Shavehead Lake

Cass County, T07S, R13W, S19
St. Joseph River watershed, 2007

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Environment

Shavehead Lake is a 289-acre natural lake located approximately 8 miles southeast of Cassopolis. This horseshoe-shaped lake has a shoreline development index of 2.14 and consists of two basins separated by a long peninsula (Figure 1; Orth 1983). The maximum depths of the east and west basins are 70 ft and 58 ft, respectively. Drop-offs generally are steep, and shallow nearshore areas (depth < 20 ft) make up only 25% of the lake's surface area. Marl is the dominant substrate in the littoral zone, but some patches of sand are scattered along the shoreline. Marl and muck substrates are common in offshore areas. The main inlet is an unnamed stream that flows from Birch Lake into the northwest end of Shavehead Lake. The outlet (Mud Creek) flows out of the southwest end of the lake and enters Long Lake 5 miles downstream. A low-head dam in Mud Creek is operated to maintain the legal lake level elevations of 793.5 ft (above sea level) in the summer and 793.0 ft during the winter.

Shavehead Lake is bordered by large deposits of glacial outwash sand and gravel to the north and east. End moraines of coarse-textured till and coarse-textured glacial till occur to the west. These materials are relatively porous, and groundwater is delivered to Shavehead Lake via numerous springs. Agriculture and forests are the predominant land uses in the watershed. There is considerable residential and vacation home development along most of the shoreline. The wetland complex at the north end of the lake includes a rare plant community known as a prairie fen that provides important habitat for a variety of aquatic and terrestrial animals. The public can access Shavehead Lake at two locations (Figure 1); Cass County maintains a small boat launch on the west side of the peninsula and a swimming beach on the east side of the peninsula.

Limnological sampling was conducted in each basin within the lake during August 5-8, 2003 (Figure 1). The temperature and dissolved oxygen profiles for the two basins were similar (Figure 2). As expected, the lake was thermally stratified into three zones. The epilimnion extended from the surface to a depth of 12 ft. The water temperature within the epilimnion was relatively uniform, ranging from 78.2 F to 79.5 F. The metalimnion (zone of thermal change) extended from 12 ft down to approximately 44 ft. Water temperatures in the metalimnion declined from 78 F at the top to 43 F at the intersection with the uniformly cold waters of the hypolimnion (below 44 ft). The oxygen distribution within Shavehead Lake followed a positive heterograde curve, with the highest dissolved oxygen concentrations occuring in the metalimnion (Figure 2). Oxygen supersaturation within the metalimnion is not uncommon, and typically is caused by blooms of stenothermal algae that are adapted to growing well at low temperatures and low light intensities (e.g., Oscillatoria; Wetzel 1983). Dissolved oxygen concentrations remained above 3 ppm to depths of 56 ft in the east basin and 36 ft in the west basin. Total alkalinities at the two basins were almost identical (139 mg/ L and 140 mg/L) and were indicative of a hardwater lake with substantial buffering capacity. This conclusion is corroborated by the slightly alkaline pH values (7.26-8.01) recorded for the surface and metalimnion water samples.

The biological productivity of a lake is strongly dependent on its supply of two key nutrients: phosphorus and nitrogen. The ratio of total nitrogen to total phosphorus was >30:1 for both basins in Shavehead Lake in 2003, so it appears that phosphorus is the limiting nutrient in this system. Total phosphorus concentrations were 13 ug/L in the east basin and 11 ug/L in the west basin. Chlorophyll a concentrations, which provide an index of algal biomass, ranged from 2.8 ug/L to 4.0 ug/L. The total phosphorus and chlorphyll a concentrations were indicative of a mesotrophic (moderately productive) lake, but the Secchi disk depths (5 ft at both basins) were more typical of a eutrophic or highly productive system (Carlson and Simpson 1996).

Recent quantitative data regarding the abundance and distribution of aquatic plants in Shavehead Lake are not available. Due to the steep drop-offs in Shavehead Lake, vegetation is limited to a relatively small percentage of the total surface area. Twenty-two species of native plants were identified during a survey conducted by the Institute for Fisheries Research in 1956. Two aquatic invasive species, Eurasian water-milfoil and curlyleaf pondweed, apparently have entered the lake during the last 50 years. Recent herbicide treatments in Shavehead Lake generally have been restricted to one site (less than 1 acre) near the northwest corner of the lake (Table 1).

History

The first fisheries survey of Shavehead Lake was conducted in 1887. Ciscoes (a state threatened species) were captured during that survey, and largemouth bass, yellow perch, bluegill, and "grass pike" (most likely grass pickerel) also were reported to be present.

Rainbow trout stocking began in 1947 (Table 2). Anglers reported good fishing for rainbow trout, largemouth bass, and bluegills during the late 1940s, but fishing success apparently declined by the early 1950s. The trout stocking program was discontinued in 1953.

During the 1930s-1950s, cisco netting and spearing were popular activities on Shavehead Lake. The cisco netting season extended from November 15-December 10. Each fisherman was only allowed to set one gill net per night. Additional restrictions on net length, mesh size, and set times were instituted to prevent overharvest and reduce bycatch of other species. No harvest data are available for the cisco netting fishery in Shavehead Lake, but data from nearby Birch Lake illustrate the popularity of cisco fishing during the 1940s. During 1944-1949, the annual number of gill net sets in Birch Lake ranged from 172 to 743, so a substantial number of people must have participated in the fishery (Clady 1967).

A fisheries survey of Shavehead Lake conducted during September 1956 yielded 140 ciscoes. The length range for these fish was 8-16 inches and six different age classes were represented in the catch. Largemouth bass, bluegill, black crappie, yellow perch, green sunfish, and warmouth were common. Most of these fish were smaller than harvestable size. Length-at-age data for largemouth bass and bluegills indicated that growth was above the state average, but few fish older than age 3 were captured. Angler reports supported the conclusion that panfish populations were dominated by small fish. Overall, 27 fish species were collected during the 1956 survey.

An electrofishing survey conducted during October 1979 revealed strong populations of bluegills and largemouth bass. The size structure of the bluegill population apparently had improved since the 1956 survey, as 48% of the bluegills collected were of harvestable size. Growth was average (mean growth index = 0), and the improvement in size structure was due to the higher relative abundance of older (age 4) fish. Growth of largemouth bass was above average for young fish, but declined rapidly after age 2. No bass older than age 4 were collected. Limnological sampling indicated that water temperatures and dissolved oxygen concentrations were suitable for trout survival.

Rainbow trout stocking resumed in 1981. An electrofishing survey was completed during November 1983 to evaluate survival and growth of stocked trout. The entire shoreline was sampled, but only four yearling trout were captured. The length range for these fish was 11.0-12.7 inches. Rainbow trout averaged 7.08 inches at stocking, so growth (4.7 inches in 7 months) was excellent. Local anglers reported that "quite a few" trout up to 15 inches had been caught in Shavehead Lake.

A volunteer creel survey was conducted by the Shavehead Lake Association in cooperation with Fisheries Division during April-November 1989 (Table 3). Ninety-seven creel census forms were returned, providing harvest information for 193 angler trips. In terms of harvest and targeted effort, panfish clearly dominated the fishery in Shavehead Lake. Bluegills and black crappie composed 93% of the harvest during the creel survey. Only one rainbow trout was reported, and this fish apparently was released. With the exception of the lucky angler who caught this trout, there was no targeted effort for rainbow trout.

Harvest statistics often misrepresent the importance of largemouth bass fisheries, as a substantial percentage of bass anglers practice catch-and-release. During the 1989 survey, anglers were asked to report the species of fish released, but not the number of fish released. Thus, it is not possible to quantitatively evaluate the catch-and-release bass fishery in Shavehead Lake; however, some qualitative information can be gleaned from the overall numbers of harvest and release reports. Of the 34 instances in which bass were included in volunteer creel forms, 9 indicated that all bass were harvested, 12 indicated that some bass were harvested while others (presumably sublegal fish) were released, and 13 indicated that all bass (legal or sublegal) were released. Based on this cursory analysis, it appears that at least 50% of legal-sized bass were harvested upon capture. If this assumption is correct, then even if all of the legal-sized bass were harvested upon capture, they would only have composed about 6% of the total harvest in Shavehead Lake.

Fisheries Division personnel conducted a hook-and-line survey on Shavehead Lake in July 1997. Zero rainbow trout were caught in 20 angler hours of effort. At this time, fisheries managers became concerned about competitive interactions between stocked trout and native ciscoes. In 1998, annual rainbow trout stocking density was decreased from approximately 40 fish/acre to 25 fish/acre.

Current Status

Two separate sampling efforts were used to determine the current status of the Shavehead Lake fishery. A general fish community survey was completed during May 2000. Multiple gear types (trap nets, gill nets, and electrofishing gear) were used during the 2000 survey to minimize sampling bias due to gear selectivity. In addition, a creel survey was conducted during June-August 2007 to collect information regarding fishing effort, harvest, and catch rates for various game fish species in Shavehead Lake.

Numerically, bluegills were the dominant species collected during the 2000 survey, making up 49% of the total catch (Table 4). Twenty-seven percent of the bluegills captured 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 scores for the Shavehead Lake bluegill population were 4.25 (satisfactory) based on the trap net sample and 2.5 (poor-acceptable) based on the electrofishing sample (Schneider 1990). Based on the length-at-age data, it appears that most bluegills reach harvestable size by the end of their fifth summer (age 4; Figure 3). Older fish (age 5 and older) composed 23% of the catch (Figure 4). Annual mortality for adult bluegills (ages 4-9) was 63% (Figure 5).

Bluegills composed 53% of the total harvest during the 2007 creel survey (Table 5). The estimated bluegill harvest for June through August was 848 fish. An additional 7,202 bluegills were caught and released, so it appears that anglers had to release several undersized fish for every "keeper". The bluegill harvest per angler hour (CPH) for Shavehead Lake was 0.12. For comparison, the bluegill CPH values for Murray Lake (Kent County), Birch Lake (Cass County), and Campau Lake (Kent County) were 0.55, 0.31, and 0.07, respectively (Table 6; Z. Su, MDNR Fisheries Division, unpublished).

Although black crappies were a relatively minor component of the catch (3.5% by number) during the 2000 netting survey, 79% of these fish were of harvestable size. Black crappies made up 17% of the total harvest during the creel survey. The black crappie CPH for Shavehead Lake was 0.038, which was relatively high for lakes in southwest Michigan (Table 6). Approximately one crappie was released for each fish harvested. Growth of black crappies in Shavehead Lake was well above the state average (mean growth index = +1.4).

Three additional panfish species were collected during the 2000 netting survey: rock bass (N = 97), yellow perch (N = 60, and pumpkinseed (N = 7). Green sunfish were not captured during the netting survey, but were observed during the creel survey. Together, these four panfish species made up 14% of the total harvest in 2007. The yellow perch population was dominated by small fish, as evidenced by the 10:1 ratio of released fish to harvested fish. Based on the length-at-age data, it appears that most yellow perch reach harvestable size during their fourth summer (age 3). Fish older than age 3 only made up about 22% of the yellow perch catch during the 2000 netting survey (Figure 4). Harvestable-sized fish made up at least 50% of the catch for the other three species during the netting survey, and the harvest-to-release ratios for these species during the creel survey were close to 1:1.

Largemouth bass are the dominant predators in Shavehead Lake. Bass (N = 215) composed 20% of the total biomass during the 2000 netting survey. Growth of largemouth bass was above average for young fish, but dropped below average for fish older than age 3 (Figure 6). Only 4% of the bass collected were of legal size. In Shavehead Lake, most bass do not reach 14 inches until age 6. Age 6 and older fish made up about 5% of the catch in 2000 (Figure 4). Annual mortality for bass ages 3 to 9 was estimated to be 51% (Figure 7).

The creel results indicate that 3,979 largemouth bass were caught during June-August, 2007. The bass fishery in Shavehead Lake is almost entirely a catch-and-release fishery, and <1% of these fish were harvested. The largemouth bass catch rate in Shavehead Lake (0.557 fish/angler hour) was higher than the catch rates recorded for most other lakes in southwestern Michigan (Table 6).

Ciscoes (N = 135) made up the bulk of the gill net catch during the 2000 survey. The length range for captured ciscoes was 10-14 inches, with most fish in the 11-13 inch size classes. Seven year classes were represented in the catch. No ciscoes were observed during the creel survey.

No rainbow trout were captured during the netting survey. No rainbow trout were observed during the creel survey, and angler interviews indicated that there was essentially zero targeted effort for this species.

Analysis and Discussion

The creel survey results indicate that Shavehead Lake receives moderate fishing pressure. Fishing pressure was estimated to be 24.7 angler hours per acre during June-August, 2007. Angler hours per acre estimates for other southwestern Michigan lakes ranged from 9.5 to 49.3 (Table 6).

The bluegill population in Shavehead Lake is dominated by small fish. The growth rate for bluegills was in the "average" range for Michigan populations, so the observed size structure is not entirely the result of poor growth (i.e., stunting). Length-at-age for young bluegills in Shavehead Lake is well below the state average; however, growth improves as the fish get older, and Shavehead Lake bluegills are up to average size by age 5 (Figure 3). The increase in growth rate suggests that bluegills in this system undergo a major change in diet or foraging strategies after they reach a length of approximately 3.5 inches.

The poor size distribution of Shavehead Lake bluegills reflects the relative scarcity of older individuals in this population (Figure 4). Two factors probably are responsible for the observed age-frequency distribution. The first factor that could be influencing the age structure of the bluegill population is sport fishing harvest. The harvest estimate for bluegills in 2007 was only 848 fish or 2.9 fish/acre. Bluegill population estimates are not available for Shavehead Lake. Population estimates for seven other southern Michigan lakes ranged from 35 to 507 harvestable-sized bluegills/acre (Schneider 1971; Schneider 1993; Schneeberger 1988; Brown and Ball 1943; Cooper et al. 1957; Laarman and Schneider 1979). Even if bluegill density in Shavehead Lake was at the bottom of this range (i.e., 35 fish/acre), the observed harvest of 2.9 fish/acre would account for a small percentage of total annual mortality. It is important to note, however, that harvest estimates only were available for June-August. In many lakes, a large portion of the bluegill harvest occurs during the nesting season (May) and the ice fishing season. Thus, the 2007 creel data probably underestimate the role of sport fishing harvest in shaping the age distribution of bluegills in Shavehead Lake.

The annual mortality estimate for adult bluegills from the 2000 catch data was 63%, which is in the middle of the range reported by Schneider (2000) for Michigan bluegill populations. Natural mortality estimates for bluegill populations in the upper Midwest range from 40% to 54% (Coble 1988; Schneider 2000). If we assume that natural mortality in Shavehead Lake is within this range, then fishing mortality would be 9-23%. Using the estimates reported by Schneider (2000) and Coble (1988) as a reference, the bluegill exploitation rate in Shavehead Lake appears to be low to moderate.

Intense predation pressure probably has had a strong influence on the age structure of the bluegill population in Shavehead Lake. Predators (largemouth bass, spotted gar, longnose gar, and bowfin) made up 51% of the biomass during the 2000 netting survey. It generally is not desirable to have predators compose more than 20-50% of the biomass (Schneider 2000), so the Shavehead Lake fish community appears to be skewed towards predators. Unlike anglers, fish predators prey heavily on juvenile bluegills. Because young bluegills were not vulnerable to some of the gear types used during the 2000 netting survey, it is not possible to estimate annual mortality for bluegills younger than age 4. Given the abundance of predators in this system, it is likely that annual mortality of young bluegills is particularly high in Shavehead Lake.

Shavehead Lake appears to be providing a good fishery for black crappies. Most crappies are in the 9-10 inch size class. This lake does have the potential to produce large fish, as evidenced by the 14-inch crappie collected during the 2000 netting survey.

Both the creel survey and the netting survey indicate that the yellow perch population in Shavehead Lake is dominated by fish smaller than harvestable size. Growth of yellow perch was average (mean growth index = +0.4), but few individuals older than age 3 were collected during the 2000 survey. Past surveys on Shavehead Lake have shown a similar pattern. The reasons for the lack of older perch in this system are not completely clear. The creel data indicate that harvest is low during the summer months, but the ice fishing harvest could be substantial. Intense predation pressure and variation in reproductive success probably also are important factors. Yellow perch populations typically exhibit wide fluctuations in annual reproductive success, and it is not uncommon for perch fisheries to be supported by one or two strong year classes. It is interesting to note that the age-frequency data suggest that a strong year class was produced in Shavehead Lake in 1998; that year also was a good year for perch reproduction in Lake Michigan. If we could have surveyed Shavehead Lake during 2002-2004, we may have found a population with a much greater percentage of harvestable-sized individuals.

Rock bass are fairly common in this lake, but few anglers fish specifically for this species. It is likely that most of the rock bass, pumpkinseeds, and green sunfish recorded during the 2007 creel survey were harvested by anglers targeting bluegills or black crappies.

Largemouth bass are abundant in Shavehead Lake, as evidenced by the high catch rate during the 2007 creel survey (Table 5); however, legal-sized fish are rare. Only 36 bass were harvested during the creel survey, but this survey did not include the opening weekend of bass season (when bass fishing effort typically is greatest). Bass anglers commonly release legal-sized fish, so more fish may be lost to hooking mortality than to harvest. The annual mortality estimate for Shavehead Lake was in the middle of the range reported by Allen et al. (2008) for North American largemouth bass populations (Figure 7).

Poor growth is a major factor limiting production of legal-sized bass in this lake. Largemouth bass in Shavehead Lake grow rapidly during their first 3 years of life, but average lengths at age for older fish were below state averages (Figure 6). As bass grow, their nutritional requirements change, and it appears that there is a limited supply of forage for adult bass in this system. As noted earlier, the predator-prey ratio in this lake is skewed toward predators, so competition for prey fish (e.g., bluegills) may be intense.

The gill net catch during the 2000 survey suggests that Shavehead Lake supports a moderately strong cisco population. Ciscoes require cool, well-oxygenated water. During the summer, ciscoes are restricted to the water layer where the temperature is 68 F or less and the dissolved oxygen concentration is at least 3.0 ppm (Latta 1995). The limnological sampling conducted in August 2003 indicated that this "cisco layer" extended from 20 ft to 56 ft in the east basin and from 20 ft to 36 ft in the west basin (Figure 2).

Although ciscoes are common in Shavehead Lake, no ciscoes were harvested during the creel survey. Ciscoes typically inhabit the deep, offshore regions of lakes and feed primarily on zooplankton and aquatic insects. Thus, incidental catches of ciscoes are uncommon, and it is likely that most anglers are not even aware that the species resides in Shavehead Lake. Some targeted fishing for ciscoes is known to occur in the southwestern portion of the lake during late fall as fish move into shallow water to spawn. Some harvest of ciscoes probably occurs during November-February in Shavehead Lake, but no creel data are available to evaluate the magnitude of this fishery.

No rainbow trout were observed during the netting survey or the creel survey, and angler interviews indicated that there was little (if any) targeted effort for this species. The volunteer creel survey conducted in 1989 yielded similar results. All of this evidence suggests that survival of rainbow trout in Shavehead Lake is minimal, and there appears to be little public interest in continuing this stocking program.

Management Direction

Three fisheries management goals have been developed for Shavehead Lake. Goal #1: Protect and rehabilitate habitat for fish and other aquatic organisms. Goal #2: Protect the Shavehead Lake cisco population. Goal #3: To the extent possible, avoid future increases in the predator-prey ratio in this system.

At least three different methods will be used to accomplish Goal #1. 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 Shavehead Lake Association 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.

Goal #2 and Goal #3 are interrelated. Sport fishing groups and lake associations often express interest in stocking predatory game fish (especially walleye) in public waters. Such stocking programs are not recommended for Shavehead Lake. The fish community already has a high predator-prey ratio, and the stocking of additional predators could further decrease growth rates for largemouth bass. Introducing another predator to this system also could lead to diminishment of the Shavehead Lake cisco population. (Introduction of walleyes resulted in the extirpation of a distinct sub-species of lake whitefish in Lake Medora [Keweenaw County; B. Miller, MDNR Fisheries Division, unpublished]). To protect the cisco population and maintain a healthy predator-prey ratio, Fisheries Division will not issue any stocking permits for predatory game fish for Shavehead Lake unless future research indicates a need for such a stocking program.

The rainbow trout stocking program in Shavehead Lake will be discontinued. Rainbow trout could affect the cisco population through competition for resources, so rainbow trout stocking would not be consistent with Goal #2. Additionally, given the poor survival of stocked fish and the apparent lack of public interest in the trout fishery, it would not be a wise use of resources to continue this expensive stocking program.

Fisheries Division will continue to monitor the fish community in Shavehead Lake and identify opportunities to enhance this fishery. If time and resources allow, the next general fish community survey will be conducted in 2017.

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Table 1.–Aquatic herbicide treatments in Shavehead Lake, 2005-2008. Data from treatment reports provided to the Department of Environmental Quality – Water Bureau by the permittees.

Year	Herbicide	Rate of application	Total amount	Target species
2005	Reward (diquat dibromide)	1-2 gal/acre	0.22 gal	Naiad/Eurasian water-milfoil
2006	Reward (diquat dibromide)	1-2 gal/acre	0.22 gal	Eurasian water-milfoil
	Aquathol K (dipotassium salts of endothall)	1.3-1.9 gal/acre-ft	0.85 gal	Curlyleaf pondweed
2007	Reward (diquat dibromide)	1-2 gal/acre	0.22 gal	Eurasian water-milfoil
	Aquathol K (dipotassium salts of endothall)	1.9 gal/acre-ft	0.85 gal	Curlyleaf pondweed
	Copper sulfate	2.6 lb/acre-ft	1.7 lb	Algae
2008	Reward (diquat dibromide)	2 gal/acre	0.22 gal	Eurasian water-milfoil
	Copper sulfate	2.6 lb/acre-ft	1.7 lb	Algae

Table 2.–Fish stocking in Shavehead Lake, 1947-2008.

Year	Species	Strain	Number	Number/acre	Average length (inches)
1947	Rainbow trout[1]		500	2	---
1947	Rainbow trout[2]		1,500	5	---
1948	Rainbow trout		3,000	10	9.00
1949	Rainbow trout		3,000	10	9.00
1951	Rainbow trout		2,000	7	8.00
1952	Rainbow trout		4,000	14	8.00
1958	Rainbow trout		5,000	17	---
1960	Rainbow trout		5,000	17	---
1981	Rainbow trout	Harrietta	7,000	24	6.08
1982	Rainbow trout		9,800	34	6.28
1983	Rainbow trout	Harrietta	11,500	40	7.08
1984	Rainbow trout	Shasta	7,800	27	6.76
1985	Rainbow trout	Shasta	11,500	40	7.04
1986	Rainbow trout	Shasta	12,700	44	6.96
1987	Rainbow trout	Shasta	14,500	50	6.40
1988	Rainbow trout	Shasta	14,500	50	6.72
1989	Rainbow trout	Shasta	12,590	44	6.40
1990	Rainbow trout	Shasta	14,497	50	6.68
1991	Rainbow trout	Arlee	10,600	37	7.12
1992	Rainbow trout	Shasta	14,491	50	6.84
1993	Rainbow trout	Shasta	10,099	35	6.52
1994	Rainbow trout	Shasta	14,000	48	6.92
1995	Rainbow trout	Shasta	14,488	50	6.76
1996	Rainbow trout	Shasta	6,011	21	6.12
1996	Rainbow trout	Eagle Lake	5,836	20	5.60
1997	Rainbow trout	Shasta	5,749	20	6.20
1997	Rainbow trout	Eagle Lake	6,089	21	6.00
1998	Rainbow trout	Eagle Lake	7,060	24	6.00
1999	Rainbow trout	Eagle Lake	7,100	25	6.24
2000	Rainbow trout	Shasta	7,655	26	6.20
2001	Rainbow trout	Eagle Lake	2,890	10	5.80
2002	Rainbow trout	Eagle Lake	3,180	11	6.00
2003	Rainbow trout	Eagle Lake	3,070	11	6.03
2004	Rainbow trout	Eagle Lake	3,200	11	7.46
2005	Rainbow trout	Eagle Lake	3,520	12	7.06
2006	Rainbow trout	Eagle Lake	2,890	10	6.50
2007	Rainbow trout	Eagle Lake	3,100	11	5.95
2008	Rainbow trout	Eagle Lake	2,890	10	7.33

[1] Adults
[2] Yearlings

Table 3.–Harvest, catch-per-effort (in fish/angler hour), and target species as reported during the volunteer creel survey on Shavehead Lake, April 29–November 30, 1989.

	Rainbow trout	Bluegill	Largemouth bass	Black crappie	Yellow perch	Other
Harvest	0	811	45	541	37	19
Catch-per-effort	0	0.9972	0.0553	0.6652	0.0455	0.0234
Target species*	1	63	38	37	5	12

* For some of the trips, anglers listed multiple species as the "species sought". In several instances, it appeared that the anglers had not filled out the questionnaire correctly. For example, anglers commonly reported that largemouth bass was the target species, yet they harvested bluegills and did not catch any bass.

Table 4.–Numbers, weights, lengths, and growth indices for fish species collected during the general fish community survey on Shavehead Lake, May 15-23, 2000. Fish were captured using trap nets, gill nets, and electrofishing gear. (Note: Small non-game species were not collected during the last 30 minutes of the electrofishing survey.)

Species	Number	Percent by number	Weight (lbs)	Percent by weight	Length range (inches)	Percent legal or harvestable[1]	Growth index[2]
Bluegill	912	48.8	88.2	14.2	0-8	27	-0.5
Largemouth bass	215	11.5	122.1	19.6	3-20	4	+0.0
Cisco	135	7.2	67.8	10.9	10-14	---	+1.3
Rock bass	97	5.2	29.2	4.7	1-10	81	---
Warmouth	76	4.1	19.9	3.2	4-9	83	---
Spottail shiner	69	3.7	0.6	0.1	2-3	---	---
Black crappie	66	3.5	31.5	5.1	5-14	79	+1.4
Yellow perch	60	3.2	10.2	1.6	2-12	35	+0.4
Bullheads	43	2.3	33.5	5.4	6-15	---	---
Spotted gar	37	2.0	53.9	8.6	16-28	---	---
Longnose gar	34	1.8	95.4	15.3	20-45	---	---
Banded killifish	34	1.8	0.2	0.0	2	---	---
Bluntnose minnow	32	1.7	0.2	0.0	2	---	---
Hybrid sunfish	16	0.9	5.5	0.9	4-9	81	---
Brook silverside	12	0.6	0.2	0.0	2-4	---	---
Bowfin	11	0.6	44.7	7.2	18-25	---	---
White sucker	7	0.4	18.8	3.0	14-21	---	---
Pumpkinseed	7	0.4	1.2	0.2	4-6	57	---
Golden shiner	2	0.1	0.2	0.0	6-7	---	---
Rainbow darter	2	0.1	0.0	0.0	2-3	---	---
Total	1,867		623.3				

[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 Shavehead Lake (Z. Su, MDNR Fisheries Division, unpublished). Survey period was June 1 through August 31, 2007. Two standard errors are given in parentheses.

Species	CPH	June	July	August	Season
HARVEST					
Largemouth bass	0.0050	25	11	0	36
	(0.0064)	(39)	(22)	(0)	(45)
Yellow perch	0.0036	26	0	0	26
	(0.0045)	(32)	(0)	(0)	(32)
Bluegill	0.1188	617	211	19	848
	(0.0817)	(494)	(228)	(39)	(546)
Pumpkinseed	0.0059	42	0	0	42
	(0.0104)	(74)	(0)	(0)	(74)
Rock bass	0.0158	12	56	45	113
	(0.0163)	(20)	(80)	(77)	(113)
Black crappie	0.0382	147	126	0	273
	(0.0509)	(305)	(185)	(0)	(357)
Rainbow trout	0.0000	0	0	0	0
	(0.0000)	(0)	(0)	(0)	(0)
Green Sunfish	0.0060	7	36	0	43
	(0.0105)	(14)	(73)	(0)	(74)
Other	0.0317	0	226	0	226
	(0.0406)	(0)	(285)	(0)	(285)
TOTAL HARVEST	0.2251	876	666	64	1,606
	(0.1159)	(588)	(424)	(86)	(730)
RELEASED					
Northern pike	0.0039	0	28	0	28
	(0.0062)	(0)	(44)	(0)	(44)
Largemouth bass	0.5527	1,499	1,576	868	3,943
	(0.2678)	(1,152)	(804)	(879)	(1,657)
Yellow perch	0.0372	7	227	32	265
	(0.0341)	(14)	(231)	(38)	(235)
Bluegill	1.0094	3,787	2,991	424	7,202
	(0.4890)	(2,533)	(1,618)	(338)	(3,024)
Pumpkinseed	0.0060	0	43	0	43
	(0.0120)	(0)	(85)	(0)	(85)
Rock bass	0.0191	0	132	4	136
	(0.0179)	(0)	(123)	(9)	(123)
Black crappie	0.0359	85	117	55	256
	(0.0339)	(144)	(146)	(112)	(233)
Rainbow trout	0.0000	0	0	0	0
	(0.0000)	(0)	(0)	(0)	(0)
Green Sunfish	0.0040	0	28	0	28
	(0.0080)	(0)	(57)	(0)	(57)
Other	0.0152	0	108	0	108
	(0.0145)	(0)	(100)	(0)	(100)
TOTAL RELEASED	1.6834	5,378	5,249	1,382	12,010
	(0.6339)	(2,786)	(1,838)	(949)	(3,470)
TOTAL CATCH	1.9085	6,254	5,915	1,447	13,616
	(0.6778)	(2,847)	(1,886)	(953)	(3,546)
ANGLER HOURS		2,901	3,170	1,063	7,134
		(1,137)	(1,134)	(624)	(1,723)
ANGLER TRIPS		1,066	1,085	295	2,447
		(433)	(502)	(188)	(689)

Table 6.–Angler survey estimates for 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
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

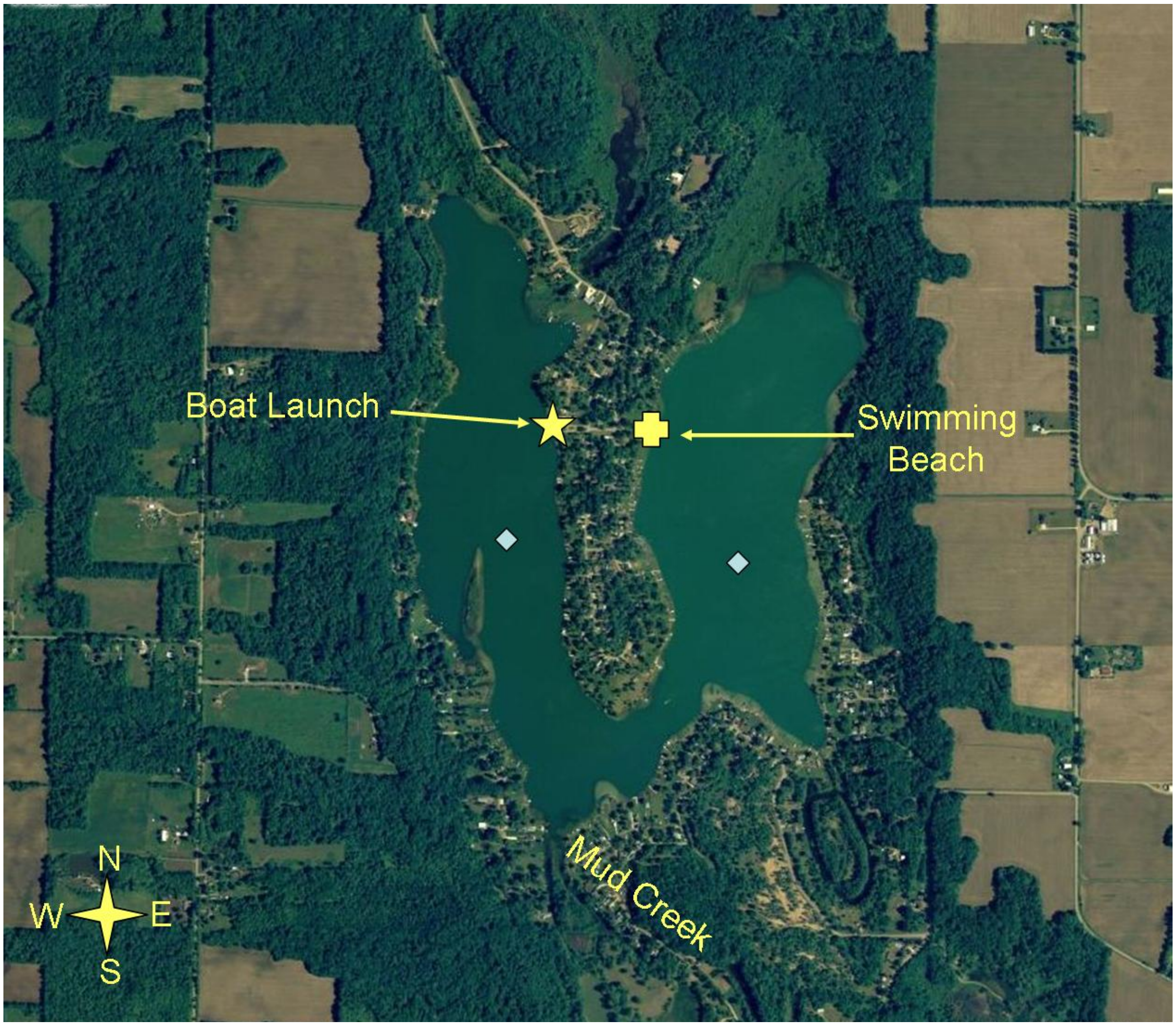

Figure 1.–Public access sites and limnological sampling locations (diamonds) on Shavehead Lake. Limnological sampling was completed during August 5-8, 2003. Image from Microsoft® Virtual Earth™ (www.bing.com/maps).

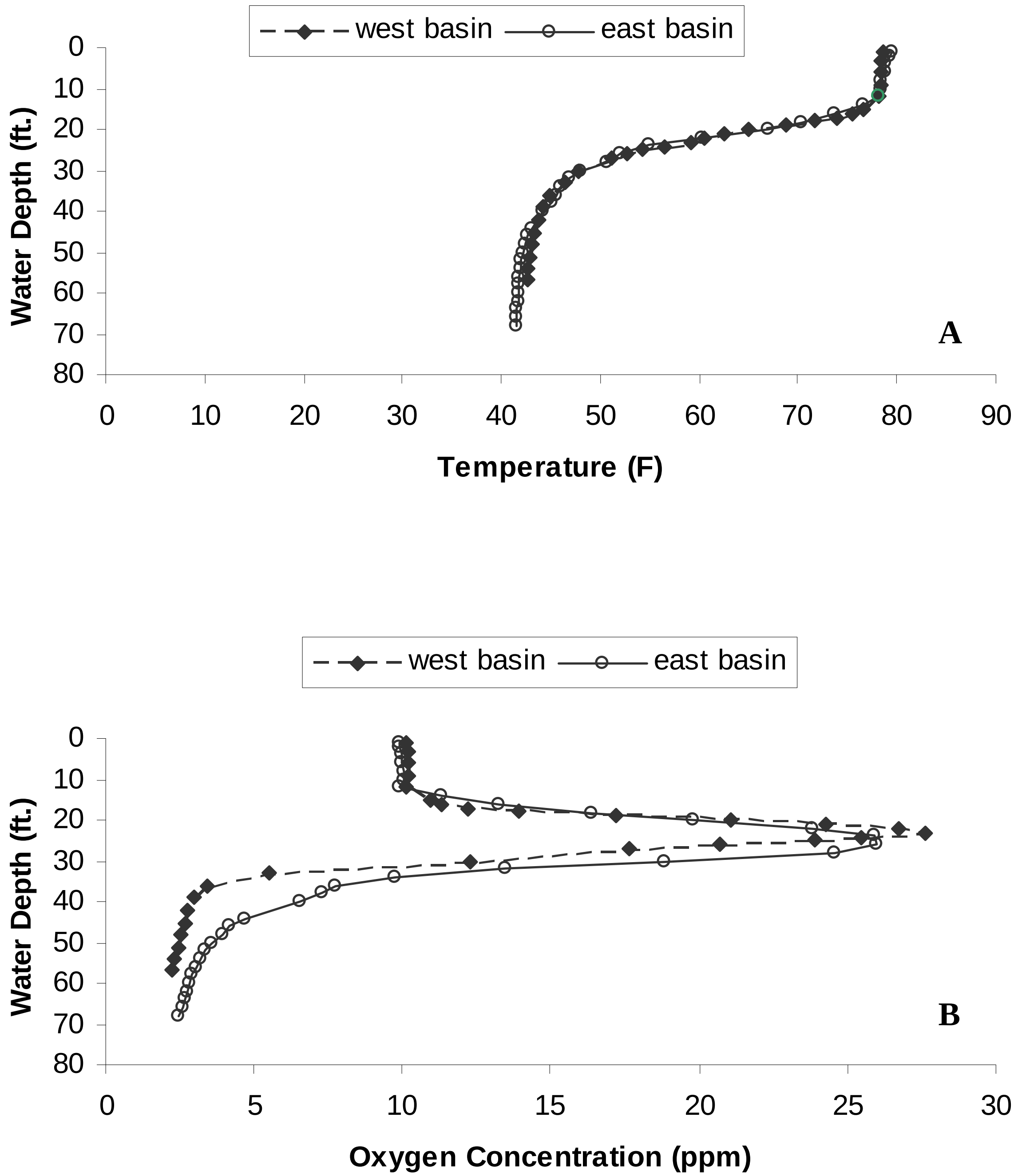

Figure 2.–Temperature (A) and dissolved oxygen profiles (B) for Shavehead Lake during August 5-8, 2003.

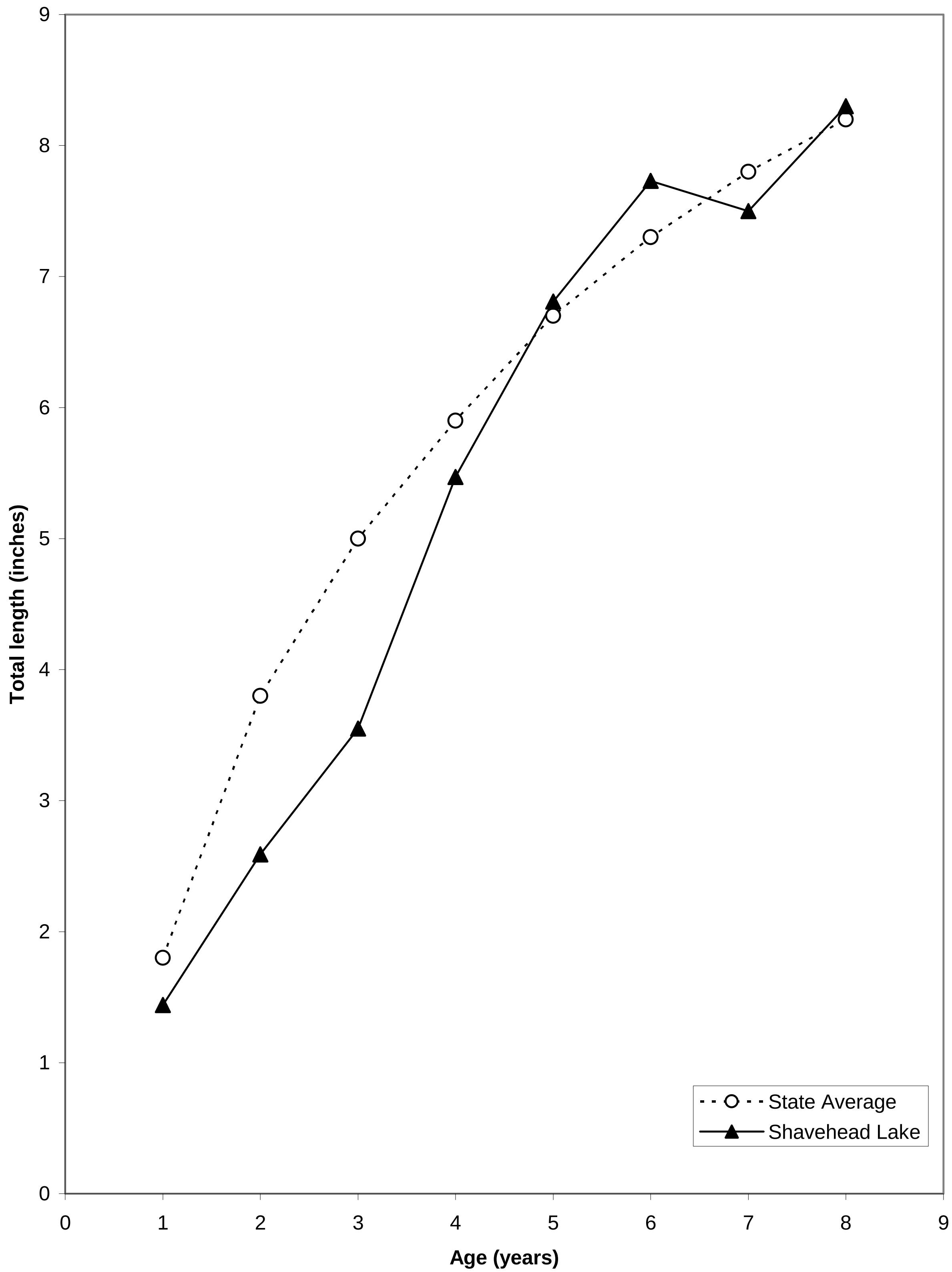

Figure 3.–Growth of bluegill in Shavehead Lake, as determined from scale samples collected during May 15-23, 2000. State average lengths from Schneider et al. (2000).

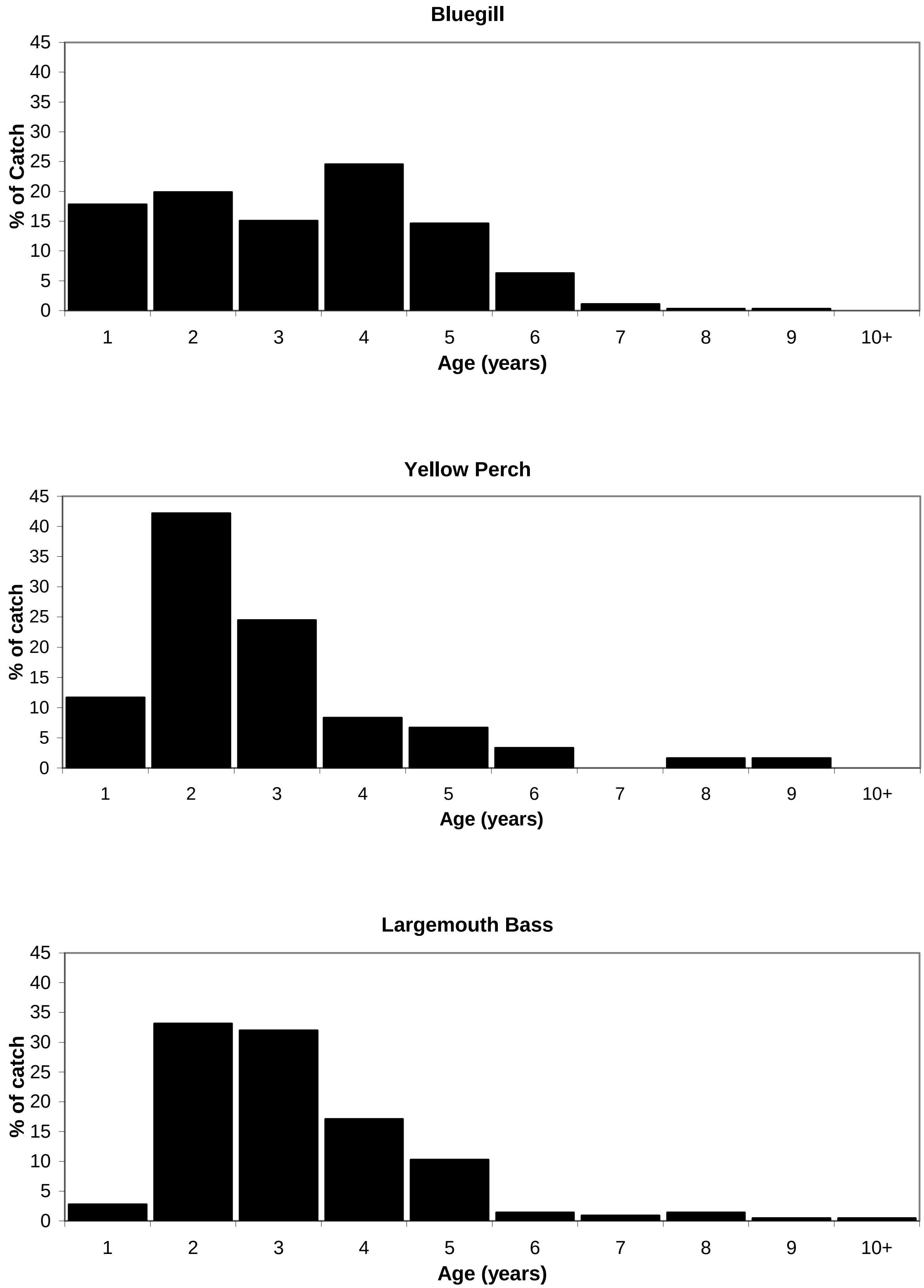

Figure 4.–Age-frequency distributions for bluegill, yellow perch, and largemouth bass captured in Shavehead Lake during May 15-23, 2000.

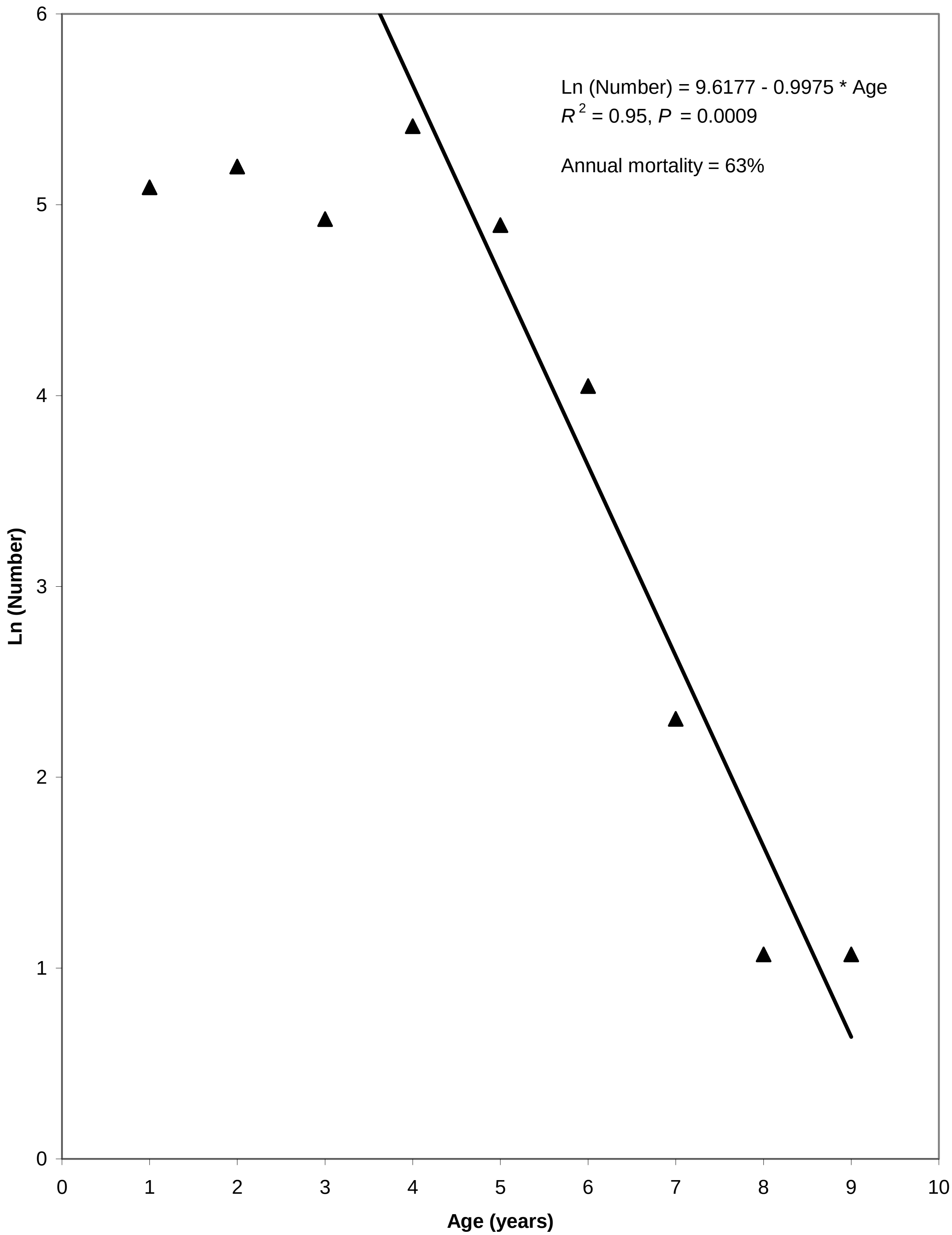

Figure 5.–Observed ln(number) versus age for bluegill captured in Shavehead Lake during May 15-23, 2000.

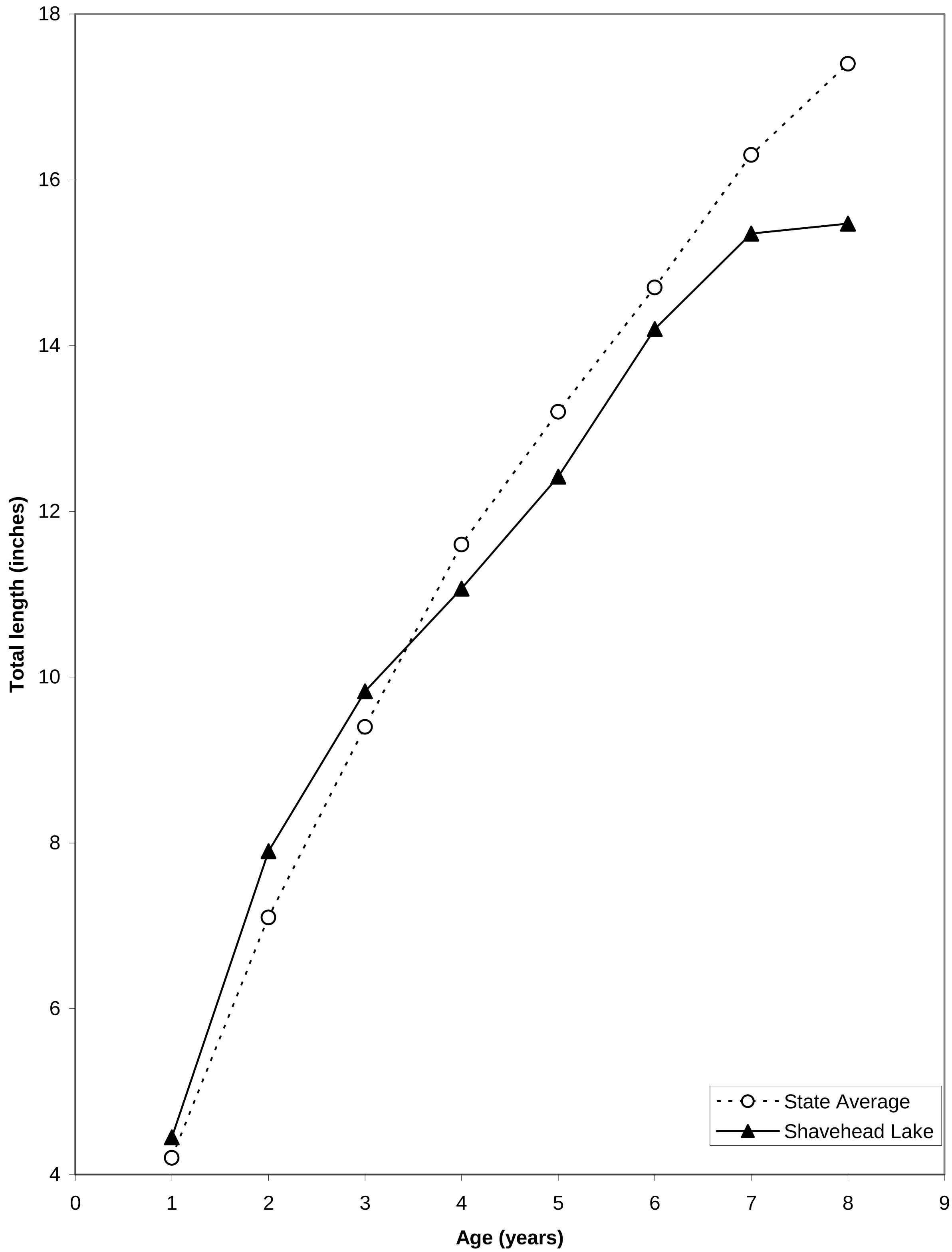

Figure 6.–Growth of largemouth bass in Shavehead Lake, as determined from scale samples collected during May 15-23, 2000. State average lengths from Schneider et al. (2000).

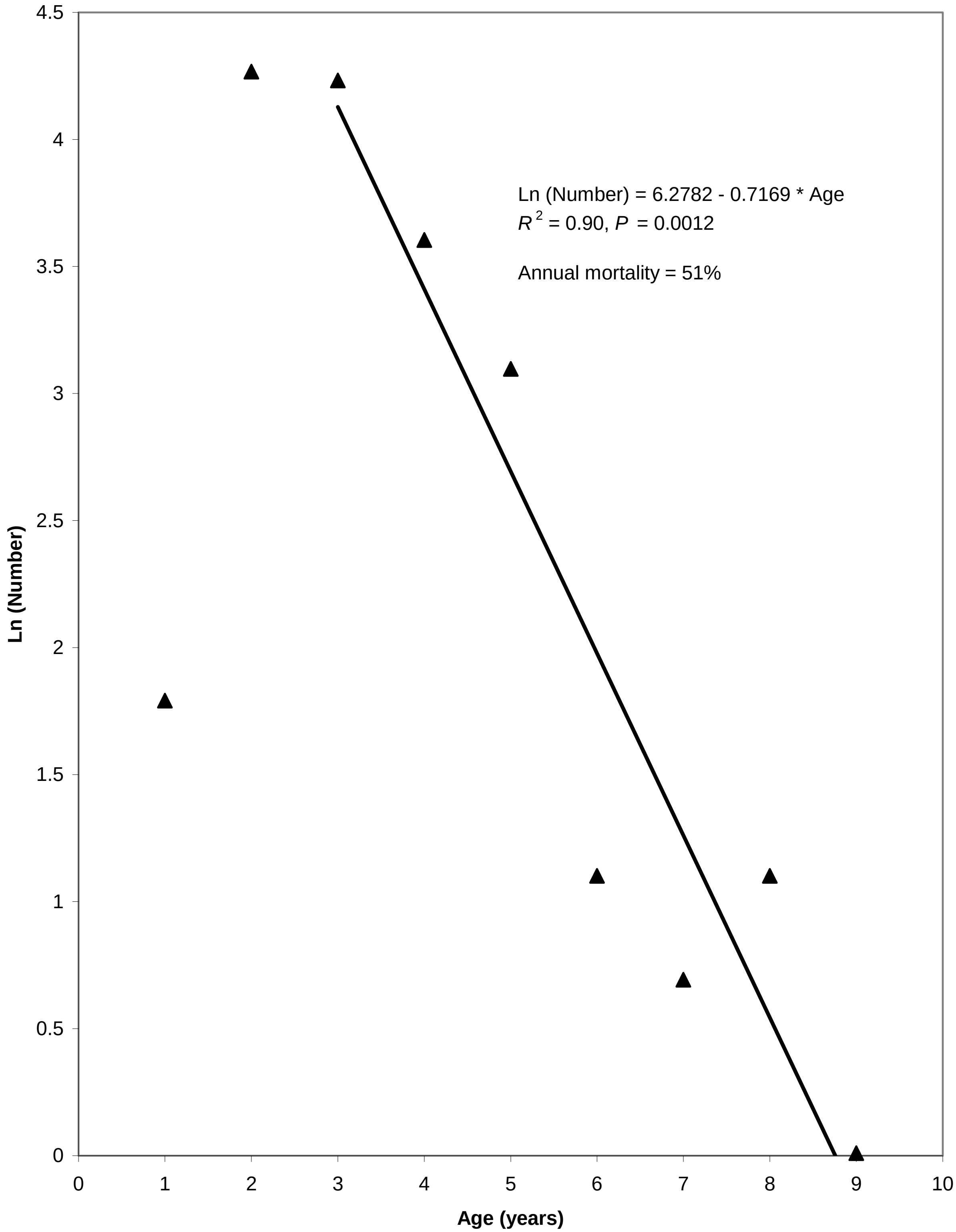

Figure 7.–Observed ln(number) versus age for largemouth bass captured in Shavehead Lake during May 15-23, 2000.