

POPULATION CHARACTERISTICS OF LARGEMOUTH BASS AND PUMPKINSEED AT LAKE PHELPS, 2013–2014



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Abstract.—The Lake Phelps Largemouth Bass *Micropterus salmoides* and Pumpkinseed *Lepomis gibbosus* populations were sampled with shoreline electrofishing in May and June 2013 and 2014. Largemouth Bass and Pumpkinseed size structure, relative abundance, and body condition (W_r) were assessed. The Largemouth Bass length-frequency distribution was unimodal in 2013, with preferred-length fish as the majority. The 2014 distribution was bimodal, with stock- and preferred-length fish as the majority. Largemouth Bass relative abundance (42.4 fish/h in 2013 and 54 fish/h in 2014) was similar to relative abundance in found in the 2012 (58.4 fish/h) and 2011 (35.2 fish/h) surveys. Body condition values in 2013 and 2014 were acceptable (mean $W_r=99.5$ in 2013 and mean $W_r=97.3$ in 2014). The relative abundance of memorable-length fish decreased from 2013 to 2014; however, additional years of data are needed to determine in data reflects actual changes in relative abundance. However, the presence of memorable-length fish indicates that fish are growing beyond the slot limit. Trophy Largemouth Bass regulations in place on Lake Phelps likely contribute to stockpiling of Largemouth Bass within the protective slot limit; however, in 2014, abundance of Largemouth Bass in the slot limit was slightly lower than in previous studies. Lake Phelps continues to provide an excellent Pumpkinseed fishery. Quality-length Pumpkinseed made up the highest proportion of collected individuals in 2013 and 2014. The relatively low numbers of Pumpkinseed greater than 200 mm may indicate overfishing or stunting of the Pumpkinseed population in Lake Phelps. Mean CPUE of Pumpkinseed was 203 fish/h in 2013 and was lower at 168 fish/h in 2014. Mean relative weight for Pumpkinseed in 2013 was 92. The large number of quality-length Pumpkinseed will continue to support recreational fishing. Future research activities should focus on collecting data to determine growth rates and to make a representative age-length key for Lake Phelps Largemouth Bass. A creel survey should be developed to collect current information on angler effort as well as catch and harvest rates of Largemouth Bass and Pumpkinseed in Lake Phelps.

Lake Phelps is a 6,480-ha lake located in Washington and Tyrell counties, North Carolina. Lake Phelps is the second largest natural lake in the state and is encompassed by Pettigrew State Park and Pocosin Lakes National Wildlife Refuge and private property owners. The majority of the lake is shallow (mean depth=1.4 m) open water with a barren sand and mud bottom fringed by a productive littoral zone. Lake Phelps boasts excellent recreational fishing opportunities for Largemouth Bass *Micropterus salmoides* and Pumpkinseed *Lepomis gibbosus*. Additionally, anglers commonly target Yellow Perch *Perca flavescens*, White Catfish *Ictalurus catus*, Yellow Bullhead *Ameiurus natalis*, and Chain Pickerel *Esox niger*. Golden Shiner *Notemigonus crysoleucas* and Killifish *Fundulus* spp. are abundant in the lake and serve as the dominant forage species, along with Pumpkinseed for Largemouth Bass and other piscivores.

The Lake Phelps Largemouth Bass population has been managed by the North Carolina Wildlife Resources Commission (NCWRC) under trophy Largemouth Bass regulations since 2002. Current regulations include a five fish daily creel limit, a minimum size of 356 mm and a protective slot limit from 406 to 508 mm. Sunfish are managed with a 30 fish daily creel limit. Previous surveys of the Lake Phelps Largemouth Bass population recommended possible modification of the current trophy bass regulations (Dockendorf and McCargo 2010; Ricks and McCargo 2011, 2013). The objectives of this survey were to assess Largemouth Bass and Pumpkinseed populations and further evaluate the current Largemouth Bass trophy regulation at Lake Phelps.

Methods

Largemouth Bass and Pumpkinseed were collected from Lake Phelps with boat-mounted electrofishing gear in 2014 on 22 May and 29 May 2013 and 27 May, 28 May, and 3 June. Boat-mounted electrofishing gear consisted of a Smith Root 7.5 GPP electrofisher with boom electrodes that delivered 140–1000 volts of pulsed direct current at 3–5 amperes. Twelve shoreline electrofishing transects were surveyed during daylight hours in 2013 and 2014 (Figure 1). Sunfish and Largemouth Bass were collected for the first 300 s and then only Largemouth Bass were collected during the remaining portion of the transect (900 s). Total length (TL, mm) was measured for all sport fish, and weight (g) was recorded for Largemouth Bass in 2013 and 2014 and Pumpkinseed in 2013. At the start of each transect, water quality parameters were recorded including: water temperature (°C), dissolved oxygen (mg/L and % saturation), specific conductivity ($\mu\text{s}/\text{cm}$), and salinity (ppt).

Relative abundance was expressed as the number of Largemouth Bass ≥ 200 mm (stock-length) and the number of Pumpkinseed ≥ 80 mm (stock-length) collected per hour of electrofishing and was indexed as catch-per-unit-effort (CPUE). Mean CPUE was \log_{10} transformed for comparison with previous study years. Size structures of Largemouth Bass and Pumpkinseed were evaluated with length-frequency histograms and calculations of proportional size distribution (PSD) and incremental PSD metrics (Guy et al. 2007). Stock, quality, preferred, and memorable minimum lengths were 200, 300, 380, and 510 mm for Largemouth Bass and 80, 150, 200, and 250 mm for Pumpkinseed (Gabelhouse 1984; Anderson and Neumann 1996).

Largemouth Bass and Pumpkinseed condition was assessed using a relative weight index (W_r) described by Wege and Anderson (1978). Relative weight was calculated as:

$$Wr = \left(\frac{W}{W_s} \right) * 100$$

where W is the measured weight (g) of each fish, and W_s is a length specific standard weight. The W_s equation for Largemouth Bass was $\log_{10}(W_s) = -5.316 + 3.191 \log_{10}(\text{TL})$ (Murphy et al. 1991), and the W_s equation for Pumpkinseed was $\log_{10}(W_s) = -5.197 + 3.237 \log_{10}(\text{TL})$ (Liao et al. 1995). Fish less than stock-length of each species were excluded from the relative weight analysis.

Results

Largemouth Bass.—A total of 180 Largemouth Bass in 2013 and 250 Largemouth Bass in 2014 were collected from Lake Phelps. Relative abundance of Largemouth Bass in 2013 and 2014 was highly variable among transects (2013 range from 0 to 101 fish/h; 2014 range from 3 to 143 fish/h). Mean CPUE in 2013 was 42.2 fish/h ($SE = 9.3$) and was higher in 2014 at 54.0 fish/h ($SE = 12.8$). Log transformations of mean CPUE indicate an increase in relative abundance from 2010 (1.31) to 2014 (1.54; Figure 2).

The Largemouth Bass length distribution in 2013 was unimodal with a peak at 350–375 mm. In 2014, the Largemouth Bass length distribution was bimodal with peaks at 200 mm and at 450 mm. In both years, a wide range of sizes was present; fish lengths ranged from 155 to 561 mm in 2013 and from 140 to 568 mm in 2014 (Figure 3). The proportion of fish in the protective slot was 38% in 2013 and 30% in 2014. The proportion of fish available for harvest was 18% in 2013 and 31% in 2014. The majority of Largemouth Bass collected in each year (51% in 2013 and 38% in 2014) were in the preferred-length group. Stock-length Largemouth Bass represented 8% of the sample in 2013 and 36% in 2014. Compared to past surveys, substock-length fish were more abundant in 2013 ($N=9$) and 2014 ($N=15$; Table 1). Memorable-length Largemouth Bass represented 6% of the sample in 2013 and 3% of the 2014 sample. Proportional size distribution was higher in 2013 (91%) than in 2014 (62%). Incremental PSD was higher for quality-, preferred-, and memorable-length Largemouth Bass in 2013 ($PSD_{Q-P}=31$, $PSD_{P-M}=54$, and $PSD_{M-T}=6$) than in 2014 ($PSD_{Q-P}=17$, $PSD_{P-M}=41$, $PSD_{M-T}=3$); however, PSD_{S-Q} was higher in 2014 (39%) than in 2013 (9%; Figure 4).

Mean relative weight for Largemouth Bass was 99.5 ($SE = 3.9$) in 2013 and 97.3 ($SE = 3.3$) in 2014. Relative weight in both years was within the acceptable range indicative of healthy Largemouth Bass populations. In 2013 and 2014, mean relative weight decreased slightly as length increased from stock-length to memorable-length, but not below levels that would indicate poor condition (Figure 5).

Pumpkinseed.—In 2013 and 2014, 189 and 192 Pumpkinseed were collected, respectively. Mean CPUE was 208 fish/h ($SE=41.5$) in 2013 and was lower in 2014 with a mean CPUE of 176 fish/h ($SE= 35.1$; Figure 6). Pumpkinseed length distribution ranged 51–222 mm in 2013 and was similar in 2014 (range 60–227 mm; Figure 7). In 2013, 72% of Pumpkinseed collected were in the quality-length group (150–199 mm); similarly, 77% of Pumpkinseed were quality-length in 2014. Few Pumpkinseed less than stock length were collected in both years. The PSD values for Pumpkinseed were 83% in 2013 and 85% in 2014; PSD values for both years were higher

than levels for balanced sunfish populations (i.e., 20–60%; Anderson and Neumann 1996), but desirable for accelerated bass growth (Figure 8).

Discussion

Relative abundance of Largemouth Bass in 2013 and 2014 was similar to previous study years, but appeared to continue on an upward trend first observed in 2010 (34.2 fish/h; 2011, 35.2 fish/h; 2012 58.5 fish/h). Comparisons of log-transformed mean CPUE confirm the increasing trend since 2010 (Figure 2); however, CPUE remains well below the peak in 2003 (100.9 fish/h) and 2004 (77.1 fish/h). The size structure of Lake Phelps Largemouth Bass varied widely and the abundance of stock-length fish in 2014 indicated the presence of strong year classes entering the fishery. This peak in stock-length fish likely represents 2012 and 2013 cohorts, as age data collected in 2010 suggest that Largemouth Bass between the lengths of 175 and 300 mm were age 2 or younger (Ricks and McCargo 2011). Future research goals on Lake Phelps should focus on obtaining age distribution and growth data. Age data will help indicate if trophy regulations are causing fish in the protected slot limit to be stunted and remain within the slot limit. Lake Phelps should continue to provide excellent opportunities for quality catch-and-release angling as evidenced by the number of adults within the protective slot limit. In addition, a good proportion of fish between the minimum length limit and slot limit were available for harvest in 2013 (31%), although fewer were available in 2014 (18%). The decline in abundance of fish ranging 356–406 mm from 2013 to 2014 could indicate that fish have grown into the slot limit or have been harvested by anglers. The abundance of fish greater than the slot limit (>508 mm) also declined from 2013 to 2014, a possible indication fish are being harvested. The lack of information regarding angler harvest, effort, and satisfaction with the fishery warrants the need to develop and implement a creel survey on Lake Phelps.

Lake Phelps is unique in that the sunfish fishery is dominated by Pumpkinseed. Relative abundance of Pumpkinseed decreased slightly from 2013 to 2014, but continued a general upward trend from 2011 (Figure 6). Length distributions indicated a wide range of size classes were present in 2013 and 2014, likely a result of good water levels since 2010. Incremental PSD indicated that the majority of Pumpkinseed were in the quality-length group and should support a good fishery in Lake Phelps. Pumpkinseed relative weights between 2013 and 2014 could not be compared because weights were not collected in 2014. In 2013, relative weights of Pumpkinseed at stock-, quality-, and preferred-length were below the 75th percentile, indicating a potential body condition issue. In 2015, weights should be recorded for Pumpkinseed to better assess their body condition in Lake Phelps.

Kornegay and Dineen (1979) observed Bluegill *L. machrochirus* in high abundance during trawl surveys. However, in the 2013 and 2014 surveys, only 16 Bluegill were collected. Furthermore, Hodges (1997) and Hand and Thomas (2001) did not report Bluegill in sportfish surveys. Relative abundance of Bluegill remained low during this survey period. The low relative abundance of Bluegill in Lake Phelps could be a result of competition with Pumpkinseed, Largemouth Bass predation, or limiting water quality parameters.

In Lake Phelps Largemouth Bass year class strength appears to be correlated with water levels, which are largely driven by precipitation. Strong year classes typically occur when average yearly water depth is above 10.5 ft, although water level fluctuations during critical

periods for fish spawning and rearing may be a better indicator (i.e., drying of critical habitat). Drought conditions at Lake Phelps have not occurred since 2009, when in subsequent years, relative abundance declined and size structures lacked stock-length fish (Figure 10). Water levels have remained above the drought benchmark since 2010, and likely influenced the large number of quality-length and greater Largemouth Bass and Pumpkinseed present in the lake during the 2013 and 2014 surveys. In 2014, average water depth was 11.2 ft, suggesting a strong year class could be predicted to enter the fishery in 2015 (Figure 10). Water levels should continue to be monitored throughout the year to better evaluate the relationship between lake level fluctuations and Largemouth Bass recruitment.

Management Recommendations

1. Continue to annually monitor Largemouth Bass population characteristics at Lake Phelps. Collect age data during 2015 surveys by collecting up to 5 fish per 10-mm length group to increase sample size and precision of an age length key.
2. Evaluate current and potential alterations to length limits on Lake Phelps aimed to protect young Largemouth Bass during drought years and increase the number of memorable-length Largemouth Bass.
3. Promote the Largemouth Bass and Pumpkinseed fisheries of Lake Phelps through distribution of sampling information on the agency website and social media opportunities.
4. Design a creel survey for Lake Phelps and coordinate implementation with Pettigrew State Park staff. Creel survey objectives should include assessing angler effort, catch and harvest trends as well as determining angler satisfaction with current regulations.
5. Continue to obtain water level data from Pettigrew State Park and further evaluate the relationship between lake level fluctuations and year class strength of Largemouth Bass.

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TABLE 1.—Number of substock- (<200 mm), stock-(200–299 mm), quality-(300–379 mm), preferred- (380–509 mm) and memorable-length (≥ 510) Largemouth Bass collected during electrofishing surveys in Lake Phelps from 2010–2014.

	Substock	Stock	Quality	Preferred	Memorable
2010	0	2	8	99	3
2011	1	26	7	129	3
2012	3	72	19	133	9
2013	9	15	54	92	10
2014	15	91	40	96	8

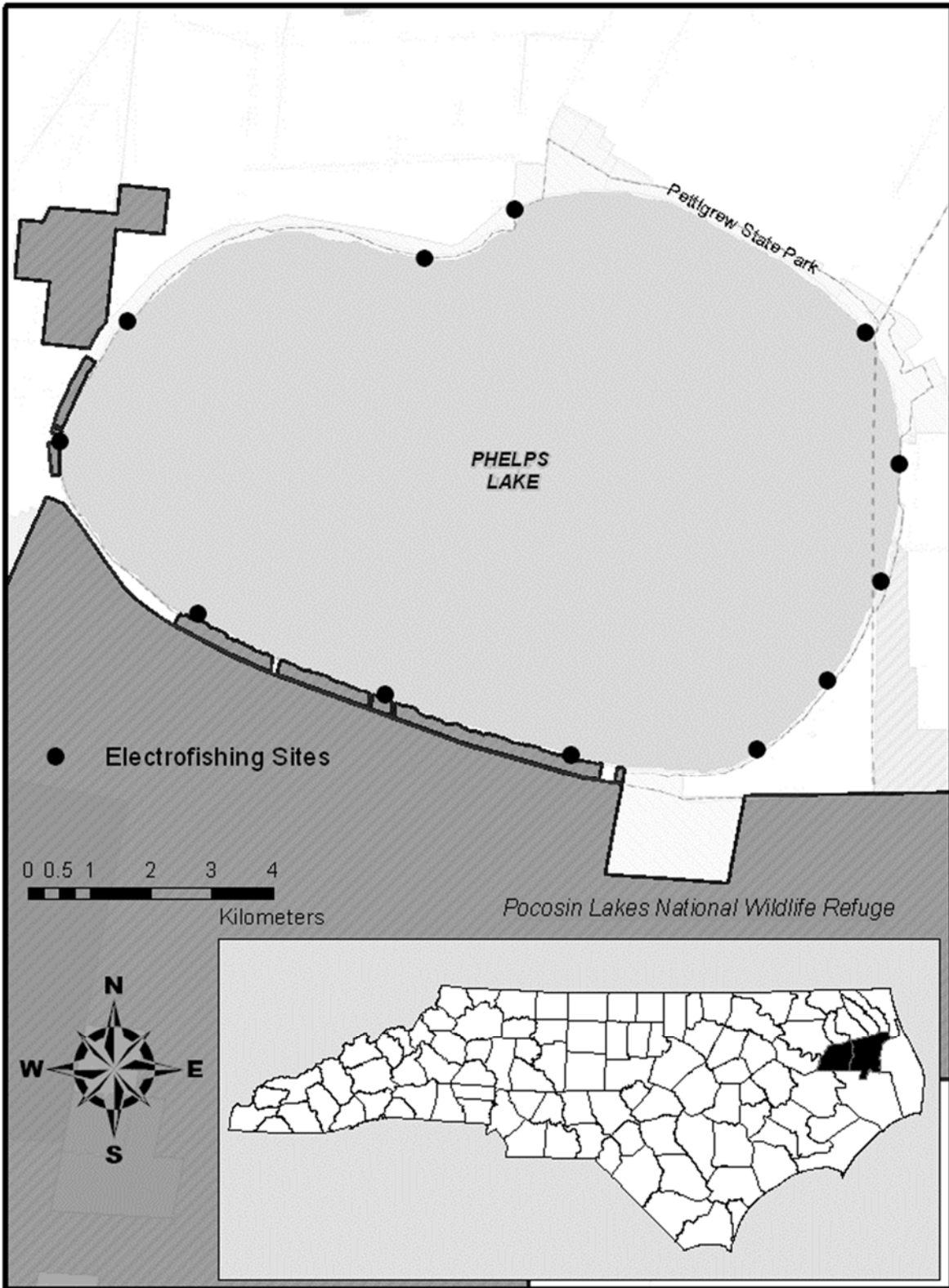


FIGURE 1.—Electrofishing sites at Lake Phelps in 2013 and 2014.

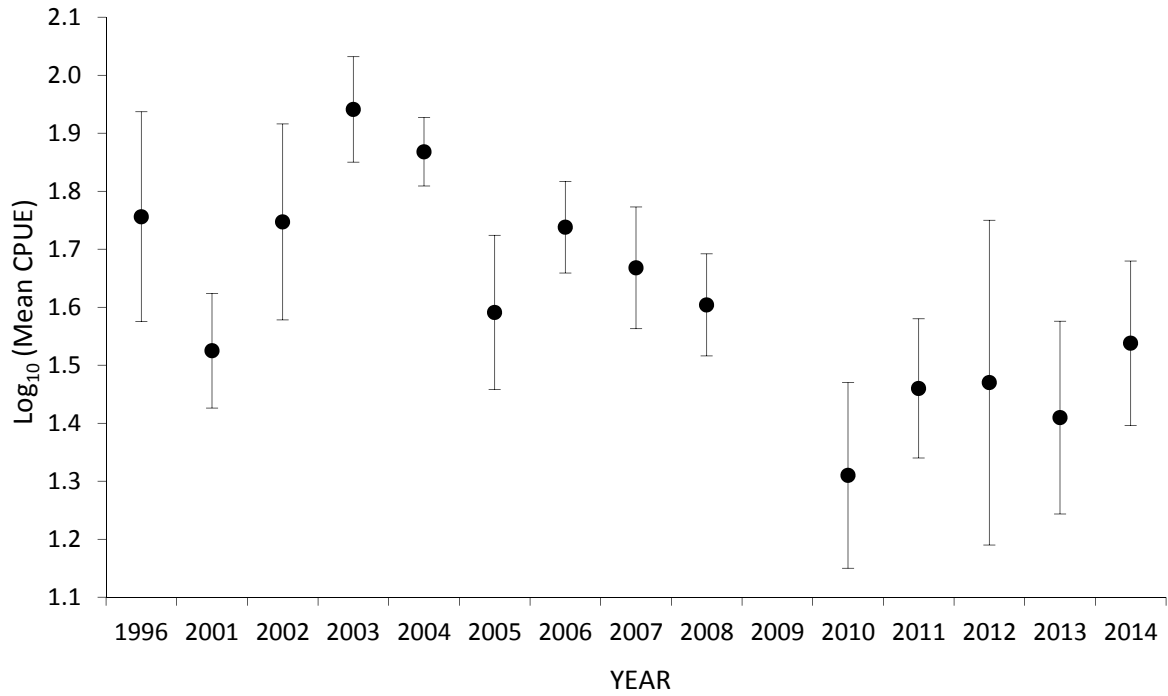


FIGURE 2.—Log₁₀ mean catch per unit effort (CPUE) of Largemouth Bass ≥ 200 mm collected at Lake Phelps with boat electrofishing from 1996–2012. Data from 1996 (Hodges 1997), 2001 (Hand and Thomas 2001), 2002 (NCWRC, unpublished data), 2003–2008 (Dockendorf and McCargo 2010), and 2010–2012 (Ricks and McCargo 2011 and 2013) are included for comparison. Error bars represent one standard error. Surveys were not conducted from 1997–2000 or in 2009.

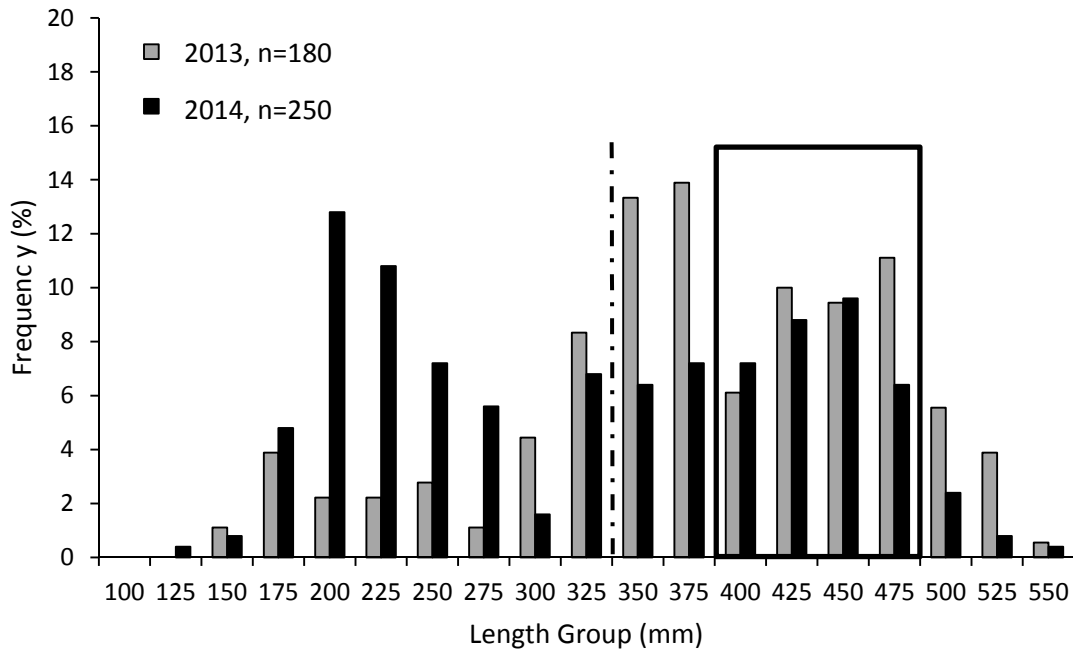


FIGURE 3.—Length distribution of Largemouth Bass collected from Lake Phelps in 2013 and 2014. The dashed line displays the 356 mm minimum length limit and the box represents the 406–508 mm protective slot limit.

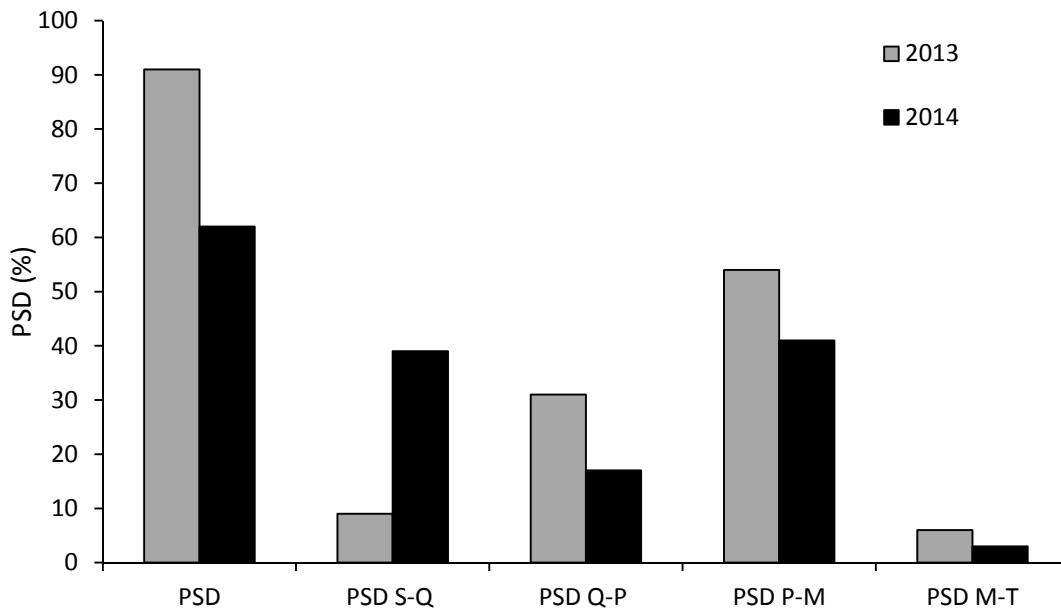


FIGURE 4.—PSD values for Largemouth Bass collected during the 2013 and 2014 Lake Phelps sport fish survey.

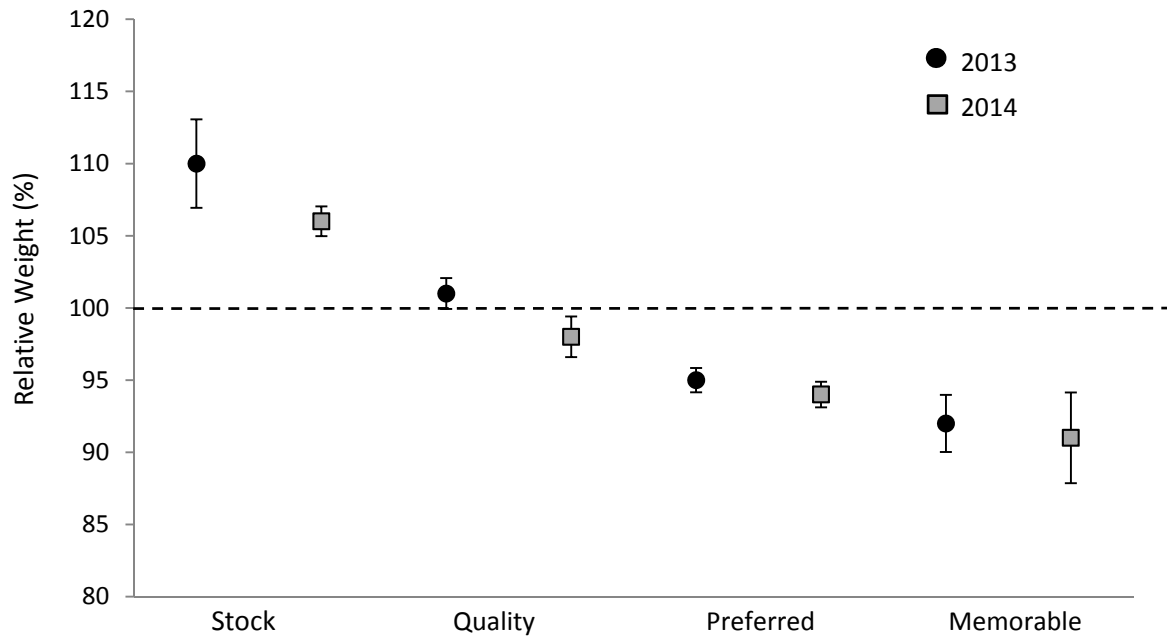


FIGURE 5.—Mean relative weights of Largemouth Bass by proportional stock density category for 2013 and 2014 Lake Phelps Sportfish survey. The dotted line at $W_r=100$ denotes the 75th percentile of weights at given length categories of Largemouth Bass across its entire range. Error bars represent one standard error.

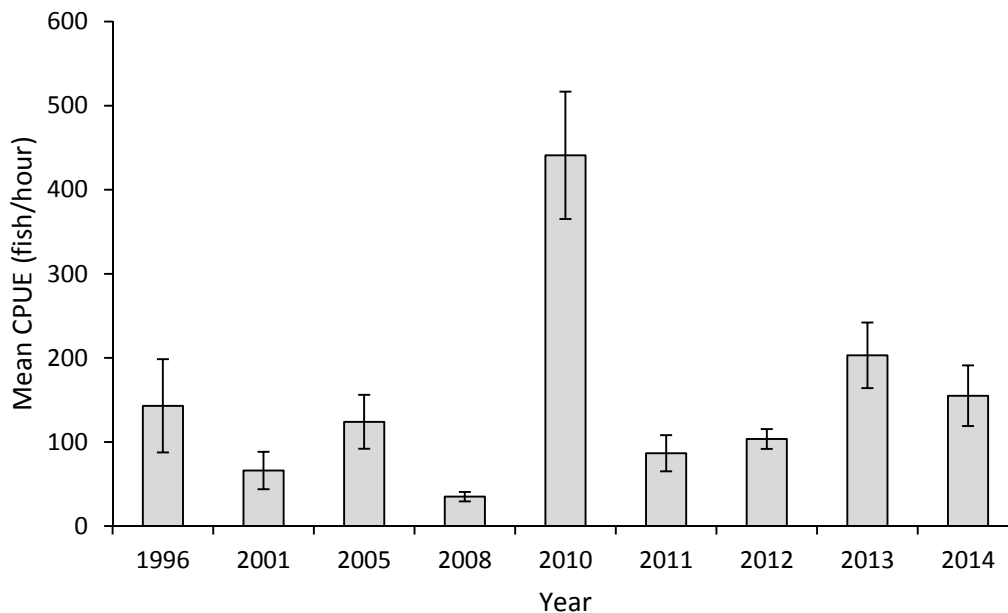


FIGURE 6.—Mean catch per unit effort (CPUE) of Pumpkinseed collected from Lake Phelps with electrofishing in 1996–2010. Data from 1996 (Hodges 1997), 2001 (Hand and Thomas 2001), 2005 and 2008 (unpublished data), and 2010–2012 (Ricks and McCargo 2013) are included for comparison. Error bars represent one standard error.

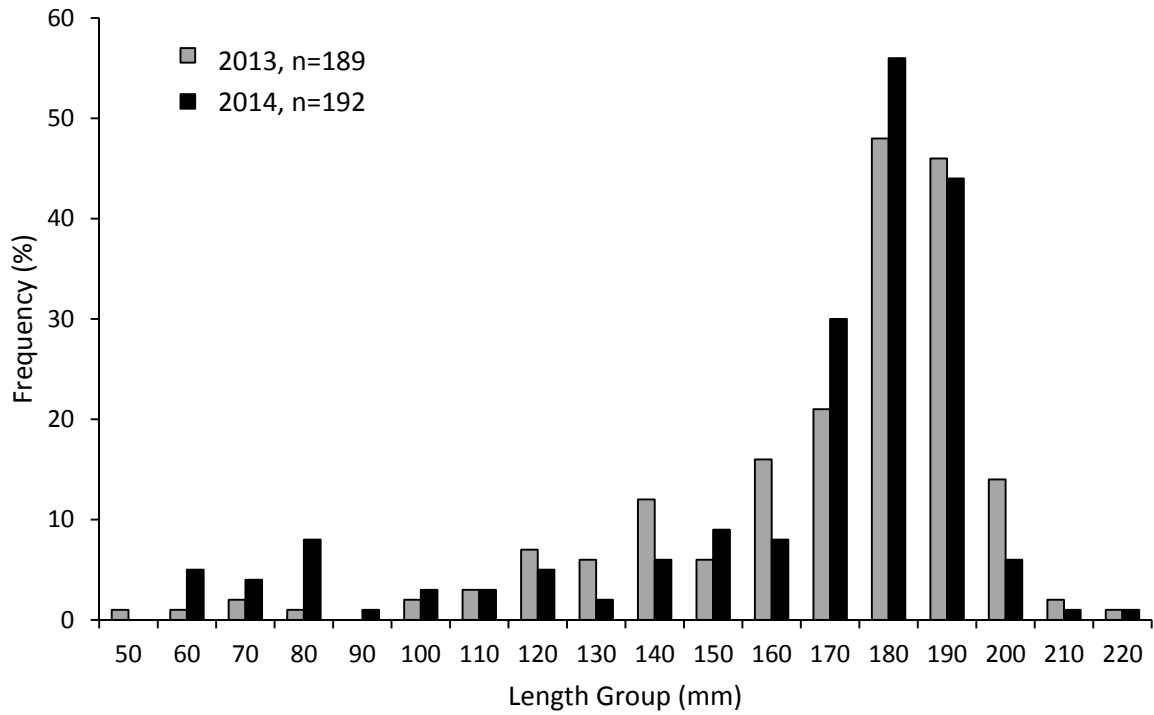


FIGURE 7.—Length distribution of Pumpkinseed collected from Lake Phelps in 2013 and 2014.

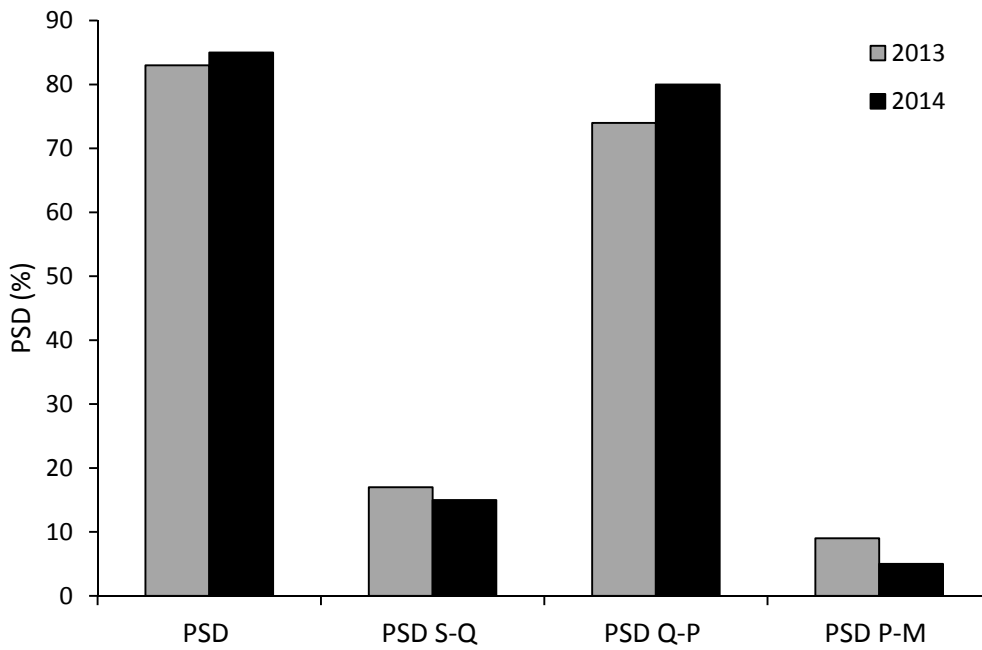


FIGURE 8.—PSD values for Pumpkinseed collected during the 2013 and 2014 Lake Phelps Sportfish survey.

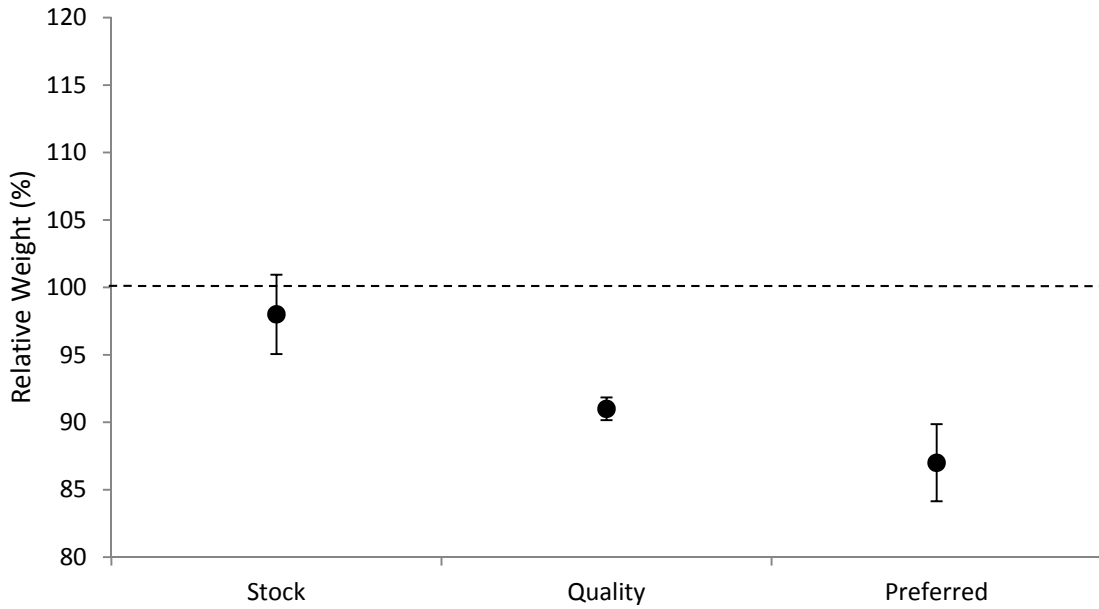


FIGURE 9.—Mean relative weights of Pumpkinseed by proportional stock density category for 2013 Lake Phelps Sportfish survey. The dotted line at $W_r=100$ denotes the 75th percentile of weights at give length categories of Pumpkinseed across its entire range. Error bars represent one standard error.

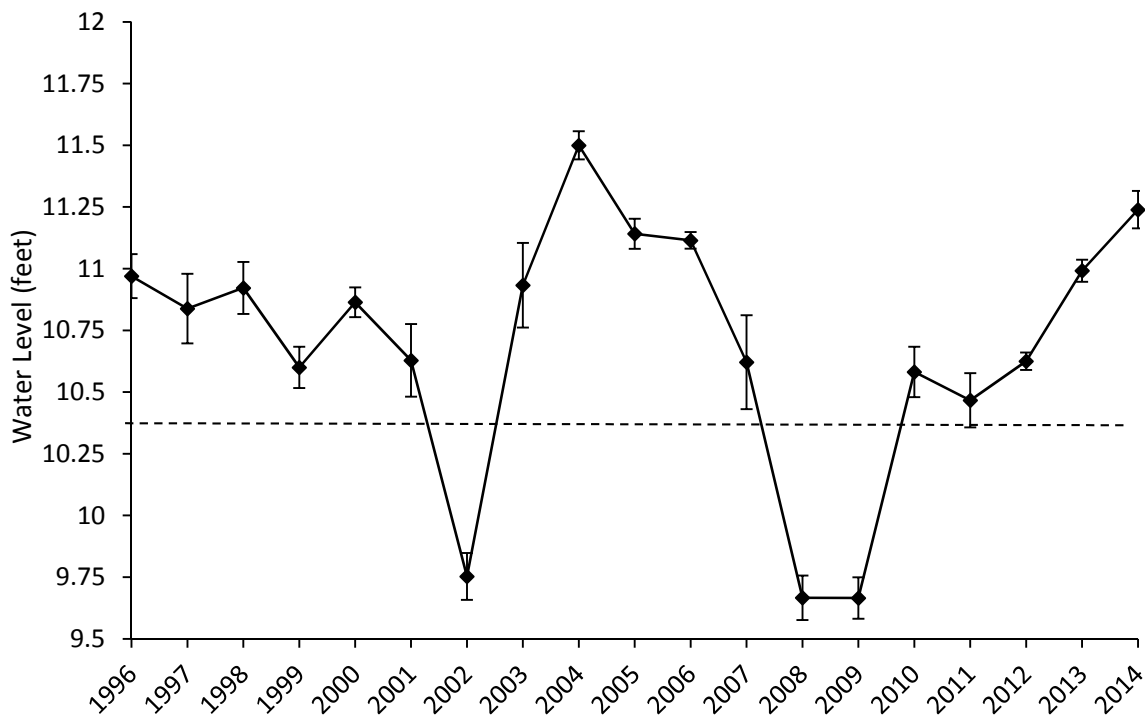


FIGURE 10.—Mean daily water level from Pettigrew State Park records (1996–2014). Dotted line represents water level below which Largemouth Bass recruitment is likely limited. Error bars represent one standard error.