sunfish	14	5			19
Rockbass	42	215	10		267
Round goby	2	227		6	235
Silver redhorse	1			8	9
Smallmouth Bass	25	6	2		33
Spottail shiner	28			5	33
Walleye			9		9
White sucker	7		7		14
Yellow bullhead		6			6
Yellow Perch	88	11	37		136
Total Collected	390	618	100	22	1130

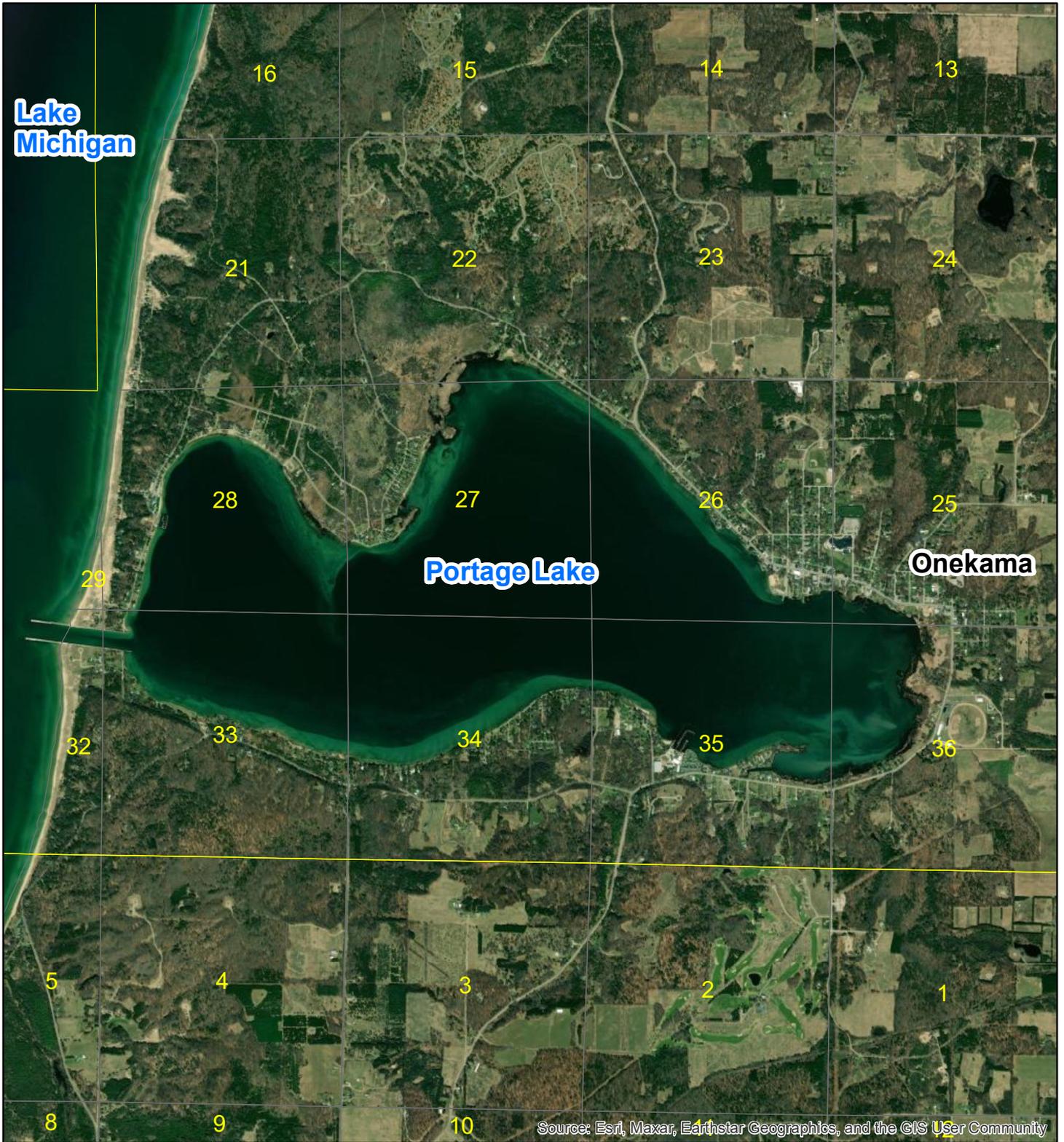
Table 4-2. Portage Lake water quality data collected by AEM on June 23, 2023.

6/23/2023	Time - 13:24	West End			
Depth (feet)	Water Temperature (C)	DO (mg of O ₂ /L)	Conductivity (micro Siemens/cm)	pH	
0	21.2	9.6	308	7.0	
2	21.1	9.6	308	6.9	
4	21.1	9.0	308	6.9	
6	20.9	9.0	307	6.8	
8	20.2	9.8	309	6.2	
10	18.7	10.6	292	6.7	
12	18.1	10.5	287	8.4	
14	17.0	10.8	278	8.3	
16	13.3	12.2	232	8.0	
18	12.1	12.5	224	8.0	
20	10.5	13.6	213	8.1	
21	10.5	13.7	213	8.1	

Secchi Depth 12.7 feet

6/23/2023	Time - 14:37	East End			
Depth (feet)	Water Temperature (C)	DO (mg of O ₂ /L)	Conductivity (micro Siemens/cm)	pH	
0	21.4	9.0	312	8.5	
2	21.4	9.0	312	8.5	
4	21.4	8.8	312	8.3	
6	21.3	9.0	312	8.1	
8	20.9	9.0	310	8.1	
10	19.3	9.8	295	8.0	
12	17.5	11.0	261	8.0	
14	15.6	12.0	248	8.1	
16	14.3	12.4	241	8.1	
18	13.9	12.6	237	8.1	
20	13.4	12.6	234	8.2	
22	13.1	12.6	232	8.2	
24	12.7	12.5	230	8.2	
26	12.3	12.4	229	8.2	
28	12.1	12.1	228	8.2	
30	12.1	11.9	228	8.2	
32	11.8	11.3	229	8.1	
34	11.7	10.7	230	8.1	
36	11.7	10.5	230	8.1	

Secchi Depth 13.3 feet

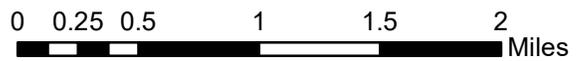


Legend

- Township Boundary
- Section Boundary



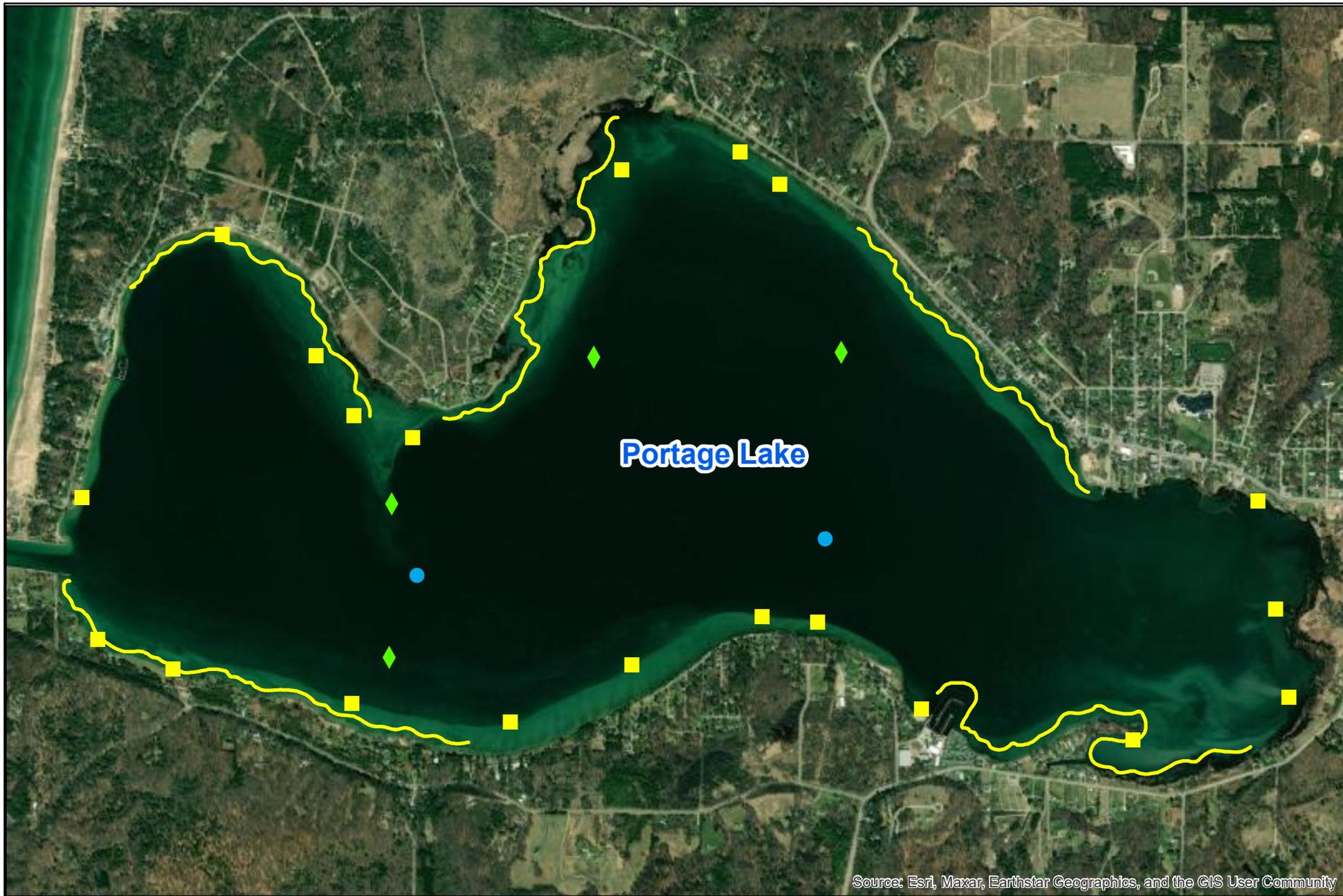
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PROJECT Portage Lake Fish Survey

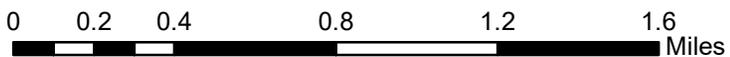
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FIGURE 1-1



Legend

- Water Quality Locations
- Fyke Net Locations
- ◆ Gill Net Locations
- Electrofishing Locations



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PROJECT Portage Lake Fish Survey

TITLE Survey Gear Locations

FIGURE 3-1

Portage Lake Rockbass Length Frequency Distribution June 2023

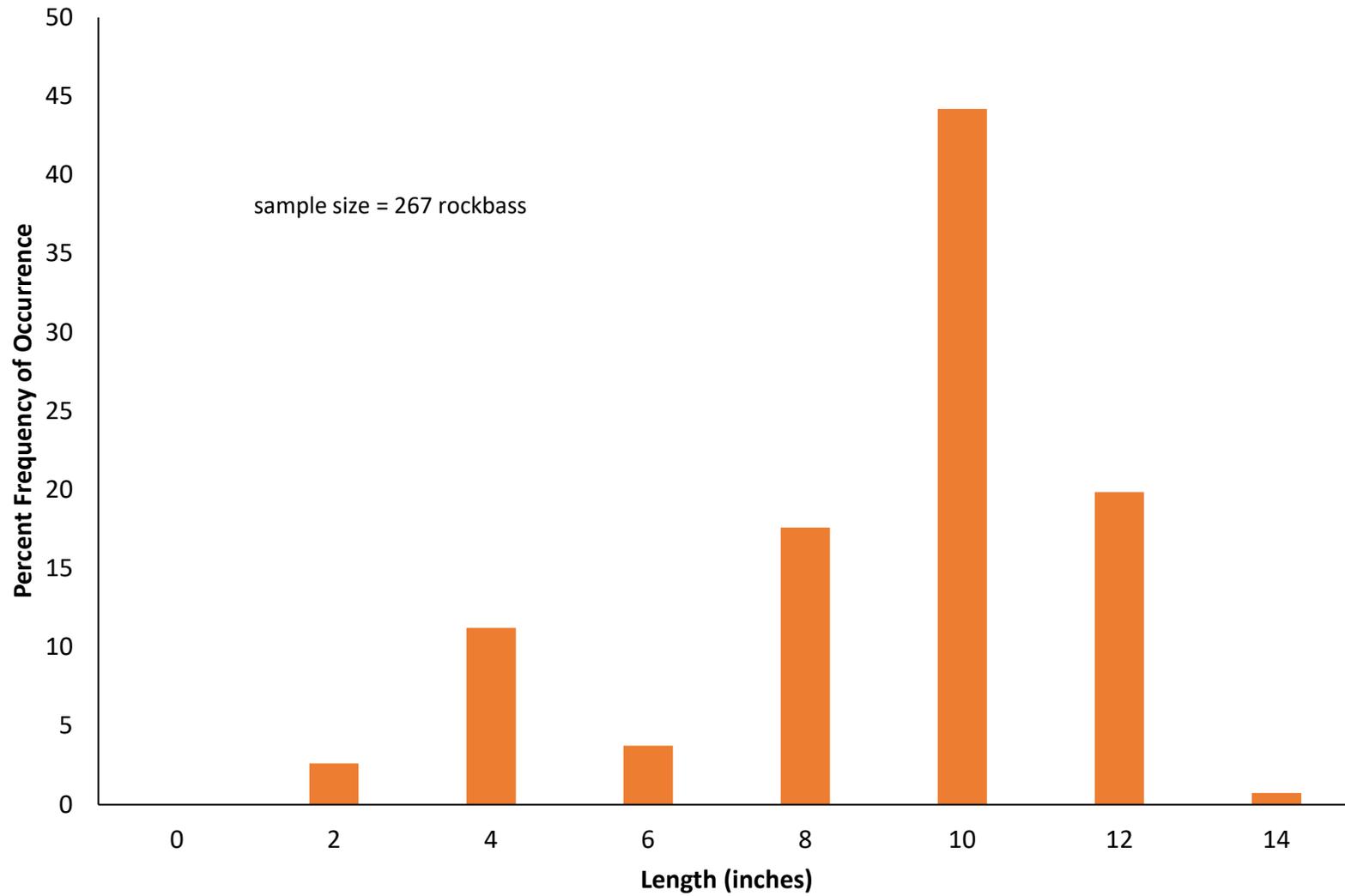


Figure 4-1. Length frequency distribution of rockbass in Portage Lake.

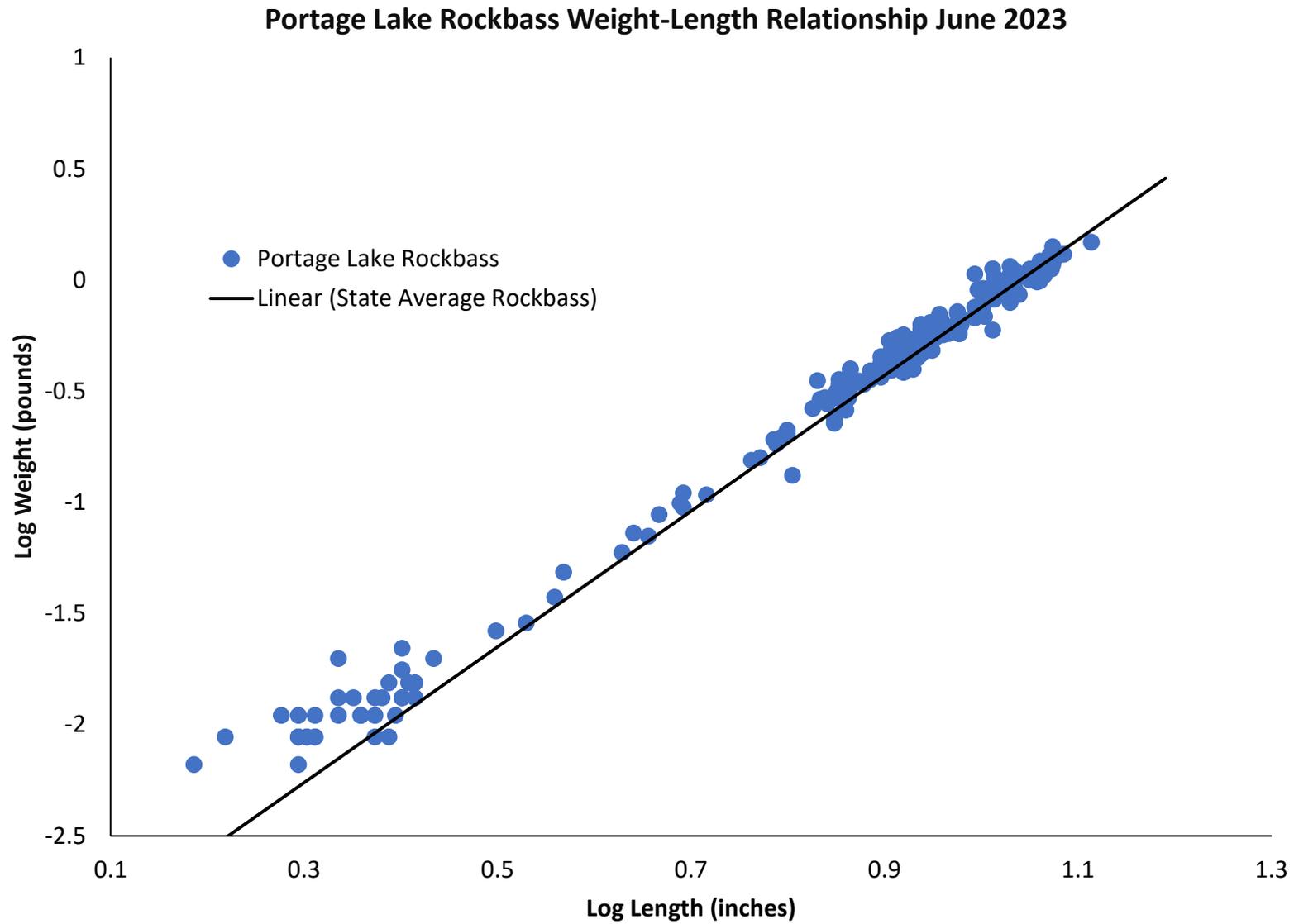


Figure 4-2. Rockbass weight-length relationship in Portage Lake.

Portage Lake Alewife Length Frequency Distribution June 2023

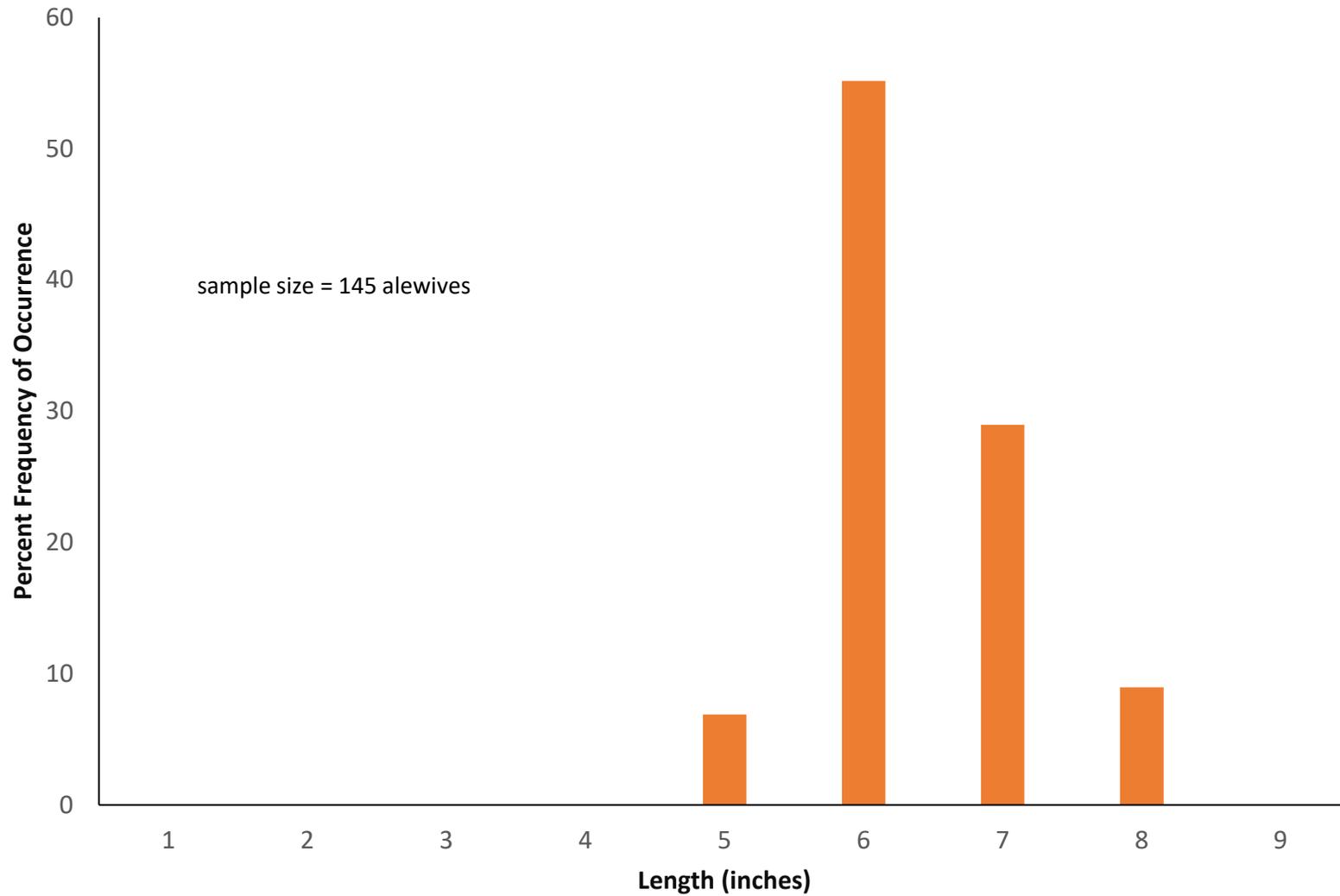


Figure 4-3. Length frequency distribution of alewives in Portage Lake.

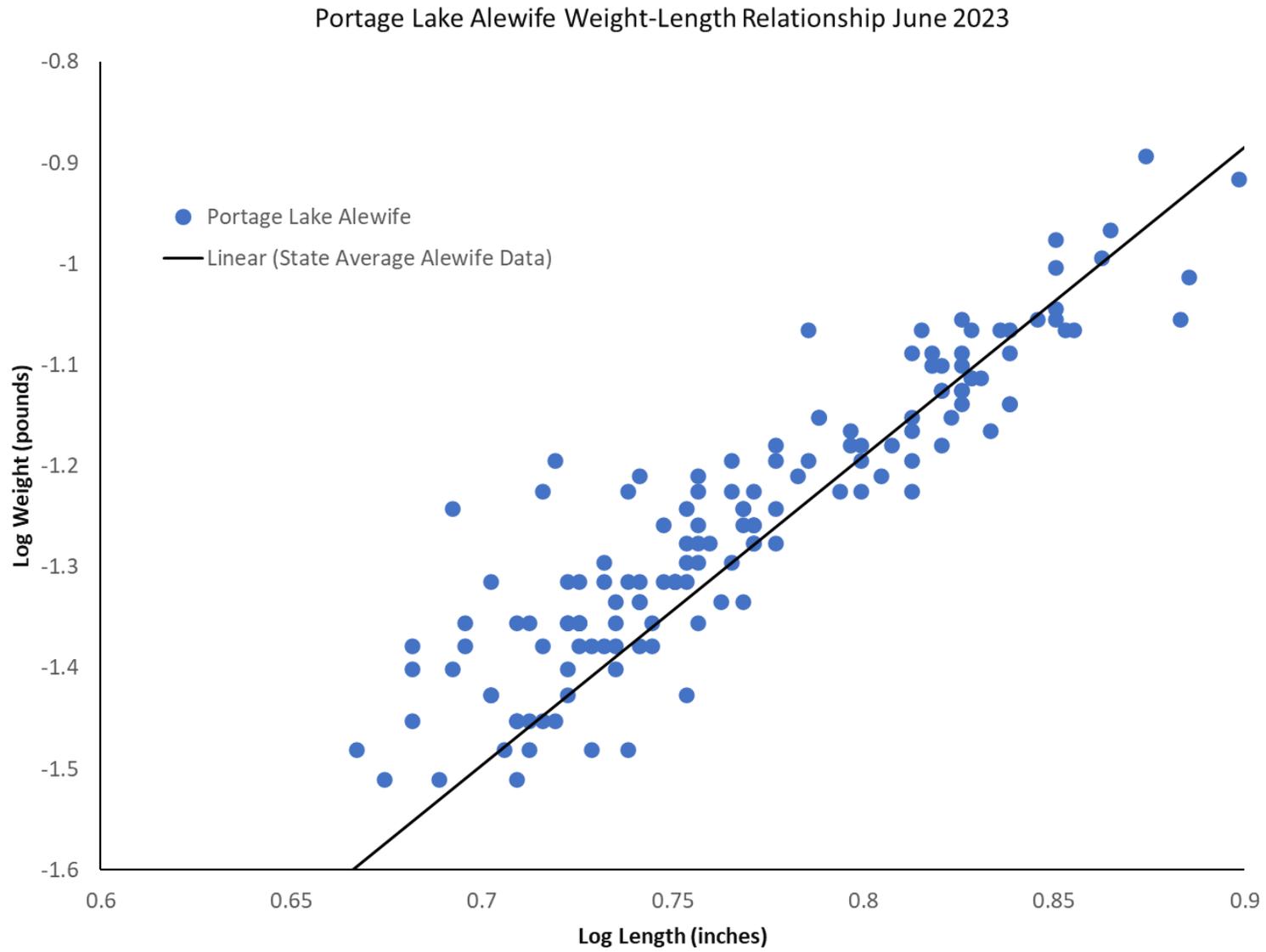


Figure 4-4. Alewife weight-length relationship in Portage Lake.

Portage Lake Yellow Perch Length Frequency Distribution June 2023

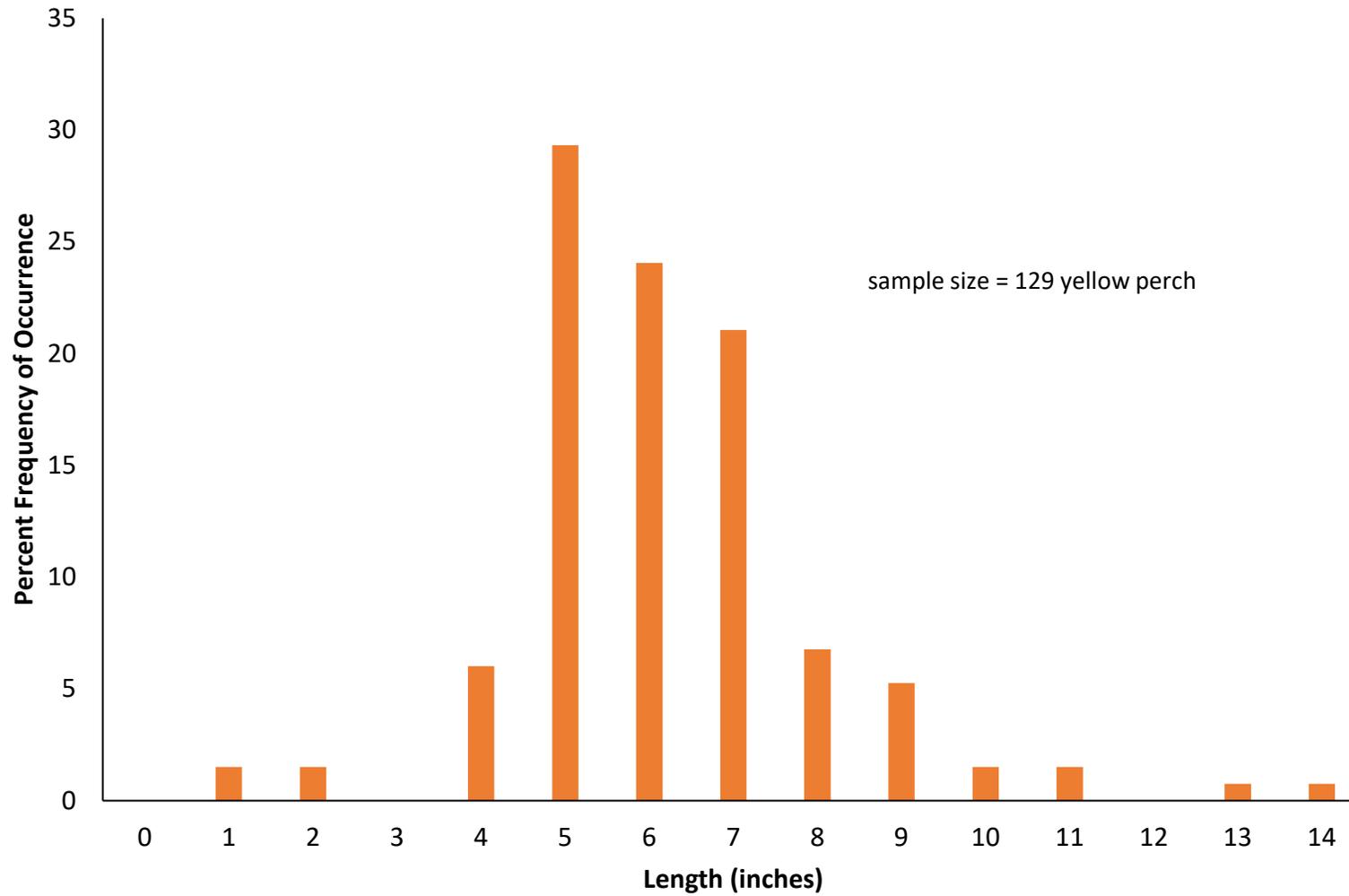


Figure 4-5. Length frequency distribution of yellow perch in Portage Lake.

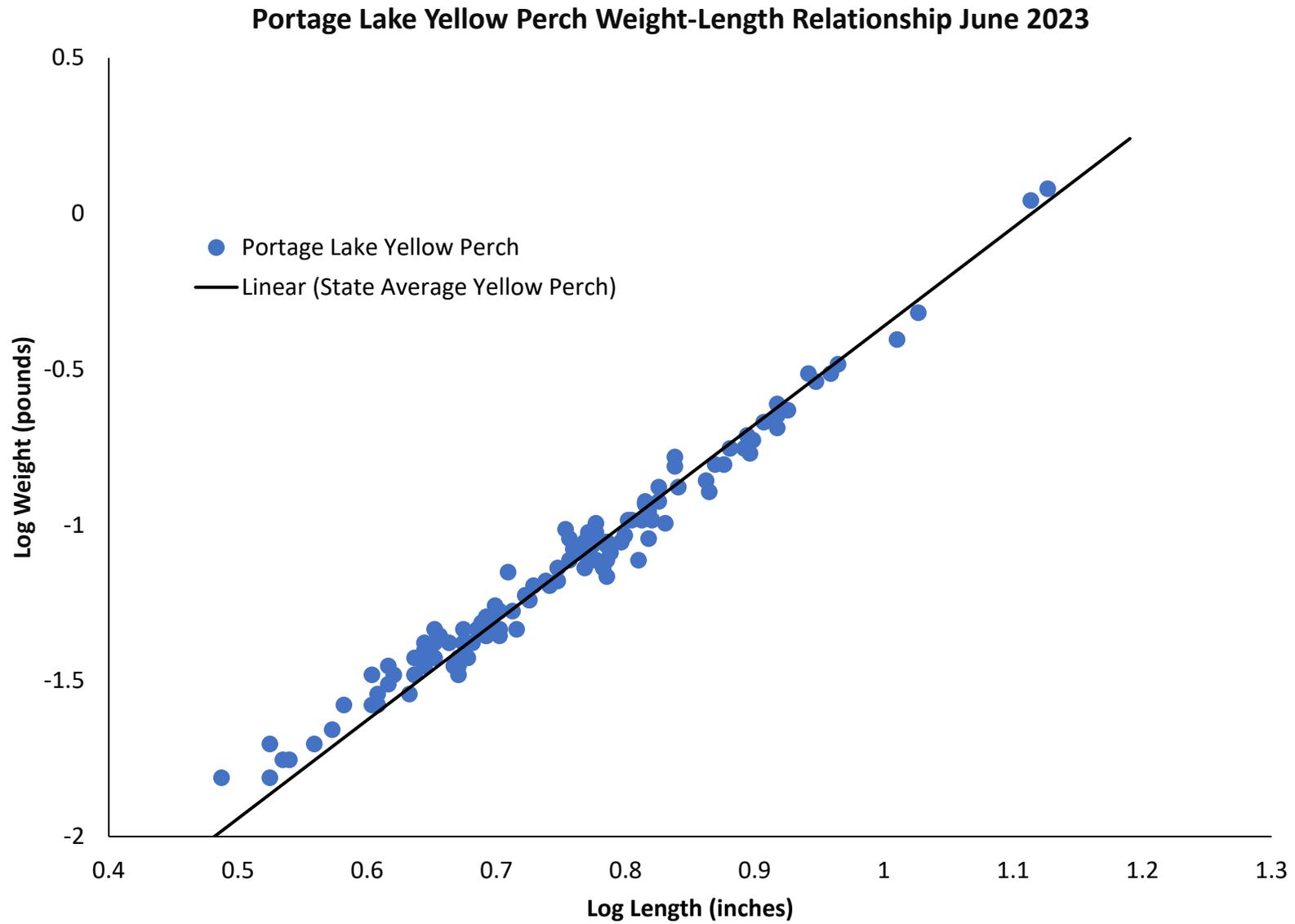


Figure 4-6. Yellow perch weight-length relationship in Portage Lake.

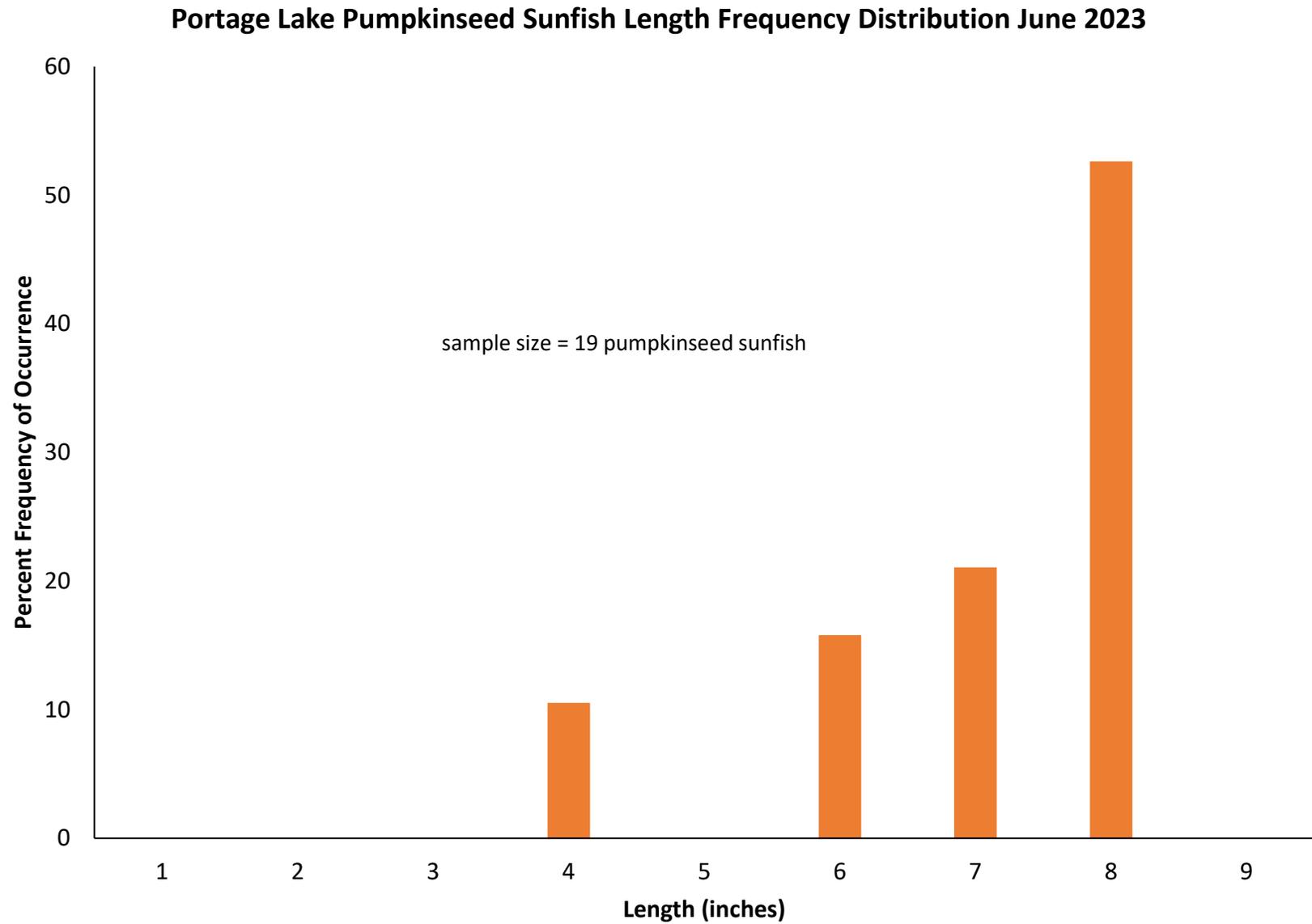


Figure 4-7. Length frequency distribution of pumpkinseed sunfish in Portage Lake.

Portage Lake Pumpkinseed Sunfish Weight-Length Relationship June 2023

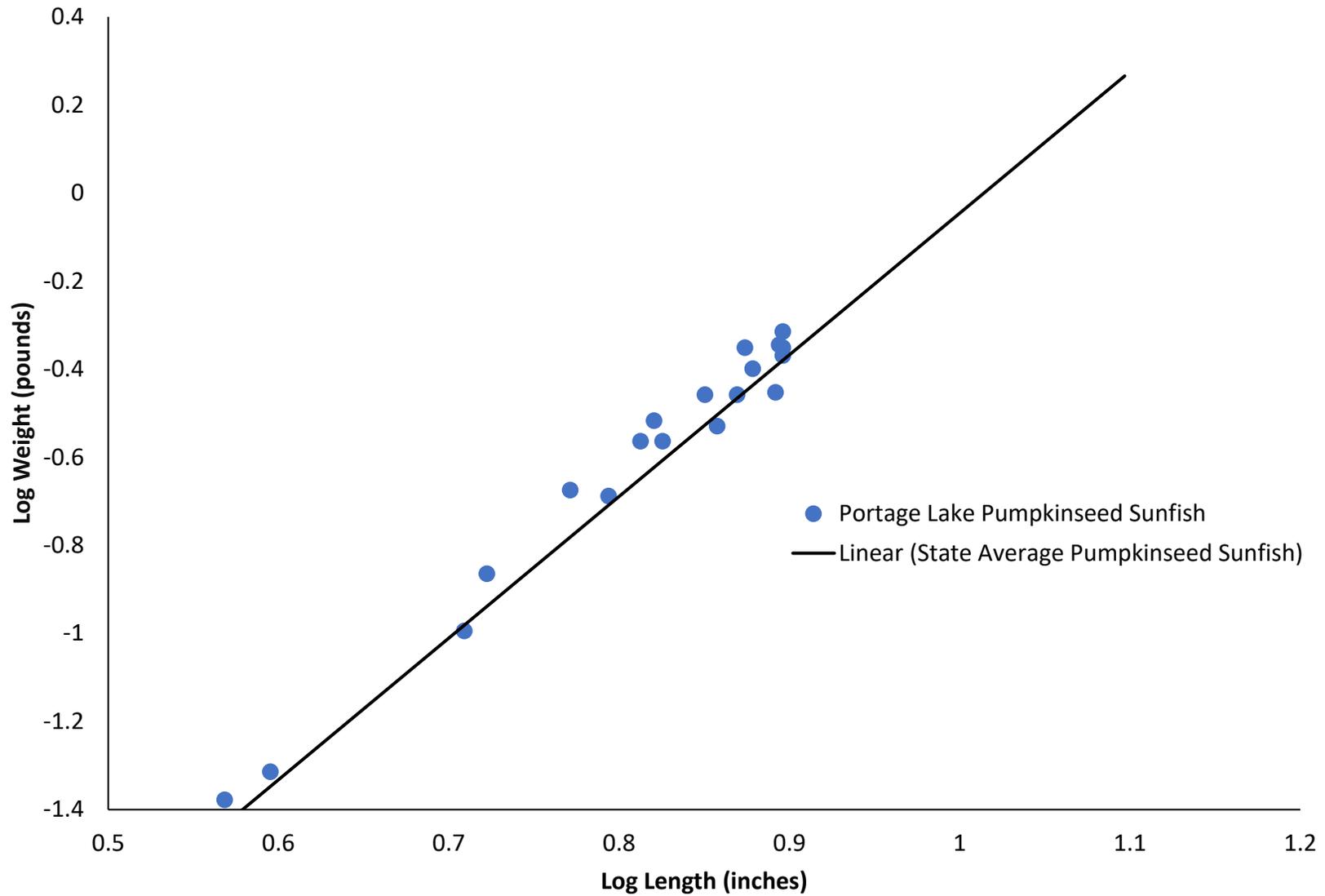


Figure 4-8. Pumpkinseed sunfish weight-length relationship in Portage Lake.

Portage Lake Smallmouth Bass Length Frequency Distribution June 2023

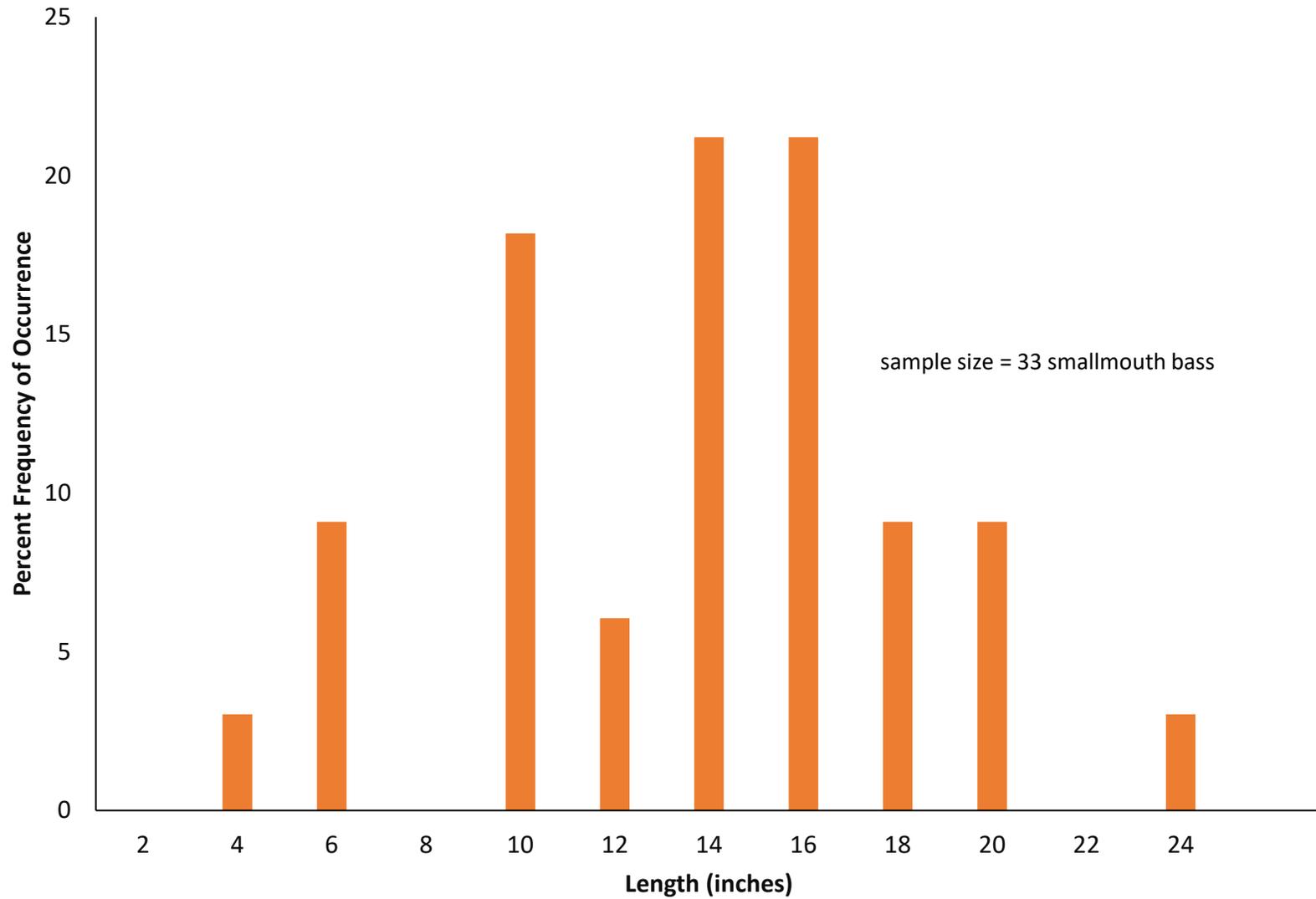


Figure 4-9. Length frequency distribution of smallmouth bass in Portage Lake.

Portage Lake Smallmouth Bass Weight-Length Relationship June 2023

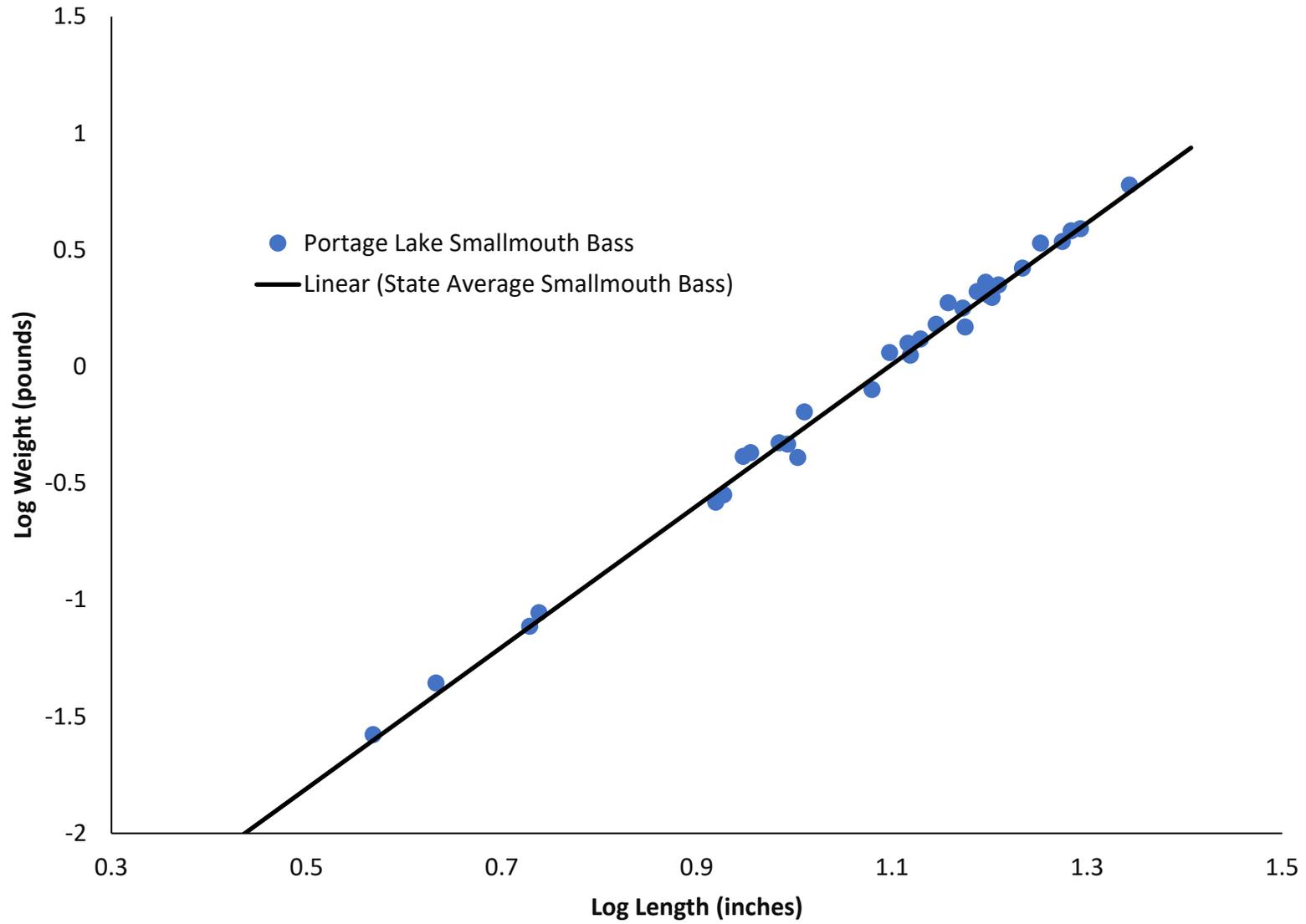


Figure 4-10. Smallmouth bass weight-length relationship in Portage Lake.

Portage Lake Northern Pike Length Frequency Distribution June 2023

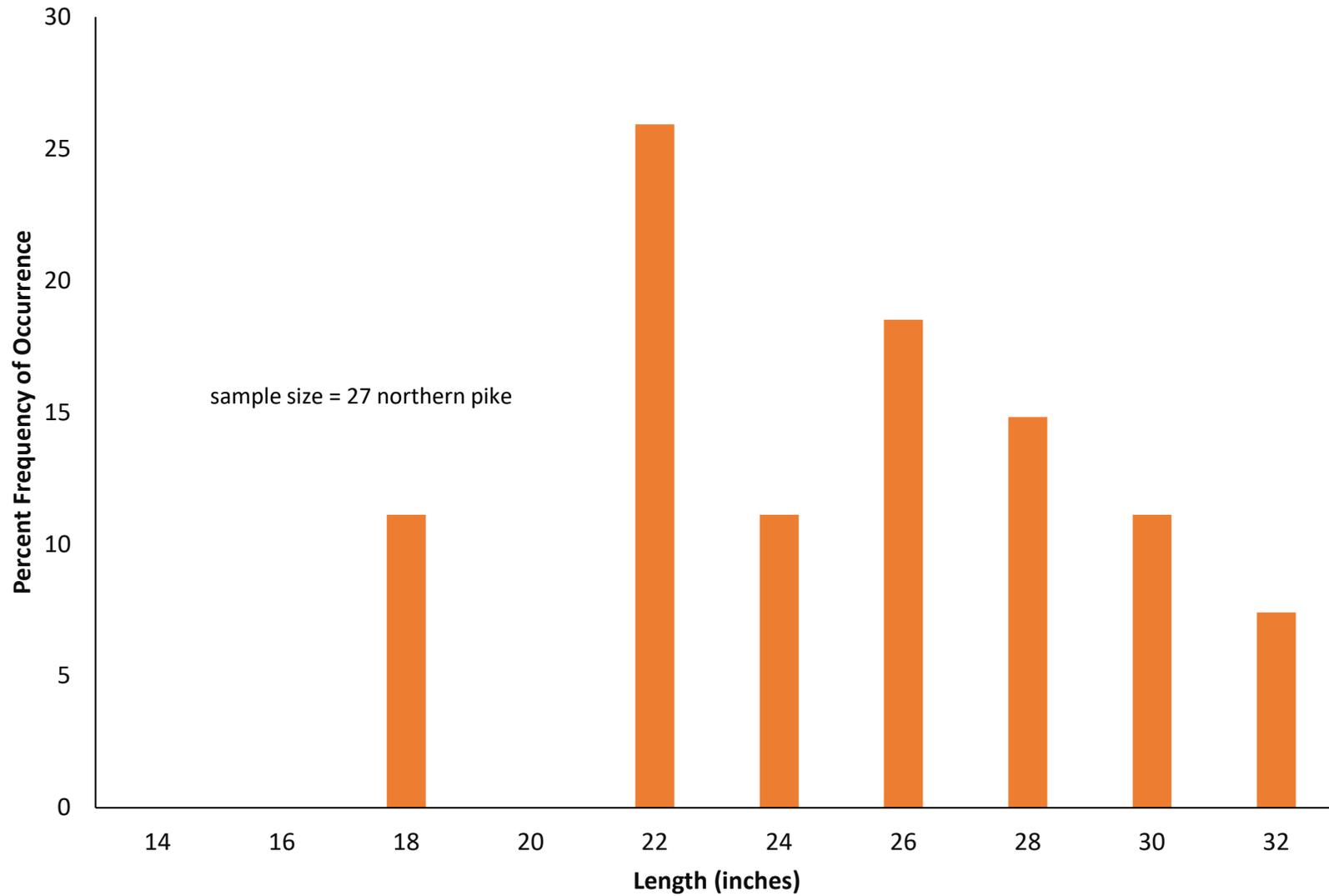


Figure 4-11. Length frequency distribution of northern pike in Portage Lake.

Portage Lake Northern Pike Weight-Length Relationship June 2023

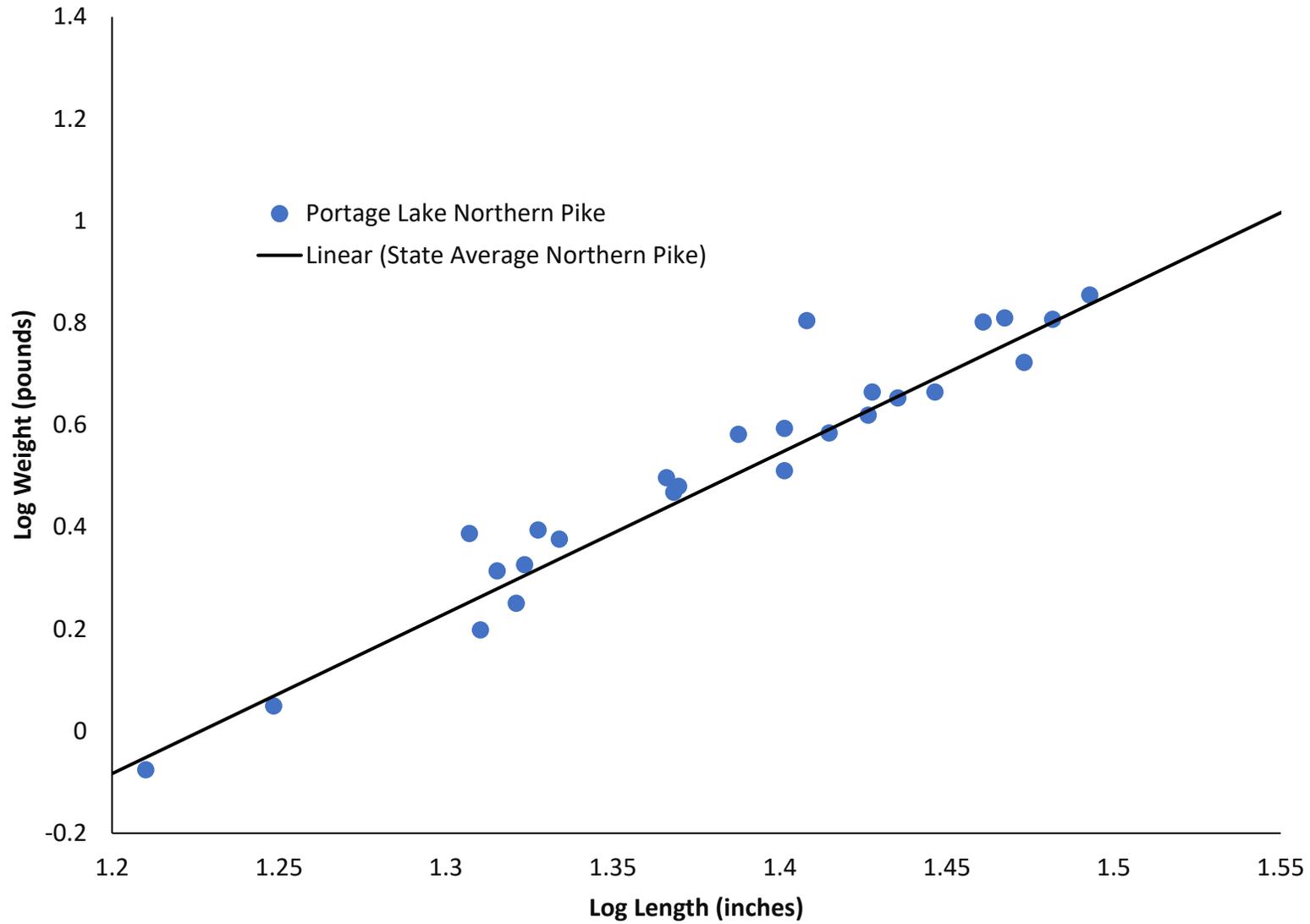
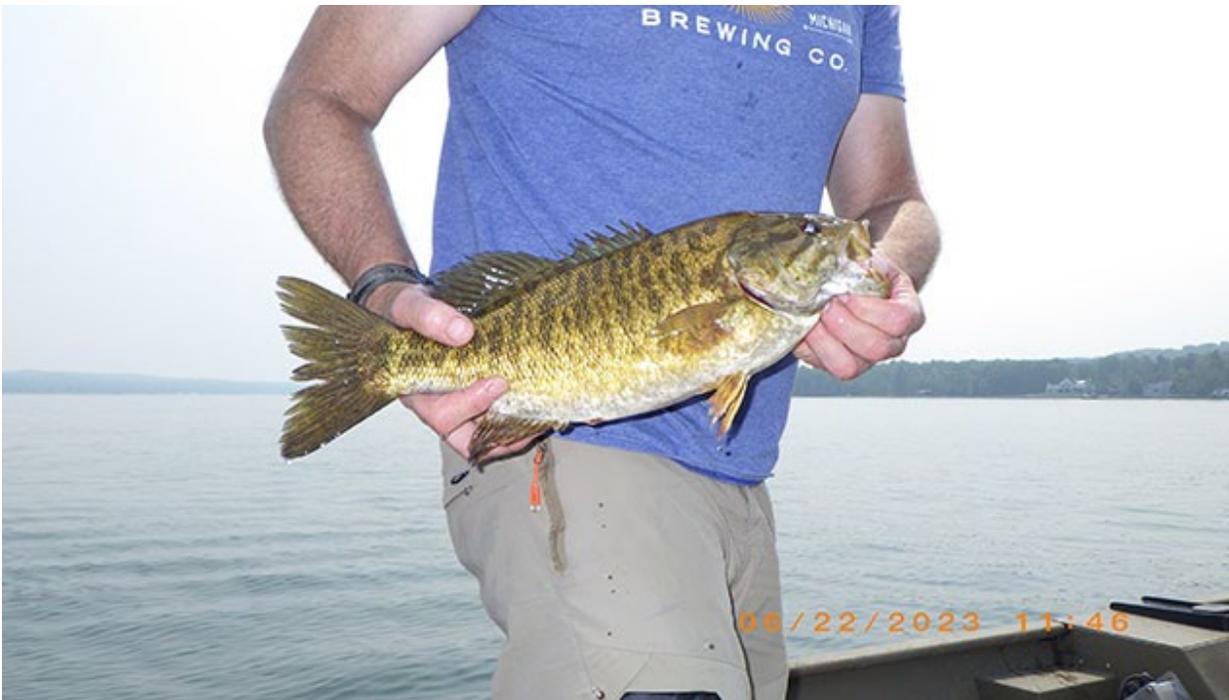


Figure 4-12. Northern pike weight-length relationship in Portage Lake.



Photograph 1. Longnose gar collected from Portage Lake, June 2023.



Photograph 2. Typical smallmouth bass collected from Portage Lake.



Photograph 3. Walleye collected from Portage Lake.



Photograph 4. Yellow perch collected from Portage Lake.



Photograph 5. Silver redhorse collected from Portage Lake.