LAKE JAMES LARGEMOUTH BASS SURVEY (2010−2011)

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Abstract.—This report summarizes the findings of a Largemouth Bass *Micropterus salmoides* electrofishing survey conducted on the Catawba River arm of Lake James in April 2010−2011. A total of 236 Largemouth Bass were collected during this survey. Mean catch rates ranged from 23.6 fish/hour (SE = 3.41) in 2010 to 42.6 fish/hour (SE = 4.99) in 2011. Sizes ranged from 98−523 mm TL (mean = 311.0 mm TL; SE = 5.89). PSD-P values ranged from 35 in 2011 to 40 in 2010, and PSD-M values from 1 in 2010 to 2 in 2011. There were no trophy-length (≥ 630 mm TL) fish collected during this survey. Largemouth Bass condition was moderate during the survey; mean W_r ranged from 86 (SE = 0.74) in 2010 to 90 (SE = 0.77) in 2011. Largemouth Bass up to age 12 were captured; however, 81% of the total catch was ≤ 3-yrs old. The von Bertalanffy growth curve that best fit the data explained 99% of the total variation in length at age. Largemouth Bass approached quality size (≥300 mm TL) by age 3 and harvestable size (356 mm TL) in just under 4 years. Total annual mortality was estimated to be 0.44, and the Largemouth Bass population in Lake James appears to be exploited at low levels.

Located in Burke and McDowell counties, Lake James is the uppermost reservoir in the Catawba River chain of Duke Power Company lakes. Impounded in 1923, the reservoir covers 2,634 ha at full pool, has 242 km of shoreline, and a watershed area of 984 km^2. Average water depth within the reservoir is 13.5 m, with a maximum depth of 43 m, and a mean hydraulic retention time of 228 d. Lake James is oligotrophic, with low alkalinity (9-14 mg/l $CaCO_3$), a pH range of 6.4-7.4, typical surface water temperature ranges of 2-30^{o} C, and an average Secchi depth of 2.8 m (NCDENR 1998; NCDENR 2003).

Initial black bass *Micropterus* spp. population assessments in Lake James were based on cove rotenone sampling and were inefficient at capturing adult black bass; thus, accurate population assessments were not possible (Brown et al. 1989). In 1989, shoreline electrofishing investigations of the reservoir's black bass population were initiated by the North Carolina Wildlife Resources Commission (NCWRC) following a 1987–1988 creel survey that estimated that only 77% of the black bass harvested were within the 356-mm minimum size limit, two-fish exemption (Borawa 1989). A subsequent creel survey conducted in 1997–1998 suggested black bass harvest rates have decreased since the 1987–1988 survey, and that harvest rates were very low (.06 fish/hour) when compared to Santeetlah Reservoir, another NC mountain reservoir surveyed in the 1990s (Yow et al. 2002; Yow 2005). Catch rates from 1989–1991 electrofishing surveys were highly variable between years; however, the data indicated that neither recruitment failure nor overharvest were impacting black bass populations within Lake James (NCWRC, unpublished data). An additional electrofishing survey was conducted in 2004–2006 and results were similar to historical surveys (Rash 2006).

Beginning in 2003, the NCWRC initiated a study to compare day versus night shoreline electrofishing techniques for black bass sampling within three Catawba River reservoirs (Hining 2004). Results suggest that day electrofishing was equally efficient as night electrofishing at collecting Largemouth Bass *Micropterus salmoides*, while night electrofishing surveys were more effective at collecting Smallmouth Bass *Micropterus dolomieu* in Lake James. This report summarizes the findings of a Largemouth Bass day electrofishing survey conducted on the nutrient-rich Catawba River arm of Lake James in the spring of 2010−2011 and makes comparisons to the 1989−1991 and 2004−2006 surveys.

Methods

Field Collections.—Largemouth Bass were collected in April of 2010 and 2011. Fish were sampled via boat mounted, 120-V pulsed direct current electrofishing equipment (3–4 A). Sample sites consisted of 12, 300-m shoreline transects scattered throughout the Catawba River arm of Lake James (Figure 1). Sampling sites were sampled during the day and water temperatures ranged from 14.7−18.8^{o}C.

All Largemouth Bass collected were placed in a plastic bag labeled by site, placed on ice, and returned to the Marion State Fish Hatchery. All fish were then weighed (g), measured (mm, TL) and sexed. Fish were considered immature if the gonads were not developed. Sagittal otoliths were removed for age determination.

Catch-per-unit-effort.—Abundance was indexed as catch-per-unit-effort (CPUE) of electrofishing time and expressed as number of fish collected per hour.

Size Structure.—Length-frequency histograms were developed to describe patterns in size distribution. Proportional size distributions (PSDs) were calculated following Anderson and Neumann (1996) and Guy et al. (2007). Length classes used for Largemouth Bass were stock (≥200 mm TL), quality (≥300 mm TL), preferred (≥380 mm TL), memorable (≥510 mm TL), and trophy (≥630 mm TL).

Age and Growth.—Sagittal otoliths were mounted on fully-frosted, cytological microscope slides using cyanoacrylate glue and sectioned transversely through the dorsoventral plane into two, 0.5-mm sections using a Buehler Isomet low-speed diamond wheel saw (Allen et al. 2003). Sections then were mounted onto glass microscope slides using Thermo Shandon synthetic mountant, and annuli were counted using a compound microscope (Hoyer et. al. 1985; Heidinger and Clodfelter 1987). Otoliths were read independently by two readers, and any aging discrepancies between the readers were rectified by jointly reading the otolith. If the age could not be rectified, the age data were not used in further analyses.

Annulus formation is due to substantial changes in fish growth (Devries and Frie 1996). Consequently, newly formed annuli of temperate fishes should become apparent in the spring when growth rates dramatically increase following a winter-time lull. Taubert and Tranquilli (1982) found that annulus formation for Largemouth Bass generally occurred between April and June in Lake Sangchris, Illinois. Thus, if fish are collected during the period of annulus formation, managers must ensure that the developing annulus is not omitted during age assignment. Therefore, once all visible annuli were enumerated for each fish in our survey, we assigned an additional year to the annuli count, accounting for annulus formation during the period of capture.

Length- and age-frequency histograms were constructed to describe patterns in age, size, and growth. In addition, total lengths at age for all fish were pooled to estimate growth rate via the von Bertalanffy growth equation (Van Den Avyle and Hayward 1999), which is defined as:

$$L_t = L_\infty \left(1 - e^{-K\,(t\,-\,to)}\right),$$

where L_t is the predicted TL at time t, L_∞ is the mean maximum TL of the population, K is the growth parameter, t is time in years, and t_o is the time at which L_t is zero.

Index of Condition.—Relative weight (W_r) values were calculated for Largemouth Bass greater than 150 mm TL via the following equation:

$$W_r = W \,/\, W_s \times 100,$$

where W is the wet weight, and W_s is the length-specific standard weight of an individual. The standard weight equation for Largemouth Bass (Anderson and Neumann 1996) is:

$$\log_{10}\mathrm{W_s} = -\,5.316 + 3.191\ \log_{10}\mathrm{TL}.$$

Mortality.—Annual mortality rate (*A*) was calculated for largemouth bass via Chapman-Robson method. Age structures for each year of the survey were pooled to estimate *A*. Fish <age 2 did not fully recruit to the sampling gear and were omitted from consideration. In addition, age classes that contained fewer than five individuals were not used to estimate *A* (Ricker 1975; Robson and Chapman 1961; Wheeler et al. 2003).

Results and Discussion

Catch-per-unit-effort.—A total of 236 Largemouth Bass were collected during this survey at 12 sampling locations (Figure 1). Mean CPUE increased over the 2-year survey from 23.6 (SE = 3.41) in 2010 to 42.6 (SE = 4.99) in 2011 (Table 1). These catch rates were similar to results from the 2004−2006 surveys (Rash 2006).

Size Structure.—Sizes of Largemouth Bass collected during this survey ranged from 98−523 mm TL (mean = 311.2 mm TL; SE = 5.2). Approximately 36% of the Largemouth Bass collected were of legal harvestable size (≥356 mm TL; Figure 2). Both the mean size and percent of harvestable fish is very similar to values reported by Rash (2006).

Proportional size distributions were consistent between years and similar to the 2004−2006 survey. Approximately 40% and 35% of Largemouth Bass were in the preferred (≥380 mm TL) length class, and 1% and 2% were in the memorable (≥510 mm TL) length class for 2010 and 2011, respectively. No fish in the trophy (≥630 mm TL) length class were captured during this survey (Table 2).

Age and Growth.—Largemouth Bass up to age 12 were collected during this survey; however, 81% of all fish collected were ≤3 years old (Figure 3). A similar age structure was observed by Rash (2006). The von Bertalanffy growth curve,

$$TL = 478.2 * (1 - e\ (^{-.644(age+0.298)}),$$

best fit the data and explained 99% of the variation in total length at age (Figure 4). The predicted asymptotic maximum length of 478.6 mm TL was similar to Rash (464.1 mm TL; 2006).

Condition.—Mean W_r values increased slightly over the 2-year survey from 86 (SE =0.74) in 2010 to 90 (SE =0.77) in 2011 (Figure 5). Observed increases in mean W_r over the 2-year period appears to be driven by stock-, quality- and preferred- length fish (Figure 6). Mean W_r of memorable-length fish actually decreased over the 2-year survey; however, sample sizes were low. In general, W_r increases may be the result of increased forage from Threadfin Shad *Dorosoma petenense* stockings. Additionally, Alewife *Alosa pseudoharengus* and Blueback Herring *Alosa aestivalis* were first documented in Lake James in 2010 (NCWRC unpublished data). Since 2010 these fish have become very prolific and may also be providing additional forage. Nonetheless, mean W_r values from 2010−2011 are less than the 3-year mean of 97.8 (SE = 0.70) reported by Rash (2006). Earlier studies by Goudreau (1989) demonstrated W_r values more similar to the 2010−2011 surveys.

Mortality.—Total annual mortality (*A*) was estimated to be 0.44, which is higher than the value of 0.35 reported by Rash (2006). The 2010−2011 *A* value was also higher than what was estimated for Hiwassee Reservoir (0.34), another North Carolina mountain reservoir (Wheeler et al. 2003). Additionally, Beamesderfer and North (1995) evaluated 698 populations of Largemouth Bass in North America and found *A* to average 0.35. Therefore, the estimated *A* of 0.44 calculated during this survey appears to be elevated when compared to historical Lake James values and values reported in the literature.

Conclusions

The Largemouth Bass population in Lake James is comprised of multiple year classes characterized by stock-length fish with average growth in moderate condition. Catch rates, age, and size structures are comparable to historic surveys; however, annual mortality appears to be higher than the 2004−2006 survey data. The recent introductions of White Perch, Blueback Herring and Alewife may influence population dynamics. Although Spotted Bass *Micropterus punctulatus* has yet to be documented in Lake James, this species remains a threat to both Largemouth and Smallmouth Bass populations. Biologists should continue to survey Lake James to document presence and impacts of these invasive species.

Recommendations

1. Continue to manage Lake James Largemouth Bass under the current statewide regulation.

2. Sample Largemouth Bass during the spring of 2014.

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TABLE 1.—Mean catch-per-unit-effort (CPUE; fish/hour) and associated standard error (in parentheses) for Largemouth Bass across all sites during the 2010−2011 electrofishing survey on Lake James, North Carolina.

Year	CPUE
2010	23.6 (3.4)
2011	42.6 (5.0)

TABLE 2.—Proportional size distributions of quality- (PSD; ≥300 mm TL), preferred- (PSD-P; ≥380 mm TL), memorable- (PSD-M; ≥510 mm TL), and trophy- (PSD-T; ≥630 mm TL) length Largemouth Bass collected during the 2010−2012 survey on Lake James, North Carolina.

Year	Index	Value
2010	PSD	67
	PSD-P	40
	PSD-M	1
	PSD-T	0
2011	PSD	78
	PSD-P	35
	PSD-M	2
	PSD-T	0

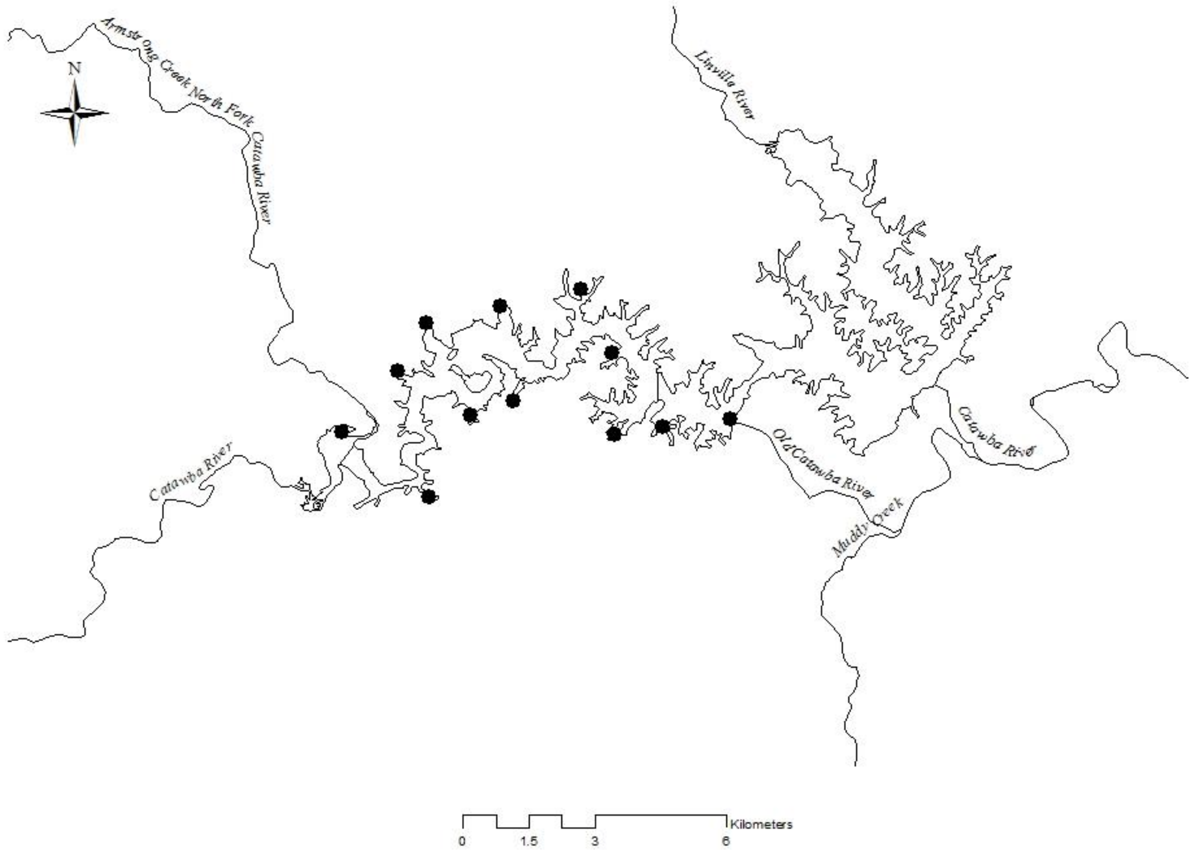

FIGURE 1.—Map of Lake James, North Carolina, with associated electrofishing sampling locations (dark dots).

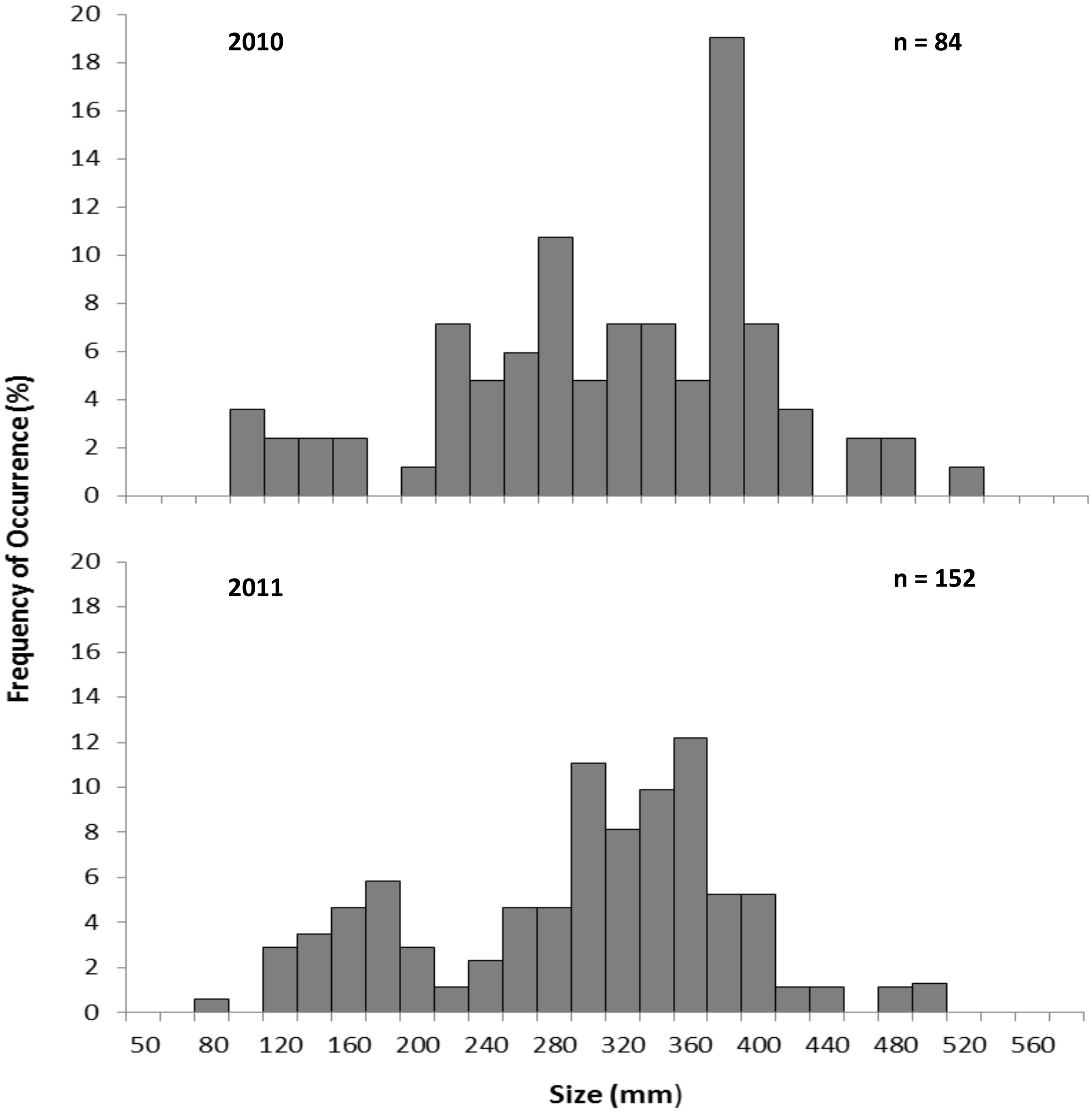

FIGURE 2.—Length-frequency distribution of Largemouth Bass collected during the 2010–2011 electrofishing survey on Lake James, North Carolina.

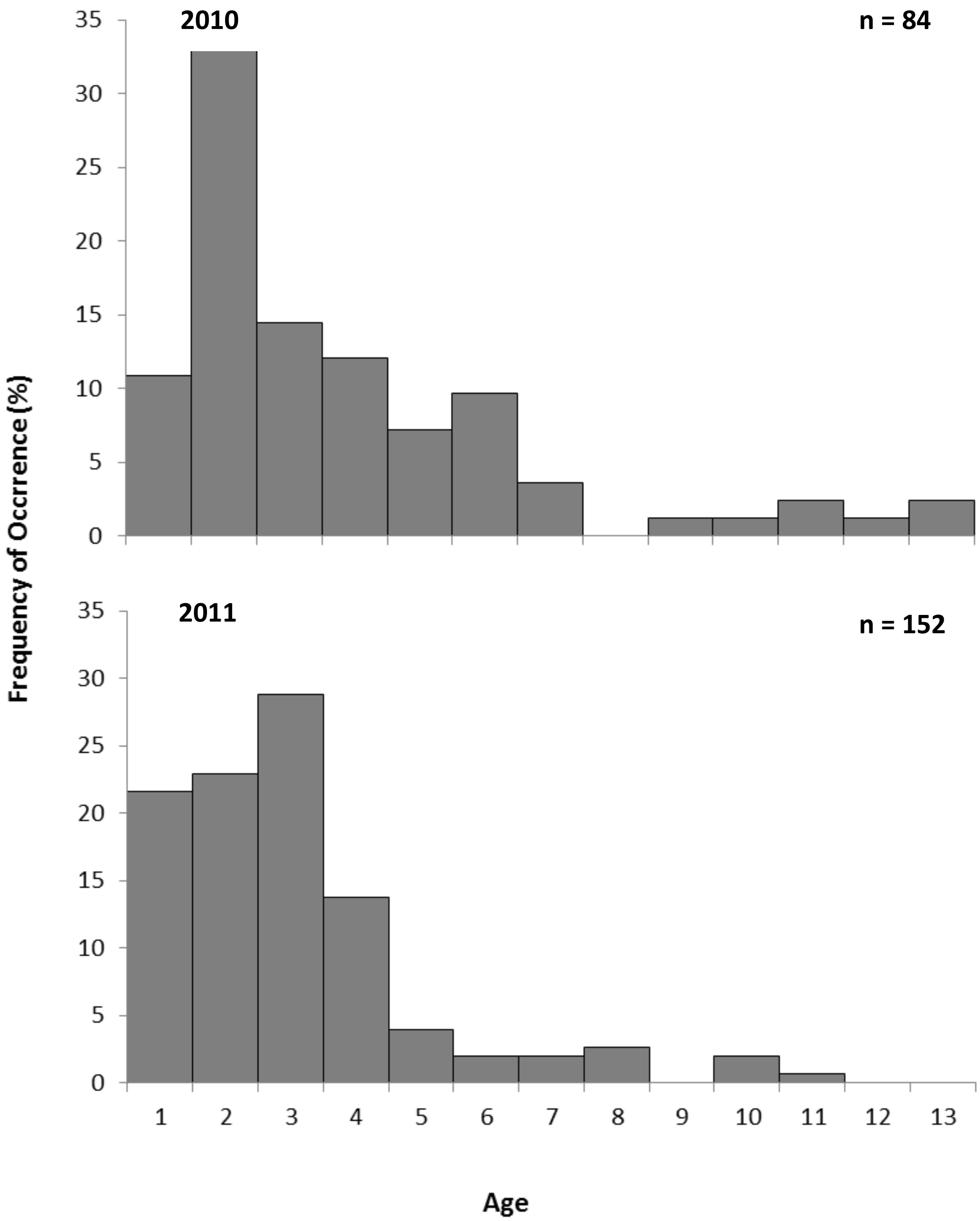

FIGURE 3.—Age-frequency distribution of Largemouth Bass collected during the 2010–2011 electrofishing survey on Lake James, North Carolina.

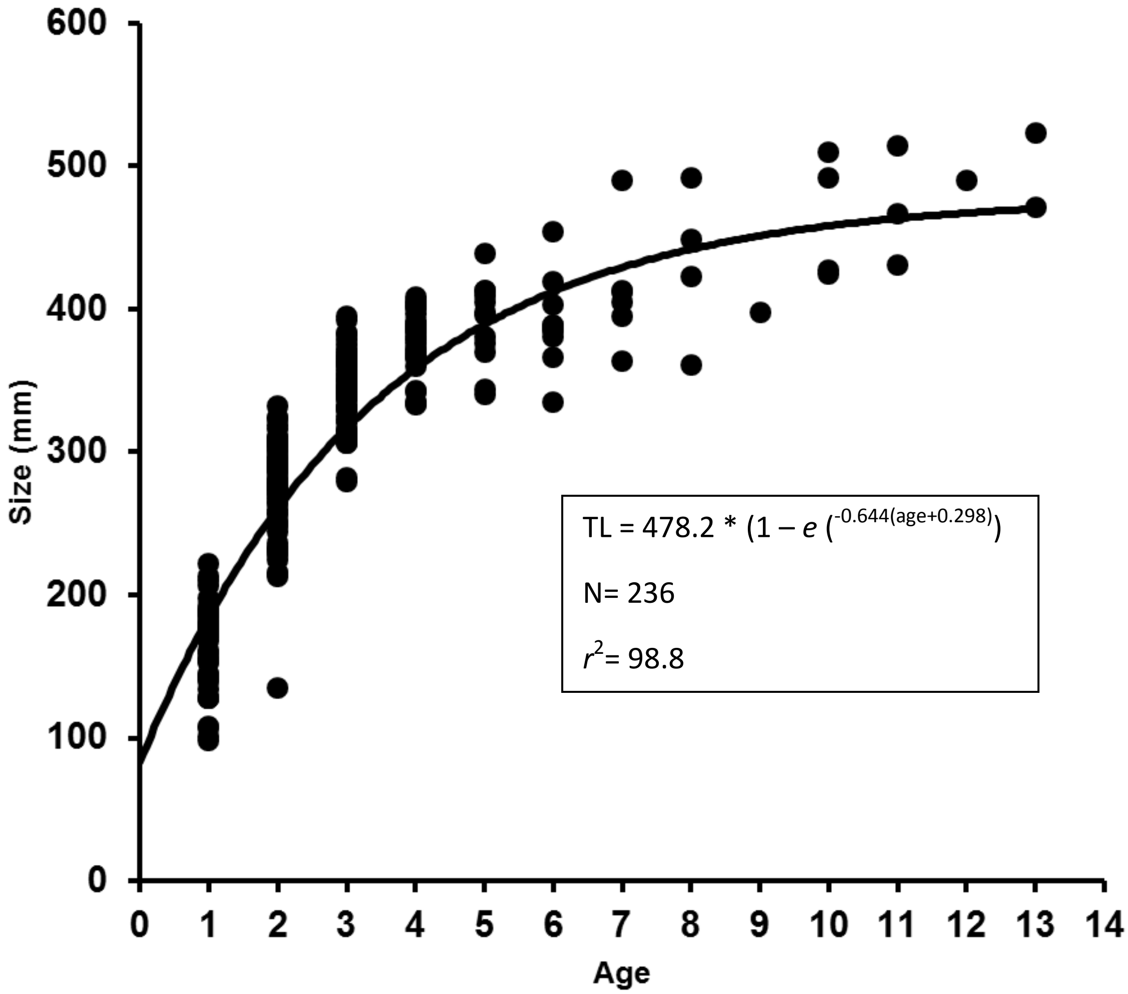

FIGURE 4.—Observed total length (TL; mm) at age values (dots) and von Bertalanffy growth curve (solid line) for all Largemouth Bass collected during the 2010–2011 electrofishing survey on Lake James, North Carolina.

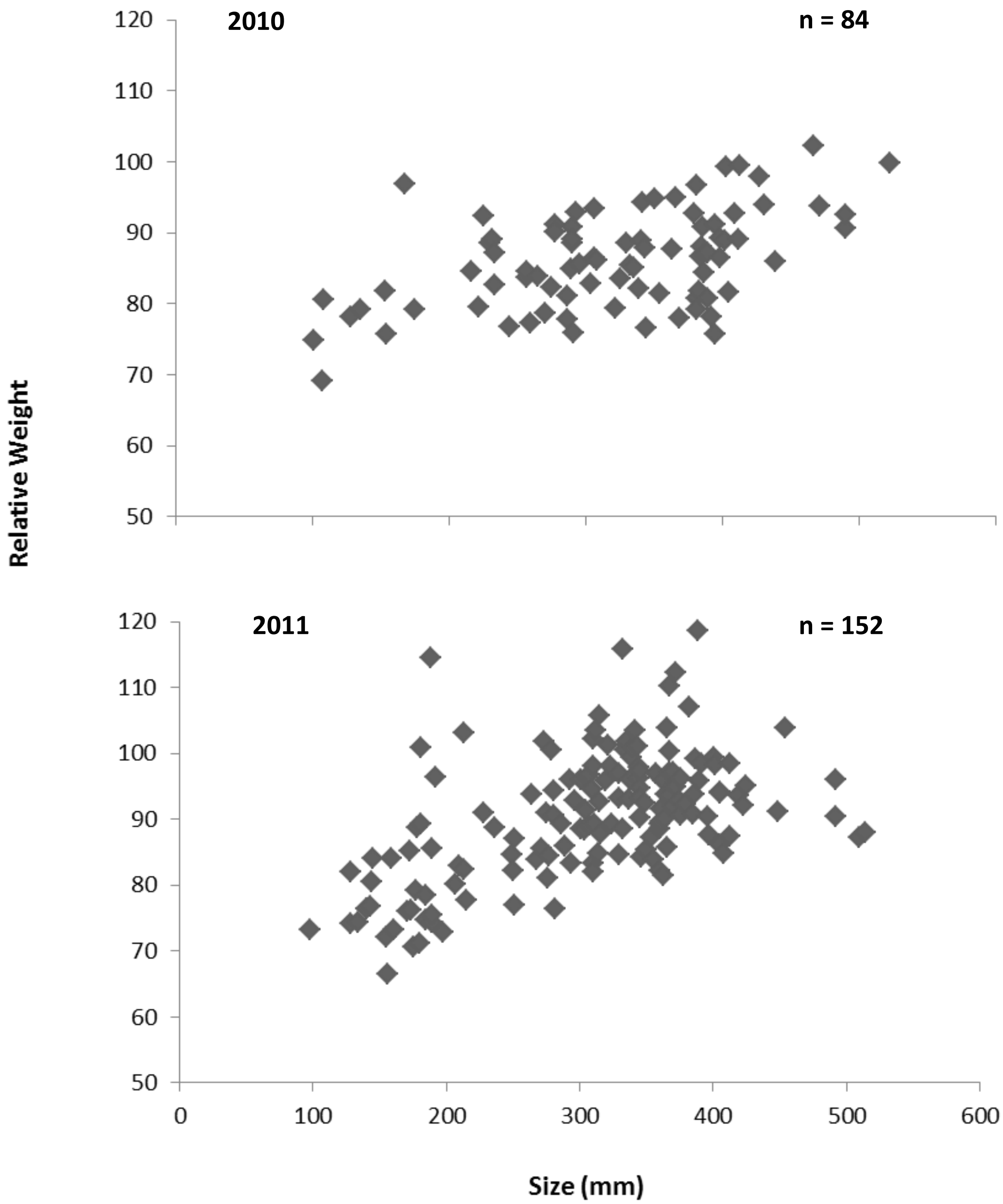

FIGURE 5.—Relative weights of Largemouth Bass collected during the 2010–2011 electrofishing survey on Lake James, North Carolina.

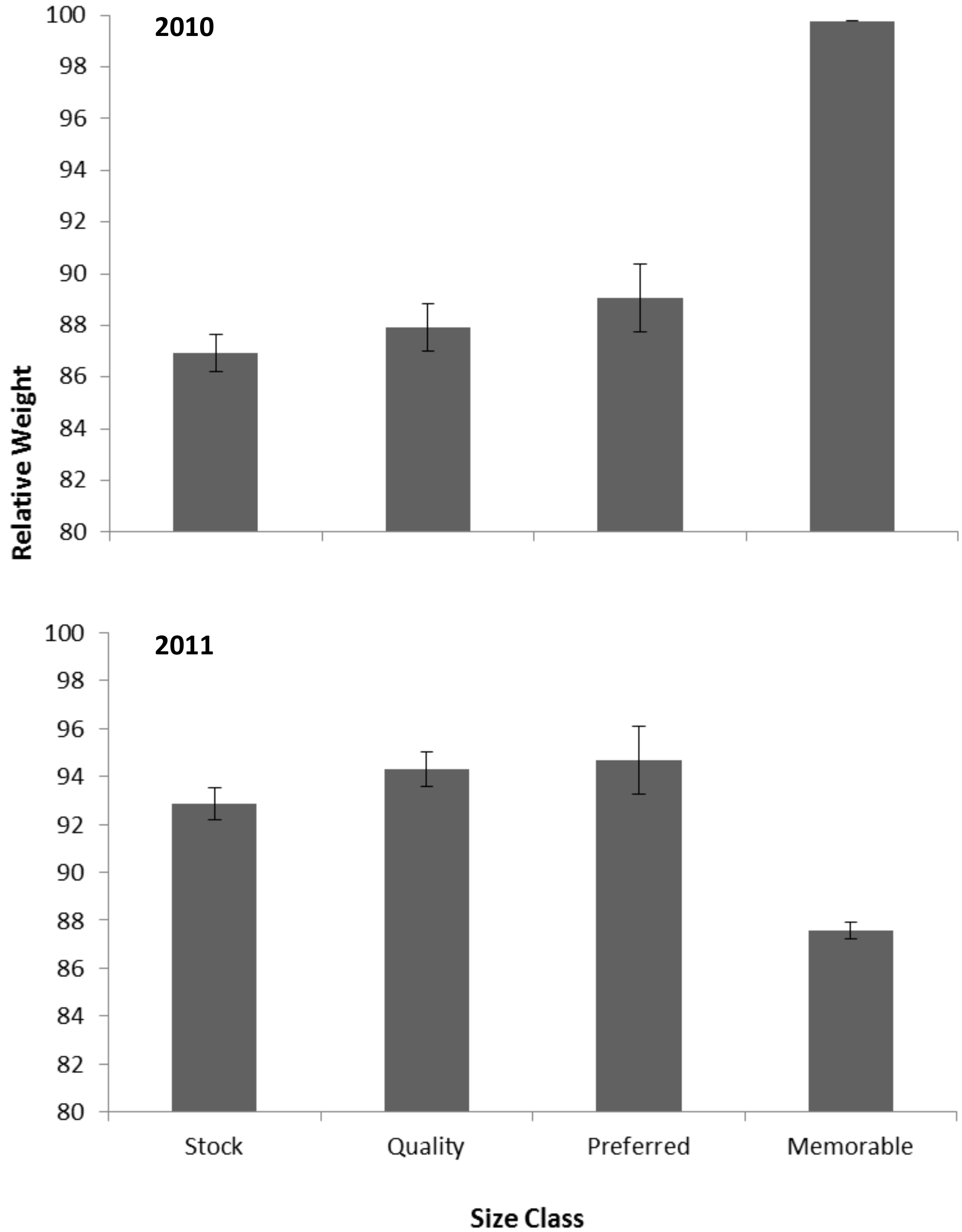

FIGURE 6.—Relative weights of stock-, quality-, preferred-, and memorable-length Largemouth Bass collected during the 2010–2011 electrofishing survey on Lake James, North Carolina.