GLENVILLE RESERVOIR BLACK BASS ELECTROFISHING SURVEY, 2000-2002

Final Report

MOUNTAIN FISHERIES INVESTIGATIONS

Federal Aid in Fish Restoration
Project F-24

Project Type: Survey

Period Covered: 2000-2002

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Raleigh

2005

This publication was funded under the Federal Aid in Sport Fish Restoration Program utilizing state fishing license money and federal grant funds derived from federal excise taxes on fishing tackle and other fishing related expenditures.

Funds from the Sport Fish Restoration Program are used for aquatic education, fisheries research and management, and boating access facilities. The program is administered cooperatively by the N.C. Wildlife Resources Commission and the U.S. Fish and Wildlife Service.

Abstract— We used boat electrofishing to perform a stock assessment of largemouth bass *Micropterus salmoides* and smallmouth bass *M. dolomieu* in Glenville Reservoir during the first week of May, 2000-2002. A total of 331 Largemouth bass were collected over the three year survey. Largemouth bass electrofishing catch per unit of effort (CPUE) ranged from 1.5 to 2.8 by distance (N / 100 m) and from 18.5 to 25.7 by time (N / h). The overall mean CPUE by distance was 2.3 and the overall mean CPUE by time was 23.9. We collected largemouth bass ranging in size from 75 to 544 mm total length. Relative stock density analyses revealed that the largemouth bass population was within what is accepted as balanced for Relative Stock Density-Quality (RSD-Q) size fish in two of the three survey years. Relative Stock Density-Preferred (RSD-P) and Relative Stock Density-Memorable (RSD-M) indices were within the ranges acceptable for a balanced population all three years. No Relative Stock Density-Trophy (RSD-T) size largemouth bass were captured. Largemouth bass relative weight (W_r) was similar across years and ranged from 90 to 92. The estimate of instantaneous mortality rate was 0.31 and the estimate of the finite annual mortality rate was 0.26. The Von Bertalanffy growth equation that best fit the data was $L_t = 497.9\ (1\text{-}e^{-0.3734\ (t+0.2988)})$. A total of 225 Smallmouth bass were collected over the three year survey. Smallmouth bass electrofishing CPUE ranged from 1.4 to 1.7 by distance and from 16.1 to 22.5 by time. The overall mean CPUE by distance was 1.6 and the overall mean CPUE by time was 19.9. We collected smallmouth bass ranging in size from 73 to 405 mm TL. Relative stock density was below what is considered to be a balanced population for RSD-Q size fish in two of the three survey years. RSD-P size fish were poorly represented all three years and no RSD-M or RSD-T size smallmouth bass were captured. Smallmouth bass W_r was similar across years and ranged from 85 to 91. The estimate of instantaneous mortality rate was 1.25 and the estimate of the annual mortality rate was 0.71. The Von Bertalanffy growth equation could not be generated due to the low number of individuals ages 3-5 and absence of cohorts $\geq$ age-6.

Reservoirs in the southern Appalachian region provide diverse recreational opportunities to an increasingly demanding public. As part of its management of fishery resources and angling opportunities on inland public waters, the North Carolina Wildlife Resources Commission (NCWRC) routinely surveys sport fish populations. Historically, fish sampling in Glenville Reservoir occurred periodically over several decades. Between 1957 and 1965, the NCWRC sampled the reservoir using a variety of gear including experimental gill nets, trammel nets, and cove rotenone as part of a statewide survey (Tebo 1961; Messer 1966). Between 1972 and 1978 the NCWRC sampled the reservoir using trammel nets and angler surveys. Much of this work was directed at walleye *Sander vitreus* and the subsequent removal of a 381 mm total length (TL) minimum size restriction (Davies 1978). Jones (1983) sampled the reservoir with rotenone and experimental gill nets. The reservoir was surveyed in 1990 using boat mounted electrofishing a single day in early April; although, objectives for this survey were loosely defined (NCWRC, unpublished data). Directed reservoir surveys were not pursued again until June 2000 to May 2001when the NCWRC conducted a year-long roving-access angler creel survey designed to survey the recreational fishery (Yow, in progress)

Therefore, a current black bass *Micropterus spp.* stock assessment was needed for Glenville Reservoir. Previous studies focused heavily on rotenone sampling to produce standing crop estimates for sport and forage fishes. Rotenone sampling is no longer used by the NCWRC and most other agencies. We needed a recent shoreline electrofishing survey to act as a benchmark for future investigations. In addition, rotenone catch is more variable than boat electrofishing catch rates; therefore, less useful for detecting population trends (Tate et al. 2003). Age estimates in historical collections were based on scales which, unlike otoliths, over age young ($\leq$ age 3) black bass and underage older black bass (Long and Fisher 2001). Furthermore, a new stock assessment is needed because there have been several changes that could influence the performance of fish stocks in the reservoir, including shoreline development and recent appearance of blueback. Additionally, because the Glenville Reservoirs' FERC license is to be renewed in 2005, it was necessary for the NCWRC to have current information on the black bass community.

Shoreline development has been occurring at a steady pace for the past couple of decades. Activities on adjoining private lake lots, such as clearing shoreline vegetation, constructing bulkheads and other manipulations to the terrestrial – aquatic interface can result in erosion, loss of cover for fishes and aquatic organisms, and compromise spawning and nursery habitats (Schindler et al. 2000).

In addition, forge fish surveys from 1998 to 2000 revealed the presence of blueback herring *Alosa aestivalis* (NCWRC, unpublished data). It is unknown if the establishment of blueback herring in Glenville Reservoir was the result of intentional or unintentional introductions. Earlier surveys identified the lack of suitable forage as a factor limiting the performance of sport fishes in the reservoir and recommended introducing an exotic forage species compatible with Glenville Reservoir habitat (Messer 1966, Jones 1983). Although blueback herring, an anadromous species, is successful in fresh water lentic habitats; it is thought to cause negative impacts on existing aquatic communities. The recent blueback herring introduction into Lake Burton, Georgia coincided with decreased abundance of black crappie *Pomoxis nigromaculatus*, largemouth bass *Micropterus salmoides*, and white bass *Morone chrysops* (Rabern 2000). Moreover, failures in walleye reproduction followed the introduction of a similar species, alewife *Alosa pseudoharengus*, in several Tennessee reservoirs (Irwin-Larrimore 1989). The blueback herring invasion in Hiwassee Reservoir, North Carolina coincided with reductions and failures in walleye reproduction (Authors, in progress). Although the mechanism by which river herring *A. spp.* reduce sport fish populations is unknown, several possibilities have been suggested including larval fish predation (Irwin-Larrimore 1989) and early mortality syndrome (Vandergoot et al. 2001).

The goal of this study was to perform a stock assessment of the black bass community in Glenville Reservoir. Glenville Reservoir contains two species of black bass; largemouth bass and smallmouth bass *Micropterus dolomieu*. For each species, our specific objectives were to 1) index fish abundance, 2) report the length distribution, 3) estimate fitness, 4) report the age distribution, 5) calculate mortality, and 6) determine the growth rate.

Methods

Glenville Reservoir is a 592 ha hydropower impoundment operated by Duke Power – Nantahala Area (DPNA). It was impounded in 1941 and drains a 95 km^2 mostly forested watershed. This reservoir was classified as oligotrophic by North Carolina Department of Environment and Natural Resources in the most recent Basinwide Assessment Report (NCDENR 2000).

We investigated Glenville Reservoir utilizing 16, 300-m shoreline electrofishing transects. Fixed stations were evenly distributed throughout the reservoir, including the four major tributaries (Figure 1). Although transects were not selected randomly, we selected transects that were representative of macrohabitats. Macrohabitats consisted of seven spawning coves, seven points and two bank transects. Surface water temperature (°C) and conductivity (μS) were recorded at each transect during fish sampling.

We used night electrofishing to sample each transect annually between May 7 and May 9, 2000-2002. Our electrofishing gear included a 5.5 m jon boat, a 7,500 W generator, and a

Smith-Root 7.5 GPP electrofisher that produced 3-4 A of pulsed DC current. One net person collected stunned fish.

All black bass were measured (TL, mm), weighed (g) and released, except for 74 largemouth bass and 80 smallmouth bass collected in 2001, which were sacrificed for sagittal otolith removal. All otoliths were initially aged in whole view. Otoliths with less than two annuli (age-0 or age-1) were aged a second time by viewing the otolith in whole view. Otoliths with two or more annuli were sectioned along the dorsal-ventral axis and the annuli were counted along the dorsal portion of the anterior half. All ages were determined by the same reader using 'blind' reads. When age agreement could not be reached by the fourth sectioned read by the primary reader, an author (CSL) determined the final age.

Data Analysis

We used electrofishing catch rates as an of index fish abundance. Electrofishing catch rates were quantified by mean catch per unit of effort (CPUE) and the precision of these estimates was reported as the standard error. We calculated CPUE assuming that transect length (effort) was a constant 300 m. However, to better standardize effort and facilitate future comparisons, we recorded the actual electrofishing time of each transect and also reported CPUE in units of time (N / h). The catch of black bass was also evaluated by macrohabitat type. Analysis of Variance (ANOVA) models were used to determine if catch differed between two of the macrohabitats. Bank transects were removed from ANOVA models; and for this exercise, catch rate was analyzed for point and cove macrohabitats only. All probability tests were considered significant at $\alpha = 0.10$. To protect against Type I errors, differences among mean catch rates for point and cove macrohabitats were determined using the Bonferroni mean comparison model.

The length distribution of fish collected was reported both qualitatively and quantitatively. Qualitatively, a length frequency histogram was constructed to visually assess the length distribution. Quantitatively, Relative Stock Density (RSD) was used to index the proportion of quality (RSD-Q), preferred (RSQ-P), and memorable (RSQ-M) sized fish in the sample (Gablehouse 1984). Standard error for the RSD estimates were calculated as

$$\sigma_{\pi} = \sqrt{\frac{\pi\,(1-\pi)}{n}} \qquad (1)$$

where π is the proportion and n is the sample size (Ott 1993).

We used relative weight (W_r) to index fish condition. Relative weight was calculated for largemouth bass and smallmouth bass $\geq$ 150 mm TL using the standard weight (W_s) equations of Wege and Anderson (1978) and Kolander et al. (1993). The precision of the estimate of mean W_r was reported as the standard error of the mean.

A catch curve was used to estimate mortality rates. The instantaneous rate of total mortality (Z) was estimated as the slope of the linear regression of *ln* (catch) on age. Young age cohorts that had not fully recruited to the sampling gear were excluded from the regression. In addition, since poorly represented older age cohorts can negatively bias the estimate of Z, older age cohorts represented by fewer than five individuals were truncated from the largemouth bass analysis when they distorted the linear relationship between *ln* (catch) and age (Chapman and Robson 1960). All data points were used for smallmouth bass because representation of cohorts > age-2 were poor. Linear regressions were considered statistically significant at a Type I error rate of 0.10. The annual mortality rate (A) was calculated from Z using the following relationship from Ricker (1975);

$$A = 1 - e^{-Z}. \tag{2}$$

Age and length information was also used to describe growth. Growth was expressed using the Von Bertalanffy growth equation (Ricker 1975);

$$L_t = L_\infty (1 - e^{-K(t-t_o)}). \tag{3}$$

where L_t is the predicted total length at a given time, L_∞ is mean maximum total length in the population, K is the growth coefficient, t is time in years, and t_o is the origin. Due to the low sample size, the Von Bertalanffy growth equation could not model growth for smallmouth bass.

Results

Water Quality

Surface water temperature and conductivity varied little throughout the three year survey (Table 1). Mean surface water temperatures ranged 2.7 °C between the highest mean (18.5 °C; 2002) and lowest mean (15.8 °C; 2001) over the three year survey. Mean water conductivity ranged 3.1 µS between the highest mean (19.3 µS; 2002) and the lowest mean (16.2 µS; 2001) over the three year study.

Largemouth Bass

We collected 331 largemouth bass during this study. Largemouth bass electrofishing CPUE varied across years and was highest in 2000 and lowest in 2001 (Table 2). We found identical trends in CPUE by time and distance. The annual mean CPUE by distance (N / 100 m) was 2.8, 1.5 and 2.5 in 2000, 2001 and 2002, respectively. The annual mean CPUE by time (N / h) was 25.7, 18.5 and 25.3 in 2000, 2001 and 2002, respectively. The overall mean CPUE by distance was 2.3 and 23.9 by time.

We found that catch rate (N / h) varied among macrohabitat transect categories during some years (Table 3). Largemouth bass catch rates were significantly different among cove and point macrohabitat categories in 2002 ($P = 0.022$). Catch rates among macrohabitat transects were similar during 2000 ($P = 0.192$) and 2001 ($P = 0.742$).

We collected largemouth bass ranging in size from 75 to 544 mm TL (Figure 2). Relative stock density analyses revealed that the largemouth bass population was within what is accepted as balanced for RSD-Q size fish in two of the three sample years (Table 2). Because two-thirds of the stock size fish were $\geq$ 300 mm TL, the RSD-Q was slightly higher and just above the balanced range in 2001, because few small fish were collected. RSD-P and RSD-M indices were within the ranges acceptable for a balanced population all three years. Overall, the mean values for each category were within the index ranges for balanced fish population (Willis et al. 1993). Largemouth bass mean W_r was similar across years ranging from 90 to 92, with a mean W_r of 91 (Table 2).

Largemouth bass in Glenville Reservoir were characterized by a wide age distribution. All age classes $\leq$ age-11 were represented in our sample (Figure 4). The age-2 cohort was best represented ($N = 19$), with age classes 6 - 11 present but represented by few individuals ($N \leq 3$). The regression of *ln* (catch) on age was not significant ($F_{1,3} = 2.4$; $P = 0.259$) due to the low samples sizes of older cohorts (Figure 5). The estimate of instantaneous mortality rate was 0.31 and the estimate of finite annual mortality rate was 0.26. The mean lengths at age of capture are shown in Table 4. The Von Bertalanffy growth equation that best fit the data was

$$L_t = 497.9\ (1\text{-}e^{-0.3734\ (t+0.2988)}). \tag{4}$$

This equation is shown in Figure 6 and explained 99.2% of the variation in the relationship between age and total length of largemouth bass.

Smallmouth Bass

We collected 225 smallmouth bass during this study. Smallmouth bass electrofishing CPUE varied little over three years, but trends were dissimilar by time and distance (Table 2). The annual mean CPUE by distance (N / 100 m) was 1.6, 1.7 and 1.4 in 2000, 2001 and 2002, respectively. The annual mean CPUE by time (N / h) was 16.1, 22.4 and 22.5 in 2000, 2001 and 2002, respectively. The overall mean CPUE by distance was 1.6 and 19.9 by time.

We found that catch rates (N / h) also varied among macrohabitat transect categories for smallmouth bass (Table 3). Smallmouth bass catch rates were significantly different among cove and point macrohabitats categories in 2002 (P=0.055). Catch rates for cove and point macrohabitat transects were similar during 2000 (P=0.880) and 2001 (P=0.652).

We collected smallmouth bass ranging in size from 73 to 405 mm TL (Figure 3). Relative stock density was below what is considered to be a balanced population for RSD-Q size fish in two of the three survey years, because few large fish were collected (Table 2). Only one-third or less of the stock size ($\geq$ 180 mm TL) fish captured were $\geq$ 280 mm TL (RSD-Q) resulting in values below the balanced range in 2001 and 2002. RSD-P ($\geq$ 350 mm TL) fish were poorly represented all three years and no memorable ($\geq$ 430 mm TL) or trophy size ($\geq$ 510 mm TL) smallmouth bass were captured. Overall, RSD values for each category were below the index ranges for balanced fish population (Willis et al. 1993). Smallmouth bass mean W_r's were similar across years and ranged from 85 to 91. Overall, the mean W_r was 88 (Table 2).

Smallmouth bass collected by shoreline electrofishing in Glenville Reservoir were characterized by a narrow age distribution. The majority of the smallmouth bass collected (N = 80) were age-2 and none were greater than age-5 (Figure 4). The mortality analysis resulted in a significant ($F_{1,3}$ = 15.0; P = 0.061) regression of *ln* (catch) on age (Figure 5). The estimate of instantaneous mortality rate (Z) was 1.25 and the estimate of annual mortality rate (A) was 0.71. The mean lengths at age of capture are shown in Table 4. The Von Bertalanffy growth equation could not be determined for smallmouth bass. The procedure failed to converge due to the low number of individuals captured for ages 3-5 and the absence of individuals older than age-6 (Figure 6).

Discussion

The paucity of black bass electrofishing data from Glenville Reservoir did not allow for comparison to historic surveys. However, the black bass assemblage in Glenville Reservoir was similar to other black bass populations in oligotrophic mountain reservoirs of western North Carolina. Catch rates, length frequencies, age distribution and growth of Glenville Reservoir largemouth bass and smallmouth bass were within the ranges observed in other western North Carolina reservoirs over the last decade. For example, the overall catch rate (N / h) of largemouth bass during the Glenville study (23.9) was intermediate to similarly conducted surveys on Santeetlah Reservoir (48.5), Hiwassee Reservoir (19.6) and Nantahala Reservoir (6.2). Moreover, mean length at age of capture data for largemouth bass was comparable between this study and surveys from the aforementioned reservoirs, with harvestable size ($\geq$ 304.8 mm TL) obtained at age-3.

Catch rate of smallmouth bass was within the range of catch rates observed from the same suite of reservoirs. The overall catch rate (N / h) from Glenville (19.9) was higher than that from Santeetlah Reservoir (5.6) and Nantahala Reservoir (7.2), but slightly lower than that reported from Hiwassee Reservoir (20.3). Mean length at age of capture data for smallmouth bass was reported from Hiwassee Reservoir only, where harvestable size ($\geq$ 304.8 mm TL) was obtained at age-3. Smallmouth bass in this study attained harvestable size at age-4.

The catch rates in this study for both black basses were similar to those reported from the other mountain reservoirs and suggest that largemouth bass are the most successful black bass species in mountain reservoirs. However, our survey techniques likely targeted largemouth bass and may not accurately represent smallmouth bass. Largemouth bass strongly associate with cover in littoral areas; therefore, may be more vulnerable to shoreline Electrofishing than smallmouth bass which may be less associated with littoral areas and cover. For example, in other wildlife district nine reservoirs, large smallmouth bass are frequently collected during walleye surveys in bottom set gill nets that are well below the effective depth of boat electrofishing gear (authors, personal observation). This could explain why smallmouth bass RSD indices were below the balanced range for most categories annually and all categories overall. If older smallmouth bass are less vulnerable to shoreline electrofishing techniques, then it may be necessary to use catch rates from gill net samples to characterize population structure. Moreover, a combination of both techniques could be used to increase sample size and allow for more robust growth and mortality estimates.

There is no evidence that the introduction of blueback herring has negatively impacted the black bass community in Glenville Reservoir. The absence of missing year classes and consistency of the descending arms of the age structures suggests consistent recruitment for both species. Although we only aged fish in 2001, the length frequencies also suggest recruitment of both species in 2000 and 2002. In addition, the consistency of the growth curves suggests that these relationships have not changed since before the blueback herring invasion. However, we do not have reliable historical data to examine whether blueback herring may have changed species densities, condition, or composition.

Recommendations

1) Conduct black bass population monitoring on 3-5 year cycle, performing a minimum of 3 consecutive years of effort during each cycle. Cyclical surveys would serve multiple purposes including; building a database to detect survey trends over time and help direct future management decisions, to monitor interaction between blueback herring and the black bass community and to allow managers to be proactive before concerns are presented by constituents.
2) Sacrifice fish for age and growth analysis from multiple years or all years of the survey. This would increase sample sizes and allow for more precise estimate of age and growth and mortality.
3) Shoreline electrofishing techniques may be less effective for smallmouth bass than largemouth bass populations. Therefore, in clear, high-gradient mountain reservoirs, bottom

set gill nets may be a better indicator of relative abundance and provide robust sample sizes for age distribution, growth and mortality estimates.

4) NCWRC fisheries biologist should continue to work with the Duke Power-Nantahala Area land manager and the NCWRC Habitat Conservation permit coordinator to identify, protect, conserve and enhance the remaining natural shoreline areas.

Acknowledgments

I would like to thank the NCWRC District 9 Management Crew leader Paul Pittman, District 8 Biologist I Bob Brown, former NCWRC employees Catherine Willard and Scott Poore, retired NCWRC employee Ed Grooms and Lorie Lewis Stroup with the US Forest Service for all their assistance and long hours in the field necessary to complete this survey. I am grateful in particular to Marshall Evans for his diligence with otolith preparation and age determination. This study was funded in part by the Federal Aid in Sport Fish Restoration Program as Project F-24 of the North Carolina Wildlife Resources Commission.

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TABLE 1.—The year, sites, sample dates, mean temperature (°C), and mean conductivity (μS), from sampling of Glenville Reservoir. Sites are described as "C" = cove, "P" = point, and "B" = straight banks. The standard deviation of the estimate is shown in parentheses.

Year	Sites	Sample Dates	Temperature	Conductivity
2000	1C,2P,3C,4P,5P,6C,7B,8P	05/08	15.6 (0.5)	18.1 (1.9)
	9C,10C,11P,12C,13P,14P,15C,16B	05/09	16.6 (0.7)	16.6 (1.1)
	All	Combined	16.1 (0.8)	17.4 (1.7)
2001	1C,2P,3C,4P,5P,6C,7B,8P	05/07	16.4 (0.7)	16.4 (0.4)
	9C,10C,11P,12C,13P,14P,15C,16B	05/08	15.2 (0.8)	16.0 (0.3)
	All	Combined	15.8 (1.0)	16.2 (0.4)
2002	1C,3C,4P,5P,6C,7B,14P	05/07	17.8 (1.1)	19.8 (0.5)
	2P,8P,9C,10C,11P,12C,13P,15C,16B	05/08	19.1 (0.8)	18.9 (2.2)
	All	Combined	18.5 (1.1)	19.3 (1.7)

TABLE 2.—The year, number collected (N), mean catch per unit effort (CPUE) in distance and time, relative stock density for quality (Q), preferred (P), memorable (M) size fish, and mean relative weight (W_r) of largemouth bass (LMB) and smallmouth bass (SMB) collected during this survey. Standard errors of the mean are shown in parenthesis.

			Mean CPUE		Relative Stock Density			
Year	Species	N	N / 100m	N / h	Q	P	M	W_r
2000	LMB	135	2.8 (0.8)	25.7 (5.9)	68 (4.1)	23 (3.7)	3 (1.5)	91 (0.4)
	SMB	76	1.6 (0.4)	16.1 (3.4)	44 (6.0)	6 (2.8)	-	91 (0.8)
	All	211	4.4 (0.8)	41.8 (5.2)				
2001	LMB	74	1.5 (0.5)	18.5 (4.4)	76 (5.4)	37 (6.1)	3 (2.2)	92 (1.1)
	SMB	80	1.7 (0.3)	22.4 (4.1)	15 (5.8)	3 (2.5)	-	85 (0.7)
	All	154	3.2 (0.5)	40.8 (5.4)				
2002	LMB	122	2.5 (0.8)	25.3 (5.8)	60 (4.8)	35 (4.6)	-	90 (0.7)
	SMB	69	1.4 (0.2)	22.5 (3.6)	31 (6.9)	4 (3.1)	-	85 (0.9)
	All	191	4.0 (0.7)	47.8 (4.0)				
All	LMB	331	2.3 (0.7)	23.9 (4.9)	67 (2.7)	30 (2.7)	2 (0.8)	91 (0.4)
	SMB	225	1.6 (0.2)	19.9 (2.9)	33 (3.8)	5 (1.7)	-	88 (0.5)
	All	556	3.9 (0.6)	43.7 (3.8)				

TABLE 3.—The year, macrohabitat, number collected (N), mean catch per unit effort (CPUE) in distance (N / 100m) and time (N / h) of largemouth bass (LMB) and smallmouth bass (SMB) collected during this survey. Standard errors of the mean are shown in parenthesis. The N / h collected with the same letter are not significantly different. Bank sites were excluded from the ANOVA analyses.

			Mean LMB CPUE			Mean SMB CPUE	
Year	Macro-habitat	N	N / 100m	N / h	N	N / 100m	N / hr
2000	Cove	83	4.0 (1.6)	33.3 (10.3)[a]	39	1.9 (0.8)	16.8 (6.1)[a]
	Point	33	1.6 (0.8)	16.3 (6.7)[a]	28	1.3 (0.5)	15.6 (5.0)[a]
	Bank	19	3.2 (2.2)	32.0 (21.4)	9	1.5 (0.2)	15.5 (1.2)
2001	Cove	34	1.6 (0.7)	17.8 (6.2)[a]	36	1.7 (0.4)	20.4 (4.0)[a]
	Point	35	1.7 (0.8)	21.2 (8.1)[a]	35	1.7 (0.6)	24.9 (8.9)[a]
	Bank	5	0.8 (0.8)	11.4 (11.4)	9	1.5 (0.2)	20.7 (2.4)
2002	Cove	98	4.7 (1.6)	41.0 (9.0)[a]	28	1.3 (0.3)	16.4 (4.5)[a]
	Point	18	0.9 (0.5)	12.6 (5.9)[b]	35	1.7 (0.2)	31.2 (5.4)[b]
	Bank	6	1.0 (0.7)	14.8 (10.4)	6	1.0 (0.7)	13.3 (8.3)
All	Cove	215	3.4 (0.8)	30.7 (5.2)	103	1.6 (0.3)	17.9 (2.8)
	Point	86	1.4 (0.4)	16.7 (3.9)	98	1.6 (0.3)	23.9 (4.0)
	Bank	30	1.7 (0.8)	19.4 (7.9)	24	1.3 (0.2)	16.5 (2.7)

TABLE 4.—Mean total length (TL, mm) at age of capture, standard error of the mean, and sample size for largemouth bass (LMB) and smallmouth bass (SMB) aged during this survey, 2001 only.

		Age										
		1	2	3	4	5	6	7	8	9	10	11
LMB	Mean TL	113.6	230.9	337.0	359.9	417.2	438.0	460.0	476.7	473.7	455.0	511.0
	SE	6.9	8.6	16.2	5.1	13.7	24.0		10.5	33.0		8.0
	N	7	19	12	18	6	2	1	3	3	1	2
SMB	Mean TL	123.9	185.8	290.3	327.0	360.0						
	SE	7.7	3.3	9.3	14.0							
	N	21	52	4	2	1						

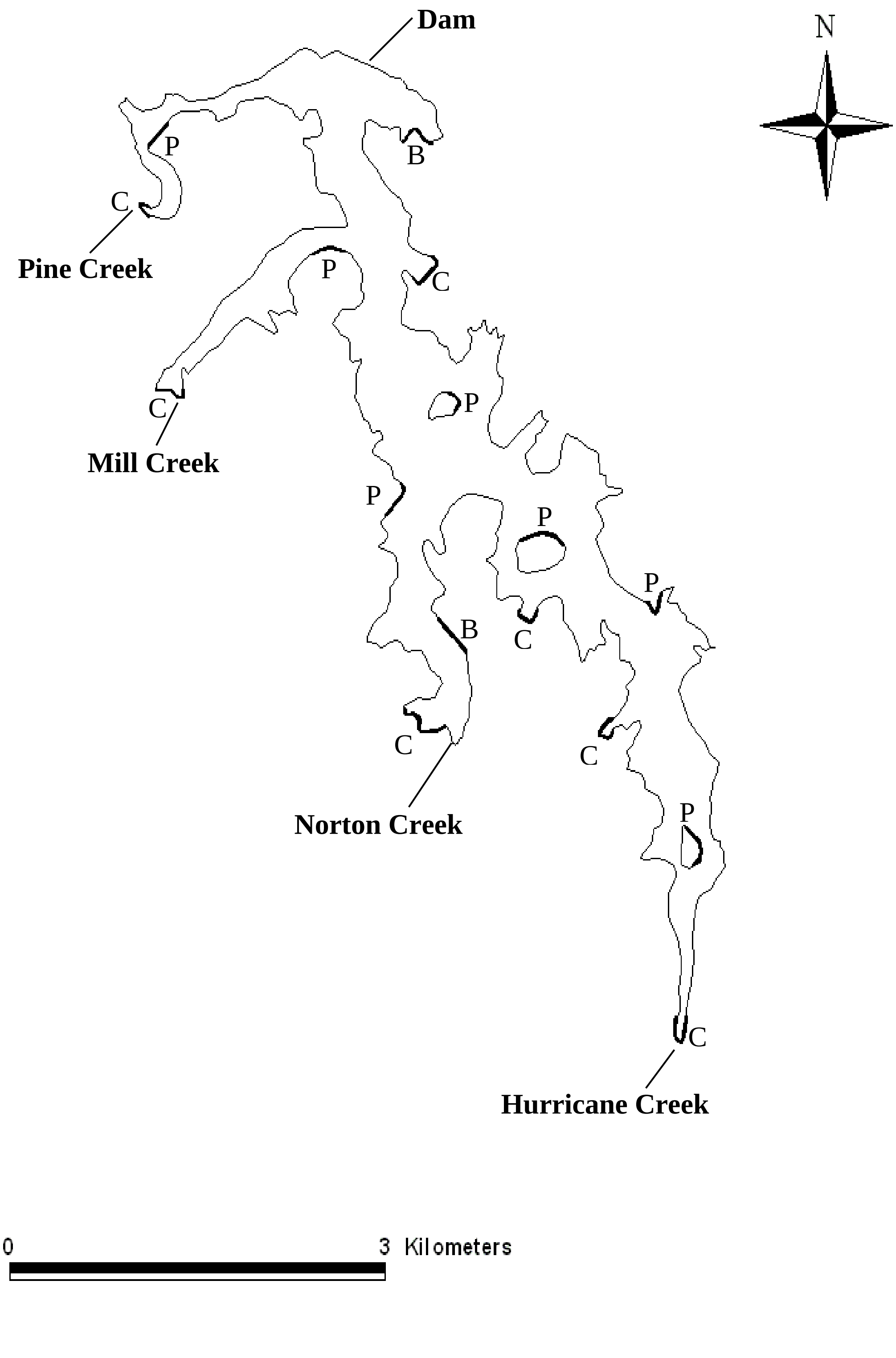

FIGURE 1.—Map of Glenville Reservoir showing the 16 shoreline electrofishing transects used in this study, 2000-2002. Cove sites (7), point sites (7) and bank sites (2) are represented by a dark line and a C, P, and B, respectively.

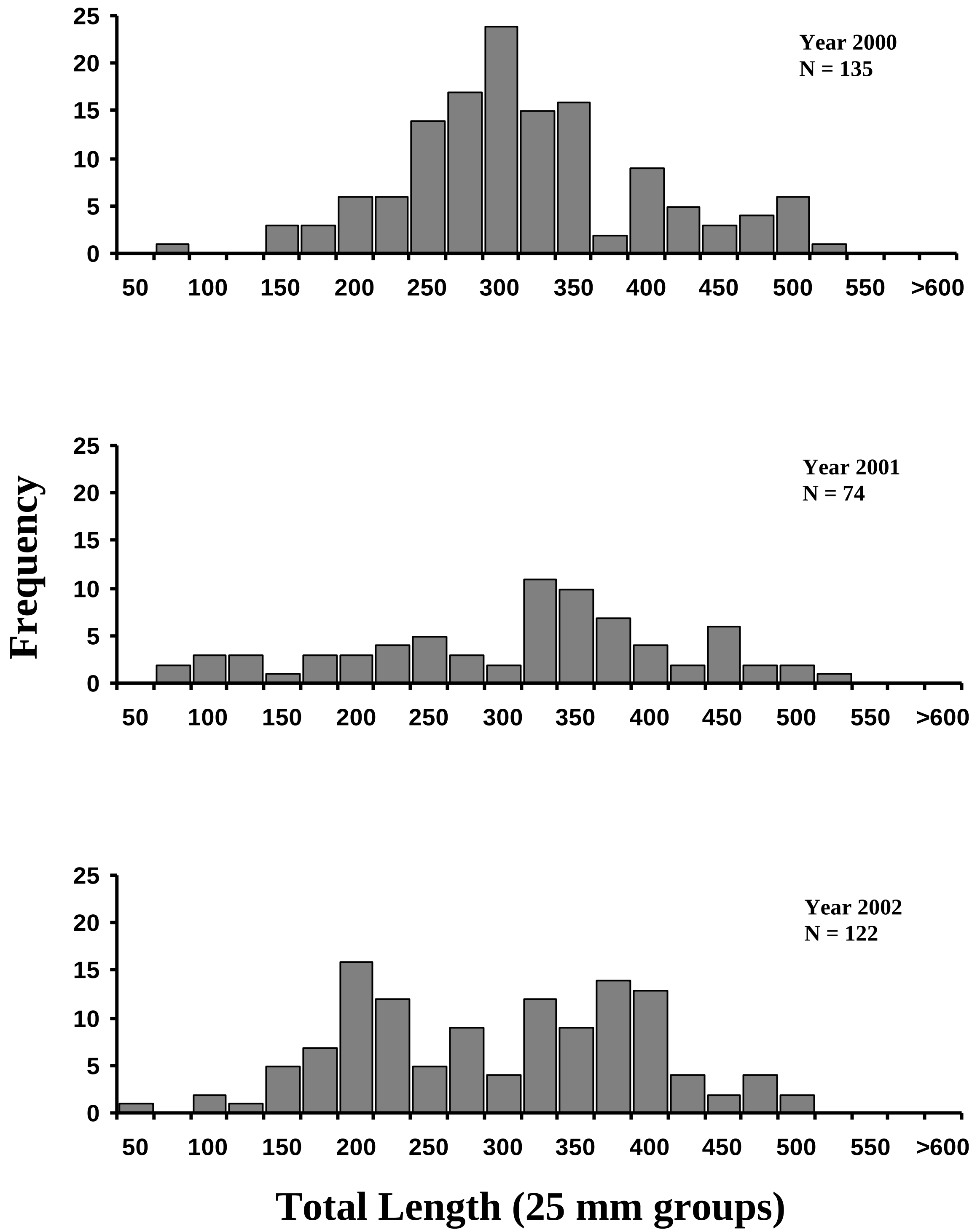

FIGURE 2.—The length-frequency distribution of largemouth bass collected during this survey.

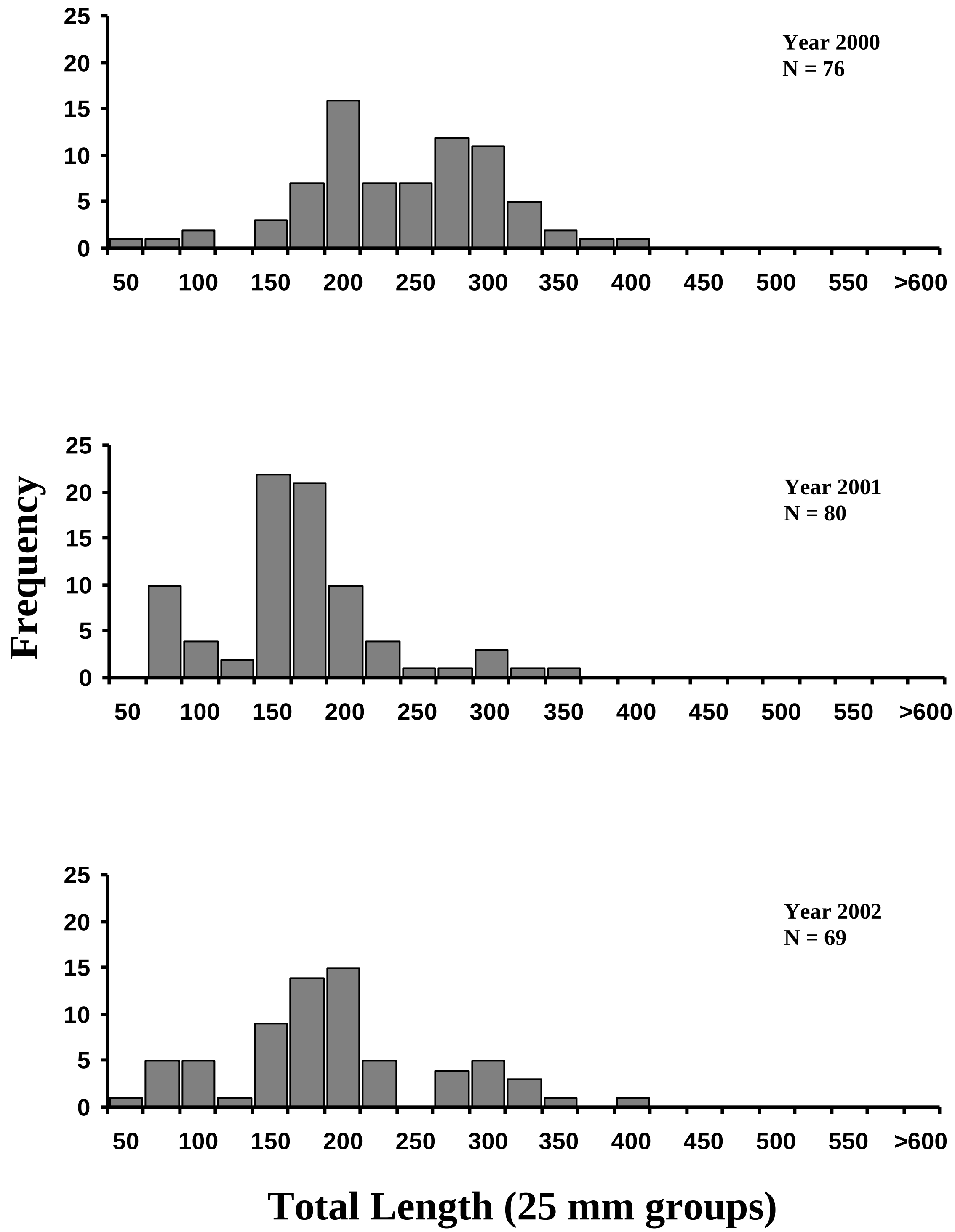

FIGURE 3.—The length-frequency distribution of smallmouth bass collected during this survey.

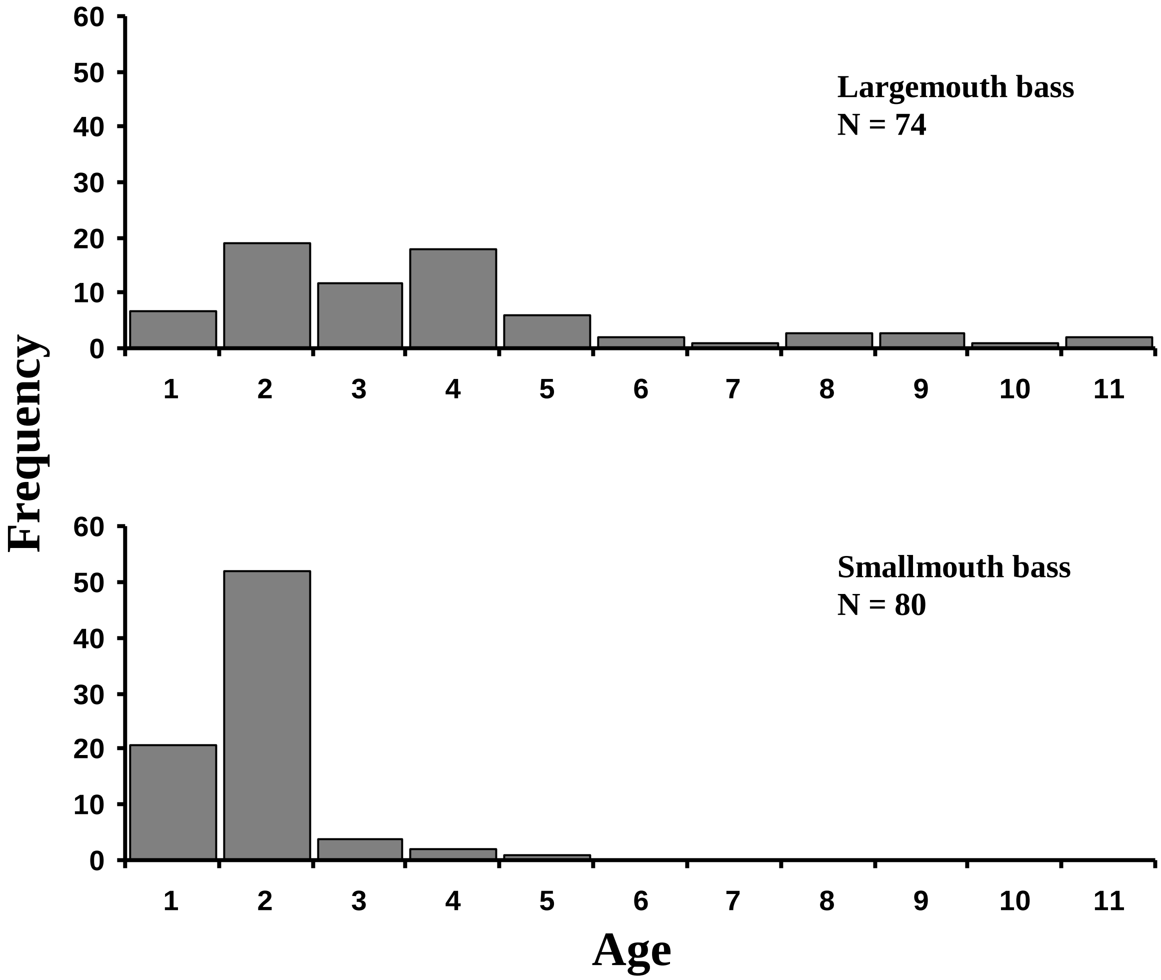

FIGURE 4.—Age-frequency distributions for largemouth bass and smallmouth bass collected during this survey.

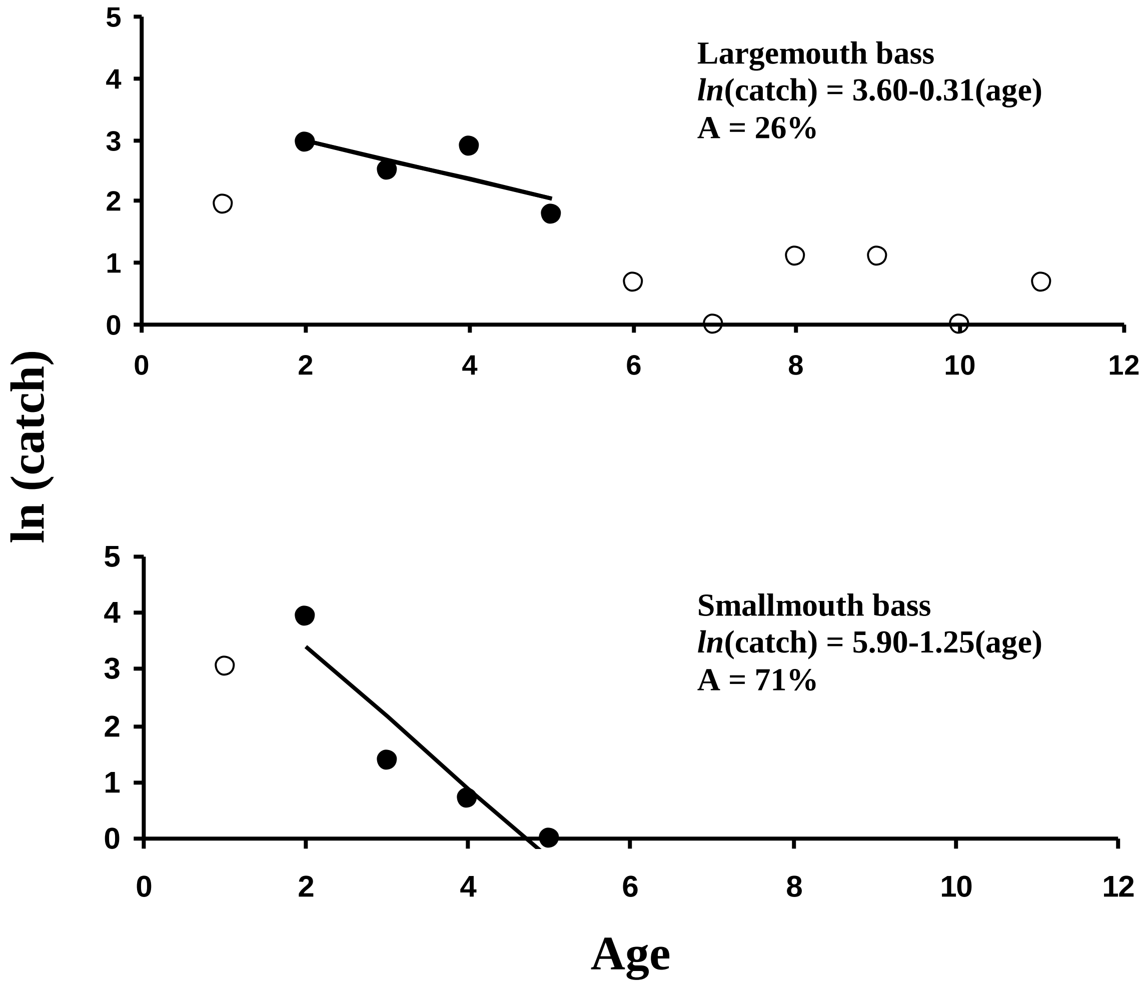

FIGURE 5.—Catch curve regressions and annual mortality rate estimates (A) for largemouth bass and smallmouth bass collected during this survey. Open circles represent age classes not used in the regression because they had not fully recruited to the gear or were represented by few individuals and biased the regression.

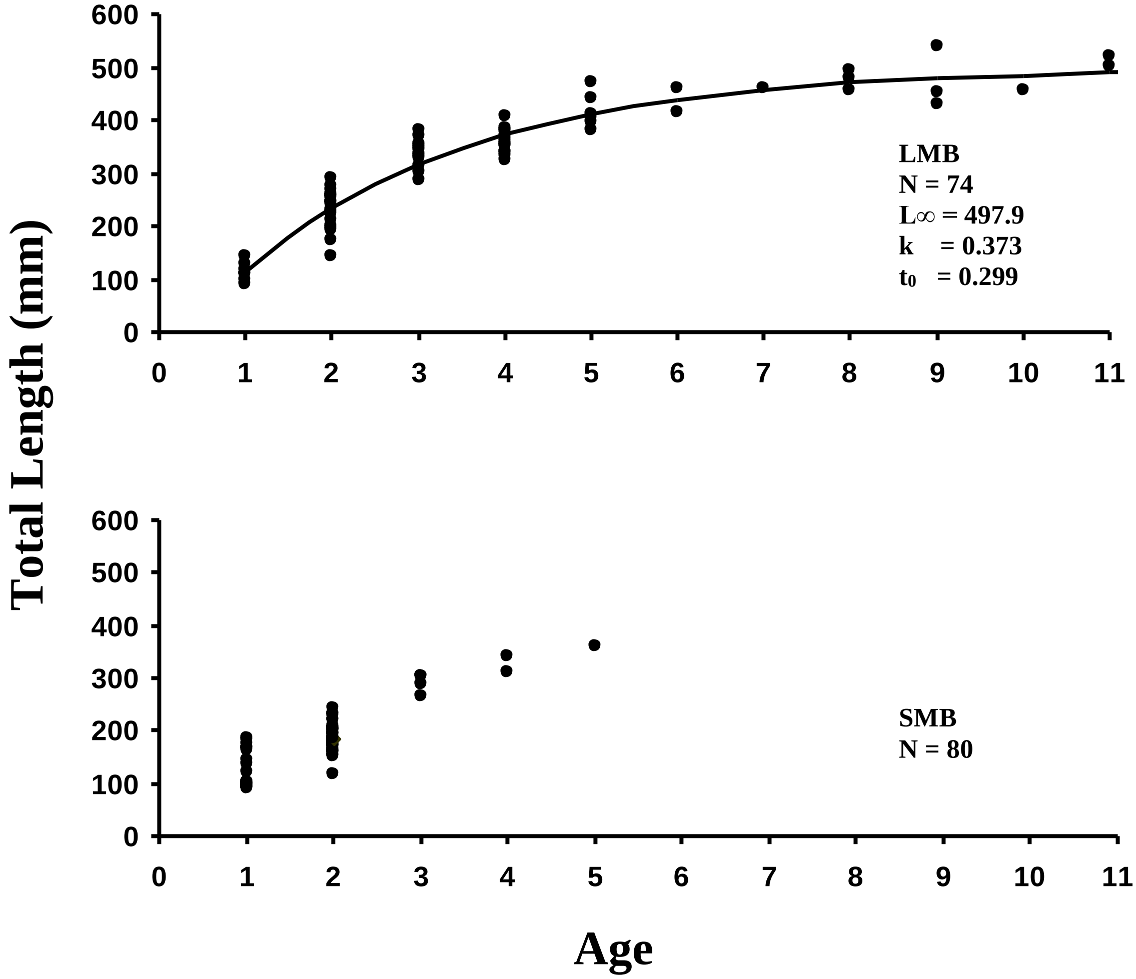

FIGURE 6.—Von Bertalanffy growth equations for largemouth bass (LMB) collected during this survey. The Von Bertalanffy growth equation could not be determined for smallmouth bass (SMB) due to inadequate sample size for ages 3-5 and absence of older age-classes.