# Clear Lake

St. Joseph County, T06S, R12W, S17
St. Joseph River watershed, 2009

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## Environment

Clear Lake is a 233-acre natural lake located 5 miles west of the city of Three Rivers. The lake consists of two basins separated by a shallow bar (Figure 1). The north and south basins have maximum depths of 31 ft and 30 ft, respectively. Drop-offs generally are gradual. About 37% of the lake (by surface area) is less than 5 ft deep, and 71% of the lake is less than 20 ft deep. Sand and marl substrates are common along the shoreline in the southern basin and along the eastern side of the northern basin. Organic substrates predominate in deeper areas and along the northern and western shorelines of the northern basin. Patches of gravel also are present, particularly along the eastern shoreline of the lake. The historical MDNRE depth contour map for Clear Lake can be found on the internet at http://www.dnr.state.mi.us/spatialdatalibrary/pdf_maps/inland_lake_maps/saint_joseph/clear_lake.pdf.

An unnamed stream flows from the south end of Clear Lake into Mud Lake. A control structure on the outlet is used to maintain the year-round legal lake level of 874.75. There are no natural inlets to Clear Lake. When the water elevation on Long Lake exceeds its year-round legal lake level of 887.0 ft, water is pumped from Long Lake to Clear Lake through an underground culvert. The St. Joseph County Drain Commission prohibits transfer of water from Long Lake to Clear Lake when the water elevation on Clear Lake exceeds 874.75 ft.

Clear Lake is surrounded by deposits of ice-contact outwash sand and gravel. These materials are relatively porous, and groundwater is delivered to Clear Lake via numerous springs. Agriculture and forests are the predominant land uses in the watershed. With the exception of the two wetland complexes at the north end of the lake, there is considerable residential and vacation home development along the shoreline (Figure 2). The 2009 habitat survey revealed a dwelling density of 44.2 dwellings/mile (27.5 dwellings/km). Approximately 34% of the shoreline is armored with seawalls or riprap, and large woody structure is scarce. The DNRE boat launch at the south end of the lake provides the only public access to Clear Lake.

Limnological sampling was conducted in the north basin of the lake on August 18, 2009. As expected, the lake was thermally stratified (Figure 3). The epilimnion extended from the surface to a depth of 12 ft. The water temperature within the epilimnion was relatively uniform, ranging from 78.8 F to 78.1 F. The metalimnion (zone of thermal change) extended from 12 ft to the bottom of the lake. Water temperatures in the metalimnion declined from 78.1 F at 12 ft to 57.51 F at 29 ft. The oxygen distribution within Clear Lake followed a clinograde curve, with the highest dissolved oxygen concentrations occurring near the surface (Figure 3). The dissolved oxygen concentration remained above 3 ppm to a depth of 18 ft. The total alkalinity was 120 mg/L, which is indicative of a hardwater lake with substantial buffering capacity. This conclusion is supported by the slightly alkaline pH values (8.17-8.20) observed in the epilimnion.

The biological productivity of a lake is strongly dependent on its supply of two key nutrients: phosporus and nitrogen. The ratio of total nitrogen to phosphorus was 89:1 in Clear Lake in 2009, so it appears that phosporus is the limiting nutrient in this system. The total phosphorus concentration was 0.011 mg/L. The chlorophyll a concentration, which provides an index of algal biomass, was 0.0089 mg/L. The phoshorus concentration and Secchi disk depth (15.5 ft) were indicative of an oligotrophic system, whereas the chlorophyll a concentration was more typical of a eutrophic lake (Carlson and Simpson 1996). Taken together, the water quality data suggest that Clear Lake is best classified as a mesotrophic (moderately productive) lake.

Recent quantitative data regarding the abundance and distribution of aquatic plants in Clear Lake are not available. For many years, the riparian landowners have hired private companies to complete weed treatments on large portions of Clear Lake. The primary target organisms for these treatments were Eurasian watermilfoil and algae, but some control efforts also have been directed toward coontail and native pondweeds (Table 1). No aquatic vegetation management plan has been developed for this lake.

## History

The first fisheries survey of Clear Lake was conducted in 1887. Yellow perch, bluegill, smallmouth bass, suckers, and bullheads were captured during this initial assessment. Bluegill and largemouth bass were stocked annually from 1933 through 1945 (Table 2). Yellow perch also were stocked periodically during the 1930s. Anglers reported good fishing for largemouth bass, bluegill, black crappie, and yellow perch during the late 1940s. Conservation officers recorded catch and effort data for anglers encountered on Clear Lake during 1953-1963. These qualitative creel census data indicated that bluegills composed most of the harvest, followed by pumpkinseed, yellow perch, black crappies, and largemouth bass. Only three smallmouth bass were observed by conservation officers during this period.

Two fisheries surveys were conducted on Clear Lake during the 1960s. In 1962, fish were collected using seines. This sampling effort indicated that bluegills were abundant. Pumpkinseed, yellow perch, largemouth bass, and black crappie were common. Several northern pike also were collected during the 1962 survey. At that time, bluegill growth was below average (mean growth index [MGI] = -0.8), northern pike growth was above average (MGI = +1.0), and growth of other species was average. (The growth index is calculated by subtracting the state average length-at-age for a given species from the average length-at-age for that species in a particular lake. Positive growth indices indicate that growth is faster than the state average, whereas negative indices indicate that growth is slower than the state average.) Approximately 11,000 spring fingerling northern pike were stocked in Clear Lake in 1963. Fyke net and gill net sampling were completed during July 1966. Bluegills, pumpkinseeds, and black crappies composed the bulk of the catch. Most of the bluegills and pumpkinseeds were smaller than 6 inches. Fishing reports from the 1960s suggest that fishing was fair to good for largemouth bass and fair for northern pike. Anglers reported catching "too many small panfish" during this period.

During the early 1970s, angler reports and an electrofishing survey indicated that the fish community was dominated by small panfish. To reduce panfish abundance (and ultimately improve panfish growth), the lake was treated with Antimycin A in May 1975. Fisheries Division personnel estimated that this treatment removed 75% of the bluegills and pumpkinseeds, 35% of the yellow perch, and 15% of the largemouth bass. To prevent panfish abundance from increasing to pre-treatment levels, predatory gamefish were stocked in Clear Lake. About 9,300 fall fingerling largemouth bass were stocked in 1975, and 1,000 fall fingerling tiger muskellunge were stocked annually during 1976-1980.

Electrofishing surveys conducted during 1976 through 1982 indicated poor survival of tiger muskellunge, and the stocking program was discontinued. Bluegills were very abundant and small, with average to below average growth. Black crappies and yellow perch were common, and pumpkinseeds were rare. Growth of yellow perch was average, whereas black crappie growth was poor. Growth of largemouth bass also was below average, and the bass population was dominated by sub-legal fish. Several adult northern pike were collected, indicating that a limited amount of natural reproduction was occurring. Growth of northern pike was above average. Angler reports from this period suggest that fishing was fair for largemouth bass and poor for other species.

Northern pike fry and spring fingerlings were stocked in Clear Lake periodically from 1982 to 1995. Surveys completed during this period indicated that northern pike were present in modest numbers, but growth of northern pike was above average. The bluegill, yellow perch, and pumpkinseed populations continued to be dominated by small fish. Growth was below average for all panfish species. The largemouth bass size structure had improved, with fish larger than 14 inches composing nearly 50% of the trap net catch in 1988 and 1994.

Channel catfish and walleye were introduced into Clear Lake through unauthorized stocking activity in 1994 and 1995. A private plant of 1,000 fall fingerling walleye was permitted in 2000.

## Current Status

A variety of methods were used to evaluate the fish community and the fishery in Clear Lake during the 2009 open water season. Fish were captured with trap nets, fyke nets, gill nets, seines, and electrofishing gear in May-June as part of MDNRE's Status and Trends (S&T) Program (Table 3). 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, dorsal spine or scale samples were collected from 10 fish per inch group for age determination. A creel survey also was conducted to collect additional information regarding fishing effort, harvest, and catch rates for various game fish species in Clear Lake. From April 25 through October 31, the creel clerk made boat and shore angler counts and interviewed anglers on Clear Lake during one weekend day and one or two weekdays each week. A total of 401 angler interviews were completed during the creel survey.

Twenty fish species were collected during the 2009 S&T survey (Table 4). Bluegill (N = 1,121) was the most abundant species, composing 51% of the catch by number and 36% of the catch by weight. Sixty-nine percent of the bluegills were of harvestable size. Size structures of bluegill populations can be challenging to interpret because each gear type exhibits some degree of size selectivity. 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 score for the Clear Lake bluegill population was 5.6 (good-excellent) based on the trap net sample and 3.0 (acceptable) based on the electrofishing sample (Schneider 1990). The mean growth index for bluegills was +0.4. (Note: Schneider et al. [2000] calculated different state average lengths for January-May and June-July. During the 2009 survey, spine and scale samples were collected in May and June. The January-May lengths were used to calculate growth indices for fish captured during the spring netting effort, and the June-July average lengths were used to calculate growth indices for fish captured during the electrofishing effort. The individual growth indices were averaged to obtain the mean growth indices.) Mean lengths-at-age were near the state average for yearling and 2-year old bluegills, and substantially above average for older fish (Figure 4). Based on the length-at-age data, it appears that most bluegills reach harvestable size at age 3.

Seven year classes of bluegills were collected (Figure 5). Age 3 fish were particularly abundant, composing 57% of the bluegill catch. Annual mortality was estimated to be 60% for adult bluegills from age 3 to age 7 (Figure 6).

Bluegills composed 95% of the total harvest during the 2009 creel survey (Table 5). For April through October, the bluegill harvest estimate was 19,357 fish. An additional 17,600 bluegills were caught and released, so it appears that anglers only had to release 0.9 undersized fish for every "keeper." During June-August, the bluegill harvest per angler hour (CPH) for Clear Lake was 0.97. For comparison, bluegill CPH values for other southwest Michigan lakes have ranged from 0.07 to 0.84 (Table 6; Z. Su. MDNRE Fisheries Division, unpublished).

Three other panfish species also were collected during the S&T survey: black crappie (N = 125), pumpkinseed (N = 87), and yellow perch (N = 44). Ninety-five percent of the black crappies captured were of harvestable size, compared to 82% for pumpkinseeds, and 50% for yellow perch. Cumulatively, these three species composed 4% of the total harvest for the 2009 open water season (Table 5). The harvest:release ratios generally corroborate the size structures observed during the S&T survey. Few crappies or pumpkinseeds were released, whereas anglers released more than two yellow perch for every fish harvested.

Numerically, largemouth bass (N = 126) were the most abundant predators in the catch. Seven year classes were represented in the sample (Figure 5). Mean lengths at age for largemouth bass were about average for ages 1-3, but were well below average for older fish (Figure 7). Only 5% of the bass collected were of legal size, and the maximum length was 14 inches. In Clear Lake, bass do not reach 14 inches until age 6 or 7. Annual mortality of bass ages 3 to 7 was estimated to be 58% (Figure 8).

The creel results indicate that 5,935 largemouth bass were caught during April-October, 2009. The bass fishery in Clear Lake is almost entirely a catch-and-release fishery, and only 2% of these fish were harvested. The largemouth bass catch rate in Clear Lake was about average for lakes in southwestern Michigan (Table 6).

Twenty-four northern pike were captured during the S&T sampling. The length range for these fish was 14-35 inches, and 38% of the fish collected were of legal size. The mean growth index for northern pike was +0.4, indicating average growth. Northern pike in Clear Lake typically reach legal size (24 inches) at age 4. Four year classes were represented in the catch. During the survey period, 66 (6%) of the 1,114 northern pike caught by anglers were harvested.

Walleyes (N = 18) were less abundant numerically, but they composed a greater percentage of the total biomass than largemouth bass or northern pike (Table 4). The length range for walleye was 18-27 inches. Nine year classes (age 6-14) of walleyes were collected. The mean growth index was +1.3, but there was considerable variation in growth between and among year classes (Figure 9). Thirty-two walleyes were harvested, and an additional 21 fish were released during the creel survey.

Three channel catfish (23-30 inches) were collected during the S&T survey. The ages of these fish were not determined. No channel catfish were observed during the creel survey.

## Analysis and Discussion

Clear Lake supports a well-balanced fish community. Predators (largemouth bass, northern pike, walleye, and grass pickerel) composed 34% of the biomass, benthivores (bullheads, channel catfish, pumpkinseed, and bluntnose minnow) composed 18%, and pelagic planktivores-insectivores made up 48% of the biomass during the 2009 S&T survey. Schneider (2000) suggested that predators typically compose 20-50% of the biomass in lakes with desirable fish communities. Based on this standard, Clear Lake appears to have a healthy predator-prey ratio.

Bluegill is the primary game fish species in Clear Lake, accounting for 95% of the total harvest during the 2009 open water season (Table 5). Both the S&T and creel survey data indicate that Clear Lake supports an excellent bluegill fishery. The bluegill harvest/angler hour was the highest value observed during recent creel surveys in southwestern Michigan. Bluegills are abundant, and anglers do not have to sort through many smaller fish to catch their limit of "keepers."

Annual mortality for bluegills was 60%, which is in the middle of the range reported by Schneider (2000) for Michigan bluegill populations. We did not obtain a population estimate for bluegills in Clear Lake, so we cannot generate estimates of fishing mortality and natural mortality. Given that 83 bluegills/acre were harvested during the creel survey, it seems logical to assume that fishing mortality composes a substantial percentage of total annual mortality in this system. The Clear Lake bluegill population apparently is able to sustain these harvest levels because fish reach harvestable size about one year earlier (age 3 instead of age 4) than the average for Michigan bluegills.

The improvement in the size structure of the bluegill population during the last 15 years has been dramatic. The reasons for this improvement are not completely understood. The addition of walleye, northern pike, and channel catfish to the lake has increased the predation pressure, which may have reduced bluegill abundance and intraspecific competition for forage. Now that the size structure has improved, fishing mortality serves as an additional mechanism for controlling bluegill abundance.

The other panfish species are small components of the fishery in Clear Lake. Most of the pumpkinseeds harvested probably were caught incidentally by anglers targeting bluegills. The size structure of the pumpkinseed population was excellent, and anglers kept most of the pumpkinseeds that they caught. The lake supports a small targeted fishery for black crappies, especially during the spring. Anecdotal reports suggest that more yellow perch are harvested during the winter, but very few perch were harvested during the open water season.

Catch rates for largemouth bass in Clear Lake are about average for lakes in this region. Although bass are common, legal-sized fish are rare. Annual mortality in this system is 58%, which is exactly the average (mean and median) of the annual mortality values reported by Allen et al. (2008) for North American largemouth bass populations. The poor size structure of the largemouth bass population in Clear Lake appears to be the result of poor growth rather than high mortality. On average, largemouth bass in Michigan lakes reach 14 inches at age 5. In Clear Lake, largemouth bass do not reach this size until age 6 or 7.

The reasons for the poor growth of largemouth bass in this system are not known. The lake does not have an abnormally high predator-prey ratio, and forage does not appear to be scarce. Slow growth of largemouth bass is not unique to Clear Lake. Growth of largemouth bass in nearby Corey and Pleasant lakes is similar, and bass growth in Long Lake is even slower than in Clear Lake.

Although northern pike only composed about 2% of the total catch during the creel survey, the population probably provides good fishing opportunities for anglers who target this species. Fish up to 35 inches were collected during the S&T survey, and anecdotal reports suggest that northern pike as large as 44 inches have been caught in Clear Lake. It is likely that targeted effort and harvest are greater during the ice fishing season, but no data are available to evaluate this hypothesis.

The presence of multiple year-classes of walleyes in Clear Lake suggests that some natural reproduction has occurred. An alternative hypothesis is that these fish were moved to Clear Lake by anglers. The absence of sub-legal fish and the wide variation in lengths-at-age support the second hypothesis (Figure 9). Given the scarcity of suitable spawning substrate and the abundance of bluegills (i.e., predators on walleye fry and spring fingerlings), it would be surprising to have natural reproduction of walleye in this system. Despite being few in number, walleyes composed nearly 13% of the biomass from the S&T survey. Thus, they are an important component of the predator community. On the other hand, they are a very minor component of the fishery. Walleyes only made up 0.1% of the catch during the creel survey.

Channel catfish are rare in Clear Lake. The ages of the three catfish collected during the S&T survey were not determined, but the size structure suggests that they could have been survivors from the 1994 stocking event. In the absence of natural reproduction, channel catfish will soon be extirpated from this system.

## Management Direction

Clear Lake currently is supporting an excellent bluegill fishery with supplemental fishing opportunities for northern pike, walleye, and small largemouth bass. The following management goals and actions have been developed primarily to maintain the existing fishery, as little enhancement is required.

The first goal is to protect and rehabilitate habitat for fish and other aquatic organisms. At least three different methods will be used to accomplish this goal. Fisheries Division personnel will continue to review MDNRE - Water Resources Division 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 continue to work with the Clear Lake Association and Michigan State University Extension personnel 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 (e.g., bans on phosphorus fertilizer for residential use) that protect aquatic habitats from pollution or unwise development.

The second goal is to maintain an appropriate predator-prey ratio within the Clear Lake fish community. In terms of biomass, walleyes are an important predator in this system. However, no walleye younger than age 6 were collected in 2009. Periodic stocking is necessary to maintain the walleye population. Survival of spring fingerling walleyes typically is poor in lakes where panfish are abundant, so fall fingerlings are preferred for Clear Lake. Stocking 2,000 fall fingerlings (9/acre) every third year should be sufficient to maintain the walleye population without overtaxing the forage base. Fisheries Division currently rears spring fingerling walleyes. Fall fingerlings are rarely available, and none of the walleye ponds in the Southern Lake Michigan Management Unit are suitable for rearing fall fingerlings. The Clear Lake Association has expressed interest in purchasing fall fingerling walleyes from a private hatchery. If the Association decides to pursue this option, Fisheries Division staff will review the fish stocking permit applications and provide technical assistance as necessary.

## References

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Table 1.–Aquatic herbicide treatments in Clear Lake, 2008-2009. Data from treatment reports provided to the Department of Natural Resources and Environment – Water Bureau by the permittees.

| Date | Herbicide | Rate of application | Total amount | Target species |
|---|---|---|---|---|
| Jun 2008 | Copper sulfate | 2.6 lb/acre-ft | 100 lb | Algae |
| | Reward (diquat dibromide) | 1-2 gal/acre | 13 gal | Eurasian watermilfoil, coontail |
| | Hydrothol 191 (amine salts of endothall) | 1 gal/acre | 7.5 gal | Native pondweeds |
| | Cygnet Plus | 1.5-2.5 pt/acre-ft | 60 pt | Adjuvant |
| | 2,4-D | 100 lb/acre | 100 lb | Eurasian watermilfoil |
| Aug 2008 | Copper sulfate | 2.6 lb/acre-ft | 15 lb | Algae |
| | Reward (diquat dibromide) | 1-2 gal/acre | 1 gal | Eurasian watermilfoil, coontail |
| | Cygnet Plus | 1.5-2.5 pt/acre-ft | 4 pt | Adjuvant |
| Jun 2009 | Copper sulfate | 2.6 lb/acre-ft | 100 lb | Algae |
| | Reward (diquat dibromide) | 1-2 gal/acre | 15 gal | Eurasian watermilfoil, waterweed (*Elodea*) |
| | Hydrothol 191 (amine salts of endothall) | 1 gal/acre | 8.5 gal | Native pondweeds |
| | Cygnet Plus | 1.5-2.5 pt/acre-ft | 80 pt | Adjuvant |
| | Navigate (2,4-D) | 100 lb/acre | 200 lb | Eurasian watermilfoil |
| Aug 2009 | Copper sulfate | 2.6 lb/acre-ft | 5 lb | Algae |
| | Reward (diquat dibromide) | 0.5-2 gal/acre | 0.25 gal | Eurasian watermilfoil, waterweed (*Elodea*) |
| | Hydrothol 191 (amine salts of endothall) | 1 gal/acre | 0.25 gal | Native pondweeds |
| | Cygnet Plus | 1.5-2.5 pt/acre | 2 pt | Adjuvant |

Table 2.–Fish stocking in Clear Lake, 1933-2009.

| Species | Year | Life stage | Number | Number/acre | Average length (inches) |
|---|---|---|---|---|---|
| Bluegill | 1933 | Fall fingerling | 10,000 | 43 | --- |
| | 1934 | Fall fingerling | 20,000 | 86 | --- |
| | 1935 | Fall fingerling | 30,000 | 129 | --- |
| | 1936 | Fall fingerling | 25,000 | 107 | --- |
| | 1937 | Fall fingerling | 40,000 | 172 | --- |
| | 1938 | Fall fingerling | 90,000 | 386 | --- |
| | 1939 | Fall fingerling | 40,000 | 172 | --- |
| | 1940 | Fall fingerling | 15,000 | 64 | --- |
| | | Yearling | 1,500 | 6 | --- |
| | 1941 | Fall fingerling | 65,000 | 279 | --- |
| | 1942 | Fall fingerling | 20,000 | 86 | --- |
| | 1943 | Fall fingerling | 10,000 | 43 | --- |
| | 1945 | Fall fingerling | 15,000 | 64 | 2.00 |
| Hybrid sunfish | 1944 | Fall fingerling | 20,000 | 86 | 2.00 |
| Largemouth bass | 1933 | Fall fingerling | 2,000 | 9 | --- |
| | 1934 | Fall fingerling | 1,000 | 4 | --- |
| | 1935 | Fall fingerling | 1,000 | 4 | --- |
| | 1936 | Fall fingerling | 1,800 | 8 | --- |
| | 1937 | Fall fingerling | 1,000 | 4 | --- |
| | 1938 | Fall fingerling | 1,500 | 6 | --- |
| | 1939 | Fall fingerling | 2,500 | 11 | --- |
| | 1940 | Fall fingerling | 2,500 | 11 | --- |
| | | Yearling | 1,500 | 6 | --- |
| | 1941 | Fall fingerling | 1,000 | 4 | --- |
| | 1942 | Fall fingerling | 1,000 | 4 | --- |
| | 1943 | Fall fingerling | 1,000 | 4 | --- |
| | 1944 | Fall fingerling | 2,000 | 9 | 3.00 |
| | 1945 | Fall fingerling | 4,500 | 19 | 4.00 |
| | 1975 | Fall fingerling | 9,300 | 40 | --- |
| Yellow perch | 1934 | Fall fingerling | 10,000 | 43 | --- |
| | 1935 | Fall fingerling | 10,000 | 43 | --- |
| | 1938 | Fall fingerling | 15,000 | 64 | --- |
| | 1939 | Fall fingerling | 15,000 | 64 | --- |
| Tiger muskellunge | 1976 | Fall fingerling | 1,000 | 4 | --- |
| | 1977 | Fall fingerling | 1,000 | 4 | --- |
| | 1978 | Fall fingerling | 1,000 | 4 | --- |
| | 1979 | Fall fingerling | 1,000 | 4 | 5.36 |
| | 1980 | Fall fingerling | 1,000 | 4 | 9.08 |

Table 2.–Continued.

| Species | Year | Life stage | Number | Number/acre | Average length (inches) |
|---|---|---|---|---|---|
| Northern pike | 1963 | Spring fingerling | 11,000 | 47 | --- |
| | 1982 | Fry | 70,000 | 300 | 0.60 |
| | 1983 | Fry | 144,800 | 621 | 0.60 |
| | 1984 | Spring fingerling | 2,750 | 12 | 3.64 |
| | 1985 | Spring fingerling | 1,211 | 5 | 3.08 |
| | 1986 | Spring fingerling | 2,750 | 12 | 3.76 |
| | 1988 | Spring fingerling | 2,750 | 12 | 3.36 |
| | 1990 | Spring fingerling | 2,750 | 12 | 3.76 |
| | 1995 | Spring fingerling | 24,244 | 104 | 1.44 |
| Channel catfish | 1994 | Yearling[1] | 1,000 | 4 | --- |
| Walleye | 1994 | Fall fingerling[1] | 1,000 | 4 | --- |
| | 1995 | Fall fingerling[1] | 1,000 | 4 | --- |
| | 2000 | Fall fingerling[2] | 1,000 | 4 | 7.12 |

[1] Unauthorized private stocking
[2] Permitted private stocking

Table 3.–Sampling effort during the Status and Trends survey on Clear Lake, May-June 2010. Each net night equals one overnight set of one net.

| Sampling Period | Gear | Effort |
|---|---|---|
| May 4-7 | Trap net | 6 net nights |
| May 4-7 | Fyke net | 6 net nights |
| May 4-7 | Graded-mesh gill net | 6 net nights |
| June 16 | Electrofishing | 30 minutes |
| June 16 | Seine | 4 hauls (25 ft each) |

Table 4.–Numbers, total weights, lengths, and growth indices for fish species collected during the Status and Trends survey on Clear Lake, May-June, 2009. Fish were captured using trap nets, fyke nets, gill nets, seines, and electrofishing gear.

| Species | Number | Percent by number | Total weight (lbs) | Percent by weight | Length range (inches) | Percent legal or harvestable[1] | Growth index[2] |
|---|---|---|---|---|---|---|---|
| Bluegill | 1,121 | 50.6 | 231.1 | 36.1 | 1-9 | 69 | +0.4 |
| Bluntnose minnow | 146 | 6.6 | 0.6 | 0.1 | 1-2 | --- | --- |
| Largemouth bass | 126 | 5.7 | 65.8 | 10.3 | 3-14 | 5 | -0.9 |
| Black crappie | 125 | 5.6 | 51.1 | 8.0 | 6-14 | 95 | +1.4 |
| Spotfin shiner | 89 | 4.0 | 0.4 | 0.1 | 1-4 | --- | --- |
| Pumpkinseed | 87 | 3.9 | 23.6 | 3.7 | 5-9 | 82 | +1.0 |
| Warmouth | 70 | 3.2 | 12.6 | 2.0 | 3-8 | 51 | --- |
| Sand shiner | 65 | 2.9 | 0.1 | 0.0 | 1-2 | --- | --- |
| Yellow bullhead | 64 | 2.9 | 44.9 | 7.0 | 3-13 | --- | --- |
| Yellow perch | 44 | 2.0 | 7.9 | 1.2 | 3-9 | 50 | +0.4 |
| Northern pike | 24 | 1.1 | 71.4 | 11.2 | 14-35 | 38 | +0.4 |
| Brown bullhead | 19 | 0.9 | 20.9 | 3.3 | 9-15 | --- | --- |
| Walleye | 18 | 0.8 | 81.4 | 12.7 | 18-27 | 100 | +1.3 |
| Blacknose shiner | 14 | 0.6 | 0.1 | 0.0 | 1-2 | --- | --- |
| Hybrid sunfish | 11 | 0.5 | 2.9 | 0.5 | 3-8 | 73 | --- |
| Iowa darter | 4 | 0.2 | 0.0 | 0.0 | 1-2 | --- | --- |
| Channel catfish | 3 | 0.1 | 24.1 | 3.8 | 23-30 | --- | --- |
| Brook silverside | 2 | 0.1 | 0.0 | 0.0 | 3-3 | --- | --- |
| Rock bass | 1 | 0.0 | 0.5 | 0.1 | 8 | 100 | --- |
| Grass pickerel | 1 | 0.0 | 0.0 | 0.0 | 2 | --- | --- |
| Banded killifish | 1 | 0.0 | 0.0 | 0.0 | 1 | --- | --- |
| Total | 2,035 | | 639.4 | | | | |

[1] Harvestable size is 6 inches for bluegill, pumpkinseed, rock bass, and warmouth, and 7 inches for black crappie and yellow perch.

[2] Average deviation from the state average length at age. Mean growth indices <-1 indicate below average growth, indices between -1 and +1 indicate average growth, and indices >+1 indicate growth is faster than the state average.

Table 5.–Angler survey estimates for Clear Lake (Z. Su, MDNR Fisheries Division, unpublished). Survey period was April 25 through October 31, 2009. Two standard errors are given in parentheses. NA = estimates not available and CPH = catch per angler hour.

| Species | CPH | April | May | June | July | August | September | October | Season |
|---|---|---|---|---|---|---|---|---|---|
| HARVEST | | | | | | | | | |
| Walleye | 0.0018 | 0 | 0 | 32 | 0 | 0 | 0 | 0 | 32 |
| | (0.0036) | (0) | (0) | (64) | (0) | (0) | (0) | (0) | (64) |
| Northern pike | 0.0037 | 8 | 0 | 24 | 22 | 12 | 0 | 0 | 66 |
| | (0.0037) | (15) | (0) | (39) | (44) | (24) | (0) | (0) | (65) |
| Largemouth bass | 0.0077 | 23 | 5 | 9 | 101 | 0 | 0 | 0 | 137 |
| | (0.0098) | (30) | (9) | (19) | (169) | (0) | (0) | (0) | (173) |
| Yellow perch | 0.0032 | 8 | 12 | 0 | 34 | 5 | 0 | 0 | 58 |
| | (0.0033) | (15) | (24) | (0) | (49) | (10) | (0) | (0) | (57) |
| Bluegill | 1.0813 | 4,439 | 5,304 | 6,518 | 2,570 | 497 | 30 | 0 | 19,357 |
| | (0.4593) | (3,845) | (4,505) | (3,331) | (1,846) | (399) | (45) | (0) | (7,053) |
| Pumpkinseed | 0.0322 | 154 | 128 | 98 | 50 | 146 | 0 | 0 | 577 |
| | (0.0224) | (212) | (146) | (156) | (97) | (211) | (0) | (0) | (380) |
| Black crappie | 0.0115 | 129 | 0 | 37 | 39 | 0 | 0 | 0 | 205 |
| | (0.0111) | (174) | (0) | (60) | (56) | (0) | (0) | (0) | (193) |
| TOTAL HARVEST | 1.1414 | 4,760 | 5,449 | 6,719 | 2,815 | 659 | 30 | 0 | 20,432 |
| | (0.4669) | (3,855) | (4,508) | (3,336) | (1,858) | (452) | (45) | (0) | (7,068) |
| RELEASED | | | | | | | | | |
| Walleye | 0.0012 | 0 | 0 | 0 | 0 | 21 | 0 | 0 | 21 |
| | (0.0023) | (0) | (0) | (0) | (0) | (42) | (0) | (0) | (42) |
| Northern pike | 0.0586 | 97 | 89 | 295 | 355 | 147 | 64 | 0 | 1,048 |
| | (0.0285) | (144) | (136) | (285) | (268) | (128) | (NA) | (0) | (457) |
| Largemouth bass | 0.3239 | 624 | 924 | 825 | 2,008 | 1,217 | 200 | 0 | 5,798 |
| | (0.1202) | (511) | (693) | (547) | (1,107) | (822) | (295) | (0) | (1,740) |
| Yellow perch | 0.0077 | 10 | 44 | 0 | 17 | 67 | 0 | 0 | 139 |
| | (0.0094) | (20) | (89) | (0) | (31) | (135) | (0) | (0) | (166) |
| Bluegill | 0.9832 | 4,606 | 5,375 | 3,922 | 2,090 | 1,541 | 67 | 0 | 17,600 |
| | (0.4016) | (4,071) | (4,154) | (NA) | (1,346) | (1,119) | (134) | (0) | (6,075) |
| Pumpkinseed | 0.0197 | 0 | 290 | 45 | 17 | 0 | 0 | 0 | 352 |
| | (0.0241) | (0) | (414) | (91) | (34) | (0) | (0) | (0) | (425) |
| Rock bass | 0.0012 | 0 | 0 | 21 | 0 | 0 | 0 | 0 | 21 |
| | (0.0023) | (0) | (0) | (41) | (0) | (0) | (0) | (0) | (41) |
| Black crappie | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (0) |
| TOTAL RELEASED | 1.3954 | 5,338 | 6,722 | 5,109 | 4,486 | 2,994 | 331 | 0 | 24,979 |
| | (0.4661) | (4,105) | (4,235) | (NA) | (1,764) | (1,401) | (NA) | (0) | (6,313) |
| TOTAL CATCH | 2.5368 | 10,097 | 12,171 | 11,828 | 7,301 | 3,653 | 361 | 0 | 45,411 |
| | (0.7662) | (5,631) | (6,185) | (NA) | (2,562) | (1,473) | (NA) | (0) | (9,477) |
| ANGLER HOURS | | 2,700 | 5,017 | 4,531 | 3,549 | 1,785 | 319 | 0 | 17,901 |
| | | (1,508) | (2,983) | (1,195) | (1,444) | (687) | (341) | (0) | (3,908) |
| ANGLER TRIPS | | 1,022 | 2,615 | 2,007 | 1,515 | 607 | 120 | 0 | 7,885 |
| | | (625) | (1,359) | (636) | (739) | (294) | (135) | (0) | (1,815) |

Table 6.–Harvest/angler hour, catch/angler hour, and angler hours/acre estimates for Clear, Long (Fabius township), Shavehead, Birch, Campau, Paw Paw, Murray, and Gull lakes (Z. Su, MDNR Fisheries Division, unpublished). Survey durations were variable. To facilitate comparisons between lakes, only data for June-August are reported in the table.

| Lake | County | Year | Bluegill Harvest/Hr | Black Crappie Harvest/Hr | Largemouth Bass Catch/Hr* | Angler Hours/Acre |
|---|---|---|---|---|---|---|
| Clear | St. Joseph | 2009 | 0.972 | 0.008 | 0.422 | 42.3 |
| Long | St. Joseph | 2009 | 0.837 | 0.033 | 0.266 | 41.9 |
| Shavehead | Cass | 2007 | 0.119 | 0.038 | 0.557 | 24.7 |
| Birch | Cass | 2007 | 0.313 | 0.056 | 0.981 | 28.1 |
| Campau | Kent | 2005 | 0.070 | 0 | 0.251 | 41.2 |
| Paw Paw | Berrien | 2005 | 0.438 | 0.025 | 0.052 | 11.2 |
| Murray | Kent | 2005 | 0.554 | 0.002 | 0.512 | 49.3 |
| Gull | Kalamazoo | 2002 | 0.681 | 0.001 | 0.252 | 9.5 |

* Includes harvested and released fish

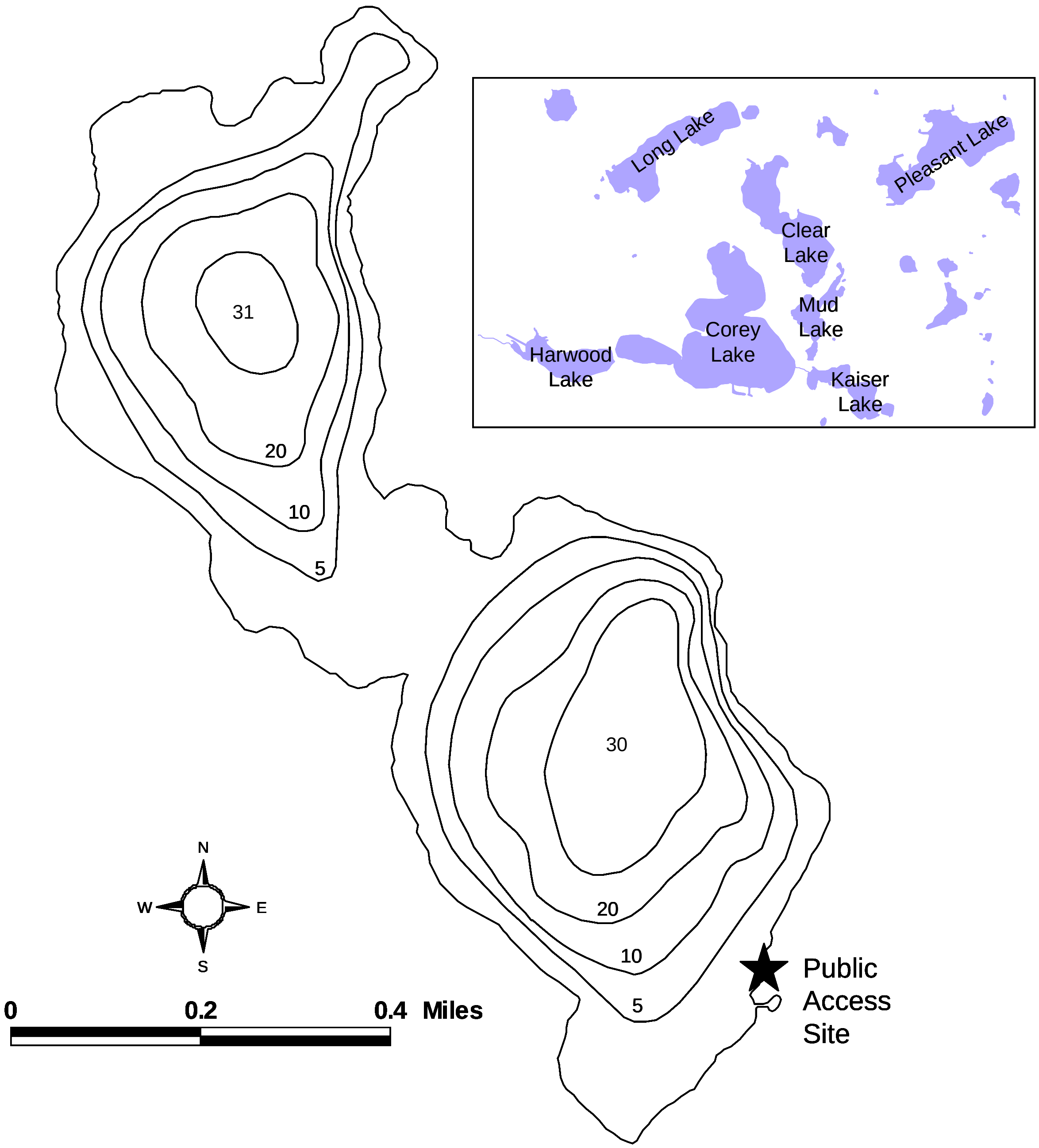


Figure 1.–Bathymetry of Clear Lake, St. Joseph County. Image of the 1949 lake map can be found on the internet at http://www.dnr.state.mi.us/SPATIALDATALIBRARY/PDF_MAPS/INLAND_LAKE_MAPS/SAINT_JOSEPH/CLEAR_LAKE.PDF.


Figure 2.–Aerial view of Clear Lake, showing land use patterns within the watershed. Image from Microsoft© Virtual Earth™ (www.bing.com/maps).

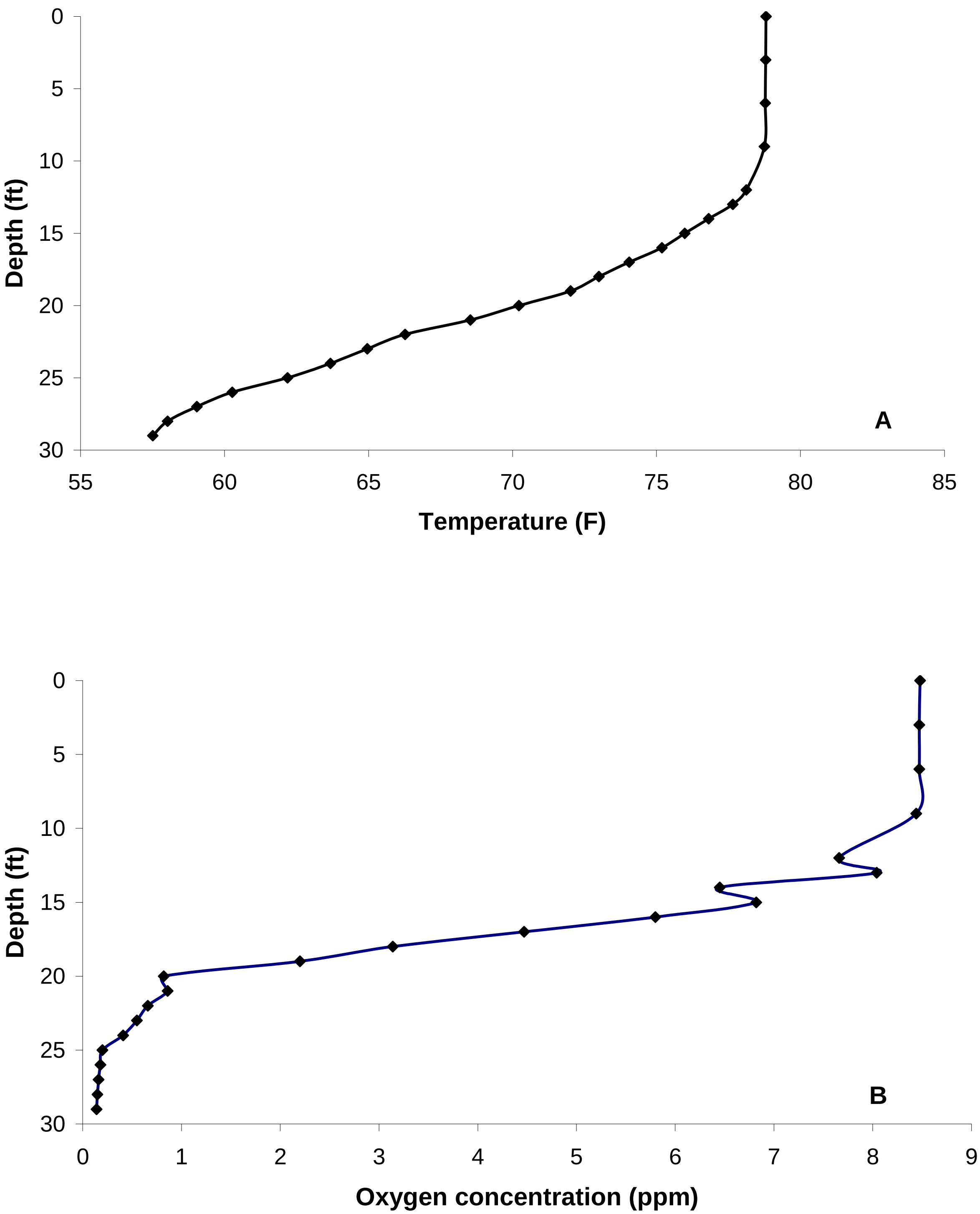


Figure 3.–Temperature (A) and dissolved oxygen profiles (B) for Clear Lake on August 18, 2009.

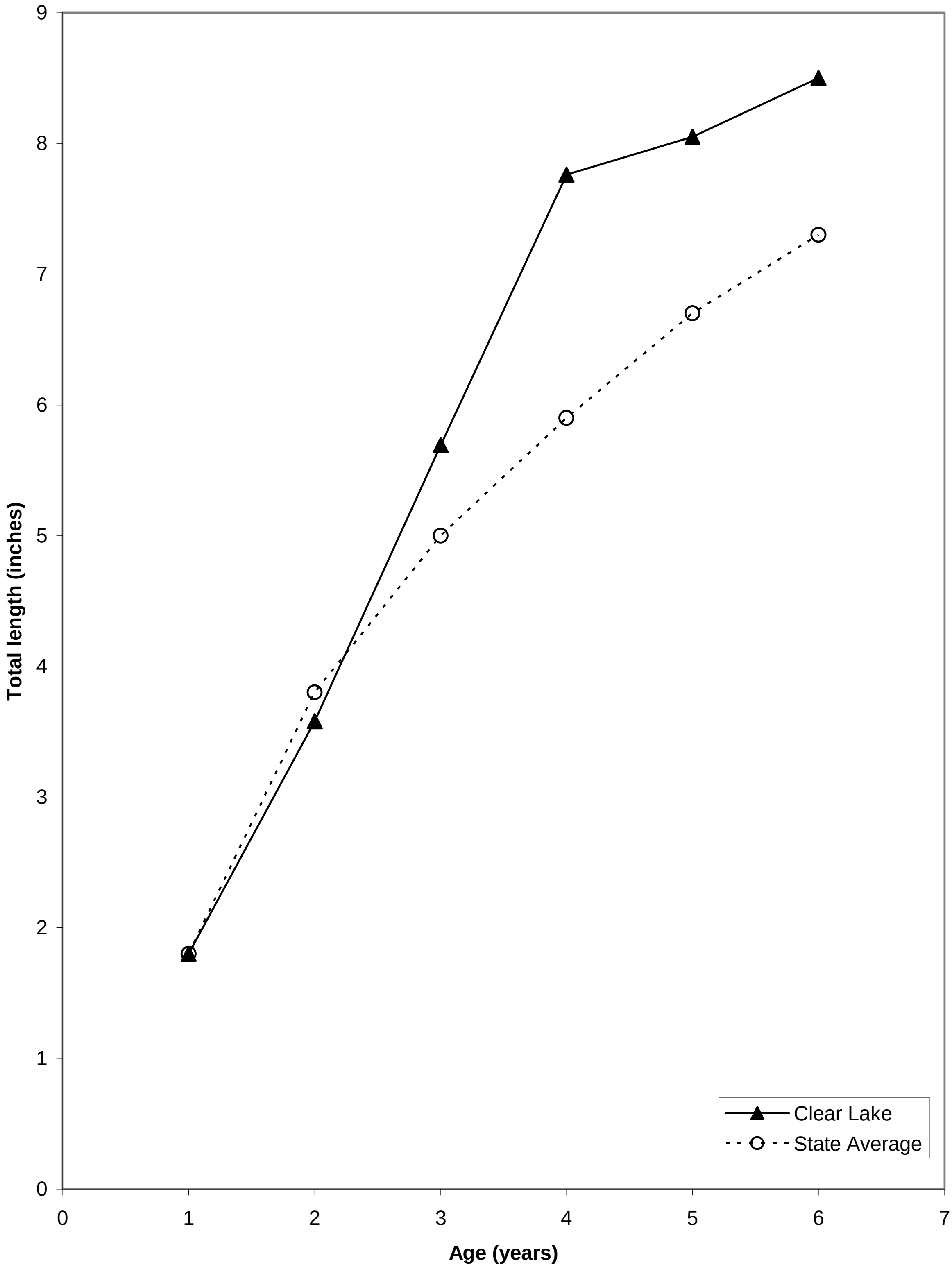


Figure 4.–Growth of bluegill in Clear Lake, as determined from scale and spine samples collected during May-June 2009. State average lengths from Schneider et al. (2000). State averages for January-May are depicted, as most of the bluegills were collected during May.

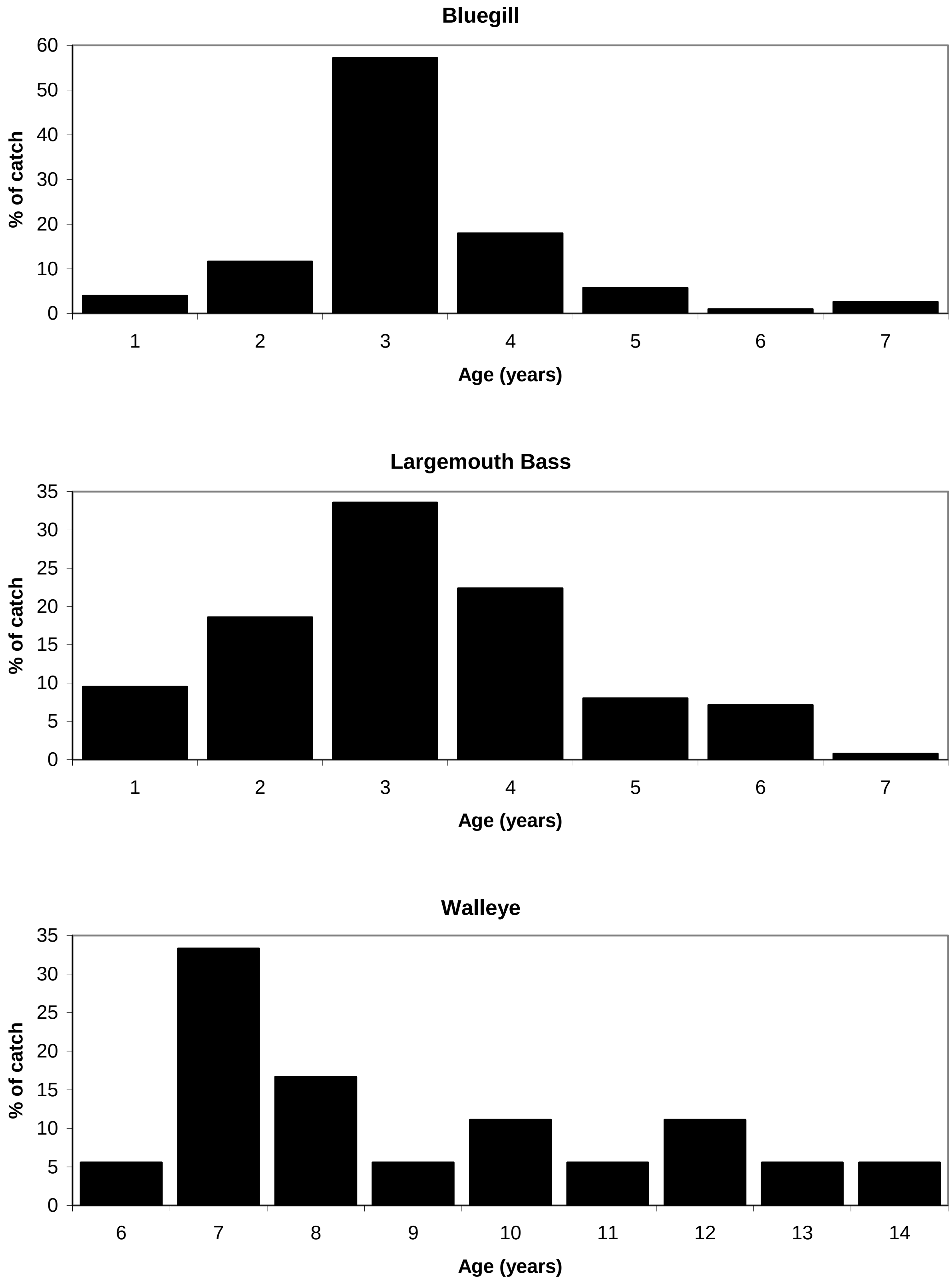


Figure 5.–Age-frequency distributions for bluegill, largemouth bass, and walleye captured in Clear Lake during May-June 2009.

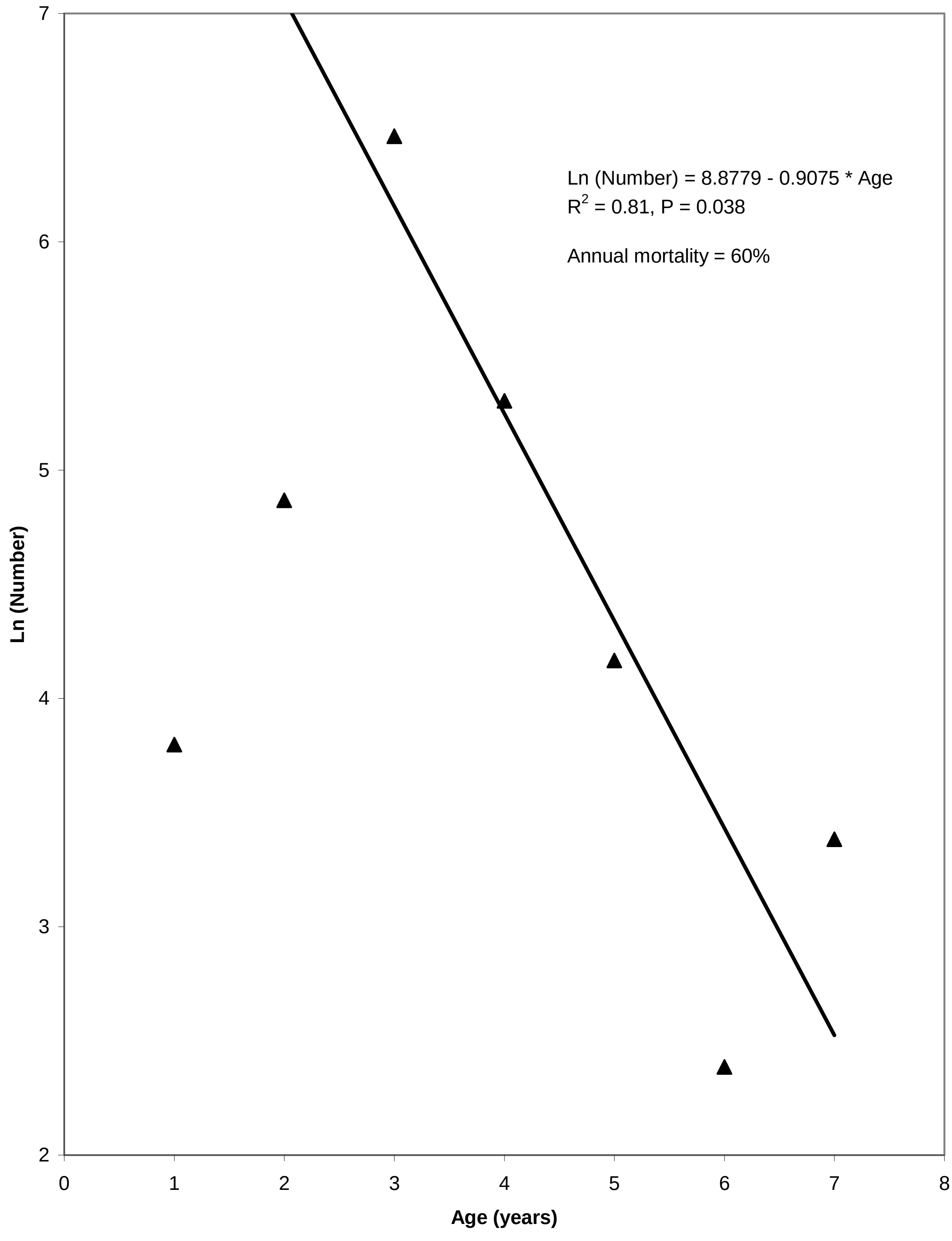


Figure 6.–Observed ln(number) versus age for bluegill captured in Clear Lake during May-June 2009.

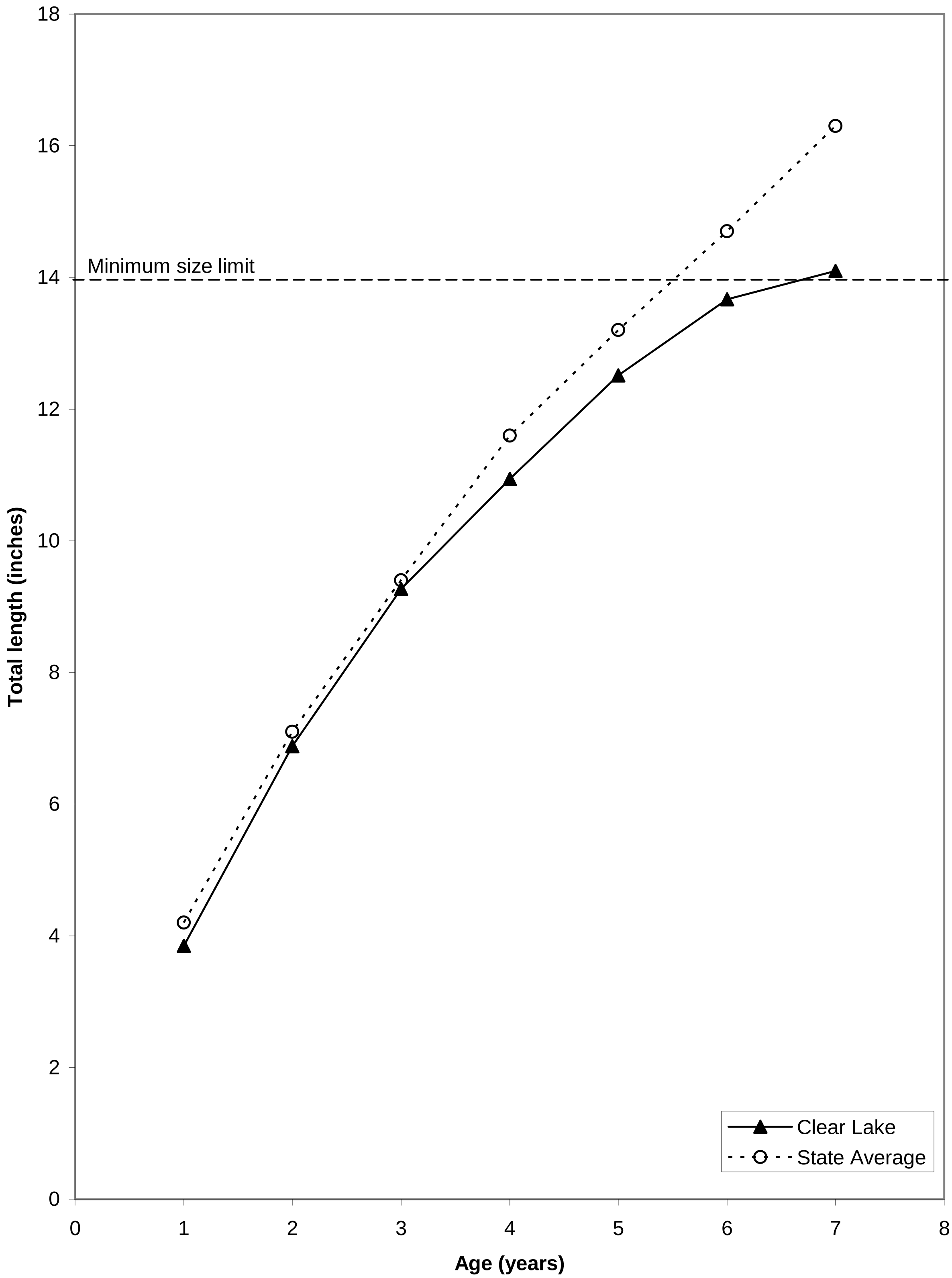


Figure 7.–Growth of largemouth bass in Clear Lake, as determined from scale and spine samples collected during May-June 2009. State average lengths from Schneider et al. (2000). State averages for January-May are depicted, as most of the largemouth bass were collected during May.

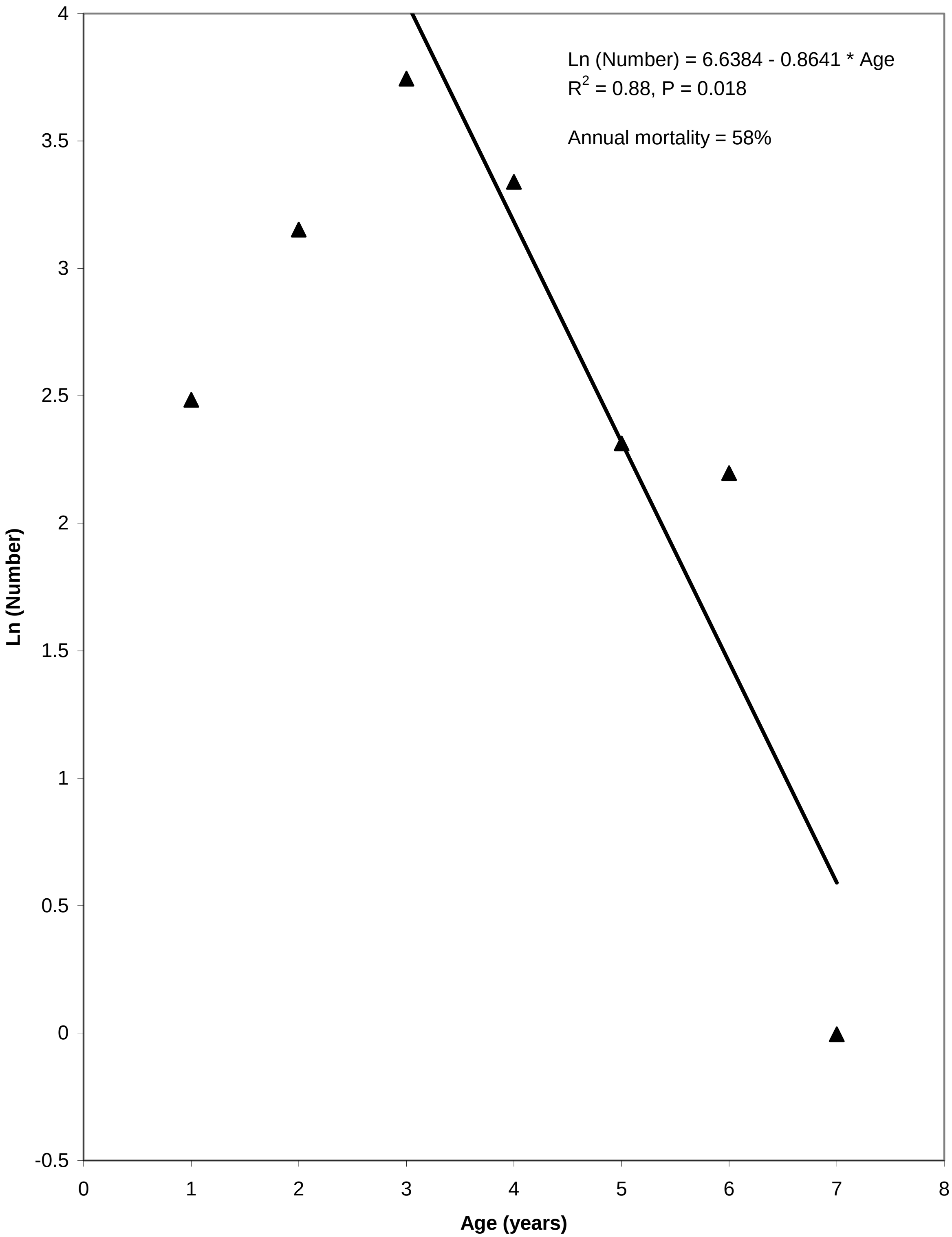


Figure 8.–Observed ln(number) versus age for largemouth bass captured in Clear Lake during May-June 2009.

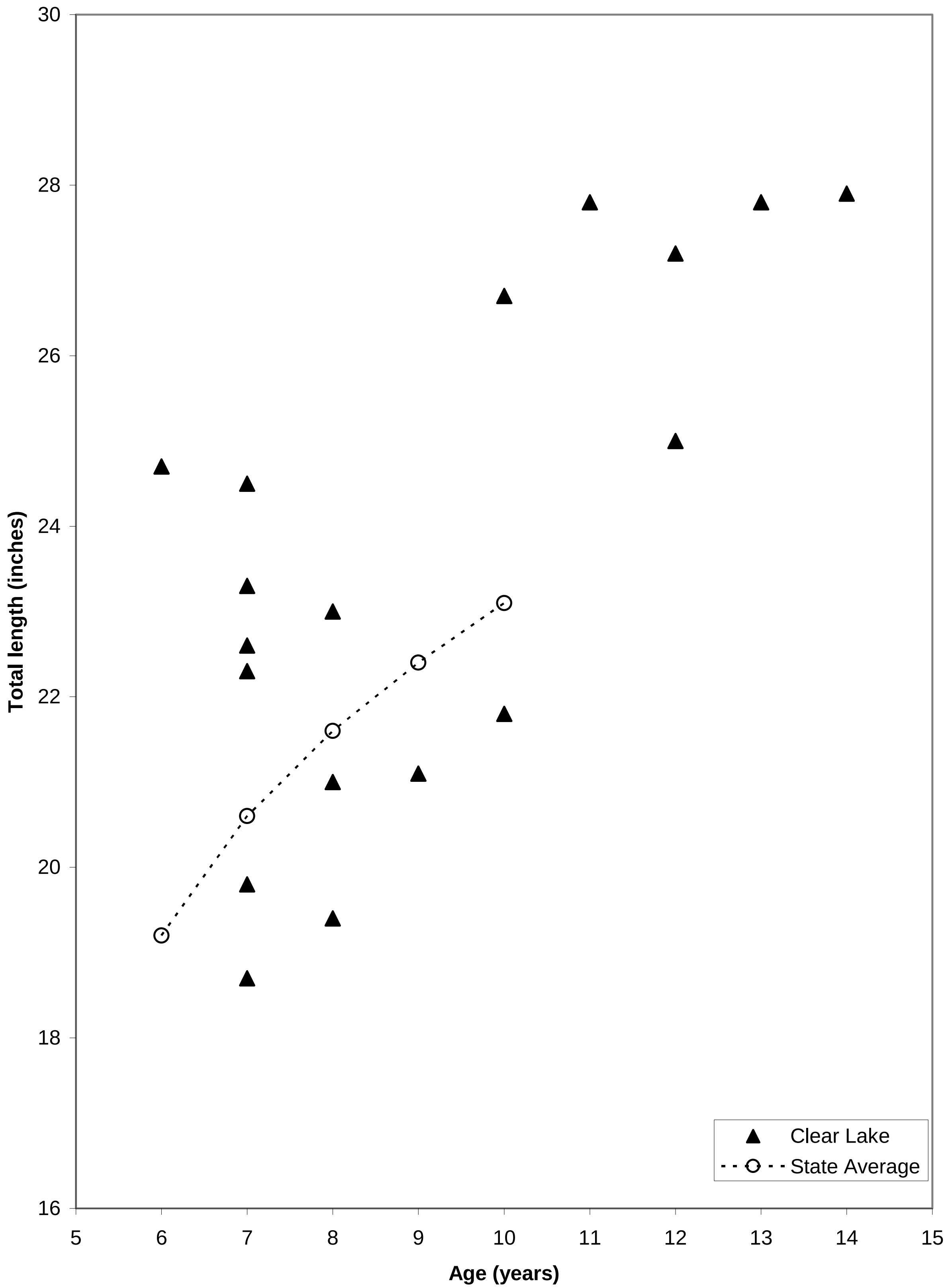


Figure 9.–Growth of walleye in Clear Lake, as determined from spine samples collected during May 2009. State average lengths from Schneider et al. (2000). State averages for January-May are depicted.