East Long Lake 2011 Survey Report

Prepared by Brian Gunderman

Introduction

East Long Lake is a 123 acre lake located about 6 miles south of the city of Coldwater. East Long Lake is part of the Coldwater-Marble Chain of Lakes. Short navigable channels connect East Long Lake to Coldwater Lake and Wright Lake (Figure 1). All of the lakes in the Coldwater-Marble Chain are at approximately the same elevation and the direction of water movement within the system is variable. There are two outlets from this system. The Sauk River flows out of Marble Lake, and the Coldwater River flows out of Coldwater Lake. There are dams on both of these outlets. These dams are used to maintain the legal lake levels of 984.5 ft above sea level in summer and 983.5 ft above sea level in winter.

Drop-offs generally are steep. The lake has a maximum depth of 45 ft and approximately 65% of the lake (by surface area) is $\geq$ 20 ft deep (Figure 2). Marl and fibrous peat are the predominant substrates in the littoral zone. East Long Lake is bordered by somewhat poorly drained fine loams of the Matherton-Sebewa-Fox series on the northwest and loamy sands of the Spinks-Houghton-Boyer series on the southeast. Darcy groundwater models show low potential for groundwater inputs to the lake.

Agriculture is the primary land use in the Coldwater-Marble Chain watershed. However, forests and wetlands are abundant in the area around East Long Lake. The 2011 habitat survey indicated a total shoreline dwelling density of 26.4 dwellings/mile for East Long Lake. This estimate is misleading because the survey did not include the human-made channels through the high density residential area on the west side of the lake. Approximately 40% of the shoreline (human-made channels excluded) is armored with seawalls or riprap. Long stretches of forested shorelines exist along the northwest and east-central portions of the lake, and a sizeable wetland complex remains at the south end of the lake. Large woody structure was common in nearshore areas along forested shorelines and scarce along shorelines with residential and vacation home development. The total estimated density for large woody structure was 34.3 logs/mile, which is relatively high for lakes in southwest Michigan and comparable to many lakes in northern Michigan (K. Wehrly, Michigan Department of Natural Resources [MDNR] – Fisheries Division, unpublished). There are no public boat launches on East Long Lake. Anglers can access the lake by launching their boats at the MDNR public access sites on Coldwater Lake or the Wright Lake Channel and navigating to East Long Lake (Figure 1).

Limnological sampling was conducted at the deepest point in East Long Lake on September 8, 2011. As expected, the lake was thermally stratified (Figure 3). The epilimnion extended from the surface to a depth of 17 ft. Water temperatures within the epilimnion were relatively uniform, ranging from 68.7 ^{o}F to 68.5 ^{o}F. The metalimnion (zone of thermal change) extended from 17 ft to 27 ft. Water temperatures declined from 68.5 ^{o}F at the top to 51.2 ^{o}F at the bottom of the metalimnion. The cold waters of the hypolimnion extended from 27 ft to the bottom of the lake. The dissolved oxygen concentration varied from 6.7 ppm to 7.1 ppm from the surface to 17 ft and dropped rapidly to <1 ppm by 18 ft. The total alkalinity was 210 mg/L, which is indicative of a hardwater lake with substantial buffering capacity.

The biological productivity of a lake is strongly dependent on its supply of two key nutrients: phosphorus and nitrogen. Nitrogen is the limiting nutrient when the ratio of total nitrogen to total phosphorus is <10:1 and phosphorus is the limiting nutrient when this ratio is >15:1 (Shaw et al. 2004). In East Long Lake the ratio of total nitrogen to total phosphorus was 26:1, so it appears that phosphorus is the limiting nutrient in this system. The total phosphorus concentration was 28 µg/L. The Secchi disk depth, which provides an index of water transparency, was 4.0 ft. These water quality parameters suggest that East Long Lake is a eutrophic or highly productive lake. The chlorophyll *a* concentration (an index of algal biomass) was 5.9 µg/L, which is more indicative of a mesotrophic or moderately productive lake (Carlson and Simpson 1996).

The first fisheries survey of East Long Lake was completed by the Michigan Fish Commission (predecessor to MDNR) in 1886. Ciscoes, black crappies, bluegills, largemouth bass, and yellow perch were captured during this initial sampling effort. Additional netting conducted in 1927 yielded bluegills, largemouth bass, yellow perch, black crappies, spotted gar, and bowfin.

During the 1930s through the early 1940s, bluegills, yellow perch, and largemouth bass were stocked in East Long Lake (Table 1). These species also were stocked in other lakes within the Coldwater-Marble Chain during this period. Throughout the state, annual stocking programs for these species were discontinued after fisheries managers determined that such programs were unnecessary and could have undesirable effects on the receiving populations (e.g., reduced growth due to increased competition for forage).

Another fisheries survey of East Long Lake was completed in 1941. Bluegills and yellow perch were the most abundant species in the catch, followed by largemouth bass, black crappies, pumpkinseeds, and northern pike. One cisco also was collected during the 1941 sampling effort. Anglers reported good fishing for bluegills, largemouth bass, and northern pike. During the summer of 1948, a seine was used to capture fish along the shoreline of the lake. Juvenile bluegills composed the bulk of the catch. Juvenile black crappies and largemouth bass also were common.

No fish have been stocked in East Long Lake since 1941, but some stocking has occurred in Coldwater and Marble lakes. Tiger muskellunge were stocked in Marble Lake during 1970-1985 and in Coldwater Lake during 1976-1991. Walleyes were stocked in Marble Lake in 1987 and in Coldwater Lake during 1982-2012. As there are no barriers between the lakes, some of these fish could have moved into East Long Lake after stocking.

A general survey of East Long Lake was conducted in September 1997 with four trap nets and one graded-mesh gill net. Bluegill was the most abundant species in terms of numbers and biomass. Fifty-one percent of the bluegills were of harvestable size (total length $\geq$ 6 inches). Numerically, black crappies were the second most abundant species in the catch. Approximately 65% of the crappies were 7 inches or larger. Growth was average for bluegills and crappies. The fish community appeared to be well-balanced, with predators making up 33% of the total biomass in the catch (Schneider 2000). Four adult walleyes were captured during the survey. These walleyes presumably were stocked fish from Coldwater Lake. No ciscoes were collected.

Ciscoes are classified as a threatened species in Michigan. As only one cisco was captured in 1941 and no ciscoes were collected in 1997, biologists hypothesized that environmental conditions had become unsuitable for this species. Ciscoes require cool, well-oxygenated water. During the summer, ciscoes are restricted to water layers where the temperature is $\leq$ 68 ^{o}F and the dissolved oxygen concentration is at least 3.0 ppm (Latta 1995). Limnological sampling was conducted at the three deepest basins in East Long Lake during September 2005. No layer of cool, well-oxygenated water was detected at any of the basins.

Materials and Methods

A variety of methods were used to evaluate the fish community in East Long Lake during May 2011. Fish were captured with trap nets, fyke nets, gill nets, seines, and nighttime electrofishing gear (Table 2) as part of MDNR's Status and Trends Program. This program involves standardized sampling in randomly selected lakes to provide information regarding spatial and temporal trends in Michigan's fish communities. Total lengths were recorded for all fish. For game fish species, spine or scale samples were collected from 10 fish per inch group for age determination.

Results

Twenty-four fish species were collected during the 2011 survey (Table 3.) Bluegill (n = 1,231) was the most abundant species, composing 60% of the catch by number and 26% of the catch by weight. Fifty-two percent of the bluegills were 6 inches or larger. Size structures of bluegill populations can be challenging to interpret because each gear type exhibits some degree of size selectivity (Figure 4). In an effort to minimize the subjectivity associated with analyses of bluegill catch data, Schneider (1990) developed a standardized scoring system for interpreting length-frequency distributions of bluegills collected with various types of sampling gear. The size scores for the East Long Lake bluegill population were 4.8 (satisfactory-good) based on the trap net and large-mesh fyke net samples and 3.4 (acceptable-satisfactory) based on the electrofishing sample (Schneider 1990).

The mean growth index for bluegills was +0.3, which is indicative of average growth (Figure 5). Most fish attained harvestable size at age 3 or age 4. No bluegills older than age 6 were collected, and age 6 fish only made up 4% of the catch (Figure 6).

Black crappie (n = 169) was the second most abundant species in the sample. Ninety-seven percent of the black crappies were 7 inches or larger and growth was average (Figures 7-8). About 76% of the crappies had total lengths of 8.0-9.9 inches. Nine year classes were collected (Figure 9). Age 6 fish were particularly abundant and composed 43% of the black crappie catch.

Yellow perch (n = 64) composed 1% of the total fish biomass during the survey. Forty-five percent of the yellow perch were of harvestable size, but only one fish $\geq$ 9 inches was captured (Figure 10). Six year classes were represented in the catch (Figure 11). The 2009 year class was relatively strong and made up 45% of the yellow perch catch. Mean lengths-at-age were slightly above average for perch up to 4 years of age (Figure 12). The sample size was limited, but growth appeared to be below average for older fish.

In combination, pumpkinseeds (n = 19) and redear sunfish (n = 4) composed 1% of the total fish biomass in the catch. Sixty-eight percent of the pumpkinseeds were 6 inches or larger. Total lengths for redear sunfish varied from 9.2 inches to 11.8 inches. Mean lengths-at-age for both species were above statewide averages. Redear sunfish, pumpkinseeds, and warmouth often hybridize with bluegills and with each other. Hybrid sunfish (n = 122) made up 6% of the total fish biomass during the 2011 survey.

Largemouth bass (n = 142) were the most abundant predators in the catch. Legal-sized fish (14 inches or larger) composed 4% of the sample (Figure 13). Mean lengths-at-age were slightly above average for young bass and below average for age 4 and older fish (Figure 14). The age structure was skewed toward young fish (Figure 15). Age 6 and older fish made up 6% of the largemouth bass catch. Total annual mortality for largemouth bass ages 4-9 was estimated to be 44% (Figure 16).

Twenty-five northern pike were captured during the survey. Though less numerous than largemouth bass, northern pike composed a greater percentage of the total fish biomass in the catch. The total length range for northern pike was 21-38 inches and 84% of the northern pike collected were of legal size (24 inches or larger; Figure 17). Age 4-6 fish composed the bulk of the catch (Figure 18). The mean growth index for northern pike was +2.0, which is indicative of above average growth (Figure 19). Two adult walleyes (total length = 23-26 inches) also were captured during the 2011 sampling effort.

Analysis and Discussion

There has been little change in the species composition of the fish community since 1997. Predators (largemouth bass, northern pike, walleye, bowfin, and spotted gar) composed 33% of the total fish biomass during the 2011 survey. Schneider (2000) observed that predators typically make up 20-50% of the biomass in lakes with desirable fish communities. Based on this standard, East Long Lake has a healthy predator-prey ratio.

Bluegills continue to be the primary game fish in East Long Lake. Catch-per-effort (CPE) with specific gear types provides an index of relative abundance of bluegills. From 2002 through 2007, 230 Michigan lakes were sampled as part of the Status and Trends Program and 184 of these lakes supported bluegill populations (K. Wehrly, MDNR – Fisheries Division, unpublished). The East Long Lake bluegill CPEs for trap nets, large-mesh fyke nets, and electrofishing gear were in the top 20% of the values recorded during the 2002-2007 Status and Trends surveys. The CPE data indicate that bluegill abundance in East Long Lake is high relative to the statewide average and slightly above the median for lakes in southwest Michigan.

There was a discrepancy between the bluegill size score based on the trap net and fyke net sample (satisfactory-good) and the size score based on the electrofishing sample (acceptable-satisfactory). The size score based on the netting effort probably is a more reliable indicator of the quality of the fishery. The nets were fished for three nights, whereas electrofishing only was conducted on a single night. Schneider (1990) expressed similar concerns regarding the suitability of one-night electrofishing survey data for calculating size scores.

Overall, East Long Lake appears to be supporting a strong bluegill fishery. Bluegills are abundant and growth is average. The age structure of the population suggests that fishing mortality is responsible for the scarcity of bluegills larger than 8 inches, but no creel survey data are available to evaluate this hypothesis.

This lake supports one of the better black crappie fisheries in southwest Michigan. The crappie population density in East Long Lake is high. The East Long Lake black crappie CPEs for trap nets and large-mesh fyke nets were in the top 20% of the values recorded during the 2002-2007 Status and Trends surveys. Black crappies of harvestable size were common, but “trophy” fish were rare. Two factors could be responsible for the observed size structure: sport fishing harvest or recruitment variability. As noted previously, no creel data are available to facilitate estimation of fishing mortality. Ecological conditions in the Coldwater-Marble Chain apparently favored black crappie recruitment in 2005, as the 2005 year class dominated the black crappie catch in both Archer and East Long lakes during the 2011 surveys. If mortality of this year class is not abnormally high, the abundance of fish >10 inches should be higher in 2012 and 2013.

Yellow perch occupy offshore areas during the period when Status and Trends surveys are conducted, and perch typically compose a small percentage of the total fish biomass in the catch. Gill nets usually are the most effective gear for capturing yellow perch. The yellow perch CPE for gill nets in East Long Lake was in the top 20% of the range for Status and Trends surveys, so it appears that the yellow perch population density in this system is high. Yellow perch populations exhibit wide annual variation in natural recruitment (Forney 1971). The 2009 year class was relatively strong (Figure 11). Based the growth data for East Long Lake, these fish are expected to reach harvestable size (i.e., 7 inches) in 2012.

Redear sunfish are not native to Michigan. This species was introduced into several Branch County lakes during the 1950s, but no records indicate that redear sunfish were stocked in the Coldwater-Marble Chain. Redear sunfish apparently were introduced into this system via unauthorized stocking activity during the 1970s or early 1980s. In terms of numbers, this species is a minor component of the fish community in East Long Lake. However, the size structure of the catch was impressive. The minimum length for redear sunfish catch-and-release entries in MDNR's Master Angler Program is 10 inches. Three out of the four redear sunfish captured during the 2011 survey were $\geq$ 10 inches.

Largemouth bass are abundant in East Long Lake. Nighttime electrofishing is the most efficient method for capturing bass. The largemouth bass CPE on East Long Lake was 4.0 fish/minute. Only four out of 136 largemouth bass lakes sampled during the 2002-2007 Status and Trends surveys had higher electrofishing CPEs.

The annual mortality estimate for age 4-9 largemouth bass in East Long Lake was low relative to the estimates for most other largemouth bass populations in North America (Allen et al. 2008). These results must be interpreted with caution as data only were collected in one year and the sample size for adult bass was small. Mean lengths-at-age were slightly above average for young bass and below average for adult bass (Figure 14). There does not appear to be a lack of forage for adult bass in this system. Thus, the most probable explanation for the pattern in mean lengths-at-age is that fishing mortality is higher for fast-growing bass than for slow-growing bass. Fast-growing individuals enter the fishery earlier and likely have a shorter life span than slow-growing individuals due to harvest and hooking mortality.

East Long Lake supports a strong northern pike fishery. The northern pike population density is about average, and growth is well above average. Northern pike spawn on flooded vegetation in wetlands, such as the wetland at the south end of the lake. Wetlands also serve as nursery areas for juvenile fish of many different species. Because wetlands are so important to the continued health of the fish, reptile, and amphibian communities, they should be protected from future draining, filling, or development.

Both of the walleyes collected during the survey were from the 2000 year class and presumably were stocked in Coldwater Lake. MDNR's walleye stocking program was temporarily disrupted due to the discovery of the viral hemorrhagic septicemia virus in the Great Lakes, and no spring fingerling walleyes were stocked in Coldwater Lake during 2007-2010. Approximately 160,000 spring fingerling walleyes were stocked in 2011-2012. The current management prescription for Coldwater Lake calls for biennial stocking of 80,000 spring fingerling walleyes.

No ciscoes were captured during the 2011 survey on East Long Lake. Limnological sampling in September 2011 indicated that environmental conditions were not suitable for ciscoes. Historic limnological data are lacking, but the summer water temperature and dissolved oxygen profiles for the lake presumably have changed since the first fisheries surveys were conducted in the late 1800s and early 1900s. Two factors could be responsible for this change. Nutrient concentrations in the lake may have increased due to human activities within the watershed. This would result in increased biological oxygen demand and lower dissolved oxygen concentrations in the metalimnion. Climate change also could have affected ciscoes by reducing the volume of cool water within the lake.

Management Recommendations

East Long Lake currently is providing good fishing opportunities for panfish, largemouth bass, and northern pike. No stocking is recommended at this time (except in Coldwater Lake). The primary management goal is to protect and improve aquatic habitat in this system.

At least three different methods will be used to accomplish this goal. Fisheries Division personnel will continue to review Michigan Department of Environmental Quality permit applications for potential effects on aquatic resources. If a proposed project is likely to degrade the aquatic habitat, Fisheries Division staff will object to the proposal and suggest feasible alternatives. Fisheries Division will work with the lake association and other organizations to educate riparian landowners on the effects of various practices (e.g., chemical weed treatments and seawall construction) on aquatic ecosystems. As opportunities arise, Fisheries Division also will provide technical assistance to local units of government interested in establishing ordinances that protect aquatic habitats from pollution or unwise development.

References

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Table 1.–Fish stocking in East Long Lake, 1934-1941. All fish were stocked as fall fingerlings (age = 4-7 months).

Year	Species	Number	Number/acre
1934	Bluegill	40,000	325
1935	Bluegill	10,000	81
1937	Bluegill	10,000	81
1938	Bluegill	10,000	81
	Yellow perch	5,000	41
1939	Bluegill	10,000	81
	Yellow perch	5,000	41
1940	Bluegill	10,000	81
	Largemouth bass	500	4
1941	Bluegill	15,000	122

Table 2.–Sampling effort during the fish community survey on East Long Lake, May 2011. Each net night equals one overnight set of one net.

Sampling period	Gear	Effort
May 9-12	Trap net	3 net nights
May 9-12	Large-mesh fyke net	9 net nights
May 9-11	Small-mesh fyke net	4 net nights
May 9-12	Graded-mesh gill net	6 net nights
May 19	Nighttime electrofishing	30 minutes
May 19	Seine	4 hauls (25 ft each)

Table 3.–Numbers, weights, lengths, and growth indices for fish species collected during the fish community survey on East Long Lake, May 2011. Fish were captured using trap nets, fyke nets, gill nets, seines, and nighttime electrofishing gear.

Species	Number	Percent by number	Weight (lbs)	Percent by weight	Length range (inches)	Percent legal or harvestable[1]	Growth index[2]
Bluegill	1,231	60.0	191.2	25.7	1-8	52	+0.3
Black crappie	169	8.2	81.8	11.0	4-13	97	-0.4
Yellow bullhead	163	7.9	94.9	12.8	7-13	---	---
Largemouth bass	142	6.9	68.0	9.2	3-17	4	-0.3
Hybrid sunfish	122	5.9	43.6	5.9	3-10	90	---
Yellow perch	64	3.1	9.5	1.3	3-9	45	+0.3
Warmouth	27	1.3	7.7	1.0	3-8	81	---
Northern pike	25	1.2	136.1	18.3	21-38	84	+2.0
Pumpkinseed	19	0.9	4.0	0.5	2-7	68	+1.4
Brown bullhead	16	0.8	16.6	2.2	11-14	---	---
White sucker	14	0.7	31.7	4.3	12-21	---	---
Bluntnose minnow	14	0.7	0.1	0.0	2-3	---	---
Brook silverside	12	0.6	0.0	0.0	2-3	---	---
Bowfin	8	0.4	30.8	4.1	9-28	---	---
Blacknose shiner	7	0.3	0.0	0.0	2-2	---	---
Redear sunfish	4	0.2	4.1	0.5	9-11	100	---
Golden shiner	4	0.2	0.2	0.0	3-8	---	---
Spotted gar	3	0.1	3.0	0.4	17-21	---	---
Walleye	2	0.1	10.4	1.4	23-26	100	---
Common carp	1	0.0	6.8	0.9	24	---	---
Golden redhorse	1	0.0	1.9	0.3	17	---	---
Lake chubsucker	1	0.0	0.5	0.1	9	---	---
Rock bass	1	0.0	0.1	0.0	4	0	---
Blackchin shiner	1	0.0	0.0	0.0	2	---	---
Iowa darter	1	0.0	0.0	0.0	1	---	---
Total	2,052		743.0				

[1] Harvestable size is 6 inches for bluegill, pumpkinseed, redear sunfish, hybrid sunfish, warmouth, and rock bass, and 7 inches for black crappie and yellow perch.
[2] Average deviation from the state average length at age (Schneider et al. 2000). Mean growth indices less than -1 indicate below average growth, indices between -1 and +1 indicate average growth, and indices greater than +1 indicate growth is faster than the state average.

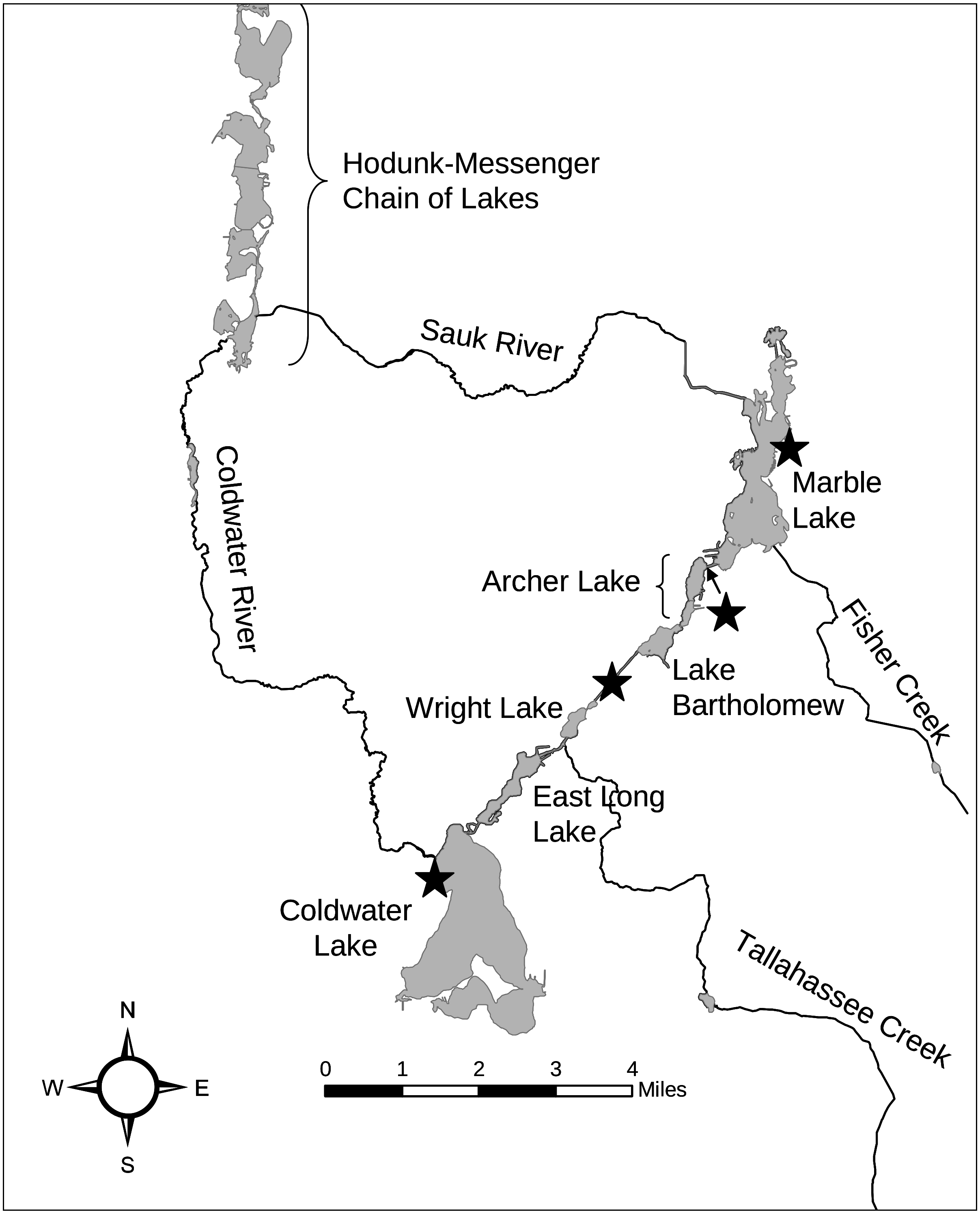


Figure 1.–Coldwater-Marble Chain of Lakes, Branch County, Michigan. Stars indicate public access sites maintained by the Michigan Department of Natural Resources.

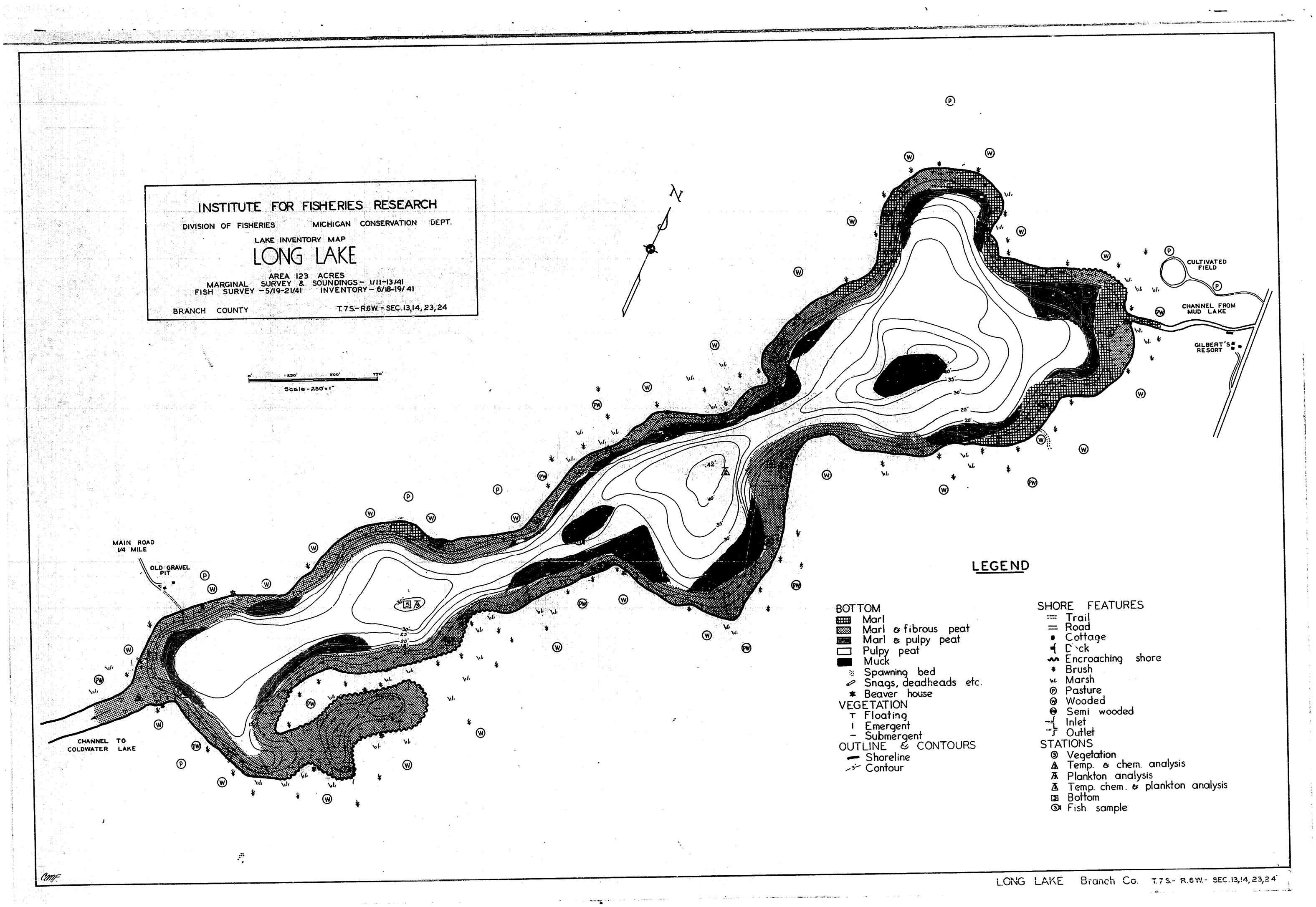
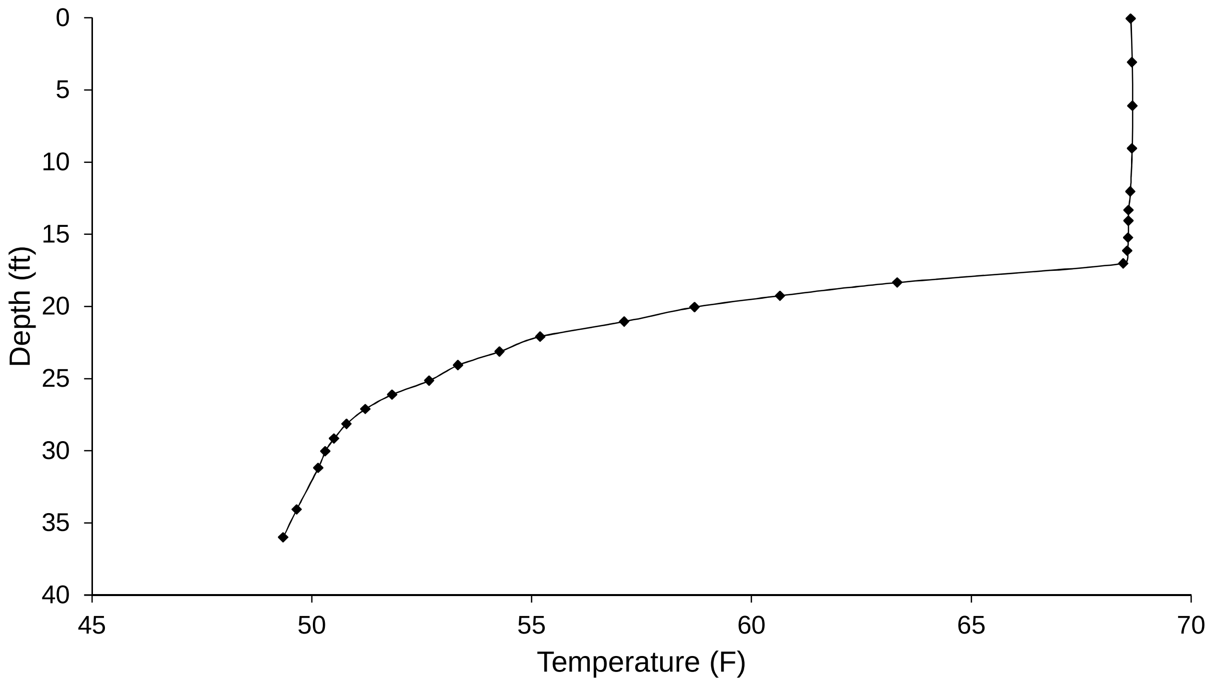


Figure 2.–Bathymetry of East Long Lake, as determined by the Michigan Department of Conservation in 1941. Depths are in feet.



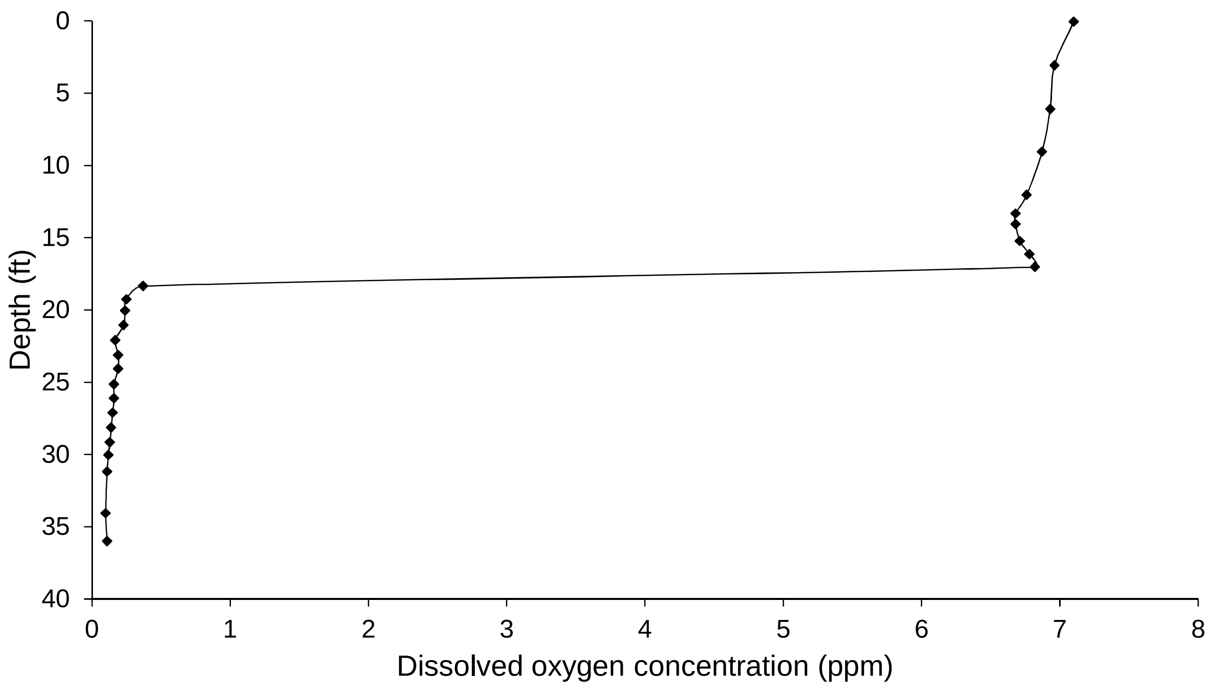


Figure 3.–Temperature and dissolved oxygen profiles for East Long Lake on September 8, 2011.

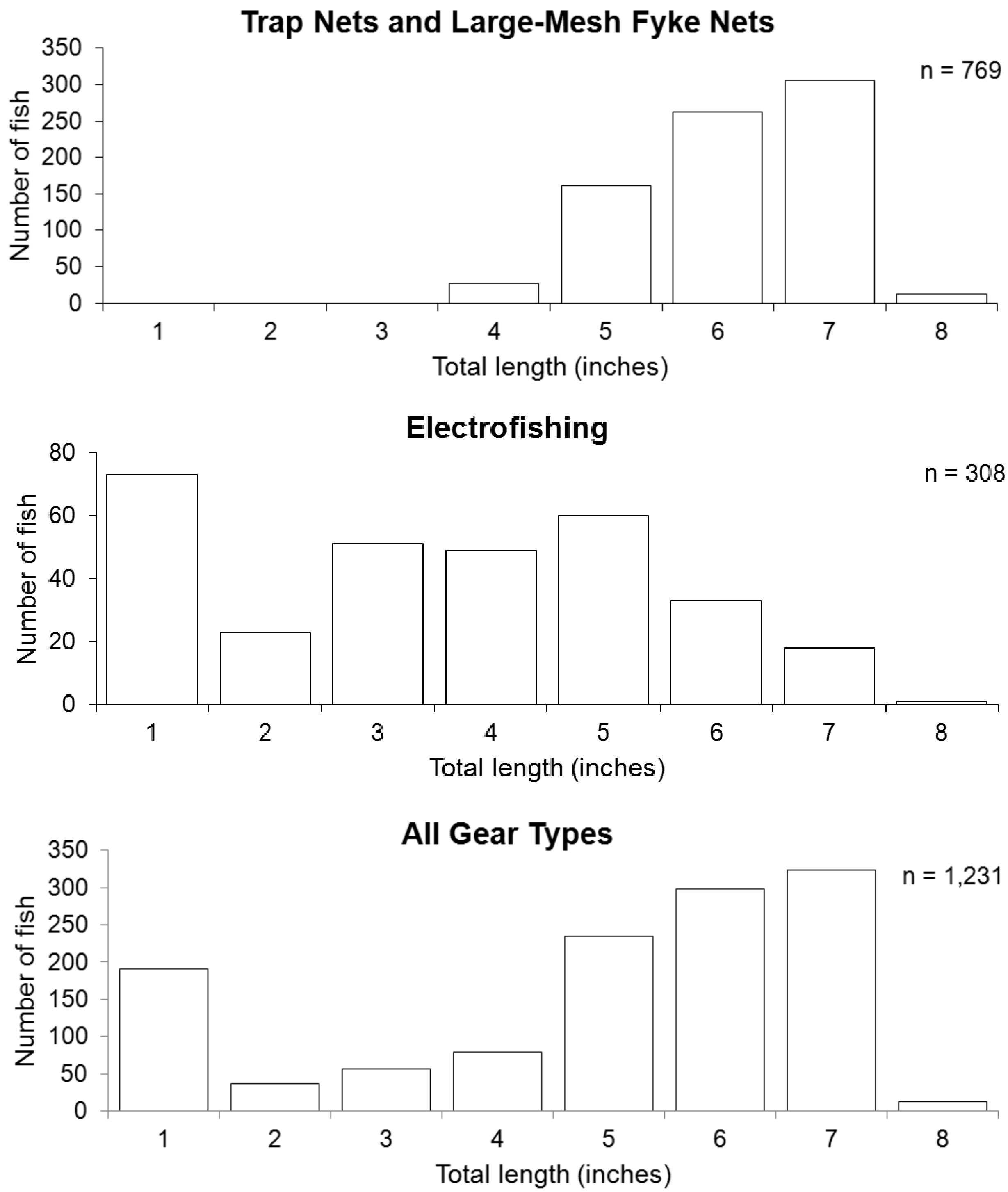


Figure 4.–Length frequency distributions for bluegills captured in East Long Lake using trap nets and large-mesh fyke nets, nighttime electrofishing gear, and all gear types, May 2011.

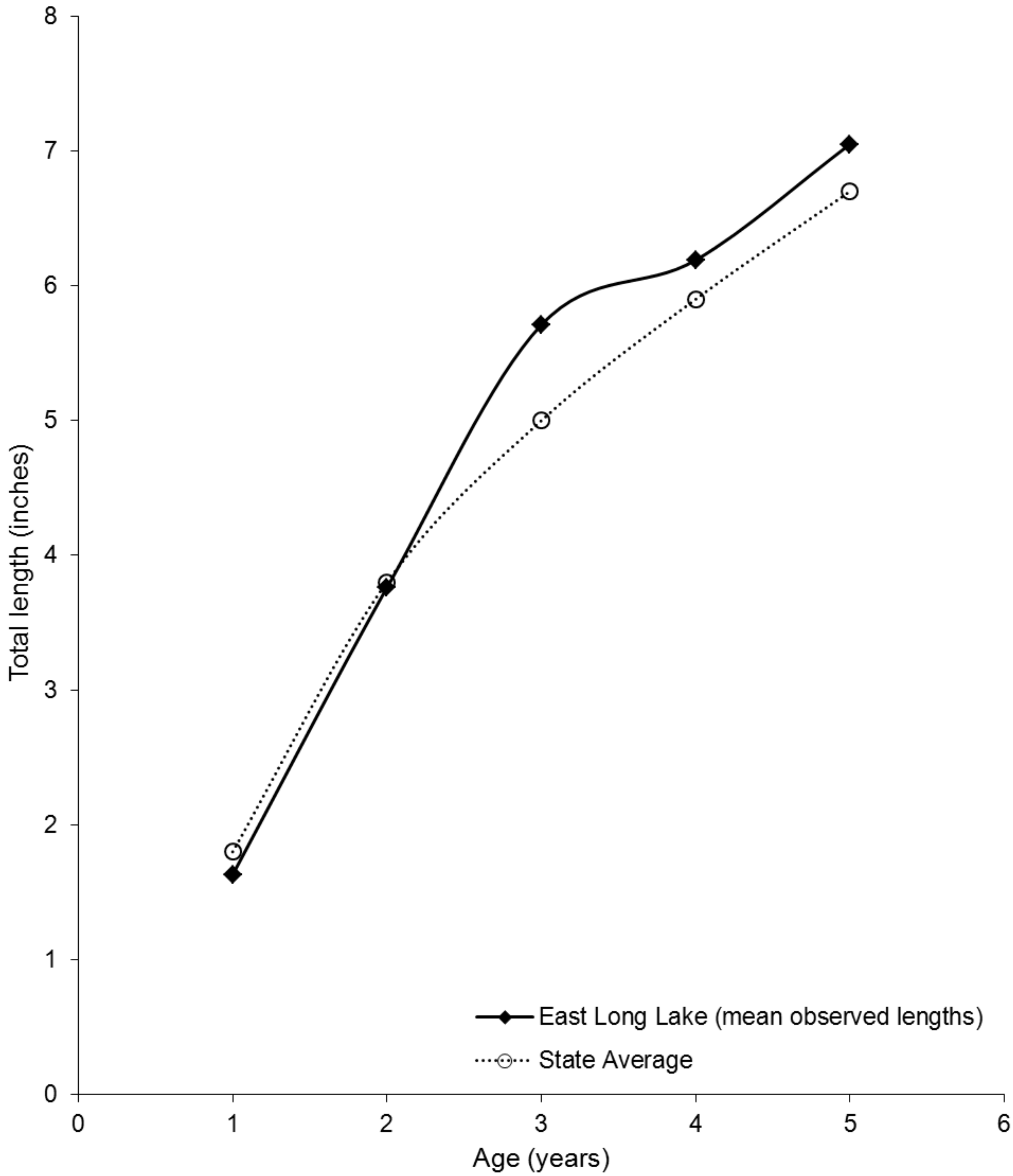


Figure 5.–Growth of bluegills in East Long Lake, as determined from scale and dorsal spine samples collected during May 2011. State average lengths from Schneider et al. (2000).

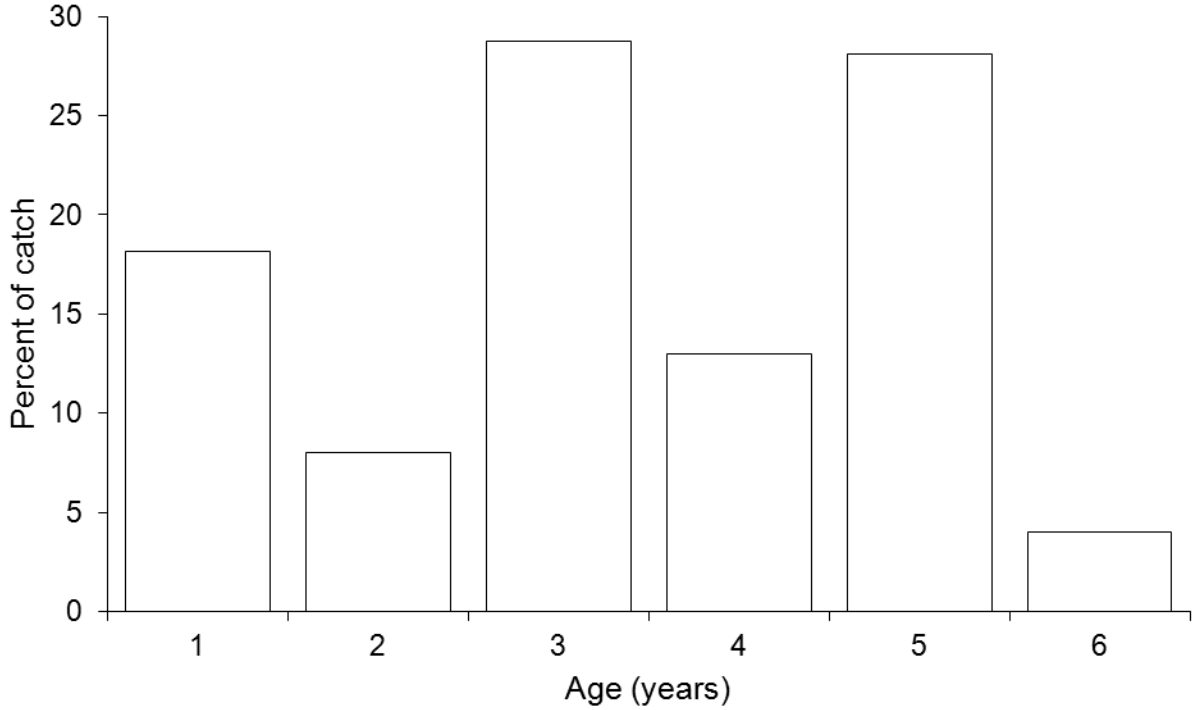


Figure 6.–Age frequency distribution for bluegills captured in East Long Lake during May 2011.

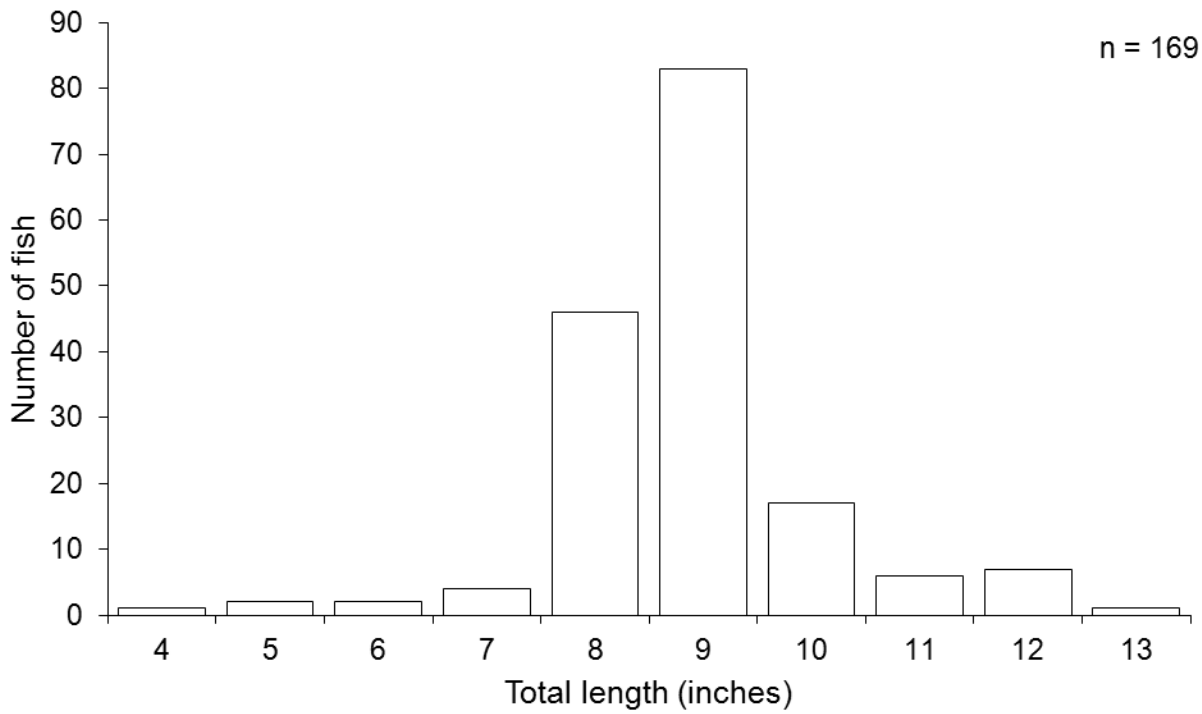


Figure 7.–Length frequency distribution for black crappies captured in East Long Lake during May 2011.

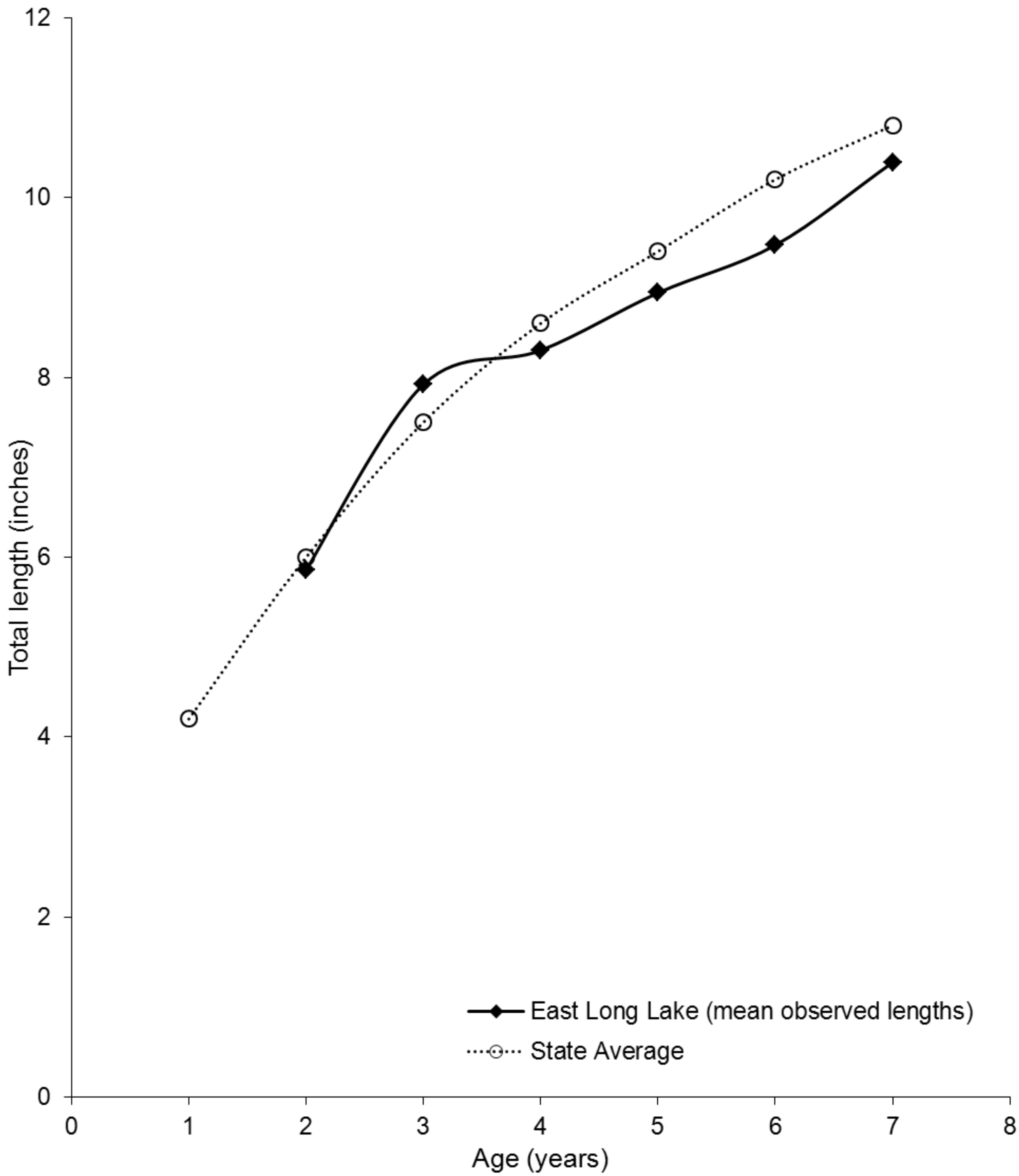


Figure 8.–Growth of black crappies in East Long Lake, as determined from scale and dorsal spine samples collected during May 2011. Only four samples were collected from the 2008 (age 3) year class. State average lengths from Schneider et al. (2000).

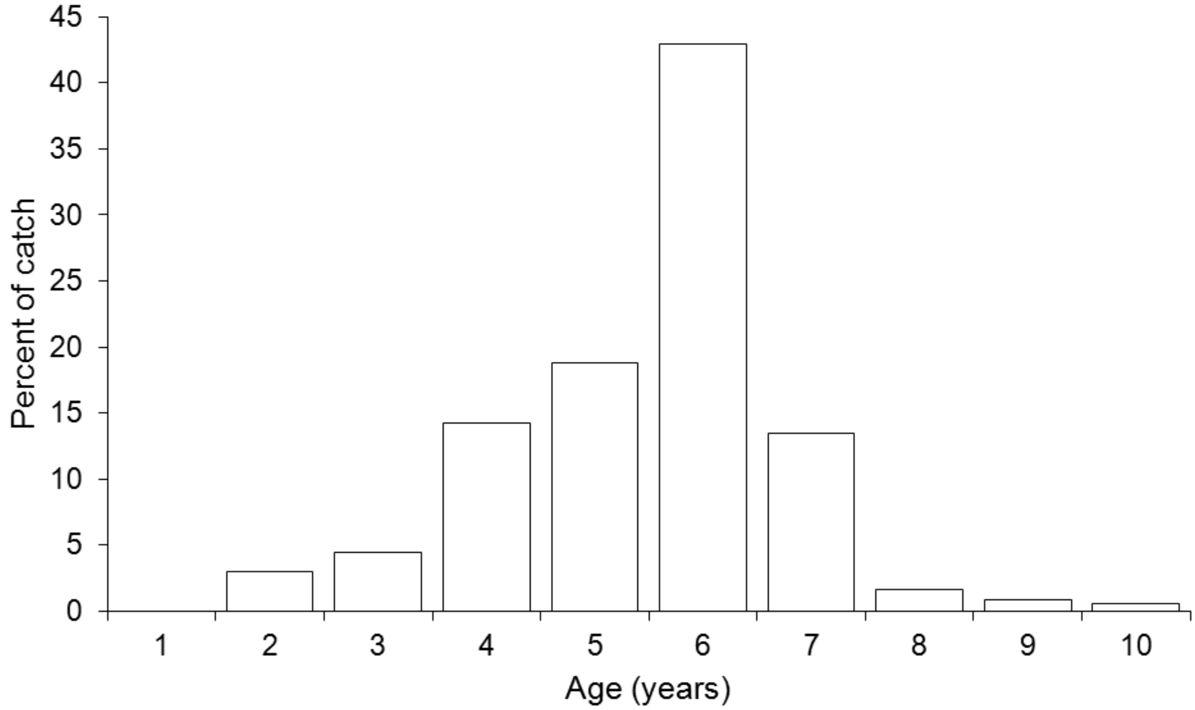


Figure 9.–Age frequency distribution for black crappies captured in East Long Lake during May 2011.

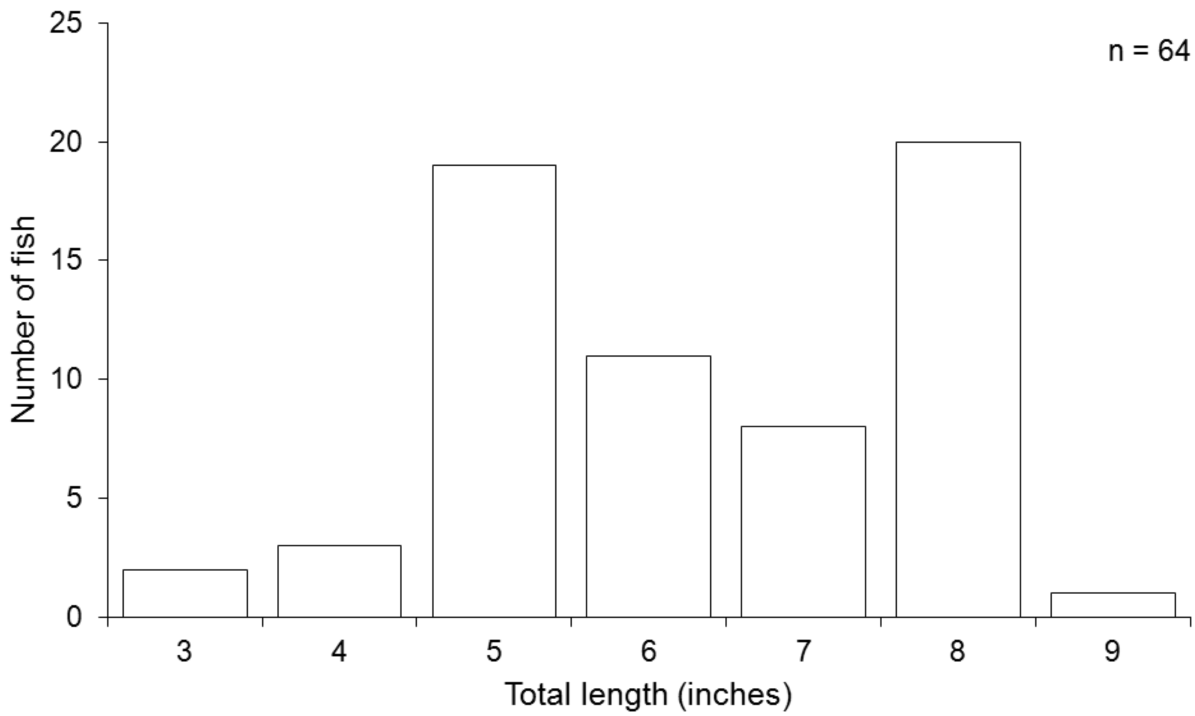


Figure 10.–Length frequency distribution for yellow perch captured in East Long Lake during May 2011.

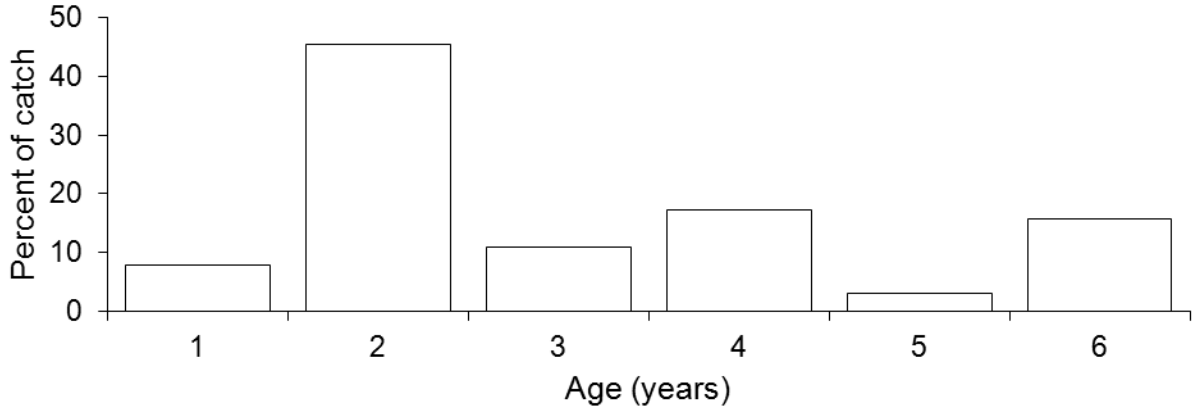


Figure 11.–Age frequency distribution for yellow perch captured in East Long Lake during May 2011.

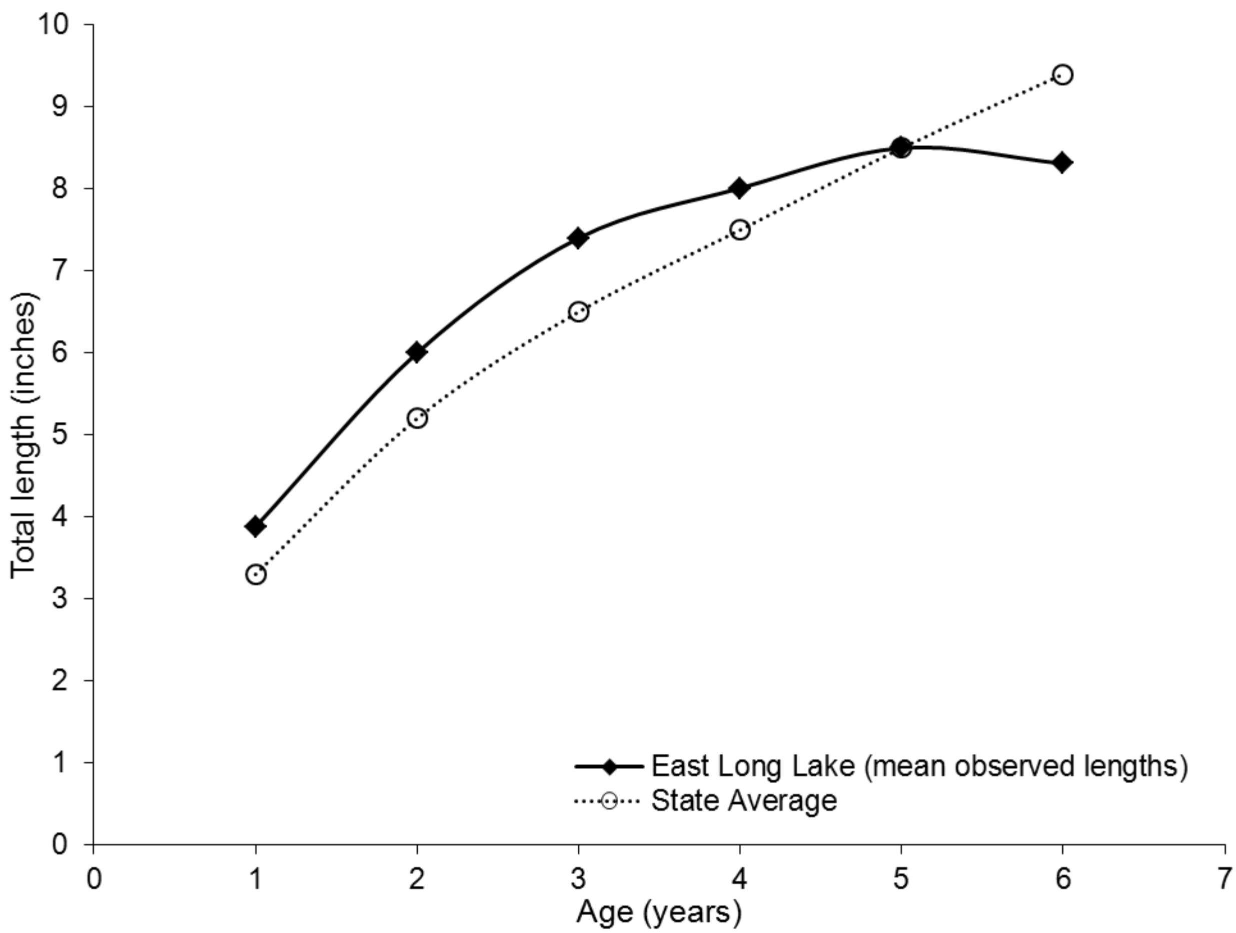


Figure 12.–Growth of yellow perch in East Long Lake, as determined from scale and dorsal spine samples collected during May 2011. Only one sample was collected from the 2006 (age 5) year class. State average lengths from Schneider et al. (2000).

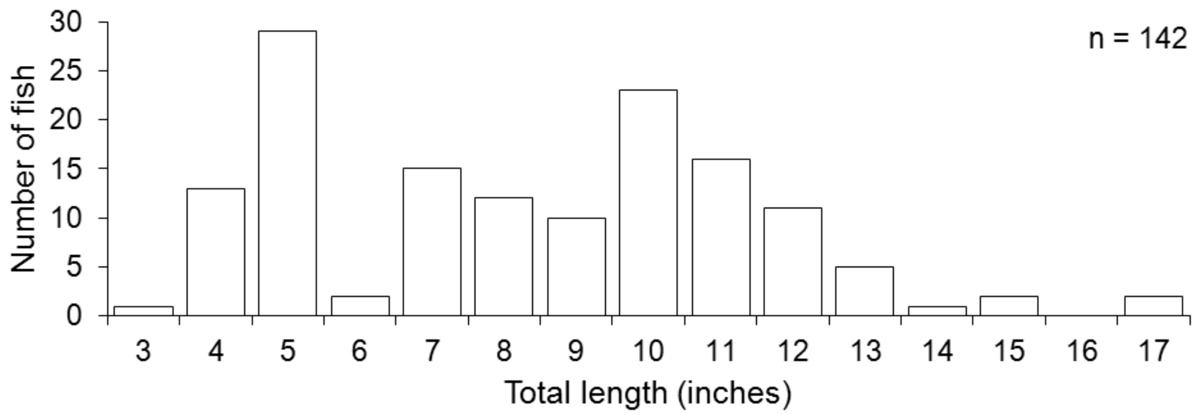


Figure 13.–Length frequency distribution for largemouth bass captured in East Long Lake during May 2011.

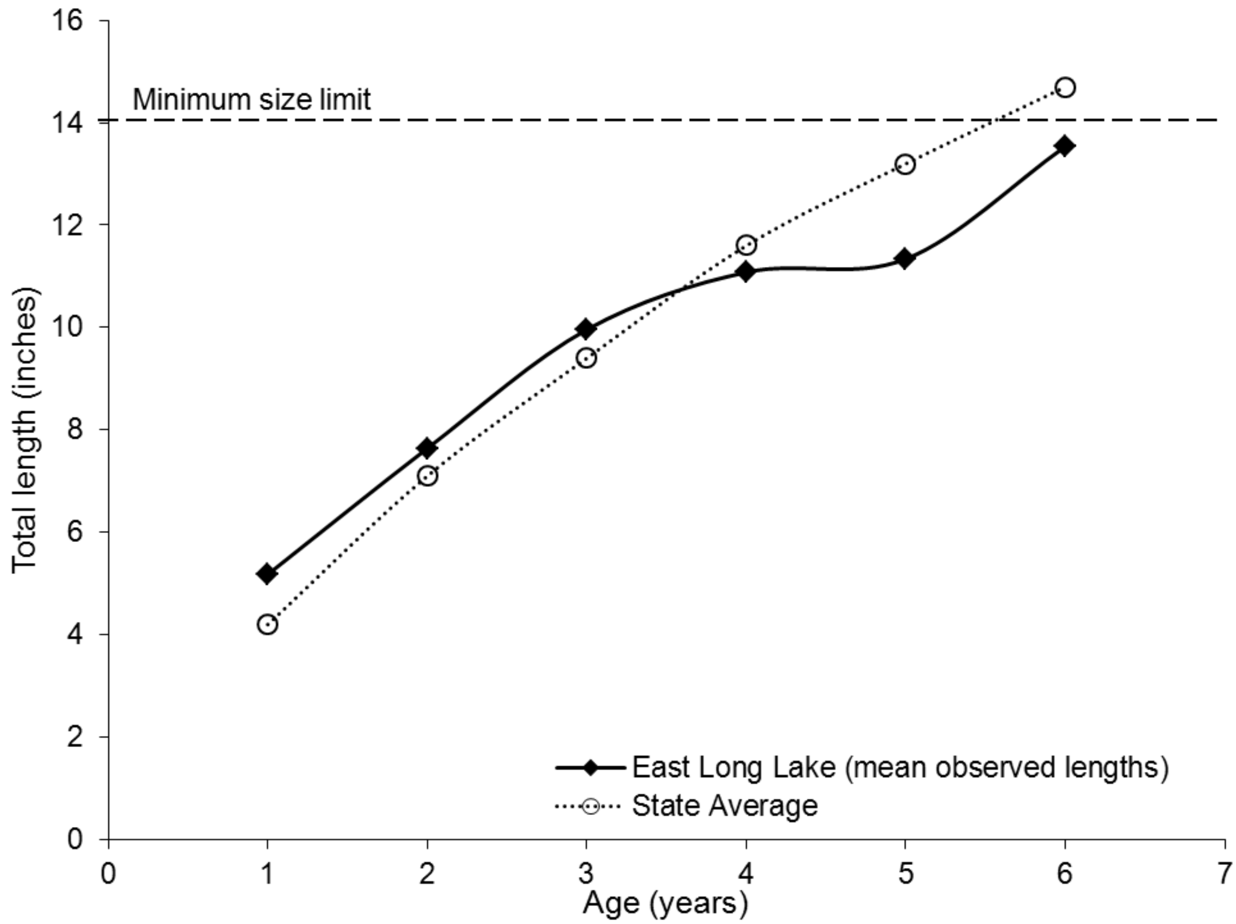


Figure 14.–Growth of largemouth bass in East Long Lake, as determined from scale and dorsal spine samples collected during May 2011. State average lengths from Schneider et al. (2000).

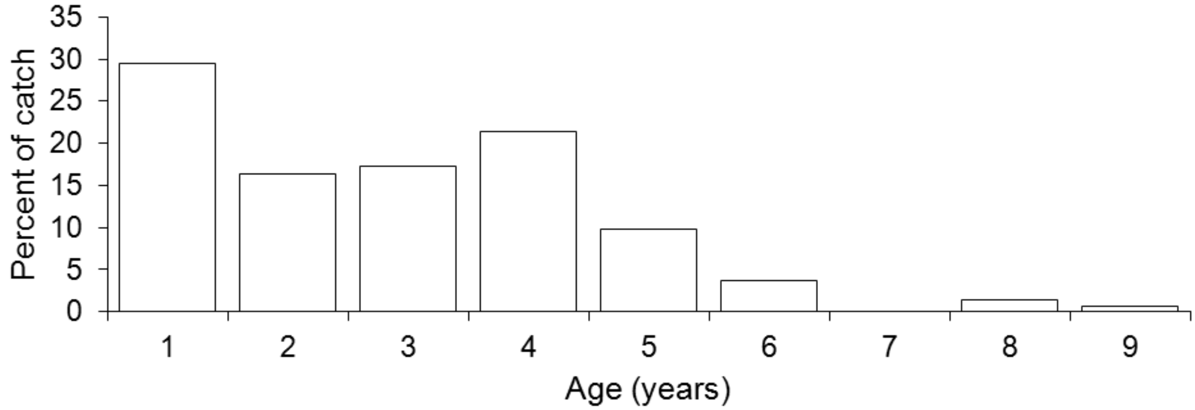


Figure 15.–Age frequency distribution for largemouth bass captured in East Long Lake during May 2011.

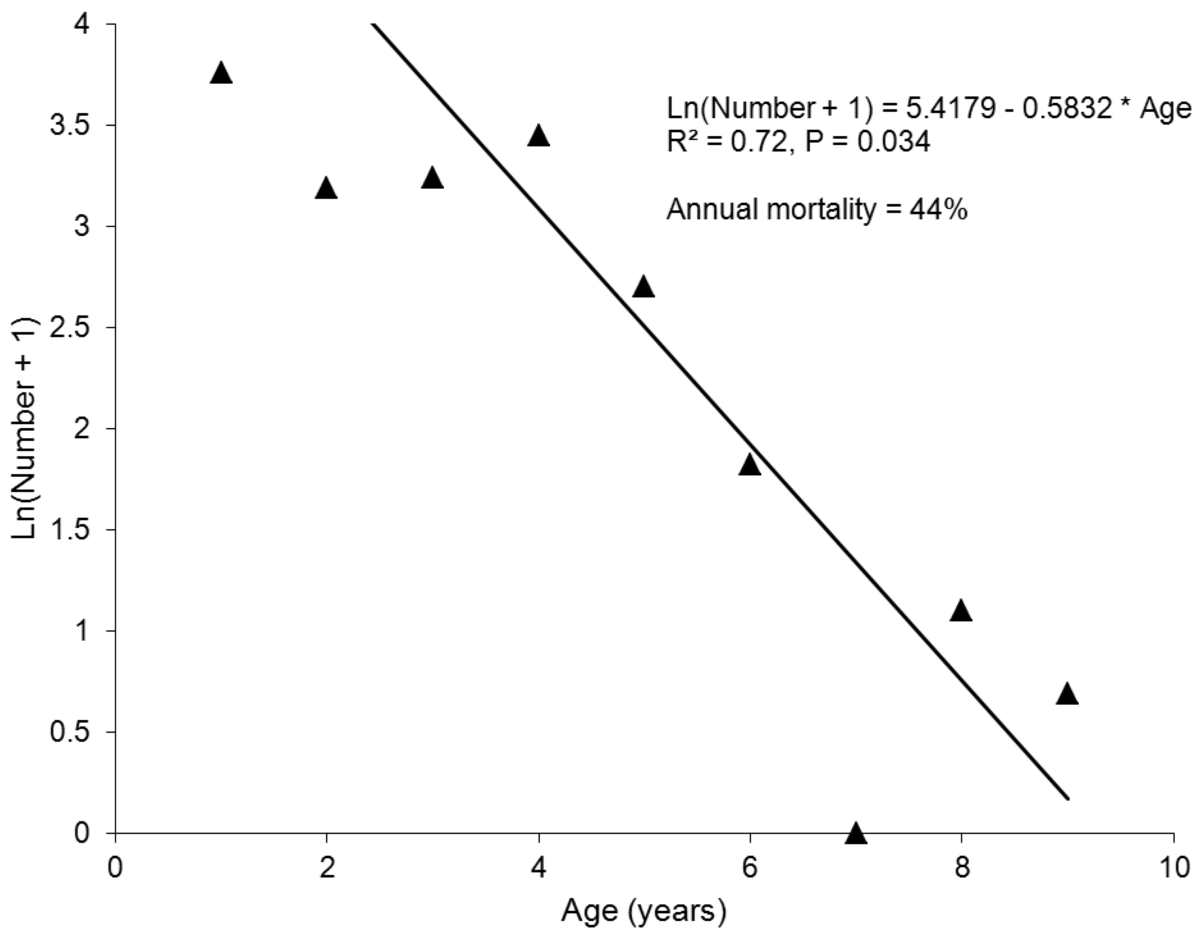


Figure 16.–Observed ln(number + 1) versus age for largemouth bass captured in East Long Lake during May 2011.

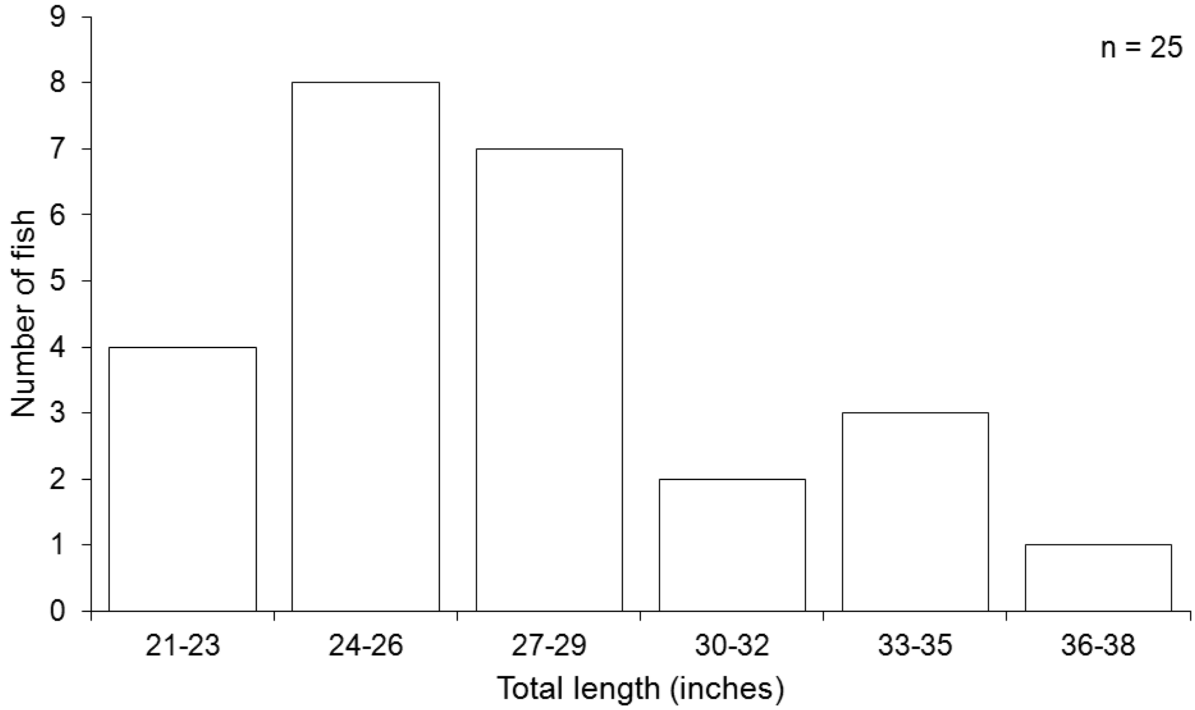


Figure 17.–Length frequency distribution for northern pike captured in East Long Lake during May 2011.

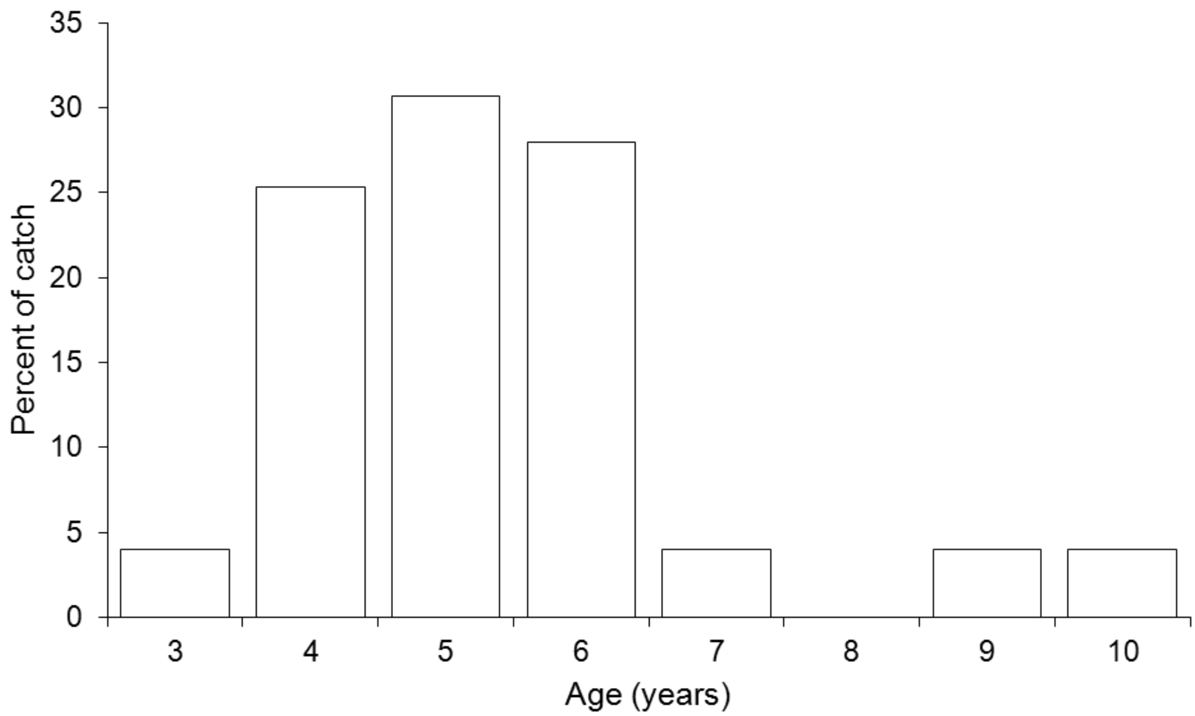


Figure 18.–Age frequency distribution for northern pike captured in East Long Lake during May 2011.

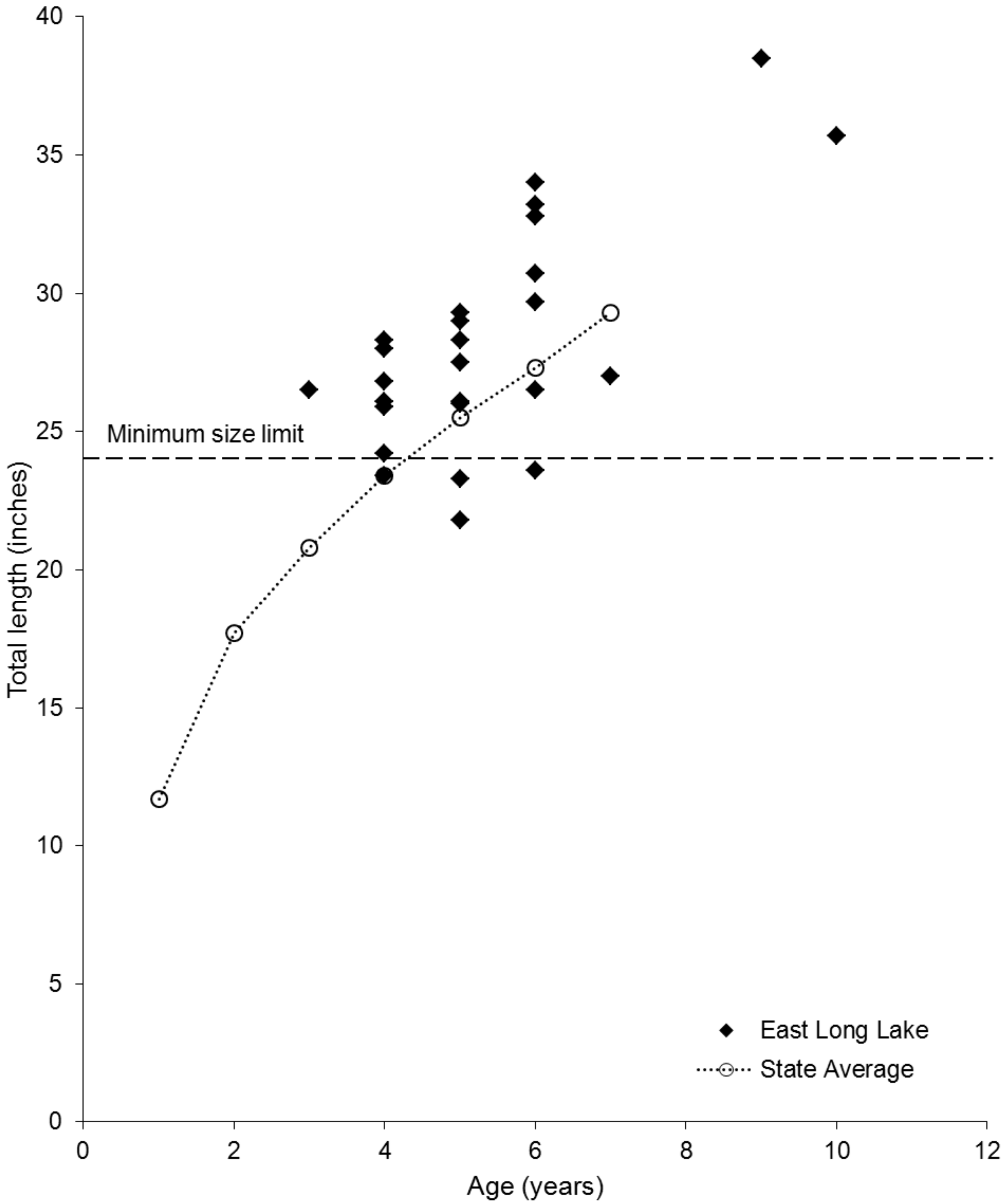


Figure 19.–Growth of northern pike in East Long Lake, as determined from dorsal fin ray samples collected during May 2011. State average lengths from Schneider et al. (2000).