Contribution of Stocked Fingerling Walleye in Lake James

Interim Report

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Abstract.–The North Carolina Wildlife Resources Commission (NCWRC) introduced walleye *Sander vitreus* fry into Lake James in 1949 and a population developed. Walleye stockings were halted after 1955 and the population was maintained by natural reproduction. Due to intensified public interest, the NCWRC resumed walleye stocking in 1980 to supplement natural reproduction. The objective of this study was to measure the contribution of stocked fingerling walleye in Lake James. Approximately 30,000 walleye fingerlings were marked with oxytetracycline hydrochloride (OTC) and stocked in Lake James in May 2000 and 2001. Gillnetting was a conducted one year later in November 2001 and 2002. Total catch of age-1 walleye varied substantially between 2001 (N = 53) and 2002 (N = 94). The percent of age-1 walleye otoliths with OTC marks ranged from 3.7% in 2001 to 2.1% in 2002. The proportionate contribution reported for both years was below the 25% management criteria used to determine stocking success. This study will be repeated in 2003.

In 1949, the North Carolina Wildlife Resources Commission (NCWRC) introduced 35,000 walleye *Sander vitreus* fry into Lake James. By 1955, 1.1 million fry had been stocked. As a result of these stockings, walleye became established and have remained a major game fish in Lake James.

Walleye stockings were halted after 1955 and the population was maintained by natural reproduction. Historically, spawning has occurred in the Linville and Catawba rivers. Some reproduction may also occur within the reservoir (Brown and Kearson 1986). A section of the Linville River is closed to angling from 15 February through 15 April to protect spawning walleye.

As a result of intensified public interest, the NCWRC resumed walleye stocking in 1980 to supplement natural reproduction. Approximately 1.5 million fry were stocked annually through 1985. Fingerling walleye stockings began in 1986 at a rate of 11/ha, or approximately 30,000 fingerlings annually. Actual numbers of walleye fingerlings stocked annually since 1986 ranged from 30,000 - 313,659 (mean 102,844). The large variation in numbers stocked was the result of public pressure to stock all walleye produced at the Table Rock State Fish Hatchery back into Lake James. Stocking rates since 1999 have been stabilized at 30,000 fingerlings.

Supplemental stocking of walleye is a common management practice in the U.S., although its effectiveness has not been widely investigated (Li et al. 1996a). Walleye stocking program goals are usually designed to establish, supplement, or maintain populations (Laarman 1978). To be successful, supplementally stocked walleye must contribute to the abundance of the fishable population. Li et al. (1996a) concluded after reviewing data on 200 Minnesota lakes that stocking walleye fingerlings in lakes with natural reproduction did not improve age-1 recruitment and such lakes should not be stocked. It was also found that although the abundance of a naturally reproduced year class was increased with supplemental stocking on some lakes, the abundance of year classes one year younger and one year older was decreased (Li et al. 1996b). Nate et al. (2000) found that total walleye abundance was higher in Wisconsin lakes with natural reproduction compared to those sustained through stocking; they concluded that poor first-year survival of stocked walleye may be a factor contributing to the consistently lower recruitment. Of the studies reviewed by Laarman (1978), only 5% of all supplemental stocking programs were considered successful.

Supplemental stocking of walleye fry or fingerlings has been successful in systems with limited natural reproduction or recruitment. McWilliams and Larscheid (1992) found that 50 -

150 mm walleye fingerlings stocked at a rate of 30 - 68/ha into West Okoboji Lake, Iowa, comprised from 70 - 99% of the age-0 population. Recruitment in this system was limiting, however, and first year mortality of stocked walleye was 2 - 16 times greater than naturally reproduced fish. Other studies have reported successful maintenance walleye stocking programs in systems with little natural reproduction or recruitment (Fielder 1992; Kayle 1992).

Recruitment of walleye and formation of year-class size is often highly variable and can be affected by both density-independent and density-dependent mechanisms. Madenjian et al. (1996) found that 98% of the variation in western Lake Erie walleye recruitment was a function of spawning stock size, water temperature, and the density of gizzard shad *Dorosoma cepedianum*. Cannibalism was listed as a major factor regulating recruitment of walleye in Oneida Lake, New York, and was found to be inversely related to walleye growth rates (Forney 1976). Hansen et al. (1998) found the number of age-0 walleye produced and surviving through their first summer was regulated largely by early mortality associated with cannibalism, intraspecific competition, and water temperatures.

The supplemental stocking of walleye fingerlings in Lake James costs the NCWRC an estimated US$5,000 annually (M.G. Martin, NCWRC, personal communication). The cost of a stocked walleye creeled on Lake James is unknown. A study of supplemental stocking in Virginia estimated that a stocked walleye returned to the creel cost an average of $27.00 per fish (Murphy et al. 1983). In order to allow better use of limited NCWRC resources and manpower, the contribution of supplementally stocked walleye in Lake James needs to be addressed. The objective of this study was to measure the contribution of stocked fingerling walleye in Lake James.

Methods

In May 2000 and 2001, 30,000 walleye fry were pond-reared to 50 mm mean total length and chemically marked at the Table Rock State Fish Hatchery, Morganton, NC. Walleye fingerlings were immersed in 500 mg/L oxytetracycline hydrochloride (OTC), 1000 mg/L sodium chloride, buffered with tris to a pH of 6.5 - 6.9, for six hours in a 1.8 m diameter round fiberglass tank. A subsample of 400 walleye fingerlings were held for 30 days at the hatchery and fed a diet of fathead minnow *Pimephales promelas* fry. Walleye fingerlings were stocked 24 h post-marking at a rate of approximately 11 fish/ha by boat in main channel areas throughout Lake James. Twenty-four hour mortality was estimated by placing a random subsample of 100 walleye fingerlings into in a 0.9-m^3 net pen which was set on the bottom of the lake at a depth of approximately 10 m. The number of dead walleye fingerlings were enumerated after 24 h.

After 30 days post-marking in 2000 and 2001, saggittal otoliths were removed from a random subsample of 100 walleye and checked for mark efficacy. One whole otolith from each walleye was bonded to a microscope slide using ethyl cyanoacrylate (super glue) and viewed whole under a Nikon Eclipse E400™ compound microscope under transmitted epiflourescent light. If no OTC mark was found, the otolith was then lightly sanded (4 - 5 strokes) using 400 grit wet-dry sandpaper and re-viewed. This process was repeated until the OTC mark was identified or the focus had been reached. The visual characteristics (color and intensity) of each OTC mark was qualitatively rated from 0 - 3: 0 = no mark, 1 = poor, 2 = fair, and 3 = good (Lorson and Mudrak 1987).

Twelve fixed gill net locations were established on Lake James in 1999 to sample walleye. These sites were located on lake points with a moderate slope of 25 - 45^o using a stratified non-random design to represent all areas of the lake. Experimental gill nets were set in November

2001 and 2002. Gill net dimensions were 2.4 x 76.3 m and consisted of five 2.4 x 15.3-m panels with 25-, 32-, 38-, 44- and 51-mm bar mesh. All nets were bottom-set perpendicular to shore for 24 hours. The mesh size towards shore was randomly selected for each net set. Gill nets were run in the same order they were set. All walleye captured were separated by site and mesh size, bagged with an identifying site label, placed on ice, and returned to the Marion State Fish Hatchery, Marion, NC.

Walleye returned to the hatchery were measured for total length (TL, mm), weight (g), and given a unique identification number. Saggittal otoliths were removed and placed in plastic otolith vials with the corresponding unique identification number, stored in the dark, and allowed to air-dry for 14 days. Otoliths were then immersed in water, and viewed under reflected light using a 10x dissecting microscope (Hammers and Miranda 1991). Otoliths were read independently by two readers to verify the age.

Age-1 walleye otoliths were mounted in epoxy resin and the otolith kernals were sectioned out using an Isomet™ low-speed saw. The thin sections were mounted to a glass side with ethyl cyanoacrylate, and viewed under the epiflourescent microscope using the same methods as the mark efficacy portion of the study. The presence, absence, and quality of the OTC marks were recorded for each age-1 walleye.

One gill net night was used as the unit of effort. The mean number of marked and unmarked age-1 walleye captured per net night was used as a measure of relative abundance. Relative abundance of stocked (OTC marked) and naturally reproduced age-1 walleye was compared using a Mann-Whitney nonparametric test. All statistical tests declared significance at $\alpha = 0.10$ and utilized the SYSTAT® computer software package (SYSTAT 2000).

The proportionate contribution of stocked walleye to its year-class was estimated by dividing the number of marked age-1 walleye, adjusted for OTC mark loss, by the total number of age-1 walleye captured. Mark loss was accounted for by multiplying the number of marked fish by 1.x, where x equals the percent rate of mark loss.

Results and Discussion

Approximately 30,000 walleye fingerlings were stocked in Lake James by boat in May 2000 and 2001. Mean TL at stocking was similar between years (range, 45.3 - 49.6 mm). Twenty-four hour post-stocking survival was high and varied little between 2000 (96%) and 2001 (98%). Walleye fingerling OTC mark retention was 100% at 30 days post stocking in both 2000 and 2001, although mean mark quality varied considerably between 2000 (2.6) and 2001 (1.6). The reduced OTC mark quality in 2001 may have been the result of unknown water quality variables in the marking tank, including pH levels which were closer to the low end of the optimal range (6.5 - 6.9) than in 2000. Because OTC mark retention was 100% (despite the variability in mark quality), no adjustments were made for tag loss in either 2000 or 2001.

Twelve gill nets were set in Lake James in November 2001 and 2002 (Figure 1). Total catch of age-1 walleye varied substantially between 2001 (N = 53) and 2002 (N = 94) (Table 1). Overall, age-1 walleye were captured at a rate of 4.4 fish/net night in 2001 and 7.8 fish/net night in 2002 (Table 2). Naturally reproduced age-1 walleye were captured at significantly (P = 0.001) higher rates than OTC-marked age-1 walleye in both 2001 and 2002. Capture rates (CPUE) of age-1 walleye were similar between the Catawba and Linville regions of Lake James in both 2000 and 2001 (P = 0.106).

Age-1 walleye ranged in size from 265 - 406 mm TL in 2001 and 265 - 450 TL in 2002 (Figure 2). Significant between-lake region differences in the sizes of age-1 walleye were found in both 2001 ($P = 0.001$) and 2002 ($P = 0.002$) Overall, the mean size of age-1 walleye captured from the Catawba arm of Lake James were 20 mm larger than age-1 walleye captured from the Linville arm (Figure 3). The age-1 walleye size differential observed among regions in Lake James has been documented for both age-0 (Besler 2002) as well as adult walleye (Besler 2000, Besler 2001). Although walleye sizes varied among lake regions, based on length frequency distributions, age-1 walleye are vulnerable to the gill nets used in this study and it is believed that the age-1 walleye obtained are a representative sample.

Stocked walleye are contributing to the age-1 population in Lake James at a low rate. The proportionate contribution of OTC marked age-1 walleye was 3.7% (N = 53) in 2001 and 2.1% (N = 94) in 2002. The proportionate contribution reported for both years was below the 25% management criteria used to determine stocking success.

Recommendations

1) Complete the study as planned in 2003.

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TABLE 1.–Summary statistics of age-1 walleye captured in gill nets from Lake James, November 2001 and 2002. Summary statistics also listed for the Catawba and Linville regions of Lake James by year.

	Overall		Catawba		Linville	
Summary statistic	2001	2002	2001	2002	2001	2002
Sample size	94	53	65	38	29	15
Mean total length (mm)	363	364	369	370	351	348
Standard error	2.9	4.4	3.4	5.5	4.6	4.9
Standard deviation	27.8	31.8	27.4	33.8	25.0	19.1
95% Upper confidence interval	369	372	362	381	341	358
95% Lower confidence interval	357	355	376	359	360	339
Coefficient of variation (COV, %)	7.6	8.7	7.4	9.3	7.1	5.5

TABLE 2.–Summary catch rate (CPUE) statistics of age-1 walleye captured in gill nets from Lake James, November 2001 and 2002. Summary statistics also listed for OTC marked and unmarked age-1 walleye by year.

	Overall age-1		Marked age-1		Unmarked age-1	
Summary statistic	2001	2002	2001	2002	2001	2002
Sample size (gill net sets)	12	12	12	12	12	12
Mean CPUE (age-1 walleye/net night)	4.4	7.8	0.2	0.2	4.3	7.7
Standard error	1.4	2.0	0.2	0.2	1.4	1.9
Standard deviation	4.8	7.0	0.6	0.6	4.8	6.6
95% Upper confidence interval	7.1	11.8	0.5	0.5	7.0	11.4
95% Lower confidence interval	1.7	3.9	0.0	0.0	1.6	3.9
Coefficient of variation (COV, %)	109	89	300	300	111	89

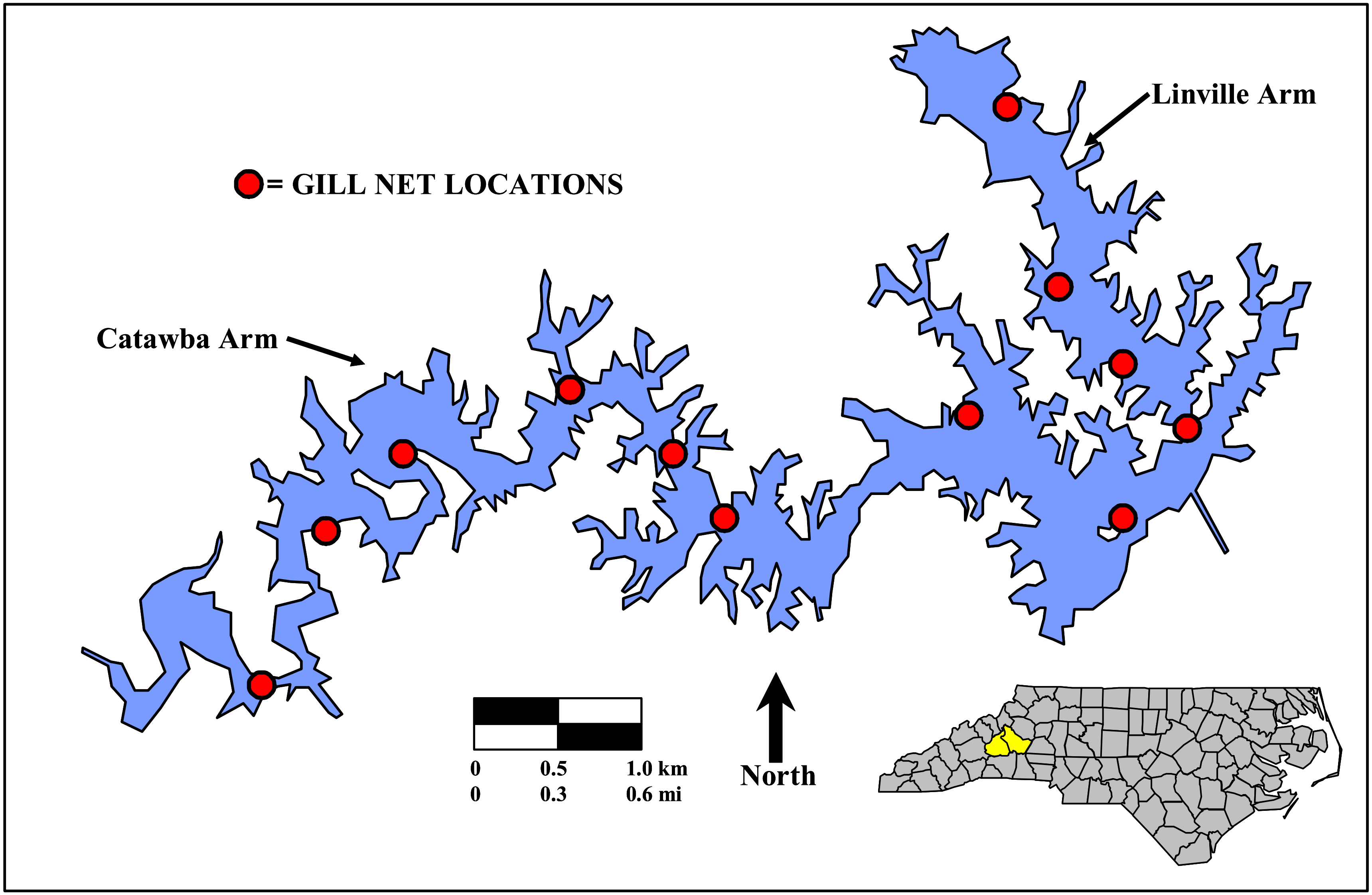

FIGURE 1.–Map of Lake James, Burke and McDowell counties, North Carolina. Identified areas are the major arms of the reservoir and the age-1 walleye study gill net sampling locations used on 6 - 9 November 2001, and 5 - 8 November 2002.

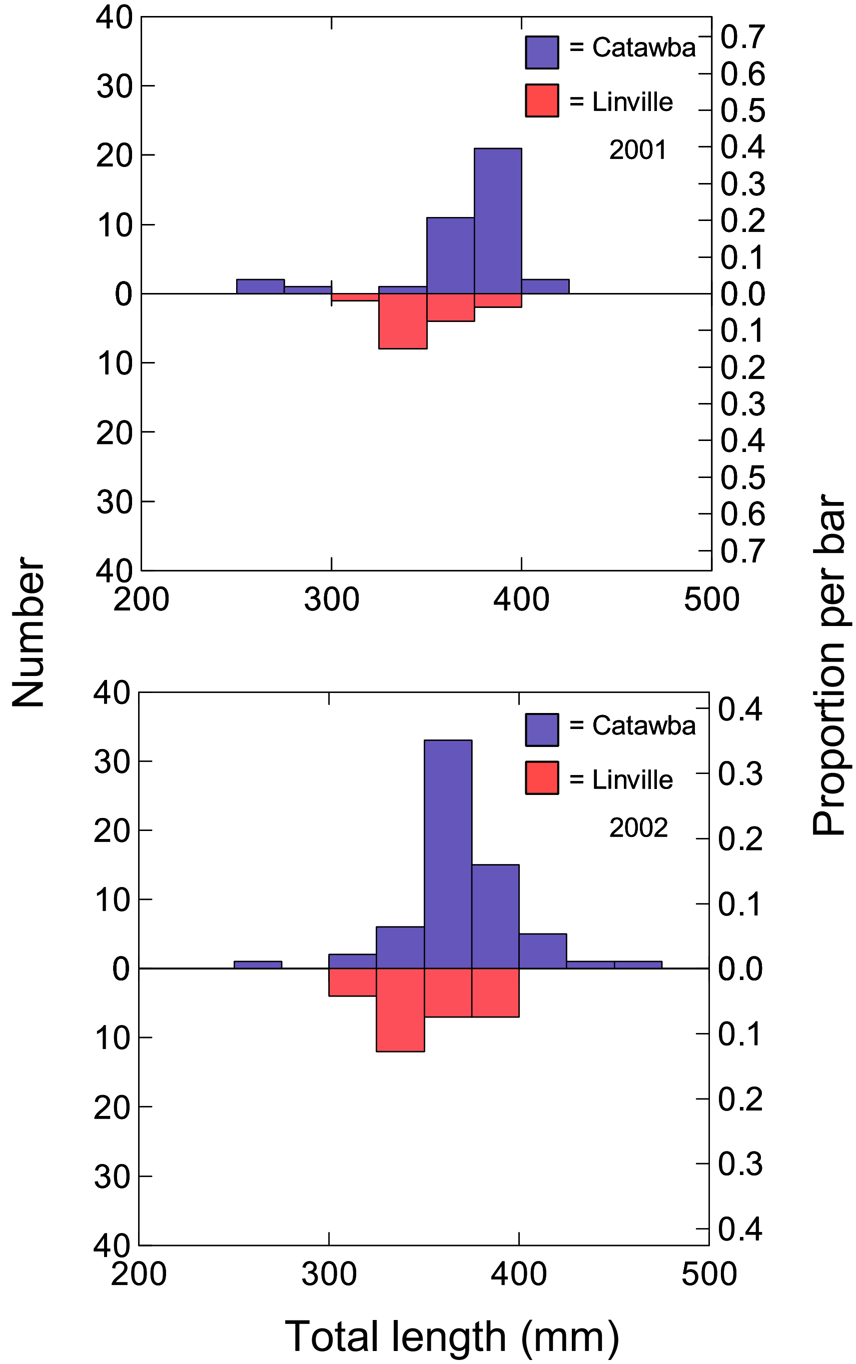

FIGURE 2.–Length frequency distribution, by lake region, of age-1 walleye captured in gill nets from Lake James, 6 - 9 November 2001 and 5 - 8 November 2002. Length frequency distributions reported for the Catawba and Linville regions of Lake James.

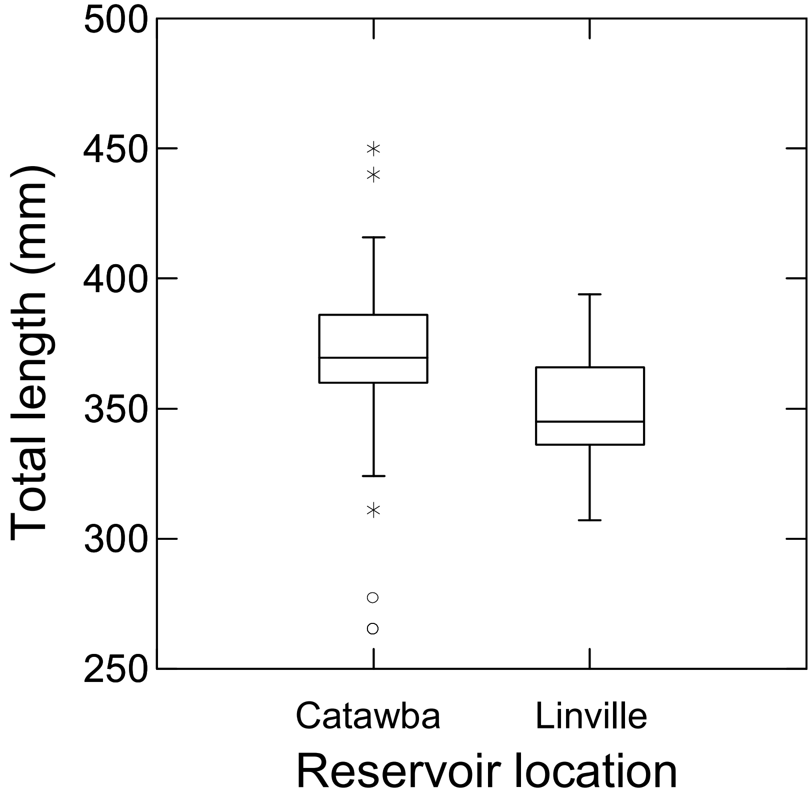

FIGURE 3.–Box plots depicting total lengths of age-1 walleye captured with gill nets in the Catawba and Linville regions of Lake James in November 2001 and 2002. Total length values are combined among years for each lake region. Center horizontal lines within each box represent the median value, while the box itself represents the range within which the central 50% of the values fall. Vertical lines, asterisks, and open circles outside the box represent outliers to the central 50% of the values.