EUFAULA RESERVOIR
MANAGEMENT REPORT
SPRING 2007

Prepared by

Michael P. Holley
District Fisheries Biologist

Kenneth C. Weathers
District Fisheries Supervisor

Rob McCarter
Biologist Aide II

Fisheries Section
Wildlife and Freshwater Fisheries Division
Department of Conservation and Natural Resources

September 1, 2007

Introduction

Lake Eufaula (Figure 1) is a 45,181-acre impoundment on the Chattahoochee River located in Russell, Barbour, and Henry Counties, Alabama. Pertinent characteristics of the lake are listed in Table 1, and a more in depth description of the reservoir can be found in Newman et al. (1986). In order to predict and evaluate population trends, sampling is periodically conducted on Alabama Reservoirs. Due to the popularity of the fishery, and the high amount of tournament activity that occurs on Lake Eufaula, sampling is conducted annually to monitor population trends. A 16-inch minimum length limit was initiated for largemouth bass in Lake Eufaula in 1992, but was reduced to a 14-inch minimum length limit in 2000, to increase the number of bass available to anglers (Weathers et al. 2000).

Lake Eufaula has been sampled in both spring and fall since 1986, but beginning in 2007, only a spring electrofishing sample will be conducted for adult largemouth bass. Also, shoreline prod-pole electrofishing targeting young-of-year (YOY) largemouth bass was conducted in place of shoreline seining in spring 2007, and will continue to be used to measure spawning success. An increase in spotted bass has been observed in Lake Eufaula, and they will be targeted in future sampling efforts.

Methods

Largemouth bass, gizzard shad, and threadfin shad were targeted during spring and summer 2007. In addition to the standardized sampling, electrofishing effectiveness for spotted bass was evaluated on March 28, 2007.

Electrofishing surveys were conducted on March 20th and March 21st to collect largemouth bass. Electrofishing gear consisted of a boat mounted Smith Root Type VI-A pulsator, Honda 5000 watt generator, with boom electrodes that delivered 5-6 amperes at 800 – 1000 volts of pulsed direct current. Six stratified random sites (Figure 1) were sampled for 1800 seconds each, and largemouth bass were collected, measured to the nearest millimeter, and weighed to the nearest gram. The same electrofishing gear was used to collect spotted bass, but the anodes on the booms were outfitted with extended cables to enhance the electric field in deeper water. Spotted bass sampling was confined to deep channel bluffs and the areas around the Highway 82 causeway.

A sub-sample of up to 10 otoliths was removed from each 25 mm (1 inch) length group to evaluate growth, longevity, and mortality of largemouth bass. Otoliths were read in whole view by District VI personnel, but if they displayed more than five annuli, they were sectioned according to the procedures described by Maceina (1988) to verify the whole view read.

Catch per effort was calculated as the number of fish caught per hour of electrofishing, and stock density indices were calculated according to Anderson and Nuemann (1996). Growth was described using the von Bertalanffy equation, and the time to reach 356 mm (minimum length limit) and 510 mm (memorable size) was calculated by inverting the equation and solving for time to reach each length. Total annual mortality was estimated by regressing the natural log of the number-at-age against age (catch-curve regression). Natural mortality was calculated using the empirical and theoretical equations in the Fishery Analysis and Simulation Tools (FAST) software (Slipke and Maceina 2000). Using estimates of growth, longevity and mortality, the

FAST software was used to evaluate the current 14 inch minimum length limit. Simulations were conducted to compare 12, 14, 15, and 16 inch minimum length limits by predicting the number of fish available to anglers, the number of memorable size fish produced, and the mean weight of largemouth bass under each restriction.

Prod-pole electrofishing was conducted on May 24th, instead of seining, to document YOY largemouth bass abundance. Gear consisted of the same boat configuration used in the standard electrofishing survey, but the electrode was an eight foot hand-held fiberglass pole with a 10 inch aluminum ring, instead of the boom electrodes. The prod-pole allowed shoreline sampling in juvenile fish habitat. Pulsator settings were lowered to deliver 2-4 amperes at 800 volts pulsed direct current. Nine stratified random sites were electrofished for 300 seconds. Three transects in each lower (Hardridge Creek), mid (Cheneyhatchee Creek), and upper (Cowikee Creek) section of the lake (Figure 1) were sampled to verify spawning.

Threadfin shad were collected using a surface trawl at a lower (Dam Forebay), mid (White Oak Creek), and upper site (Old Creek Town) in Lake Eufaula (Figure 1). Trawling consisted of 3 five minute pulls at each site. Shad were measured to the nearest 1 cm total length, and density was calculated as the number of shad per cubic meter of water. Pearson correlation coefficients and multiple regression were used to explore the effects of shad density on age-1 largemouth bass recruitment.

Water quality was evaluated on August 15, 2007 at the dam fore bay. A dissolved oxygen meter with a temperature sensor was used to collect data from the water surface to the bottom in 1 meter increments. Chlorophyll-a and total dissolved solid data was acquired from Alabama Department of Environmental Management (ADEM).

Results and Discussion

Largemouth Bass

Largemouth bass (N = 385) were captured at a rate of 128 fish/hour, which is slightly higher than catch rates observed during 2006, and similar to the lake average of 130 fish/hour (Table 2). Catch rates were above average for sub-stock, and stock size fish, but were below average for quality, preferred and memorable size fish (Table 2). Largemouth bass ranged from 67 mm to 563 mm total length (TL), and 1 to 16 years old (Table 3; Figure 2). Proportional stock density (PSD) was 64, and incremental RSD values were similar to the statewide average for RSD-(S-Q), RSD-(Q-P), and RSD-(P-M) size groups (Table 2, Figure 3). RSD-(M-T) was below average for Alabama reservoirs (Table 2, Figure 3). Approximately 41% of the bass stock size and larger exceeded the 14 inch minimum length limit (356mm), but larger fish were rare, as only 1.6% were memorable size (510mm; 20 inches) or larger.

Largemouth bass growth rates were similar to those observed in Spring, 2006, but growth rates are still at a record low for Lake Eufaula. The von Bertalanffy equation (Figure 4) predicted that it took largemouth bass 4.7 years to reach the 14 inch minimum length limit (356 mm), and 11.8 years to reach memorable size (510 mm). The growth curve for age 1 to 5 fish from Lake Eufaula was below the statewide average, and was similar to the lower 25th percentile through age-3, and lower than the lower 25th percentile for fish older than age-3 (Figure 5). It should be noted that average growth rates for Alabama reservoirs is from data through 1996, and a statewide decrease in growth rates has been observed since that time (Maceina et al. 2003). Average relative weight was adequate for fish quality (mean Wr = 91) and preferred (mean Wr = 93) size, but stock size and memorable size fish displayed relative weight values less than 90 (Table 2).

Total annual mortality from catch-curve analysis was 30% for largemouth bass in Lake Eufaula (Figure 6). The regression was highly significant ($F = 75.08$; $P < 0.0001$), however the adjusted r^2 (adj $r^2 = 0.86$) did not meet criteria set forth in the Alabama Reservoir Management Manual (Cook 1999). Residuals indicate that 1998, 2001, 2002 and 2003 were good year-classes for bass. Natural mortality ranged from 0.18 to 0.28, and averaged 0.26 from the equations in FAST. The estimate of natural mortality and total annual mortality indicated that fishing mortality (F) is about 0.09. Therefore, exploitation (μ) was calculated as approximately 8% in Lake Eufaula.

Using the estimates of growth, longevity, and mortality, simulation modeling was used to evaluate the current 14 inch minimum length limit on Lake Eufaula. The predicted number of fish available to anglers under a 15 or 16 inch minimum length limit, would decrease 16 and 32%, respectively (Figure 7). Under a more liberal 12 inch minimum length limit, the number of fish available to anglers would increase about 33% (Figure 7). The predicted number of fish reaching memorable size (510 mm) would only increase 8 and 16 % respectively under 15 and 16 inch minimum length limits, and would decrease about 12 % under a 12 inch minimum length limit (Figure 8). The mean weight of harvested bass would only increase about 277 grams (0.6 lbs) with a 16 inch minimum length limit, compared to the 14 inch minimum length limit (Figure 9).

Considering the large amount of tournament activity that occurs on Lake Eufaula, the ability to weigh-in fish and produce larger fish at the same time is best accomplished with the current 14 inch minimum length limit. Although a slight increase in the number of memorable size fish was predicted with the 15 and 16 inch minimum length limits, the cost of higher length limits outweigh the benefits, as a decrease in the number of fish available to anglers was predicted with the 15 and 16 inch minimum length limits. Additionally, the slower growth rate that has been observed indicates that the time to reach 15 and 16 inches would be 5.3 and 6.1 years, respectively, opposed to 4.7 years to reach 14 inches. The low harvest rates that were estimated are supported by an increase in longevity of bass over the past several years. During the 2007 sample, a 16 year old bass was collected, which ties the record maximum age for Alabama.

The 2006 Bass Anglers Information Team (B.A.I.T) report indicated that Lake Eufaula received more tournament reports (45) than any other reservoir in Alabama (Abernethy 2007). The number of bass per day (1.78) and average weight (2.09) remained similar to data from the 2005 B.A.I.T report. Although Lake Eufaula ranks low in the pounds per angler day (3.73) category, the average weight of bass (2.09) still remains high. The number of hours required to catch a bass over 5 pounds in Lake Eufaula remained below 300 in 2006, and ranked 4th overall behind Guntersville, West Point, and Aliceville reservoirs.

YOY Largemouth Bass

Spawning success was verified at all sampling locations, and the catch rate for YOY bass across all sites was 303 fish/hour of prod-pole electrofishing. The mean catch rate was 468, 294, and 148 for the upper (Cowikee Creek), mid (Cheneyhatchee Creek), and lower (Hardridge Creek) sites, respectively. Catch rates of YOY bass displayed a decreasing trend from the upper end of the reservoir to lower end.

Shad

Catch rates of young-of-year shad were at a five year low, and the last above average year-class occurred in 2003 (Figure10). Shad density, as estimated with the surface trawl, has not played a major role in year-class strength of bass during the last 11 years (Figure 10). Spurious correlations were derived when shad density was correlated against age-1 catch rates of bass (Pearson; $r = 0.42$; $P = 0.1934$), indicating that shad density did not have a major effect on recruitment to age-1. Shad density was weakly correlated to mean length-at-age of age-1 bass (Pearson; $r = 0.56$; $P = 0.071$), implying that increased shad density may improve first year growth rates.

The catch rate of age-1 bass was above average in 2007, but the mean length-at-age was below average (Figure 11). The pattern of smaller size-at-age for age-1 bass is evident in the 2007 sample, as shad catch rates were very low in 2006. It is predicted that 2008 will also reveal smaller size-at-age of age-1 bass due to low shad abundance in summer 2007.

Shad density was also used to explore year-class strength of bass over the last ten years (ages 2-11) by adding the term into the catch-curve regression to create a multiple regression. Shad density was not significant in the model, and age alone accounted for approximately 95% of the variation in year-class strength. Data transformations did not improve correlation between shad density and age-1 catch rates, or significance in the multiple regression. Strong and weak year-classes of bass have been identified by residual analysis (Figure 6) from catch-curve regressions, and age-1 catch rates (Figure 11), however, they do not correlate with strong or weak year-classes of shad (Figure 10).

Spotted Bass

The catch rate of spotted bass (N=38) was 38.4 fish/hour, which is slightly higher than the statewide average of 31.3 fish/hour. Spotted bass ranged in length from 97 to 454 mm, and from 1 to 7 years old (Figure 12). Relative weight was high (> 110) for all size groups of spotted bass, and the mean relative weight for all size groups was 113. More intensive sampling will be conducted for spotted bass during Fall, 2007, as it appears that they can be captured effectively in Lake Eufaula with electrofishing.

Water Quality

The temperature and dissolved oxygen profile (Figure 13) revealed that water temperatures remained relatively stable to 10 meters in Lake Eufaula. Oxygen began to decline after 3 meters, and fell below 4 mg/L between 6 and 7 meters. A review of ADEM water quality data indicates that chlorophyll-a concentration has steadily declined from 14.8 ug/L in 1999, to 11.0 ug/L in 2006, however Lake Eufaula is still considered eutrophic. Total dissolved solids have remained relatively stable and have averaged 84 mg/L from 1999 to 2006. No problems are associated with water quality at this time.

Hybrid Striped Bass Stocking

Alabama Freshwater Fisheries stocked 43,036 hybrid striped bass fry that were approximately 1 inch in length into Lake Eufaula on the 23rd and 24th of May, 2007, (Table 4). Georgia Department of Natural Resources stocked 225,942 (5.1/acre) hybrid striped bass fry into Lake Eufuala in 2007 that averaged 1inch in length.

Grass Carp Stocking

The United States Army Corps of Engineers (USCOE) stocked 13,440 (12/vegetated acre) 9 to 12 inch triploid grass carp into Lake Eufaula during Summer, 2007. Grass carp were stocked near high density areas of hydrilla.

Summary

Largemouth bass growth rates have declined in Lake Eufaula, but the population does not appear as cyclic since the implementation of a 14 inch minimum length limit. The number of bass at or above the length limit is relatively high (41%), however, the production of larger fish is still low. Catch and release angling, and presumably largemouth bass virus (Maceina et al. 2003), appears to have slowed growth of largemouth bass in Lake Eufaula (Weathers et al. 2006). Although no differences have been detected in growth rates between length limit periods (16 to 14 inch minimum length limit) for largemouth bass, differences have been observed when pre largemouth bass virus and post largemouth bass virus data were analyzed.

The increase in submersed plant (hydrilla) abundance is another factor that is most likely contributing to slower growth rates. Although plants can concentrate fish, making them more vulnerable to angling, forage species are able to avoid predation more effectively in thick weeds. Anglers have reported an increase in redear sunfish catch rates, as well as an increase in size of bluegill and redear sunfish as the submersed plants become more abundant. It will be interesting to see if the stocking of triploid grass carp by the USCOE slows the progression of hydrilla on Lake Eufaula. The decrease in chlorophyll-a concentration indicates a decrease in planktonic algae (phytoplankton).

Nutrients in the reservoir are taken up by plants, and become unavailable to algae. As phytoplankton decreases, a decrease in filter feeding forage species such as threadfin shad and gizzard shad is expected.

The reservoir fact sheet and general reconnaissance survey has not changed since being published in the 2004 Lake Eufaula Reservoir Report (Weathers et al. 2004). A new boarding pier has been constructed at the Thomas Mill Creek boat landing. Lake levels have been low during the summer of 2007 due to drought conditions that have affected basin inflows. These low lake levels have led to launching problems at several boat ramps on Lake Eufaula. Boaters are encouraged to view the Freshwater Fisheries website at www.outdooralabama.com to view boating access information for their favorite ramp. During the summer of 2007, old ramps at White Oak Creek, Barbour Creek, and Cowikee Creek (Gammage Road) were not usable.

Conclusions

1. No change is recommended at this time concerning management of the largemouth bass fishery.

2. Continue to encourage B.A.I.T. participation by leaving program literature at local bait and tackle stores, and contacting bass clubs.

3. Alabama Division of Wildlife and Freshwater Fisheries will perform an angler creel survey on Lake Eufaula during the spring of 2008 to determine angler harvest, catch rates, and angler perceptions of the fishery. Contacts will be made to recruit more participation in the B.A.I.T. program.

4. The 2008 spring sample at Lake Eufaula will target bluegill sunfish and redear sunfish in addition to largemouth bass.

References

Abernethy, D.L. 2007. Bass angler information team 2006 annual report. Alabama Division of Wildlife and Freshwater Fisheries, Montgomery, AL.

Anderson, R.O., and R.M. Neumann. 1996. Length, weight, and associated structural indices. Pages 447-482 in B.R. Murphy and D.W. Willis, editors. Fisheries Techniques. 2nd edition. American Fisheries society, Bethesda, Maryland.

Cook, S.F. 1999. Alabama reservoir management manual. Alabama Division of Wildlife and Freshwater Fisheries, Montgomery, AL.

Jenkins, R. M. 1967. The influence of some environmental factors on the standing crop and harvest of fishes in U.S. reservoirs. Pages 298-321 in Reservoir Fisheries Resources Symposium. Southern Division, American Fisheries Society, Bethesda, Maryland, USA.

Maceina, M.J. 1988. A simple grinding procedure for sectioning otoliths. North American Journal of Fisheris Management 8:141-143.

Maceina, M.J., J.M. Grizzle, J.W. Slipke, and M.P. Holley. 2003. Largemouth bass population and virus assessment on Wheeler Reservoir. F-40 Final Report. Alabama Department of Conservation and Natural Resources.

Newman, M. J., M.L. Nail, and F. Hamilton 1986. Eufaula Reservoir Management Report. Alabama Department of Conservation and Natural Resources, Montgomery, Alabama.

Ryder, R.A. 1965. A method for estimating the potential fish production of north-temperate lakes. Transactions of the American Fisheries Society 94:214-218.

Slipke, J.W. and M.J. Maceina. 2000. Fisheries analysis and simulation tools (FAST 2.0). Auburn University Department of Fisheries, Auburn, Alabama.

Weathers, K.C., M.J. Newman, and R. L. McCarter. 2000. Eufaula Reservoir Management Report. Alabama Department of Conservation and Natural Resources, Montgomery, Alabama.

Weathers, K.C., M.J. Newman, and R. L. McCarter. 2004. Eufaula Reservoir Management Report. Alabama Department of Conservation and Natural Resources, Montgomery, Alabama.

Weathers, K.C., M.P. Holley, and R. L. McCarter. 2006. Eufaula Reservoir Management Report. Alabama Department of Conservation and Natural Resources, Montgomery, Alabama.

Welch, P.S. 1948. Limnological Methods. McGraw-Hill. pp. 93-94.

APPENDIX A

TABLES AND FIGURES

Table 1. Lake Eufaula morphometric, physical, and chemical characteristics.

Surface area	45,181	acres
Drainage area	7,460	sq. mi.
Full pool elevation	190	feet-msl
Mean annual fluxuation	6	feet
Shoreline distance	515	miles
Shoreline development index	17.3	(Welch 1948)
Mean depth	20.4	feet
Maximum depth	93	feet
Outlet depth	65	feet
Total dissolved solids	84	mg/l
Morphoedaphic index	4.1	TDS/mean depth(ft) (Ryder 1965)
Growing season	249	frost free days (Jenkins 1967)
Date of Impoundment	1962	

Table 2. Relative stock density (RSD), catch per effort (CPE), and relative weight (Wr) of largemouth bass over the last 5 sampling events for Lake Eufaula.

Largemouth Bass			TOTAL NUMBER, CPE, PERCENT OF SAMPLE AND Wr																			
		Number	SUBSTOCK			RSD (S-Q)				RSD (Q-P)				RSD (P-M)				RSD (M-T)				TOTAL	
Year	Gear	Samples	no.	cpe	ratio	no.	cpe	pct.	Wr	no.	cpe	pct.	Wr	no.	cpe	pct.	Wr	no.	cpe	pct.	Wr	no.	cpe
2003	E	3	16	14	15	23	20	22	97	33	29	32	99	43	38	41	98	5	4	5	104	120	106
2004	E	3	10	12	9	25	30	24	89	41	49	39	91	34	41	32	95	6	7	6	96	116	140
2005	E	3	9	12	8	24	33	22	96	41	56	38	96	42	57	39	102	1	1	1	96	117	159
2006	E	3	28	23	25	41	33	36	91	31	25	27	96	40	33	35	94	2	2	2	111	142	116
2007	E	6	73	24	23	111	37	36	88	104	35	33	91	92	31	29	93	5	2	2	87	385	128
LAKE AVERAGE				17	16		29	26	92		39	34	95		40	35	96		3	3	99		130

Table 3. Age composition and mean length-at-age of largemouth bass from Lake Eufaula, Spring 2007.

Age	Year Class	Number	Percent	CPE	Mean TL	Range	SE
1	2006	71	18.4	23.7	154.3	67-224	4.5
2	2005	113	29.4	37.7	258.2	175-327	3.7
3	2004	59	15.3	19.7	332.7	267-411	4.7
4	2003	44	11.4	14.7	365.8	302-459	5.1
5	2002	42	10.9	14.0	391.6	310-527	6.9
6	2001	26	6.8	8.7	390.2	303-483	9.9
7	2000	10	2.6	3.3	438.2	410-472	7.5
8	1999	6	1.6	2.0	491.7	431-563	23.2
9	1998	7	1.8	2.3	448.0	427-485	7.9
10	1997	2	0.5	0.7	440.0	431-449	9.0
11	1996	1	0.3	0.3	440.0	-	-
12	1995	0	0.0	0.0	-	-	-
13	1994	1	0.3	0.3	477.0	-	-
14	1993	1	0.3	0.3	544.0	-	-
15	1992	1	0.3	0.3	425.0	-	-
16	1991	1	0.3	0.3	561.0	-	-
Total		385	100.0	128.3			

Table 4. Stocking history for Lake Eufuala by Alabama Wildlife and Freshwater Fisheries.

Species	**Year**	**Number/Acre**	**Size**	**Total**
Hybrid Striped bass	1975	1.1	1”	49,000
	1976	1.5	1”	69,075
	1977	2.2	1”	99,938
	1979	1.3	1”	59,790
	1980	0.7	1”	32,307
	1982	2.3	1”	105,000
	1983	2.7	1”	120,630
	1984	2.4	1”	108,200
	1986	2.2	1”	99,700
	2007	0.95	1”	43,036
Largemouth Bass (Florida Strain)	1986	0.3	1-2”	13,800

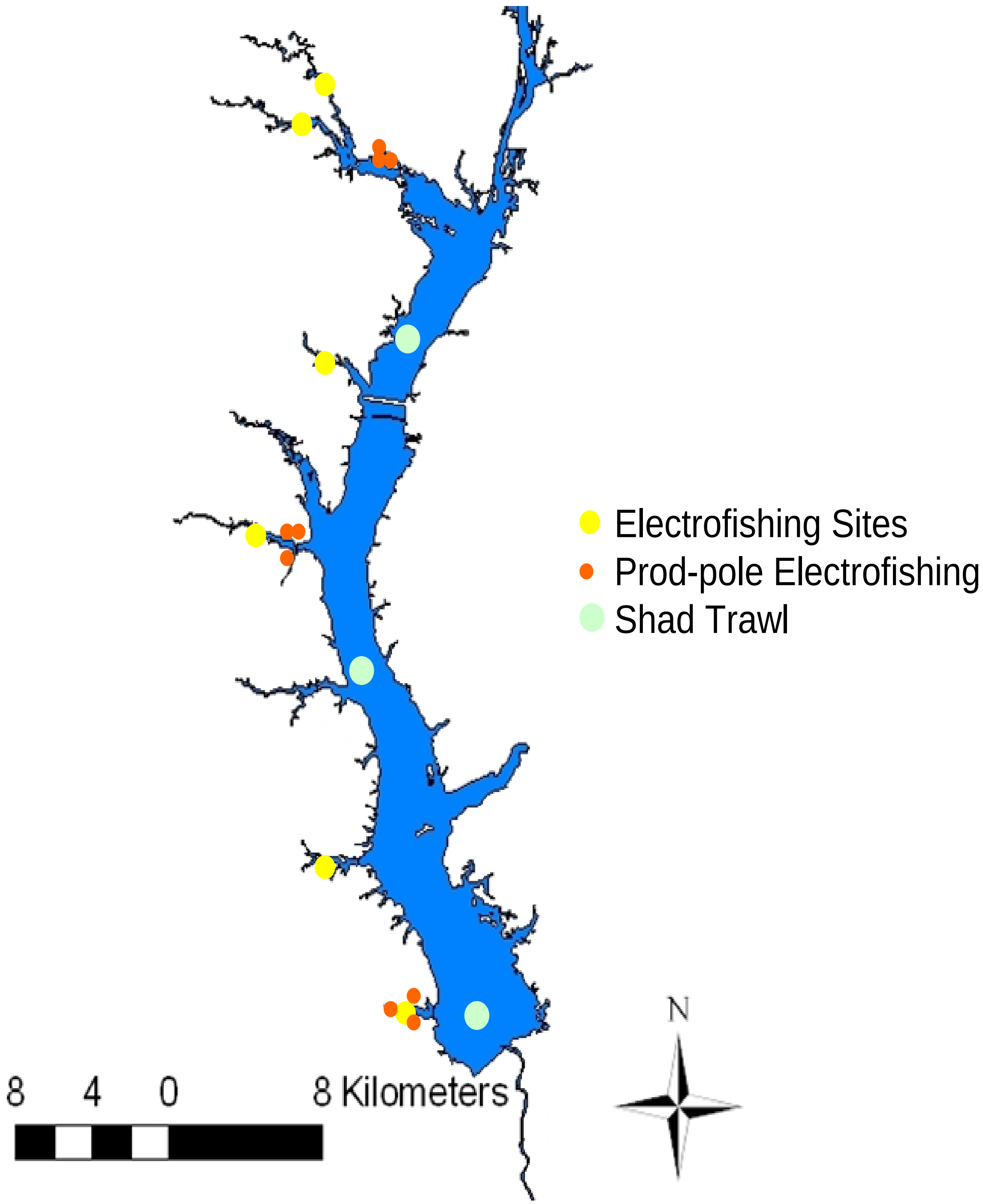

Figure 1. Map of Lake Eufaula, and sampling locations for Spring-Summer, 2007

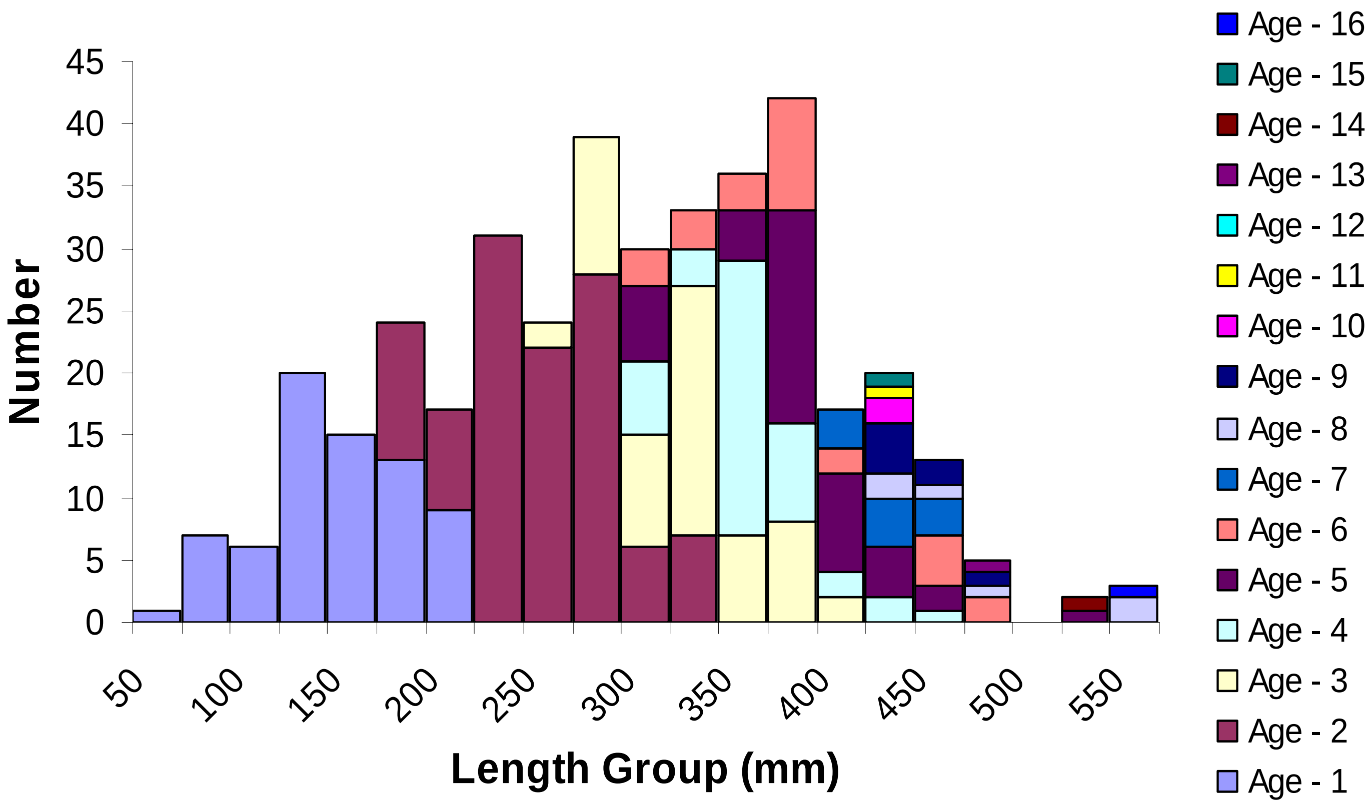

Figure 2. Length-at-age frequency for Lake Eufaula largemouth bass (N = 385), Spring 2007.

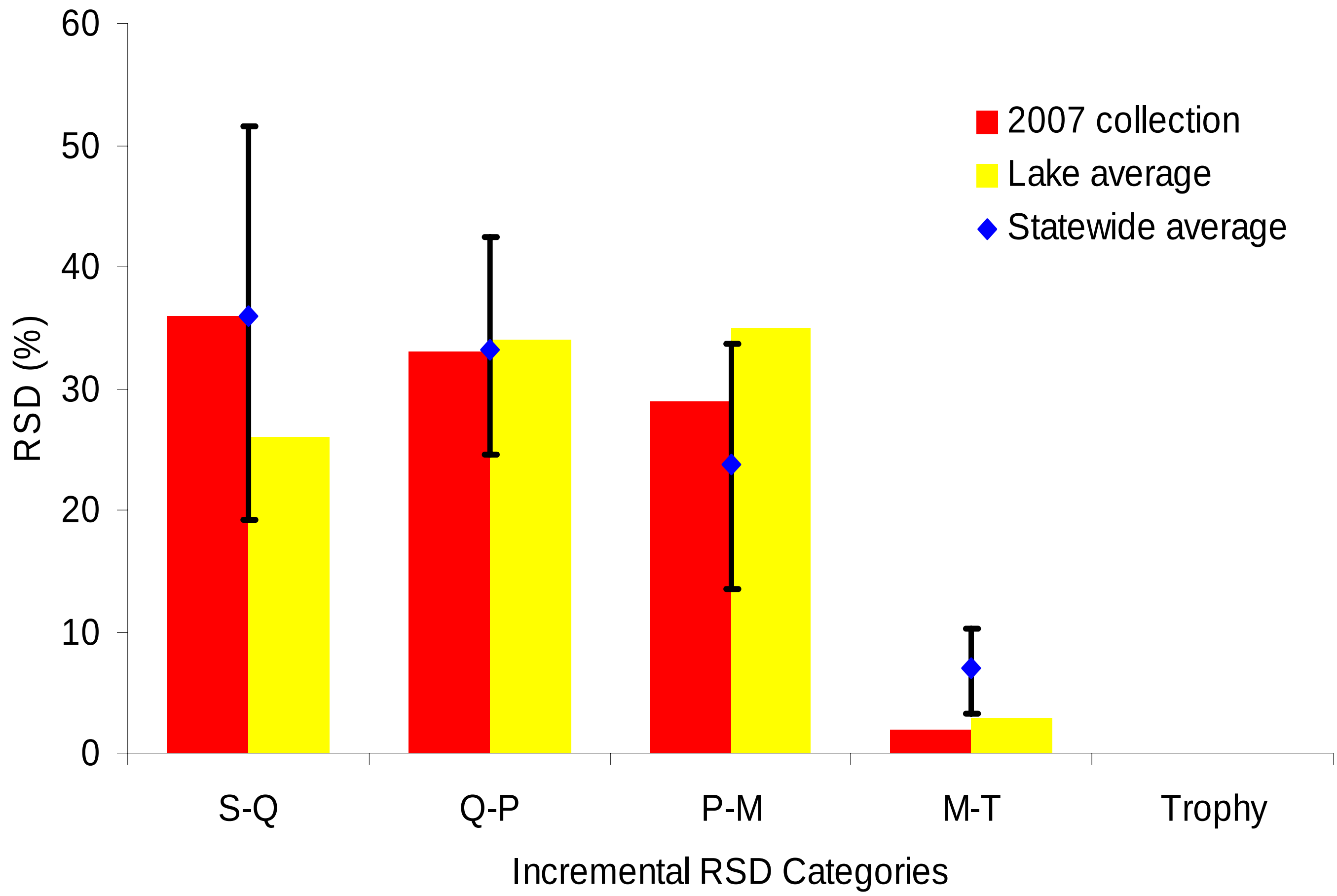

Figure 3. Relative stock densities (RSD) for Lake Eufaula largemouth bass. The I-beam represents the 25th and 75th percentiles for largemouth bass population RSD values in Alabama reservoirs. The blue diamonds are the statewide mean values, and the red and yellow bars are 2007 collection and five year lake average values, respectively.

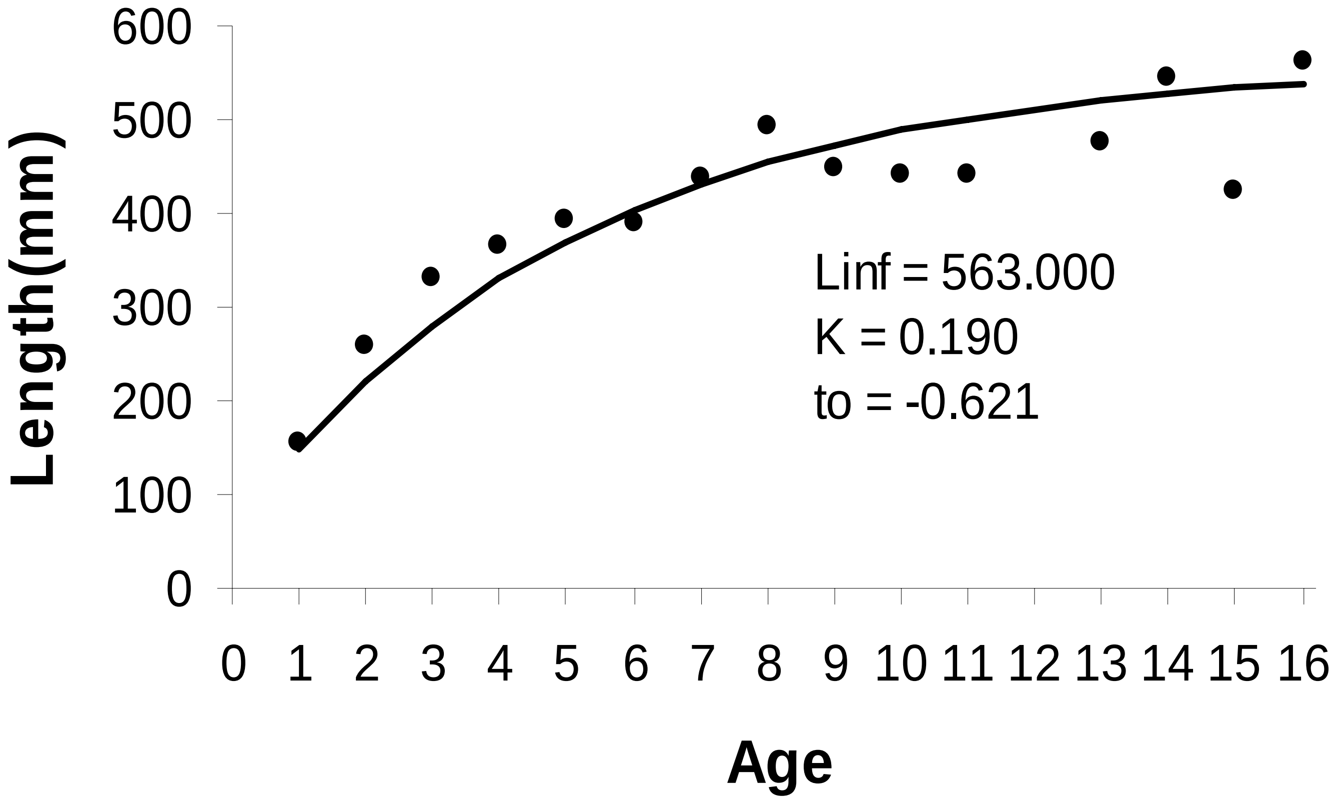

Figure 4. von Bertalanffy growth curve for largemouth bass from Lake Eufaula, Spring 2007. Plotted data (circles) are mean lengths-at-age, and the solid line represents the predicted growth curve.

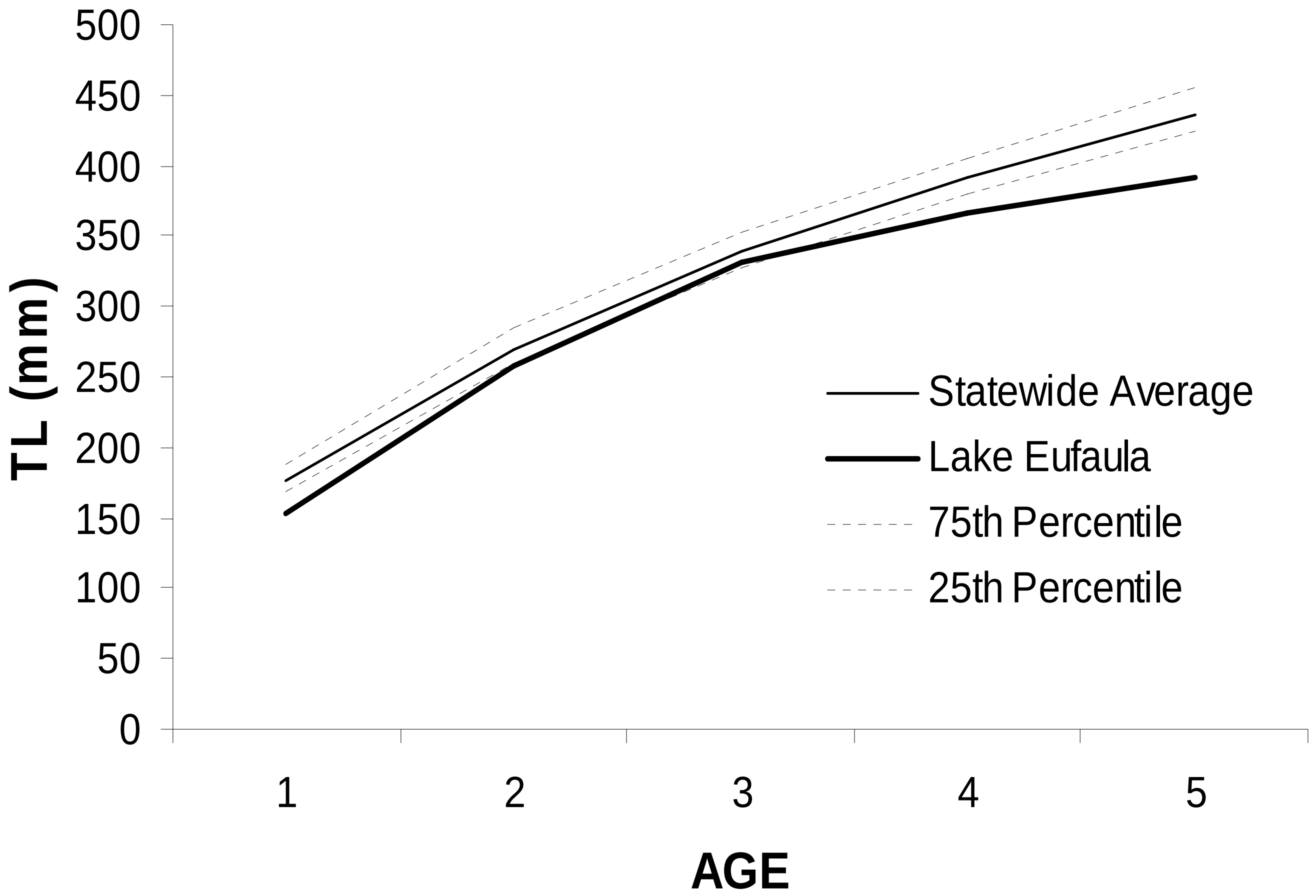

Figure 5. von Bertalanffy growth curves for age 1-5 largemouth bass from Lake Eufaula (solid bold line), the statewide average (solid line), and the statewide 25^{th} (lower dashed) and 75^{th} (upper dashed) percentiles.

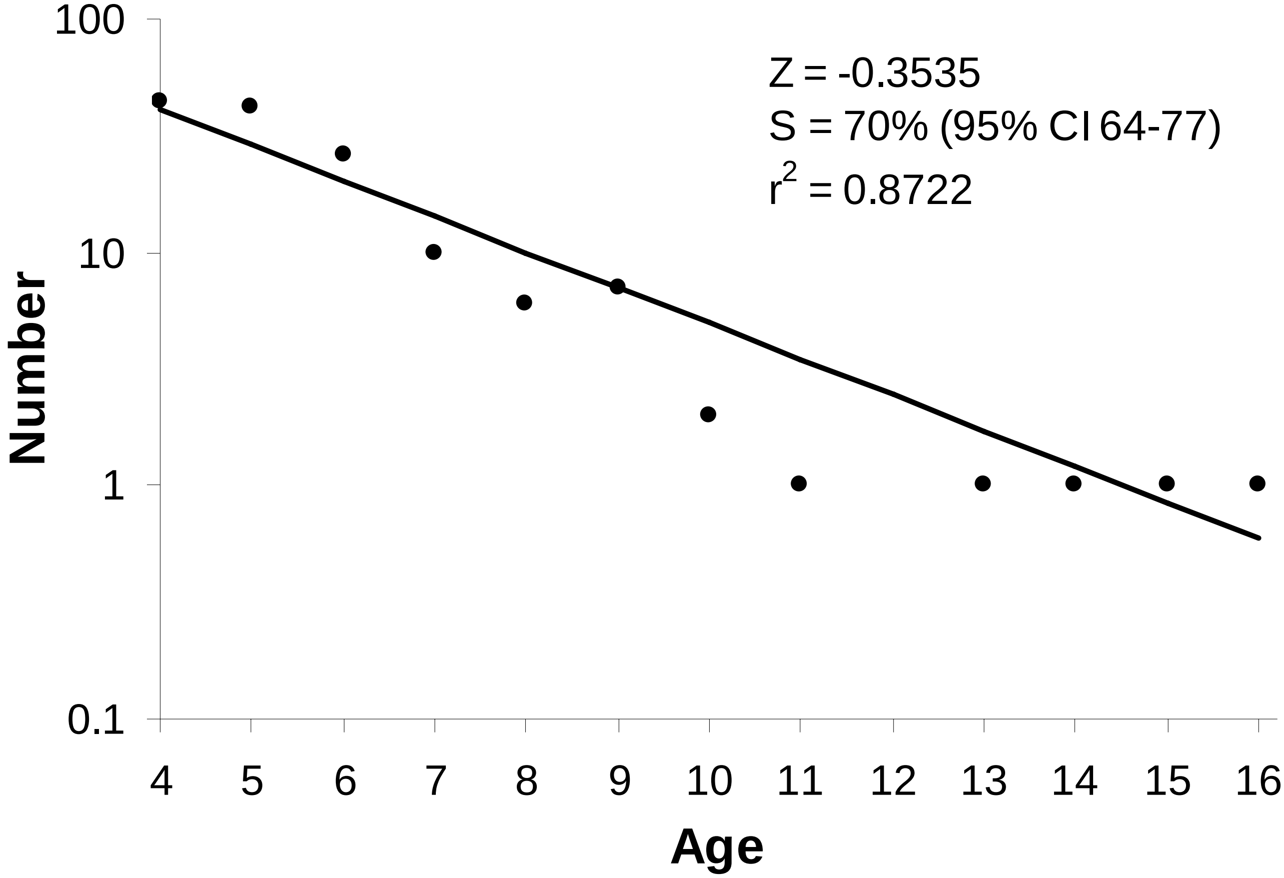

Figure 6. Catch-curve regression for largemouth bass from Lake Eufaula, 2007. The circles represent the number-at-age, and the solid line is the predicted number-at-age (slope or Z).

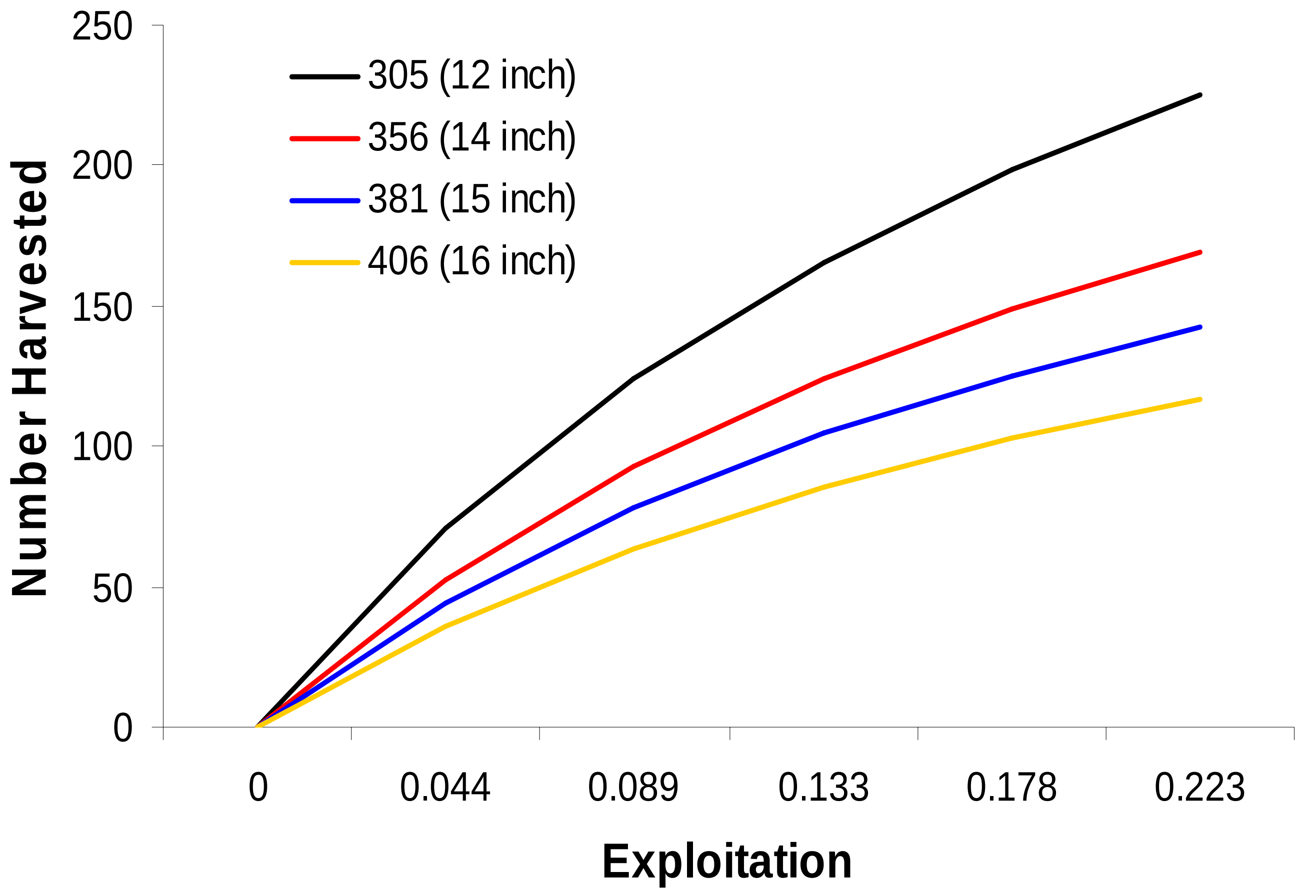

Figure 7. The predicted number of largemouth bass available to anglers under 12, 14, 15, and 16 inch minimum length limits at varying levels of exploitation (current estimate = 0.08).

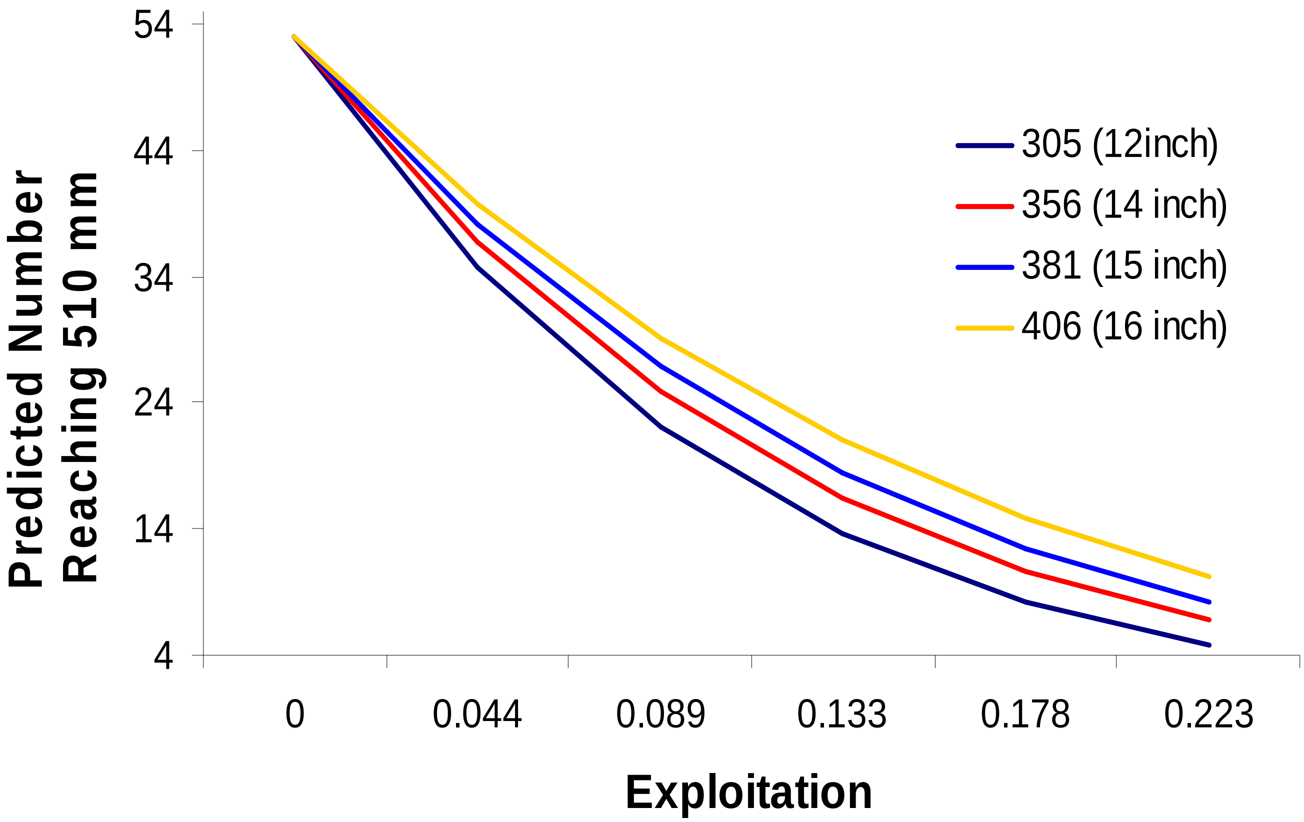

Figure 8. The predicted number of largemouth bass reaching memorable size under 12, 14, 15 and 16 inch minimum length limits and varying levels of exploitation (current estimate = 0.08).

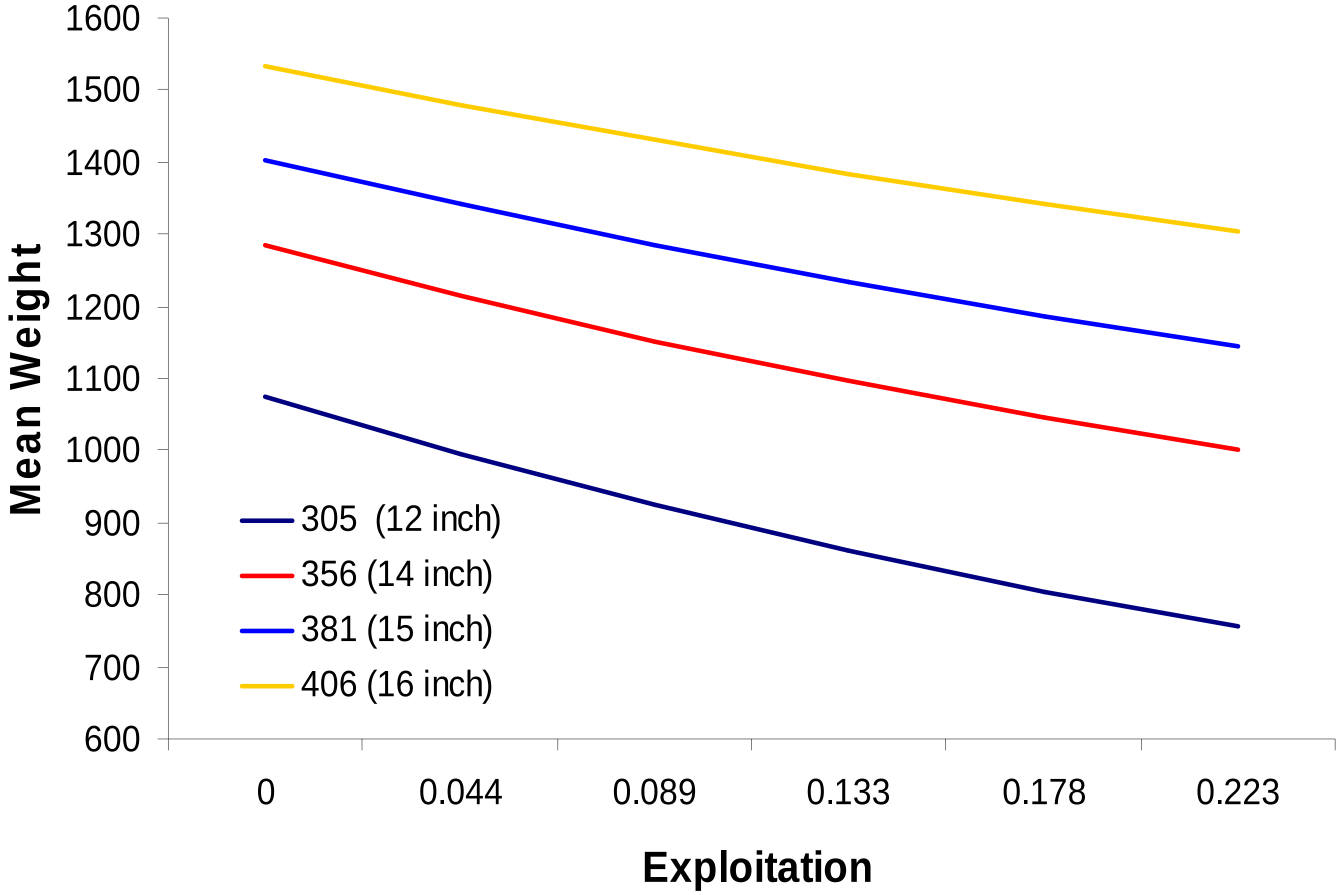

Figure 9. The predicted mean weight of largemouth bass under 12, 14, 15 and 16 inch minimum length limits and varying levels of exploitation (current estimate = 0.08).

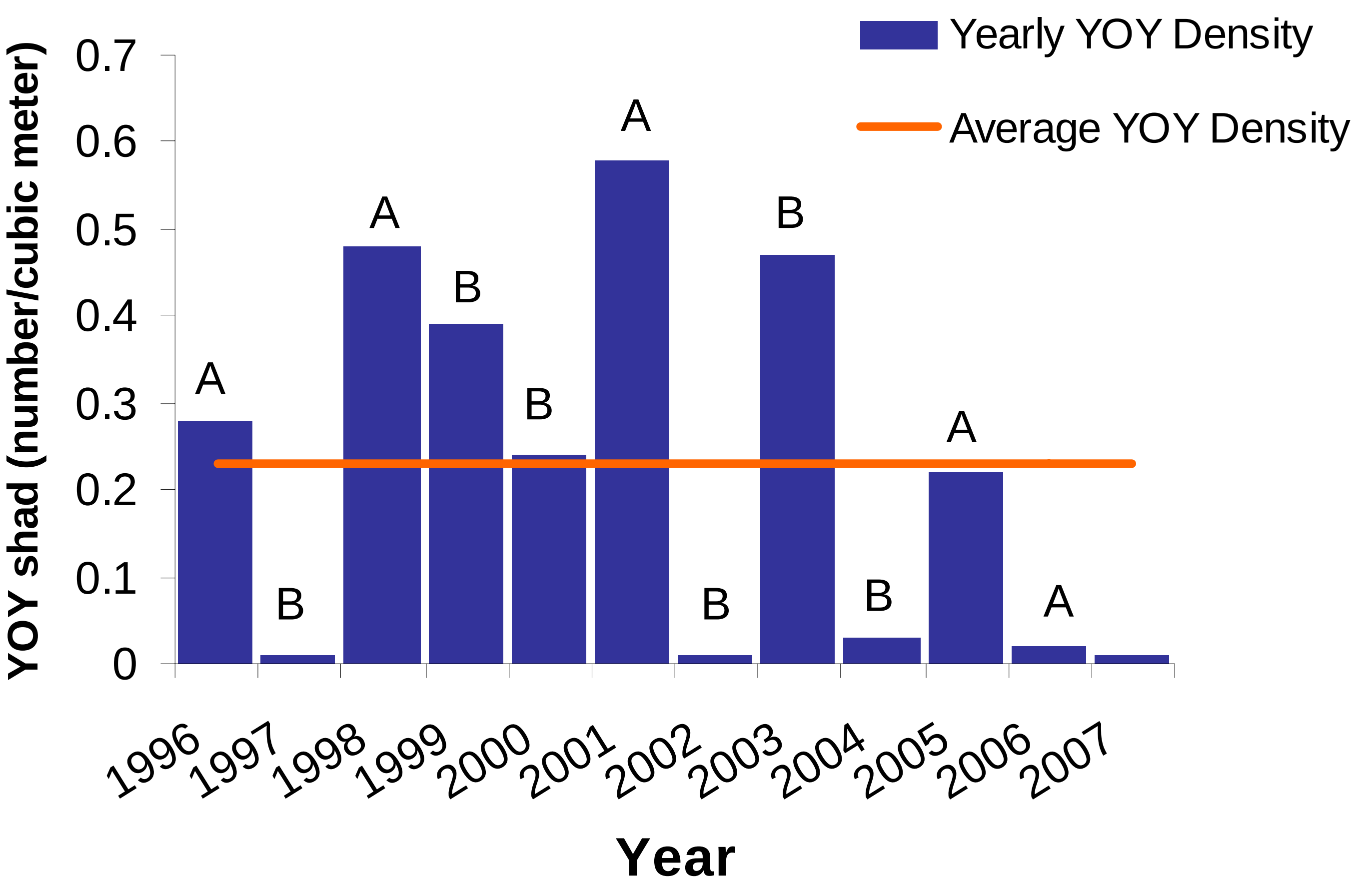

Figure 10. Shad density in Lake Eufaula over and 11 year period. The vertical bars represent yearly density estimates, and the solid line is the mean density over the 11 year period. The letter A corresponds to above average catch rates of age-1 bass, and the letter B corresponds to below average catch rates of age-1 bass the following spring after shad collection.

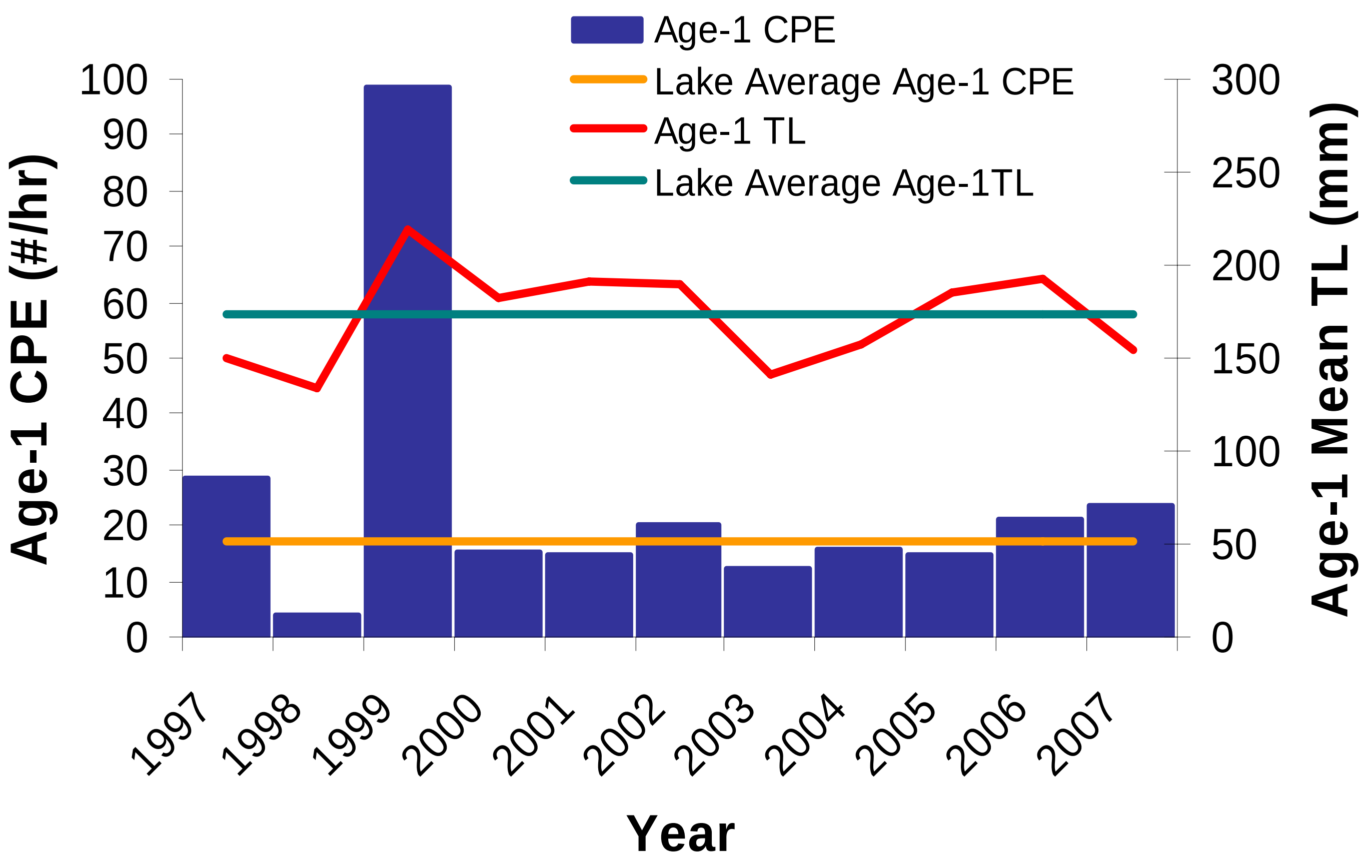

Figure 11. Age-1 catch rates and age-1 mean TL for largemouth bass over a 10 year period. The primary (left) y axis corresponds to catch rate and the secondary (right) y axis corresponds to mean TL. The vertical bars (blue) are mean CPE for each year, and yearly mean total length is represented by the red line. The mean CPE (orange line) and mean TL (green line) are averages over the 10 year period.

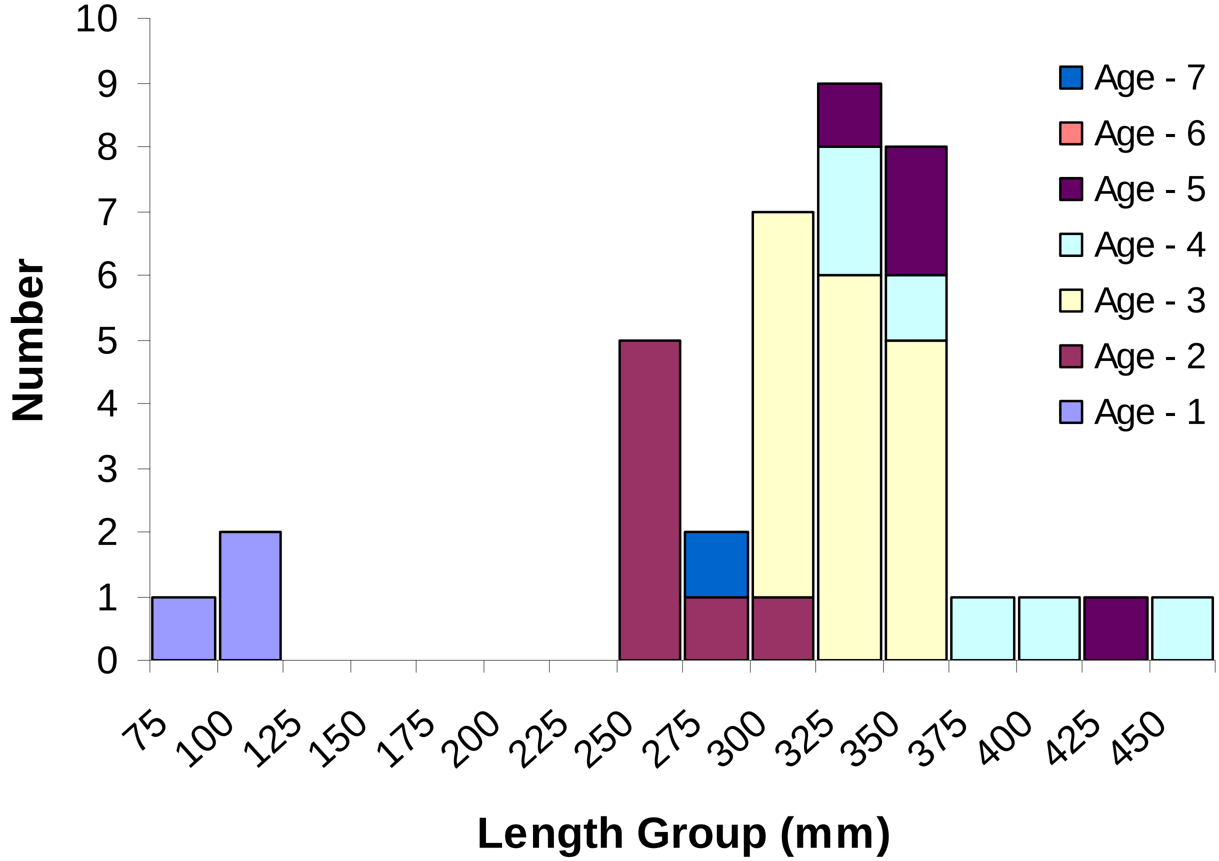

Figure 12. Length-at-age frequency for spotted bass (N = 38) from Lake Eufaula, Spring 2007.

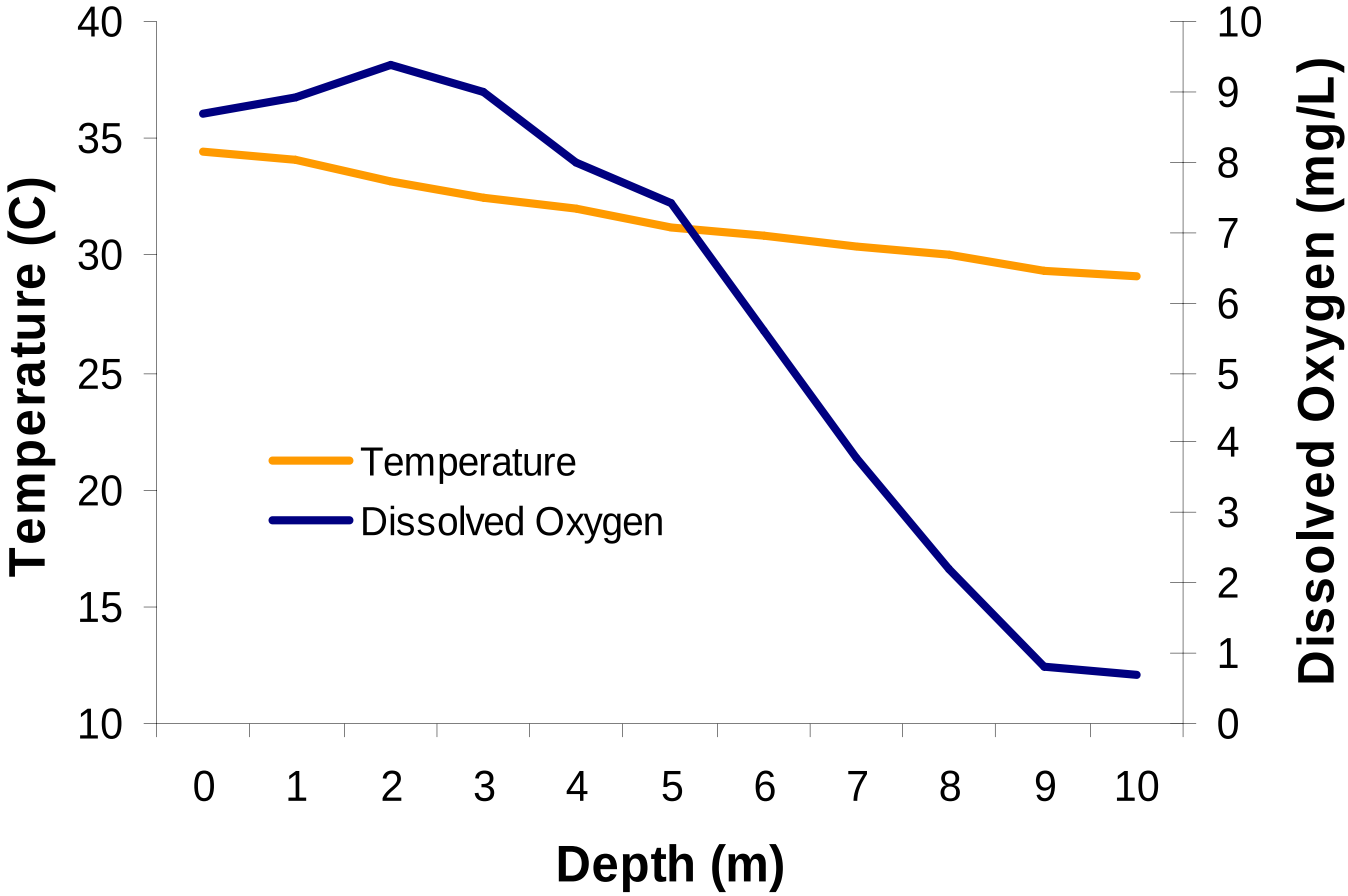

Figure 13. Temperature and dissolved oxygen profile for Lake Eufaula, Summer 2007.