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Population Attributes of Lake Trout in Tennessee Reservoirs

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Abstract - We sampled stocked *Salvelinus namaycush* (Lake Trout) in Watauga Lake and South Holston Lake, TN using experimental gill nets in 2009–2010 to describe their growth, longevity, and condition. Annuli in sagittal otoliths formed once a year in early spring in both reservoirs. South Holston Lake (*n* = 99 Lake Trout) has been stocked since 2006, and the oldest fish was age 4. Watauga Lake has been stocked since the mid-1980s, and we collected 158 Lake Trout up to age 20. Annual mortality for age-3 and older fish in Watauga Lake was 24%. When compared to Lake Trout in northern lakes, Tennessee Lake Trout exhibited average to above-average growth and longevity. Condition of Lake Trout in both reservoirs varied seasonally and tended to be lowest in fall, but rebounded in winter and spring. Lake Trout in both reservoirs appeared to be spatially segregated from pelagic prey fishes during summer stratification, but growth rates and body condition were high enough to suggest that neither system was being overstocked.

Introduction

Salvelinus namaycush Walbaum (Lake Trout) are widely distributed throughout Canada and the northern United States (Crossman 1995), predominating in deep, cold lakes (Johnson 1976). Lake Trout are well adapted to cold oligotrophic lakes with extensive hypolimnia and prefer temperatures of approximately 10 ± 2 °C (Magnuson et al. 1990). While they can be found in shallow water only 3 to 5 m deep in spring and fall, Lake Trout will seek cold temperatures at depths of 60 m or more in the summer and are one of the most stenothermal freshwater species in North America (Magnuson et al. 1990). Their large body size, high longevity, iteroparity, great fecundity, and large eggs are attributes that contribute to their persistence in harsh environments where recruitment can be highly variable (Evans and Olver 1995). Lake Trout have been introduced extensively outside of their native range (Crossman 1995). In many reservoirs in the western United States, introduced Lake Trout populations are managed as trophy fish because of their potential to reach large sizes (Johnson and Martinez 2000). Lake Trout can live up to 50 years, and the current all-tackle angling world record fish (according to the International Game Fish Association) weighed 32.65 kg. A large body size assures low predation on adults and often places this piscivore at the top trophic position in food webs (Vander Zanden and Rasmussen 1996). Because they are an apex predator, introduced Lake Trout pose a serious threat to indigenous fish species in western US lakes, including other salmonids such as *Salvelinus*

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confluentus Suckley (Bull Trout) and *Oncorhynchus clarkii* Richardson (Cutthroat Trout) (Ruzycki et al. 2003).

Lake Trout were first stocked into Tennessee waters (Dale Hollow Lake in the Cumberland River watershed) in 1977 (Hubbs 1988). The Tennessee Wildlife Resource Agency (TWRA) began stocking Lake Trout into Watauga Lake in northeast Tennessee during the mid-1980s. At latitude 36°19'N, the Watauga Lake population of Lake Trout represents one of the southernmost populations of this species in North America. Lake Trout have also been stocked annually into South Holston Lake since 2006. By 2009, over one million hatchery-reared Lake Trout had been stocked into both reservoirs. During the first years of stocking, the numbers of Lake Trout stocked were low and variable; however, an average of more than 80,000 Lake Trout have been stocked annually into Watauga Lake since 1999, and 50,000 have been stocked annually in South Holston Lake since 2006. When Lake Trout are stocked each winter as age-1 individuals, they average about 152 mm (6 inches) in total length (TL) and subsequently grow to harvestable sizes in sufficient numbers to support recreational fisheries in both reservoirs. In a 2005 Watauga Lake creel survey, about 9% of intended fishing effort (12,903 angler-hours) was directed at "any trout" or "Lake Trout" (Black 2006). Despite the long-running Lake Trout stocking program, there is no published information on the ecology of Lake Trout in either of these two Tennessee reservoirs. Both Lake Trout populations are thought to be supported entirely by hatchery fish because (1) there has been no indication of natural recruitment (J. Hammonds, Tennessee Wildlife Resources Agency, Morristown, TN, pers. comm.), and (2) Lake Trout eggs require sediment-free rocky substrate with abundant interstitial spaces to incubate (Dorr et al. 1981, Martin and Olver 1980). These types of substrates are scarce in Watauga and South Holston Lakes.

Lake Trout do not pose any known threats to the ecological integrity of reservoir systems in Tennessee because of differences in habitat preferences of Lake Trout and native species. Most indigenous fish species in Tennessee reservoirs prefer littoral or benthic habitat, whereas Lake Trout occupy the pelagic zone throughout most of the year. In the absence of native salmonids or pelagic piscivores to compete with, Lake Trout introduced into Tennessee reservoirs are filling an essentially unoccupied habitat in these ecosystems. In addition, the apparent inability of Lake Trout to reproduce in these reservoirs gives managers the ability to control population levels and curtail any unwanted impact of the species by adjusting stocking rates, harvest regulations, or both.

Our primary objective was to describe attributes of the Lake Trout populations in Watauga Lake and South Holston Lake. Specifically, we present information on annulus formation, longevity, growth, robustness, and mortality and contrast some of these population attributes among seasons and between reservoirs. We also compared growth and longevity of Tennessee Lake Trout with those of Lake Trout populations elsewhere in North America. Growth, in particular, is one of the most important and reliable indicators of fish health and habitat quality

(DeVries and Frie 1996), and modeling growth rates is an important component of any effective management plan.

Study Area

Watauga Lake (36°31'23.85"N, 82°5'17.38"W) is a 2602-ha impoundment on the Watauga River in the headwaters of the Tennessee River system in northeast Tennessee. It holds the distinction of being the highest reservoir in the Tennessee River system with a full-pool elevation of more than 597 m above mean sea level (amsl). The Tennessee Valley Authority (TVA) constructed the dam and reservoir in 1948, principally for flood control and hydropower generation. At full pool, Watauga Lake has a capacity of 1.885 x 10^8 m^3 and a shoreline length of 169 km and is 26.2 km long (Hammonds and Peterson 2007a). It has a shoreline development index of 9, an average depth of 7 m, and a maximum depth of 95 m. Watauga Lake is monomictic and exhibits a heterograde dissolved oxygen (DO) profile each summer; DO concentrations are depressed in the metalimnion, but recover in the hypolimnion (Fig. 1). The TWRA classified Watauga Lake as mesotrophic with a trophic index of 44.3 (Carlson 1977). As a two-story reservoir, it supports a warmwater fishery for *Micropterus salmoides* Lacépède (Largemouth Bass) and *M. punctulatus* Rafinesque (Spotted Bass), a coolwater fishery for *M. dolomieu* Lacepède (Smallmouth Bass) and *Sander vitreus* Mitchill (Walleye), and a coldwater fishery for *Onchorhynchus mykiss* Walbaum (Rainbow Trout), *Salmo trutta* L. (Brown Trout) and Lake Trout. Pelagic forage for Lake Trout is provided by *Alosa pseudoharengus* Wilson (Alewife; Vandergoot and Bettoli 2001), which were stocked in the late 1970s.

South Holston Lake (36°19'21.52"N, 82°7'19.52"W) is a 3068-ha impoundment on the South Fork of the Holston River (just north of Watauga Lake) that straddles the Virginia border. The reservoir was constructed in 1950 for flood control and power production. At full pool, South Holston Lake is 527 m amsl, has a capacity of 3.118 x 10^8 m^3 and a shoreline length of 293 km, and is 38.6 km long. It has a shoreline development index of 15, an average depth of 10 m, and a maximum depth of 75 m (Hammonds and Peterson 2007b). South Holston Lake also has a negative heterograde DO profile when the reservoir is stratified each summer (Fig. 1). The TWRA classified South Holston Lake as mesotrophic with a trophic index of 44.7 (Carlson 1977). South Holston also is a two-story reservoir that supports a warmwater fishery for Largemouth Bass and Spotted Bass, a coolwater fishery for Smallmouth Bass and Walleye, and a coldwater fishery for Rainbow Trout, Brown Trout, and Lake Trout. The pelagic forage base includes both Alewives and *Dorosoma petenense* Günther (Threadfin Shad; Vandergoot and Bettoli 2001).

Methods

Sampling

Gill netting is a widely used method for sampling Lake Trout in northern US and Canadian lakes (Carl 2007, Hansen et al. 2008, Madenjian et al. 2008). We

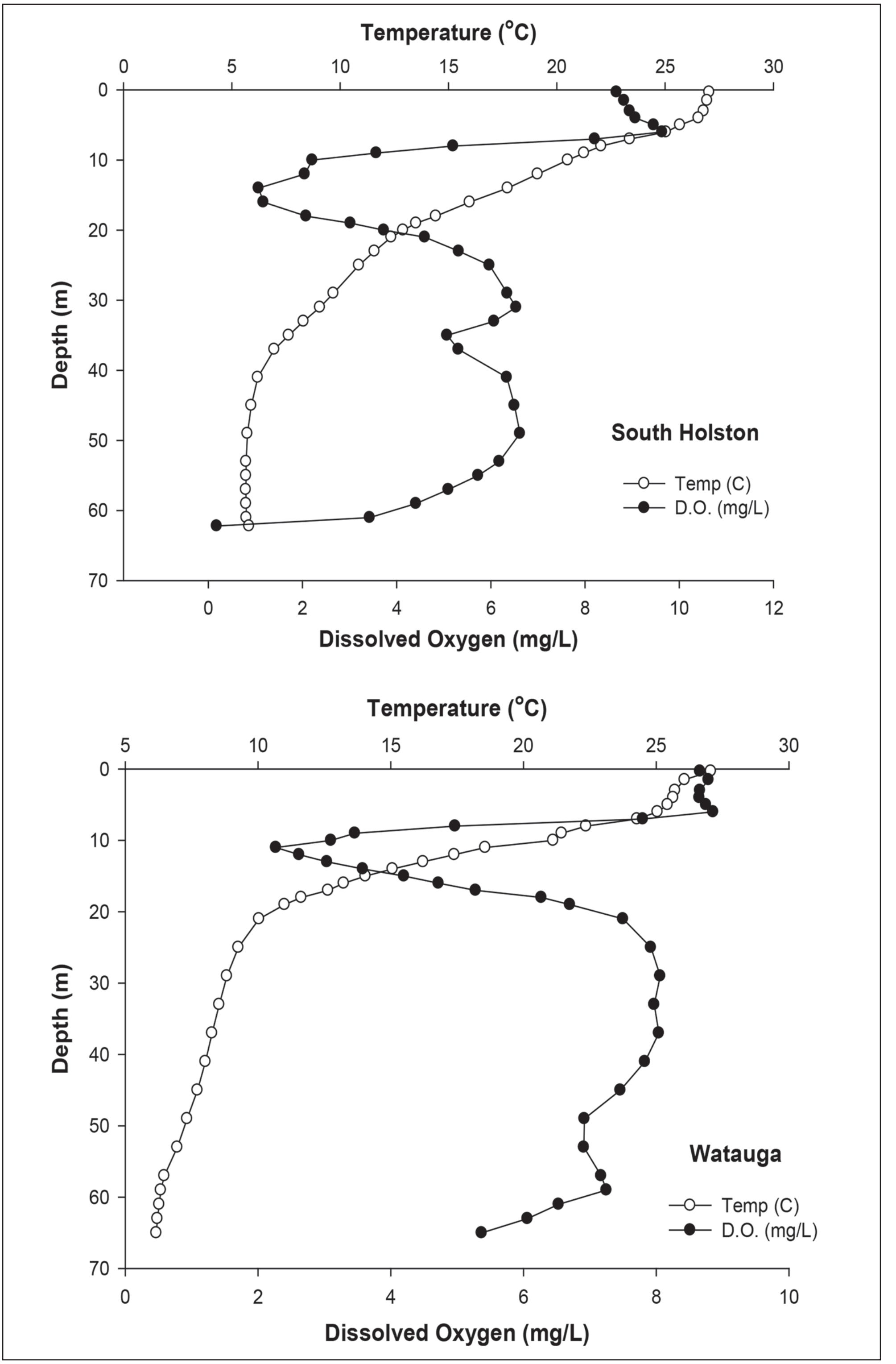

Figure 1. Dissolved oxygen (mg/L) and temperature (°C) profiles in August 2009 for Watauga Lake and South Holston Lake.

deployed sinking experimental monofilament horizontal gill nets, the most common type of gill nets used to sample Lake Trout (e.g., Gunn et al. 1987, Trippel 1993). Experimental gill nets reduce size-selectivity biases encountered when using nets of a single mesh size, and a broader range of size classes in the population is vulnerable to such gear (Helser et al. 1991). Each net measured 107 m x 3 m and consisted of 7 separate panels, each 18 m long with the following bar-measure mesh sizes (mm): 25, 38, 51, 64, 76, 89, and 102. The use of large mesh sizes (e.g., 102 mm) increased the probability of capturing the largest individuals in the population (Hansen et al. 1997). Nets were hung on a 2:1 basis, whereby 4 meshes are hung in the space of 2 stretched meshes. Sampling locations were chosen based on information obtained from Lake Trout anglers, fishing reports, and location of fish using sonar. Lake Trout thermal preferences and minimum oxygen requirements are well documented (Christie and Regier 1988, Magnuson et al. 1990, Stewart et al. 1983); therefore, we measured temperature and dissolved oxygen profiles to target Lake Trout. Both lakes were sampled on six different occasions from late May 2009 to February 2010. Thirty gill nets were set in South Holston Lake and 31 in Watauga Lake over four seasons; we attempted to set at least five gill nets per sampling trip. Each reservoir was sampled twice in May 2009 (Spring), once in July and once in August 2009 (Summer), once in September 2009 (Fall), and once in either January or February 2010 (Winter). Netting sites were not fixed, though nets were most often deployed in the deep water of the lower reaches of both reservoirs. Nets were set perpendicular to the shoreline or on offshore humps with the lead line on the bottom. Nets were set at dusk and retrieved the following morning. An electric line hauler (Ace Line Hauler™ Model Number 99481, Nanaimo, BC, Canada) was used to retrieve nets. Weight (g), total length (mm), and sex of each Lake Trout were recorded, as well as the mesh size that captured each fish. We also enumerated all other species caught (i.e., bycatch). In order to better estimate longevity, growth, and maximum size, we also posted notices at marinas on each reservoir requesting that anglers retain Lake Trout heads (and their total lengths) in the hope that we could collect otoliths from some large individuals.

Estimating population parameters

Scales have traditionally been used for aging Lake Trout because their collection is nonlethal. Although scales are adequate for aging immature Lake Trout, the accuracy and precision of scale ages declines considerably after sexual maturity (Casselman 1987, Sharp and Bernard 1988). We examined sagittal otoliths because they are considered the most accurate bony structure for estimating age of slow-growing, long-lived species such as Lake Trout (Beamish and McFarlane 1983) and are better indicators than scales of true age of Lake Trout (Casselman 1983, Power 1978, Sharp and Bernard 1988). Otoliths were removed from each Lake Trout captured in gill nets or by recreational anglers. Otoliths were cleaned in bleach (sodium hypochlorite) to remove any adhering tissue, rinsed in deionized water, and stored dry in paper envelopes. Otoliths were then embedded in epoxy and sectioned along the transverse axis of the nucleus with an Isomet™

low-speed saw and examined under 100x magnification using transmitted light with a compound microscope. The number of annuli on each cross section was counted independently twice by the same reader; if the counts did not agree, the otolith was read a third time before an age was assigned. Mean marginal increments also were measured on each otolith and plotted against season of capture to estimate the time of annulus formation and to confirm that opaque bands were annuli. The marginal increment was measured as the distance from the distal margin of the outermost annulus to the otolith edge (Casselman 1987). The greatest marginal increments would occur just before an annulus was laid down; the smallest would occur just after annulus formation.

Total annual mortality (A, %) was estimated for Lake Trout in Watauga Lake, which had the oldest population of the two reservoirs sampled. The natural logarithms of catch-at-age were modeled against age and a weighted catch-curve regression was used to estimate the slope, z, of the descending limb of the catch curve (i.e., instantaneous mortality). Total annual mortality was estimated with the formula $A = 1 - e^{-Z}$ (Miranda and Bettoli 2007). Only fish captured in gill nets were used to estimate mortality (i.e., angler-caught fish were excluded from this analysis), and only those age-classes fully recruited to the gear were incorporated into the catch-curve (i.e., age classes in the left, ascending limb of the catch curve were excluded).

Growth rates of Lake Trout were described using the von Bertalanffy growth model:

$$L_t = L_\infty (1 - e^{-K[t - t_0]}),$$

where L_t is the total length in time t (years), L_∞ is the maximum theoretical attainable length (mm), K is the growth coefficient, and t_0 is the time in years when the length theoretically would be zero (von Bertalanffy 1957). The parameters of the model were estimated using Fisheries Analysis and Simulation Tools (FAST) software (Slipke and Maceina 2000). Growth rates of Lake Trout in Watauga Lake and South Holston Lake were then compared to their growth in several northern US lakes for which we could obtain estimates of those same growth model parameters and where otoliths were used to age fish. Data on Lake Trout populations from the following eastern US lakes were used in the comparison: Moosehead Lake, ME and Sebago Lake, ME (P. Johnson, State of Maine Department of Inland Fisheries and Wildlife, Greenville, ME, unpubl. data); Piseco Lake, NY (S. Jameson, New York State Department of Environmental Conservation, Ray Brook, NY, unpubl. data). Lake Superior Lake Trout also were included in the comparisons (T. Halpern, Minnesota Department of Natural Resources, Grand Rapids, MN, unpubl. data), although they are known to behave differently than most inland lake populations because of morphotypes that can differ in their biology (e.g., Bronte 1993, Burnham-Curtis and Bronte 1996, Khan and Qadri 1970). The parameter ω, which is the product of the theoretical maximum length L_∞, and the growth coefficient K (Gallucci and Quinn 1979), was calculated for each population; this parameter has been shown to be a useful metric for comparing growth among populations (Gangl and Pereira 2003, OMNR 1983).

The robustness of Lake Trout in our study reservoirs was qualitatively compared to the condition exhibited by other North American populations by calculating relative weights. The standard weight equation was provided by Piccolo et al. (1993). We used analysis-of-covariance (ANCOVA) to evaluate differences in adjusted mean weights of Lake Trout among seasons and between the two Tennessee reservoirs. In these analyses, $\log_{10}$(weight) was the response variable, $\log_{10}$(total length) was the covariable, and season (or reservoir) was the independent variable. Adjusted mean weights were not compared unless the slopes of the $\log_{10}$(weight):$\log_{10}$(total length) regression lines were similar ($P > 0.05$); the interaction term testing the slopes was subsequently dropped when adjusted means were tested. Statistical Analysis System software (SAS Institute, Inc. 1989) was used to perform analyses of covariance, with an alpha level of 0.05 in tests of statistical significance.

Results

Using gill nets, we collected 99 Lake Trout from South Holston Lake (260–636 mm TL) and 158 Lake Trout from Watauga Lake (251–842 mm TL). In addition to the gill net catches, anglers provided us with the skulls and lengths of five Lake Trout from South Holston Lake (393–464 mm TL) and 12 Lake Trout from Watauga Lake (431–635 mm TL). As many as 12 Lake Trout in a single net were caught during spring and summer in South Holston Lake, and the greatest catch in a single net in Watauga Lake (17 Lake Trout) occurred in the fall. The depths at which nets were set depended on temperature and dissolved oxygen profiles and thus differed each season. For instance, the shallowest nets were set in spring in each reservoir, when the average depth of each net ranged from 4.2 to 31.3 m in South Holston Lake and 9.5 to 28.9 m in Watauga Lake. Average net depths were the deepest in the fall, ranging from 27.6 to 46.0 m in South Holston Lake and 20.7 to 43.9 m in Watauga Lake. The most common piscivores (i.e., potential competitors with Lake Trout) collected in gill nets (both reservoirs combined; all seasons) were Walleye ($n = 310$), *Ictalurus punctatus* Rafinesque (Channel Catfish; $n = 58$), Rainbow Trout ($n = 49$), and Smallmouth Bass ($n = 25$).

We collected otoliths from 20 Lake Trout reared at the Dale Hollow National Fish Hatchery (the source of all Lake Trout stocked in Tennessee) in December 2009, approximately one month before they were stocked, to check for pre-stocking annuli. No opaque bands were observed on any of those otoliths. The two ages assigned independently to otoliths removed from Lake Trout collected in South Holston Lake and Watauga Lake agreed within 1 year or less for 88% of the otoliths examined. Otoliths exhibited alternating translucent and opaque zones, and marginal increments increased steadily from a low in spring 2009 to a high in winter 2010, which indicated that a single opaque band was formed once per year between late winter and spring. Three Lake Trout that were stocked in January 2010 were caught in May 2010, and the number of annuli on those three known-age fish were in agreement (i.e., one annulus was present on each of the otoliths). Three year classes of Lake Trout from Watauga Lake that were missing from our samples (1991, 1993, and 1994) corresponded with years when no Lake Trout were stocked. These aforementioned observations support the conclusion that annuli were laid down once a year in the otoliths we examined.

Lake Trout in Watauga Lake ranged from age 1 to age 20, whereas the South Holston population ranged from age 1 to age 4. Lake Trout from the 2006 year class represented the highest percentage of Lake Trout collected in both Watauga

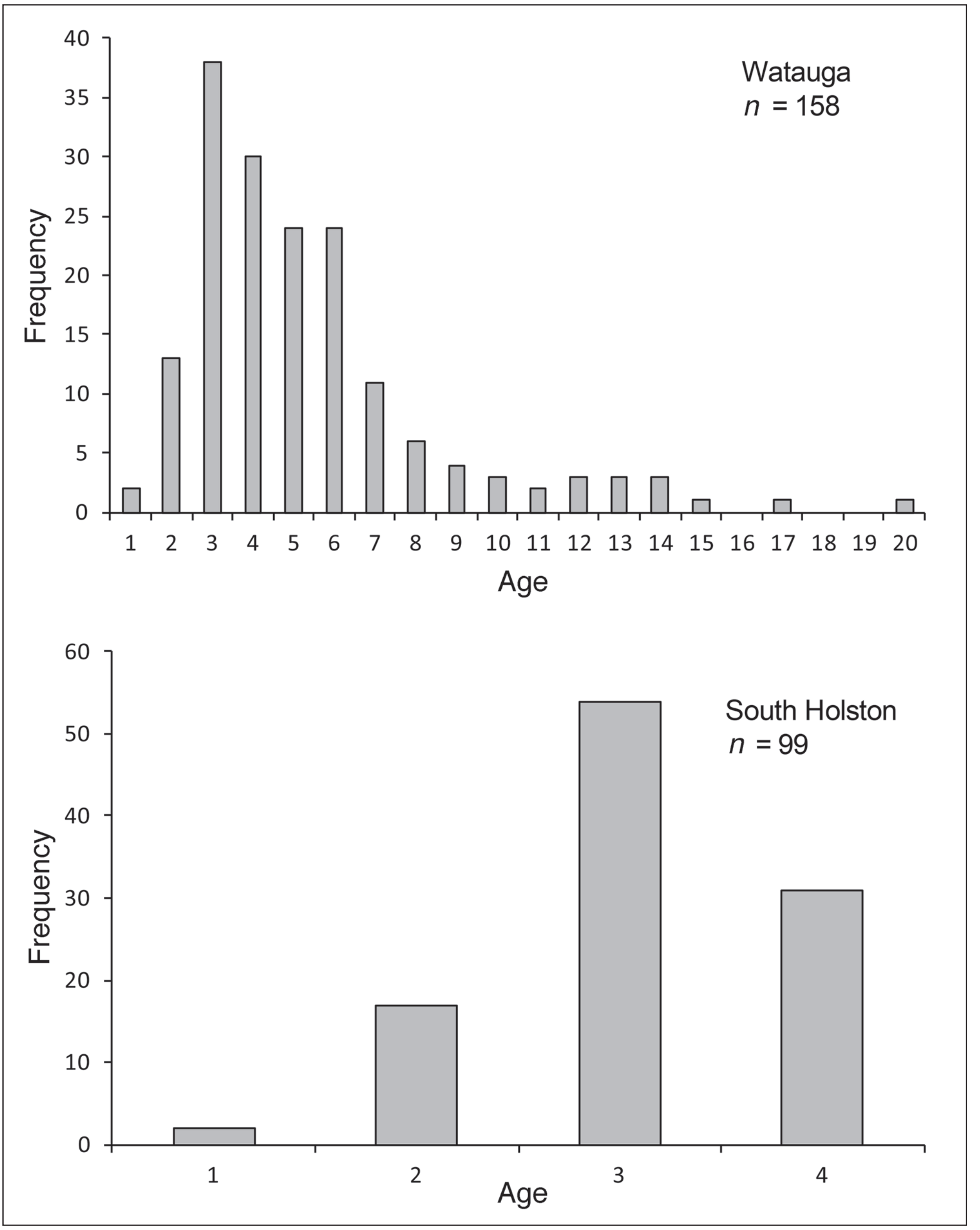

Figure 2. Age distributions of Lake Trout collected in gill nets at Watauga Lake and South Holston Lake, May 2009–February 2010.

Lake (22%) and South Holston Lake (45%) (Fig. 2). The instantaneous mortality rate (z) for age 3 and older Lake Trout in Watauga Lake was 0.268, which corresponds to a total annual mortality rate (A) of 24%. The longest and heaviest fish collected from Watauga Lake was an 842-mm-TL, 7.21-kg, age-13 female. The longest fish from South Holston Lake was a 636-mm-TL, 2.23-kg, age-4 female, and the heaviest was a 604-mm-TL, 2.46-kg age-3 female.

The von Bertalanffy model fit to mean length-at-age data for all Lake Trout (gill-netted and angler-caught; Table 1) yielded theoretical asymptotic maximum total lengths (i.e., L_∞) of 809 mm and 647 mm in Watauga Lake and South Holston Lake, respectively. However, to produce potentially more accurate growth curves, we fixed L_∞ as the total length of the current state record Lake Trout (from Watauga Lake [940 mm]) and we solved for the other parameters of the von Bertalanffy growth model for both populations. Growth of Lake Trout in each reservoir was then best described by:

$$\text{Watauga Lake:} \quad L_t = 940(1 - e^{-0.109[t + 2.823]})$$

$$\text{South Holston Lake:} \quad L_t = 940(1 - e^{-0.149[t + 1.588]}).$$

Values of the growth parameter ω for Lake Trout in Watauga Lake and South Holston Lake fell within the bounds of the growth rates for Lake Trout in northern lakes, with values of 102.5 and 140.1, respectively (Table 2). Lake Trout lived longer in Watauga Lake than in five of the six northern lakes we used in our comparisons; in Lake Superior, slow-growing Lake Trout lived up to age 37.

Table 1. Mean total length (TL, mm) and frequencies for each age class of lake Trout caught in gill nets or supplied by anglers at Watauga Lake and South Holston Lake, May 2009–February 2010. One outlier from Watauga Lake was excluded from the analysis.

	Watauga Lake		South Holston Lake	
Age	*n*	Mean TL	*n*	Mean TL
1	2	259	2	299
2	13	403	17	381
3	38	460	54	493
4	30	517	31	514
5	24	544		
6	24	574		
7	11	581		
8	6	670		
9	4	683		
10	3	745		
11	2	763		
12	3	809		
13	3	807		
14	3	800		
15	1	759		
17	1	758		
20	1	735		
Total	169		104	

The weight-length relationships for Lake Trout in each reservoir were best described by the following equations:

Watauga Lake: $\log_{10}WT = 3.190 \log_{10}TL - 5.502$ ($n = 157$, $r^2 = 0.98$)

South Holston Lake: $\log_{10}WT = 3.329 \log_{10}TL - 5.893$ ($n = 98$, $r^2 = 0.98$).

There was no significant difference among seasons in slopes of the $\log_{10}$(TL):$\log_{10}$(WT) regression lines in Watauga Lake ($P = 0.274$) or South Holston Lake ($P = 0.0560$); thus, adjusted mean weights could be computed and compared. Season was a significant source of variation in the robustness of Lake Trout in Watauga Lake (ANCOVA: $F = 11.57$; df = 3, 152; $P < 0.0001$) and South Holston Lake ($F = 1285.84$; df = 3, 93; $P < 0.0001$). Lake Trout in Watauga Lake were most robust in the spring, while there were no significant differences among adjusted mean weights in other seasons. Lake Trout in South Holston Lake were most robust in spring and winter and least robust in fall (Table 3).

The slopes of the $\log_{10}$(TL):$\log_{10}$(WT) regression lines were similar between the two lakes when data were pooled over all seasons and both sexes ($F = 3.53$; df = 1, 251; $P = 0.0614$), and Lake Trout robustness in each reservoir was similar ($F = 0.13$; df = 1, 252; $P = 0.7186$). In terms of relative weights, the condition of Lake Trout in each reservoir was virtually identical; mean relative weights were 102.8 (SE = 1.1) in Watauga Lake and 102.5 (SE = 0.98) in South Holston Lake (Fig. 3). The relative weight plots also demonstrate that Tennessee Lake Trout were in good condition relative to Lake Trout populations elsewhere in North America.

Table 2. Parameters of the von Bertalanffy growth model, the growth parameter ω, and maximum age of stocked Lake Trout from Watauga Lake and South Holston Lake, 2009–2010, and for wild and stocked Lake Trout from lakes within the natural range of Lake Trout in the United States.

Lake, State (source)	K	L_∞	ω	Maximum age
Sebago, ME (wild)	0.290	589	170.8	9
Moosehead , ME (stocked)	0.361	473	170.8	11
Piseco, NY (wild)	0.269	630	169.5	7
S. Holston, TN (stocked)	0.149	940	140.1	4
Moosehead , ME (wild)	0.186	627	116.6	14
Sebago , ME (stocked)	0.121	940	113.7	9
Watauga, TN (stocked)	0.109	940	102.5	20
Lake Superior, MN (both)	0.069	1029	71.0	37

Table 3. Adjusted mean weights for Lake Trout in Watauga Lake and South Holston Lake, 2009–2010. Pooled mean total lengths at Watauga Lake and South Holston Lake were 548 mm and 482 mm, respectively. Seasonal values within each lake that share a letter were statistically similar ($P > 0.05$). Slopes of the seasonal $\log_{10}$ (total length):$\log_{10}$ (weight) regression lines at each lake were similar ($P > 0.05$).

Season	Watauga	South Holston
Spring	1652^{B}	1069^{BC}
Summer	1464^{A}	1027^{B}
Fall	1422^{A}	941^{A}
Winter	1387^{A}	1099^{C}

Discussion

King et al. (1999) reported that Lake Trout grew slower in years of early stratification; however, growth was not otherwise associated with stratification variables, (e.g., warmer epilimnion, larger thermal gradient, shallower thermocline), which suggested that springtime feeding on littoral prey was a major determinant of growth for Lake Trout. Fry and Kennedy (1937) and Martin

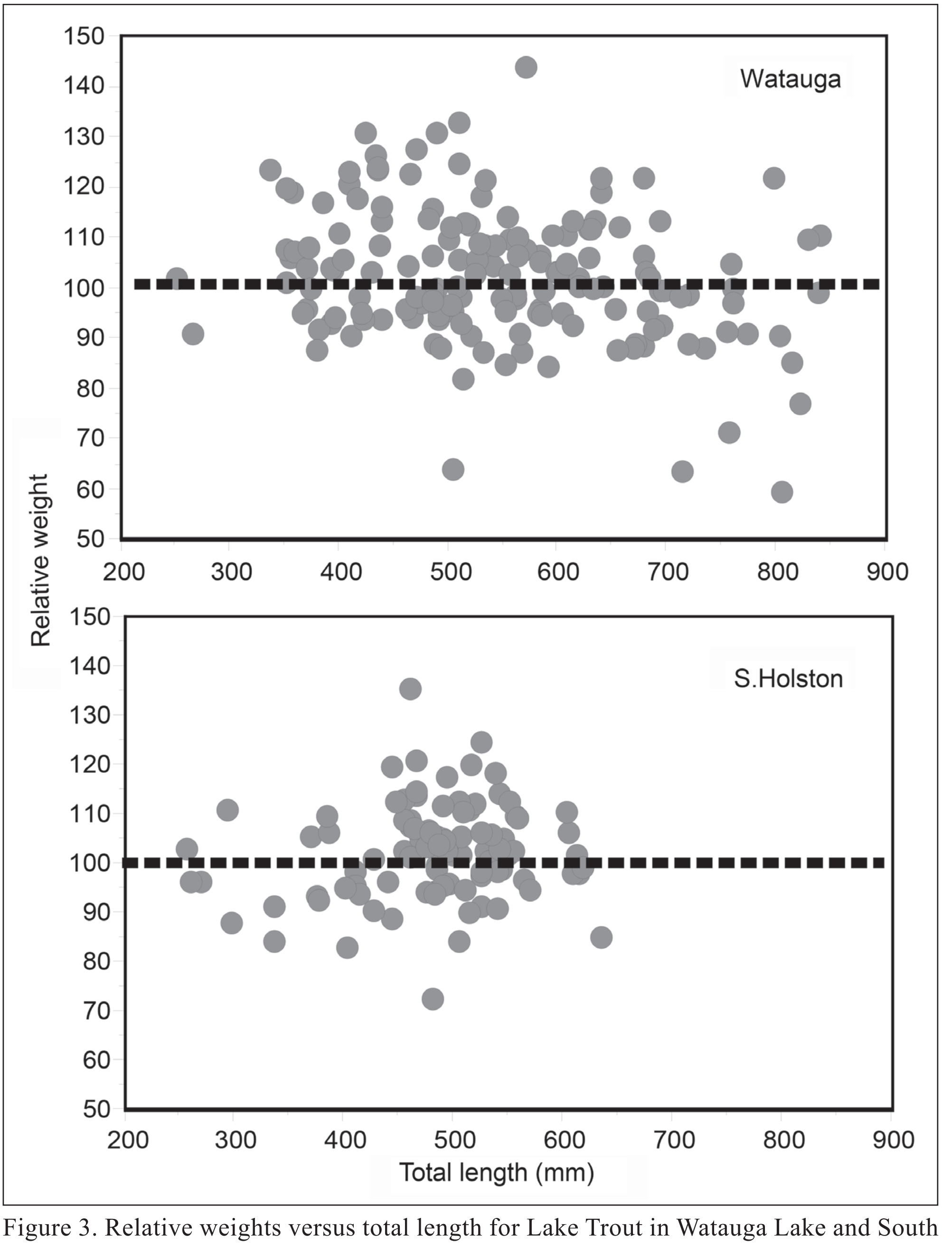

Figure 3. Relative weights versus total length for Lake Trout in Watauga Lake and South Holston Lake, May 2009–February 2010.

(1970) also suggested that seasonal migration to the hypolimnion usually marks cessation of feeding by most Lake Trout (except the largest individuals, which become cannibalistic in Lake Opeongo, ON, Canada). This scenario appears to be the case in Watauga Lake and South Holston Lake as evidenced by increases in robustness of Lake Trout in both reservoirs after destratification occurred in late fall.

In six small Canadian lakes with favorable abiotic conditions (i.e., cold temperatures, high dissolved oxygen concentrations), competition with other fish species in the hypolimnion, more than water quality, stocking season, or stocking size, appeared to affect survival and growth of stocked Lake Trout (Gunn et al. 1987). Powell et al. (1986) found that body condition of stocked Lake Trout in eight lakes in northeastern Ontario, Canada, declined with increasing abundance of coregonids, suggesting that competition for food was affecting growth. In contrast, there is likely little competition between Lake Trout and other fish species in the hypolimnions of Watauga Lake and South Holston Lake, especially in the fall as evidenced by low bycatch rates. We caught (combined) only 6–11 Walleye, Rainbow Trout, and Channel Catfish in 5–6 nets set in each reservoir in the fall, compared to catches in winter of 29–39 of those same three species in 5–6 nets and catches in summer of 98–105 of those same piscivores in 10–11 nets. Intraspecific competition as well as separation from forage during stratification are probably the two most important factors regulating Lake Trout growth in Tennessee reservoirs during periods of intense stratification.

The maximum age of Lake Trout in Watauga Lake (20 years) is consistent with the general observation for many species that slow-growing individuals tend to live longer (Cushing 1968, Metcalfe and Monaghan 2003); that is to say, Lake Trout in Watauga Lake grew slower than most of their northern US counterparts but lived longer. Lake Trout in Watauga Lake lived about as long as Lake Trout in 63 southern Canadian lakes (mean = 23.8 years) but not nearly as long as Lake Trout in 62 northern Canadian Lakes (mean = 34.3 years; McDermid et al. 2010). It remains to be seen whether the recently stocked, young population of fast-growing Lake Trout in South Holston Lake will follow the expected pattern and live shorter lives than Lake Trout in nearby Watauga Lake.

The current TWRA regulations for Lake Trout on both study lakes limit anglers to two Lake Trout per day with no length limit. No minimum length limit exists because catch-and-release mortality of undersized Lake Trout would undoubtedly be high during warmer months, perhaps as high as the catch-and-release mortality that Striped Bass experience (67%) when caught and released in Tennessee reservoirs during summer (Bettoli and Osborne 1998). The likelihood of high catch-and-release mortality limits the possibility of establishing typical trophy-fish management practices such as a protective slot limit that encourages recruitment to larger lengths. However, with control over stocking rates and the implementation of the sampling protocols described herein, the TWRA can ensure that Watauga Lake and South Holston Lake will continue to produce trophy Lake Trout and provide a unique angling experience for anglers in the southeastern United States.

Acknowledgments

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