Management Plan for the South Holston Tailwater Trout Fishery 2015-2020

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March 2015

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South Holston Tailwater Trout Fishery Management Plan (2015-2020)

I. Management Goal and Strategies

The Tennessee Wildlife Resources Agency's (TWRA's) management goal for the South Holston Tailwater (South Fork Holston River) is to continue providing a high-quality trout fishery and the variety of angling opportunities it offers.

TWRA's primary strategies for attaining the management goal for the South Holston tailwater will continue to feature the exceptional wild brown trout *Salmo trutta* fishery which is comparatively unique among Tennessee's tailwaters, while also providing put-and-grow and put-and-take fisheries for rainbow trout *Oncorhynchus mykiss.*

II. Background

The South Holston tailwater was created in 1950 when the Tennessee Valley Authority (TVA) completed construction of the dam at South Fork Holston River Mile (SFHRM) 49.8 in Sullivan County, Tennessee. The reservoir upstream of the dam (7,580 acres) has a drainage area of 703 $mi.^2$ and extends 24 miles upstream into Washington County, Virginia. Much of the watershed is forested and includes portions of the Cherokee National Forest (Tennessee) and the Jefferson National Forest (Virginia). TVA operates South Holston Reservoir primarily for flood control and power production. The dam's single turbine is capable of producing a maximum of 38,500 kW and an average discharge of 2,400 cfs (68 m^3/s). The tailwater extends ~13.7 miles from the dam to the headwaters of Boone Reservoir and has an average width of 131 ft. and surface area of ~217 acres at base flow (Bettoli et al. 1999).

Turbine discharges from South Holston Dam historically provided low dissolved oxygen (DO) levels during summer and fall (Scott et al. 1996). While this DO depression was not as severe as those in other TVA tailwaters, it was a concern for the trout fishery. Consequently, TVA constructed a labyrinth weir at SFHRM 48.5 (~1.25 miles below the dam) to address the DO issue and a lack of minimum flow as part of its Reservoir Releases Improvement Program. The weir, completed in December 1991, maintains a minimum flow of 90 cfs (2.55 m^3/s) in the tailwater and recovers approximately 40-50% of the oxygen deficit as water passes over it (Yeager et al. 1993). The turbine is typically pulsed 2-3 times daily to maintain the weir pool. Additionally, releases from South Holston Dam have been aerated via turbine venting since 1992 (Scott et al. 1996). The weir and turbine improvements combine to help maintain the target DO concentration of 6 ppm. Bettoli et al. (1999) found that DO levels downstream of the weir were suitable for good trout growth and survival and that water temperatures were usually below 68º F (20º C) and did not exceed 71.6º F (22º C). Temperature data collected by TWRA during June 2014 (Habera et al. 2015) indicated that the lower portion of the tailwater (Rockhold area near SFHRM 37 and downstream) can temporarily exceed 70° F (21° C) on a daily basis during extended periods of minimum flow (Figure 1).

The South Holston tailwater was initially stocked with fingerling and adult rainbow and brook trout *Salvelinus fontinalis* in 1952. It was managed for many years as a put-and-take and put-and-grow trout fishery through annual stockings of adult rainbow trout (typically 9-12 inch) and fingerling rainbow and brown trout. Natural reproduction by brown trout had become so

successful by 2003 that stocking of this species was discontinued and management shifted to featuring the wild brown trout fishery (Habera et al. 2003). The South Holston tailwater continues to provide one of the finest trout fisheries in Tennessee and the Southeast. It was previously estimated to have a total economic value of $931,525 (Williams and Bettoli 2003).

Prior to Bettoli et al.'s (1999) intensive studies during 1997-1998, limited biological data were available for the South Holston tailwater. TWRA had data from two fish and benthic macroinvertebrate monitoring sites sampled during 1995-1998 (Bivens et al. 1996, 1997, 1998; Habera et al. 1999) and TVA's biological and water quality assessment of tributary tailwaters included the South Holston in 1993 and 1994 (Scott et al. 1996). TVA's electrofishing catch rate for four stations in 1994 averaged 98 fish/h for all trout ≥7 inches (Scott et al. 1996) and were dominated by brown trout, as were TWRA's (except in 1998). TVA concluded that the water quality and minimum flow improvements had much enhanced the tailwater's trout fishery (Scott et al. 1996). However, while there were increases in the number of benthic macroinvertebrate taxa (including EPT taxa) and a concurrent decrease in the proportion of tolerant taxa following DO and minimum flow improvements, corresponding tailwater benthic index scores changed little ("fair" range for most samples; Scott et al. 1996).

Bettoli et al. (1999) made the first detailed assessment of the South Holston's trout fishery, including an estimation of overwintering trout biomass, a spawning redd survey, assessments of survival and growth of stocked trout, and a creel survey. The biomass estimate of 207 lbs./acre (232 kg/ha) in May 1997 (~80% brown trout) exceeded all other Tennessee tailwaters in the 1990s and rivaled other high-quality tailwater trout fisheries in the U.S. (Bettoli et al. 1999). Brown trout over 20 inches (508 mm) were relatively common throughout the tailwater and fish over 27 inches (686 mm) were present; however, few rainbow trout >18 inches (457 mm) and none >20 inches were captured (Bettoli et al. 1999).

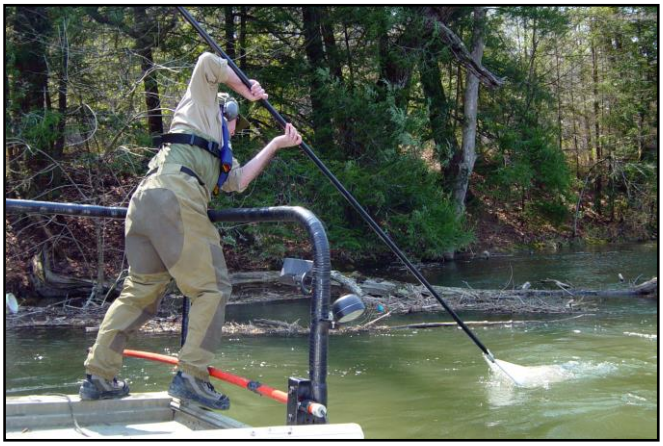
TVA observed brown trout spawning below the labyrinth weir shortly after its installation (1991) and collected gravid female brown trout throughout the tailwater during its 1993-1994 sampling efforts (Scott et al. 1996). Bettoli et al. (1999) later documented numerous trout redds during December 1997 and January 1998 and a subsequent study (Banks and Bettoli 2000) during 1998-2000 identified trout spawning at seven distinct spawning sites throughout the tailwater. Spawning activity peaked in mid to late December and was most intense in the vicinity of the island at River's Way near SFHRM 46 (Banks and Bettoli 2000). Successful recruitment of wild brown trout was documented in 1997, when 55% of all overwintering trout were wild age-1 browns, and their growth (0.43 inches/month) was similar to that for hatchery fish and brown trout in other tailwaters (Bettoli et al. 1999).

In recognition of the management potential afforded by the South Holston tailwater's trout fishery, a "quality zone" with special angling regulations was considered during 1992-1993, but never officially proposed. Later, a quality trout management regulation based on a 16-22 inch PLR (or "slot limit") was proposed and established for the entire tailwater in November 1999. Additionally, snagging for all species was banned in 1999 and two spawning refuges were closed to fishing during November through January beginning in 2000. These measures were

taken to protect vulnerable large brown trout during the spawning season and to potentially improve recruitment. The initial management plan for the South Holston tailwater (2004-2008) focused on improving the abundance of large trout and developing a wild brown trout fishery through these regulation changes, along with optimizing rainbow trout stocking rates (Habera et al. 2003). It was successful, thus the subsequent management plan (2009-2014; Habera et al. 2009) sought to maintain these improvements.

III. Current Status

Trout Abundance



TWRA monitors the South Holston tailwater trout fishery at 12 boat electrofishing stations (Figure 2) in March each year to provide an assessment of the overwintering trout populations before stocking begins. These stations are sampled (600 s each) during the day at a flow of approximately 2,400 cfs. Electrofishing catch rates are based on trout at least 7 inches in length, as this is the minimum size considered fully recruited to the sampling gear and technique.

The mean electrofishing catch rate for all trout ≥7 inches steadily increased during 2001-2011, when it exceeded 400 fish/h (Figure 3)—six times the corresponding 1997 catch rate (Bettoli et al. 1999) and well above that for any other Tennessee tailwater. This increase was almost entirely driven by growth of the wild brown trout population. Since 2011, the total trout catch rate has moderated, ranging

between 300 and 400 fish/h (Figure 3). The mean electrofishing catch rate for brown trout ≥7 inches during 2009-2014 (300 fish/h) easily exceeded the corresponding management plan objective (Habera et al. 2009) of ≥135 fish/h (≥7 inches), which was considered adequate for sustaining the wild brown trout fishery.

The catch rate for rainbow trout ≥7 inches was relatively consistent during 2009-2014 (34-70 fish/h; Figure 3) and the mean catch rate (51 fish/h) met the corresponding management plan goal (50 fish/h; Habera et al. 2009). Previously, the mean catch rate for rainbow trout ≥7 inches during 1999-2003 was somewhat lower (39 fish/h) even though the average stocking rate was nearly double (90,000/year). This continues to affirm the management decision to reduce fingerling rainbow trout stocking rates in 2004 (Habera et al. 2003).

Unlike catch rates for all trout ≥7 inches, those for larger trout declined during 2009-2014. Electrofishing catch rates for all trout ≥14 inches and those within the 16-22 inch PLR averaged 63 fish/h and 25 fish/h, respectively, during 2004-2008 (Figure 4). No other Tennessee tailwater trout fishery produced comparable electrofishing catch rates for trout in these size groups at that time. However, these catch rates averaged only 41 fish/h and 13 fish/h respectively during 2009-2014, although there was some improvement from 2013 to 2014 (Figure 4). Decreases in the abundance of larger brown trout (particularly 16-22 inch fish) were primarily responsible for the changes. The management plan objective directed at maintaining the abundance of large trout (mean electrofishing catch rate of ≥25 fish/h within the PLR; Habera et al. 2009) was not met and

in fact, the PLR catch rate did not exceed 20 fish/h in any year during 2009-2014 (Figure 4). By comparison, electrofishing catch rates for trout in the 14-20 inch PLR on the Norris tailwater (Clinch River) increased from 12 fish/h to 81 fish/h during the same six-year period (Habera et al. 2015). The Norris tailwater PLR primarily targets hatchery-produced rainbow trout stocked as fingerlings.

The mean catch rate for fish exceeding the upper PLR boundary (i.e., ≥22 inches) has been low (≤2 fish/h) since 2000 and has not exceeded 1 fish/h since 2010. If the PLR was able to maintain higher abundances of 16-22 inch fish, it seems likely that more fish ≥22 inches could also be expected as a byproduct. Trout in this size class would have the protection of a one fish/day creel limit, which should help sustain any increases. However, these large trout may use habitats or have behaviors (e.g., migration to Boone Lake after spawning) that make them less vulnerable to our standard sampling procedure. Mork (2011) studied movement of large (>18 inch) brown trout in the Boone Reservoir system (which includes the South Holston and Wilbur tailwaters) and verified that some fish do use the reservoir in winter and spring, making them unavailable during the March monitoring surveys in the tailwater. Interestingly, Mork (2011) also found that no fish from the Wilbur tailwater used the reservoir and that there was no intermingling of fish from the South Holston and Wilbur tailwater populations.

Trout Growth, Condition and Recruitment

The large increase in trout abundance for the South Holston tailwater has produced an exceptional trout fishery consistent with TWRA's management goal. However, excessive expansion of the wild brown trout population appears to have affected growth (Bohlin et al. 2002; Vøllestad et al. 2002; Lobon-Cervia 2007) and recruitment (Walters and Post 1993) as increasing numbers of fish compete for food resources that tend to limit salmonid populations in tailwaters and unregulated streams (e.g., Filbert and Hawkins 1995; Ensign et al. 1990). Although mean

relative weights (W_r) for brown trout below the PLR (7-16 inches) and within the PLR (16-22 inches) have typically ranged from 90-100, there has been a general decline since 2005 (Figure 5). This may indicate that abundance is now affecting condition and thereby limiting survival and recruitment into the PLR. McKinney et al. (2001) found that increased abundance of rainbow trout in the Lee's Ferry tailwater, AZ (resulting from higher, more stable flows) was accompanied by reduced relative condition, particularly for fish ≥12 inches (305 mm). The best recruitment into the South Holston's PLR occurred during 2005-2007, when brown trout catch rates were in the 150-200 fish/h range and total trout catch rates were 200-250 fish/h (fish ≥7 inches).

Stocking

Stocking rates for the South Holston tailwater have been relatively consistent since brown trout stocking ended in 2003 (Figure 6). The annual fingerling rainbow trout stocking rate was set at 50,000/year in 2004 (Habera et al. 2003) and only deviated in 2008, when no fingerlings were available from Dale Hollow National Fish Hatchery. The annual adult (9-10 in.) rainbow trout allocation for the South Holston tailwater was 47,000 during 2009-2014 and the actual stocking rate was consistent with this, averaging 47,000 and ranging from 37,000-56,000 (Figure 6).

Angler Use

Creel / angler use surveys were previously completed for TWRA on the South Holston tailwater in 1997 (Bettoli et al. 1999), 2002 (Bettoli 2003), and 2006 (Bettoli 2007). Another survey was conducted by Agency personnel in 2014, but pressure, trips, catch, and harvest estimates are not yet available.

Results for the 1997-2006 surveys are provided in Table 1. Total estimated fishing pressure in 1997 (100,844 h; 29, 028 trips) made the South Holston in Tennessee at that time. Angling

Table 1. Results of previous South Holston tailwater creel surveys (1997-2006).

Year	Pressure (h)	Mean Trip length (h)	Trips	Catch rate (fish/h)	Harvest rate (fish/h)
1997	100,844	3.47	29,028	1.11	0.35
2002	48,190	2.71	17,782	1.71	0.32
2006	64,440	3.34	19,293	1.43	0.20

pressure declined substantially by 2002 (52% for total hours; 39% for trips), then recovered somewhat by 2006 (Table 1). Catch rates for the South Holston tailwater have routinely exceed 1.0 fish/h (Table 1) and would generally be considered representative of good fishing (>0.7 fish/h; McMichael and Kaya 1991; Wiley et al. 1993). The 2002 and 2006 catch rates were statistically similar and significantly higher than the 1997 rate (Bettoli 2007). Harvest rates have been relatively low (Table 1), with the 2006 rate (0.20 fish/h) being significantly below those observed in 1997 and 2002 (Bettoli 2007). This reflects the shift away from harvest-oriented angling that has occurred in most Tennessee tailwaters (Bettoli 2007).

Hutt and Bettoli (2003) characterized 23% of South Holston tailwater anglers as non-consumptive specialists and found that overall, anglers were more satisfied with fishing conditions there (score of 4.1 on a 5-point scale) than at other Tennessee tailwater trout fisheries they surveyed. Angler satisfaction has remained high, with 77% of surveyed anglers rating TWRA's management of the fishery as good or excellent in 2006 (Bettoli 2007) and 96% providing a similar rating in 2014 (Habera et al. 2015). Additionally, South Holston tailwater anglers have overwhelmingly supported the special regulations in place there, with ≥80% in favor of the spawning refuges and 16-22 inch PLR in 2006 (Bettoli 2007) and 2014 (Habera et al. 2015). Only three anglers (1%) indicated during the 2014 survey that other river users in boats (floating

or motoring) often negatively affected the quality of their fishing experience. The majority (85%) of the 260 anglers interviewed regarding this issue stated that the quality of their fishing experience was never negatively affected.

IV. Management Objectives and Recommendations

The previous South Holston tailwater management plan (Habera et al. 2009) was generally successful, as two of the three primary objectives were met. The wild brown trout fishery and rainbow trout stocking rates (and abundance) were maintained during 2009-2014. However, declining electrofishing catch rates for trout within the PLR indicated that the objective of maintaining large trout abundance in the fishery was not met. Given the much higher trout abundance that has become established in the tailwater, the primary focus of the current management plan (2015-2020) will be to monitor the effectiveness of the existing PLR regulations. Accordingly, the management objectives for fulfilling the management goal during 2015-2020 will be:

Objective 1: *Further evaluate the PLR's effectiveness toward increasing large trout abundance*

TWRA established the 16-22 inch PLR in 2000 to enhance the abundance of large trout in the fishery and protect a large portion of the spawning population, thus promoting natural reproduction and recruitment of wild brown trout. This regulation was initially quite successful, as electrofishing catch rates for 16-22 inch fish increased from an average of 12 fish/h pre-PLR (1997-2000) to ≥25 fish/h during 2005-2007. However, as the wild brown trout population as a

whole has grown, the abundance of fish in the PLR has declined to pre-PLR levels (mean of 13 fish/h for 2009-2014). The 16-22 inch PLR will remain in effect during 2015-2020, but there will be no specific catch rate objective. However, if electrofishing catch rates for trout within PLR do not approach 25 fish/h again, then the PLR may need to be re-evaluated and its boundaries adjusted if angler satisfaction with the fishery declines. Given the paucity of 16-22 inch rainbow trout both before and after establishment of the PLR, most of the larger trout in the fishery will continue to be brown trout.

Objective 2: *Maintain the wild brown trout fishery*

The South Holston's wild brown trout fishery has flourished since the establishment of spawning refuges (Figure 1), ban on all snagging, implementation of the PLR, and elimination of brown trout stocking. These regulations/strategies will remain in effect. Mean electrofishing catch rates for brown trout ≥7 inches have increased from 22 fish/h in 1997 to well over 300 fish/h in 2014. Existing levels of natural reproduction are therefore clearly quite capable of sustaining the South Holston tailwater's brown trout fishery. Additionally, because density-dependent limitations such as reduced growth and condition now appear to be operating, it is also clear that recruitment into the PLR is not being limited by a lack of successful reproduction and there is no need to protect more spawning areas. The new management objective will be to sustain the wild brown trout fishery while evaluating means for promoting better recruitment into the larger size classes. Based on previous data, a mean electrofishing catch rate in the 200-250 fish/h range for all trout ≥7 inches would likely indicate an abundance more conducive to such recruitment (Figure 7). However, this would be difficult to manage, as the South Holston tailwater is primarily a self-sustaining brown trout fishery subject to substantial natural variability. Anglers will be encouraged to harvest 9-12 inch (254-305 mm) brown trout, as reducing their abundance may help improve growth, condition, and recruitment into the PLR.

Objective 3: *Maintain rainbow trout abundance*

Electrofishing catch rates for rainbow trout ≥7 inches averaged 41 fish/h during 1997-2004 and 58 fish/h afterward (Figure 3), indicating the reduced fingerling stocking rate (to 50,000/year in 2004) continues to be capable of sustaining the put-and-grow rainbow trout fishery. This stocking rate will continue during 2015-2020, with the objective of maintaining current abundance, which corresponds to a mean electrofishing catch rate ≥50 fish/h for rainbow trout ≥7 inches. This was the basic objective during the previous management plan term (2009-2014) and was met with a mean catch rate of 51 fish/h. The annual stocking rate for adult rainbow trout for the put-and-take fishery will remain consistent with rates used during the past several years (47,000). These rainbow trout stocking rates assume that Dale Hollow National Fish Hatchery will continue to provide mitigation fish during 2015-2020. If funding issues eliminate these fish, then stocking rates will likely be reduced.

Evaluation

Annual sampling at the 12 South Holston tailwater monitoring stations will continue during 2015-2020. Following completion of the 2020 sampling efforts, an assessment of management objective accomplishments will be made and strategies will be adjusted, if necessary, to meet the South Holston tailwater management goal.

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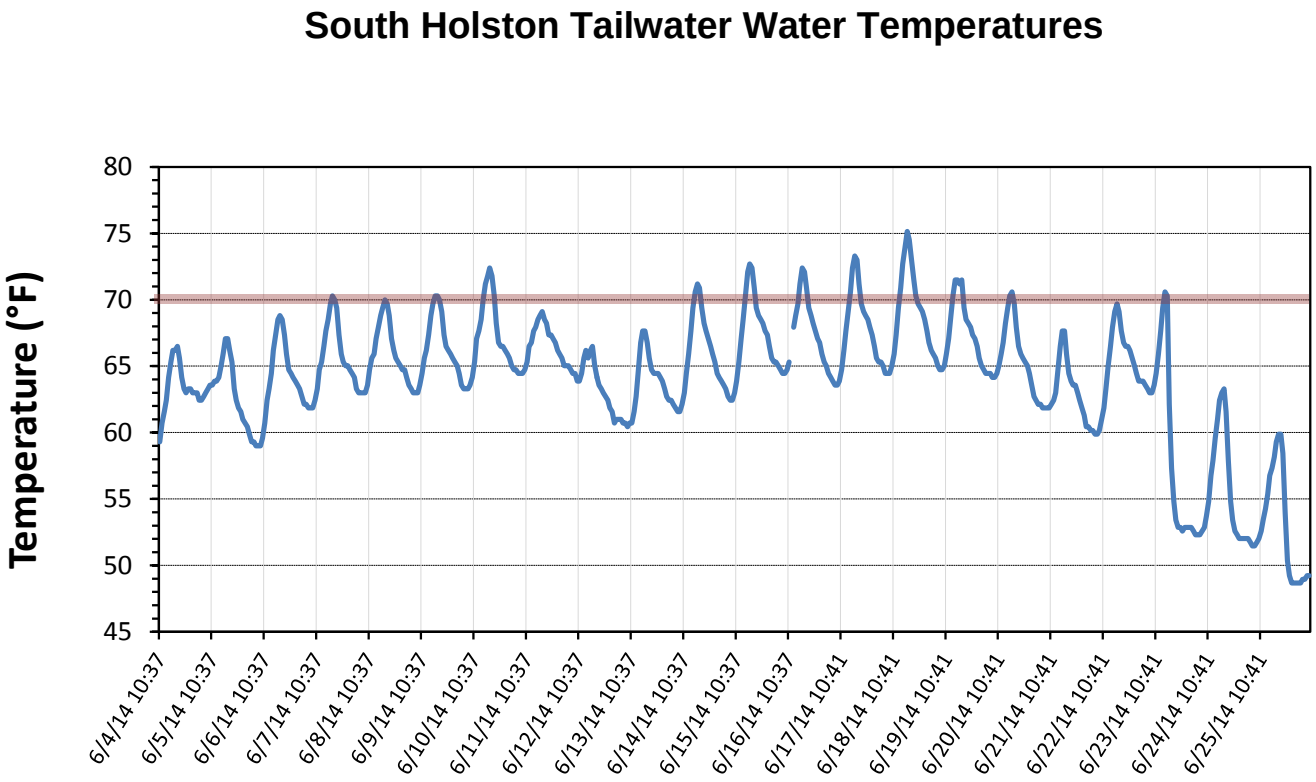

Figure 1. Hourly water temperatures in the Rockhold area of the South Holston tailwater (SFHRM 37) during 4-25 June 2014. Releases from the dam consisted of three 1-hour pulses each day during 4-22 June. One pulse was lengthened to 3-4 hours during 23-25 June.

South Holston Tailwater

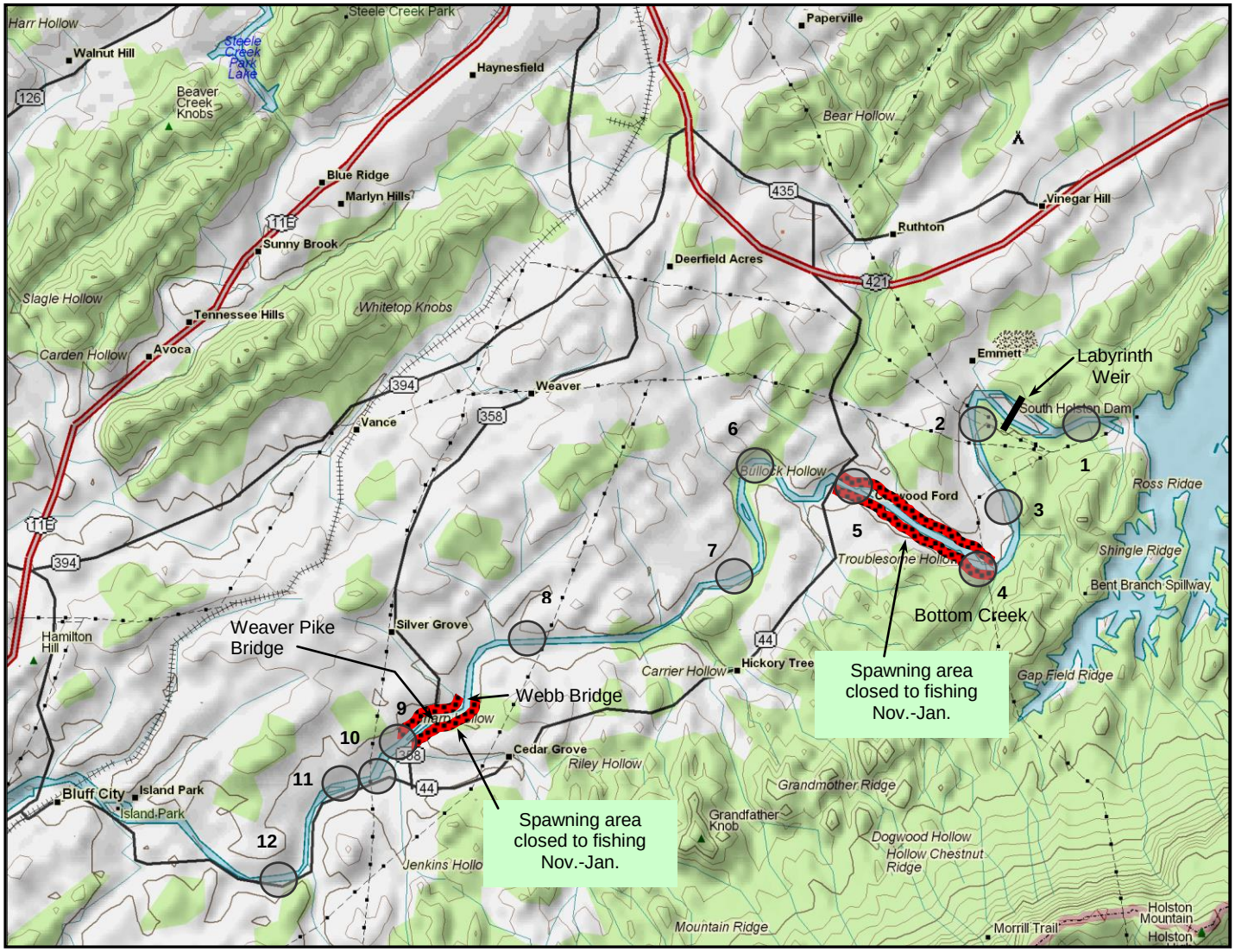

Figure 2. Locations of the South Holston tailwater (South Fork Holston River) monitoring stations.

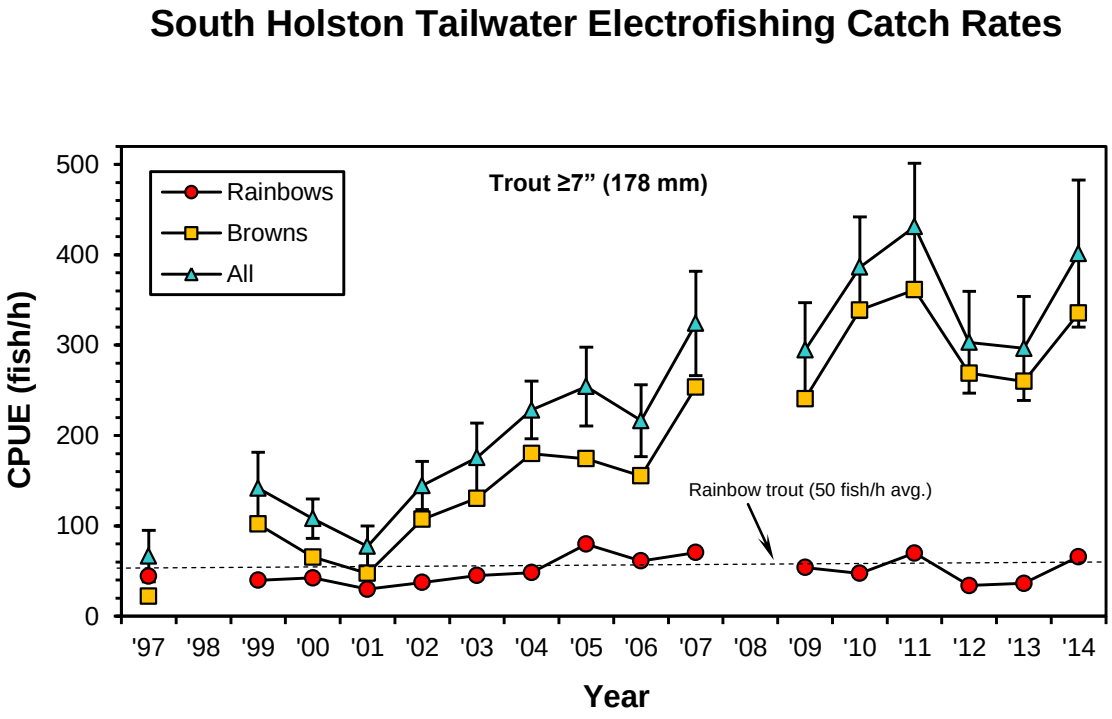

Figure 3. Mean electrofishing catch rates for the South Holston tailwater. Bars indicate 90% confidence intervals. No sample was available from 2008 because of inadequate flows.

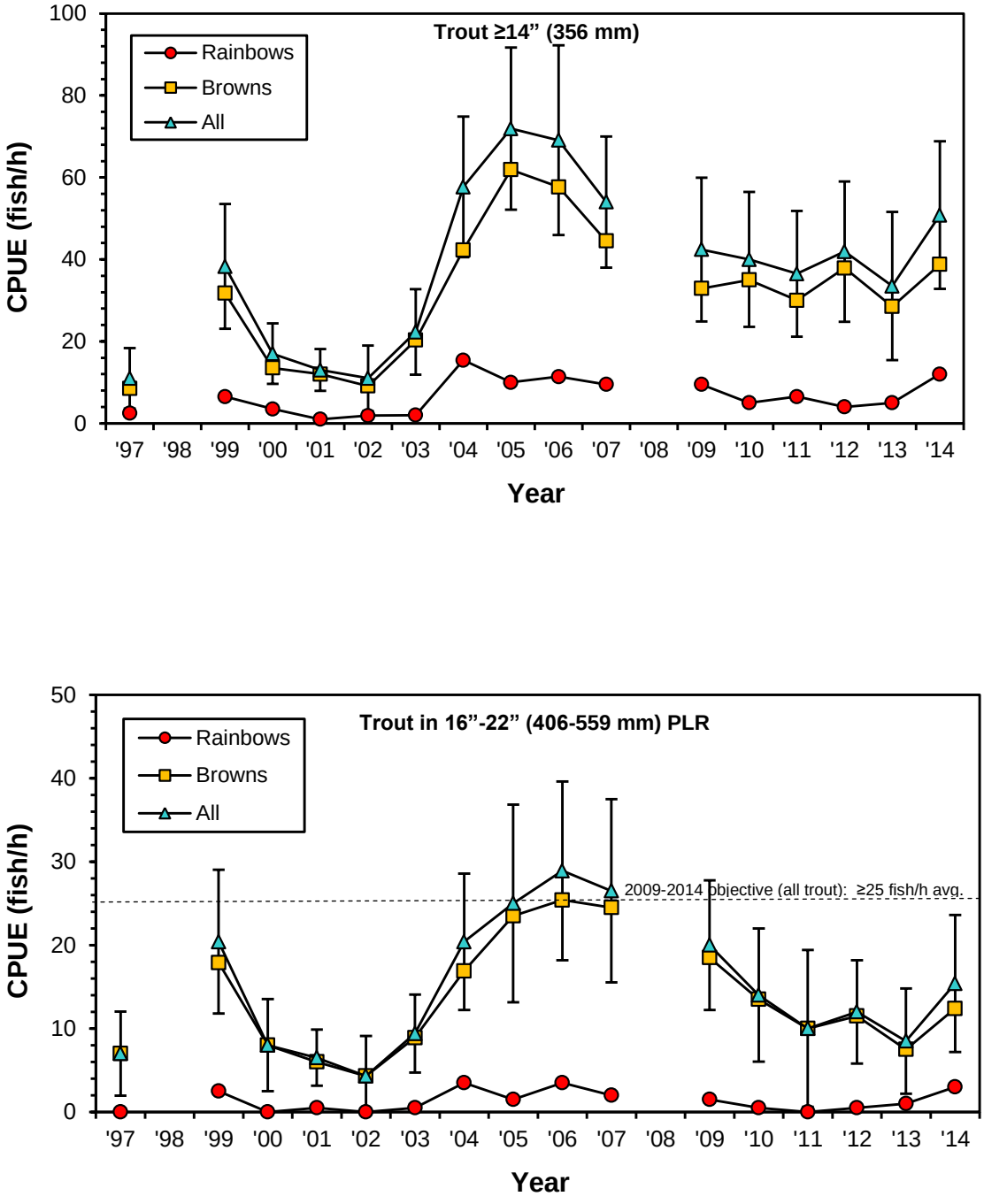

Figure 4. Mean electrofishing catch rates for larger trout for the South Holston tailwater. Bars indicate 90% confidence intervals. No sample was available from 2008 because of inadequate flows.

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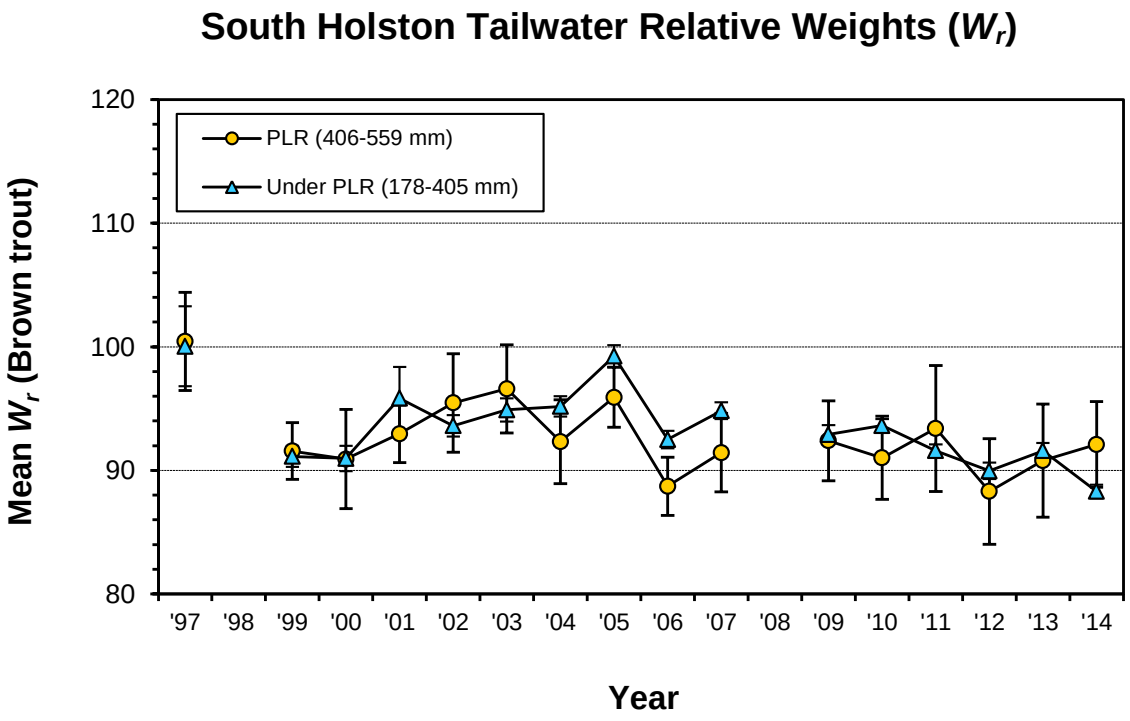

Figure 5. Mean relative weights (Wr) for brown trout from the South Holston tailwater (1997-2014). Bars indicate 90% confidence intervals.

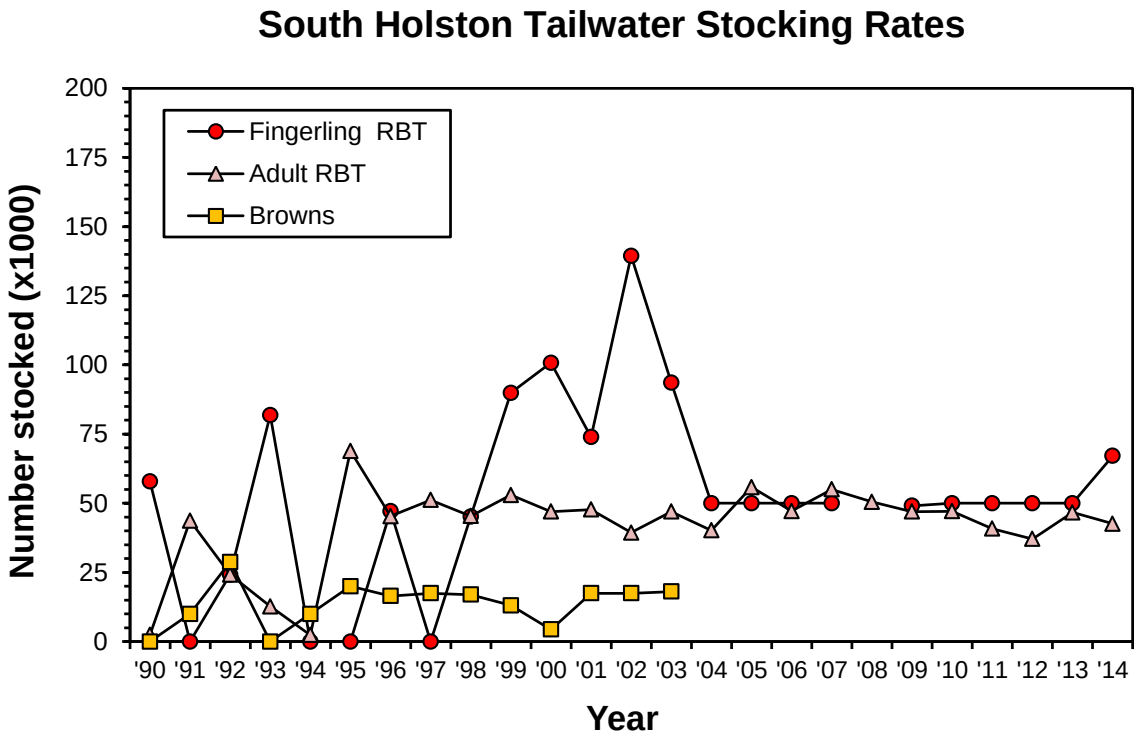

Figure 6. Trout stocking rates for the South Holston tailwater (1990-2014). Nearly 100,000 rainbow trout are stocked each year (50,000 fingerlings and ~47,000 adults). Fingerlings were not available from the Dale Hollow National Fish Hatchery in 2008 and were not stocked that year.

South Holston Tailwater Electrofishing Catch Rate Comparison

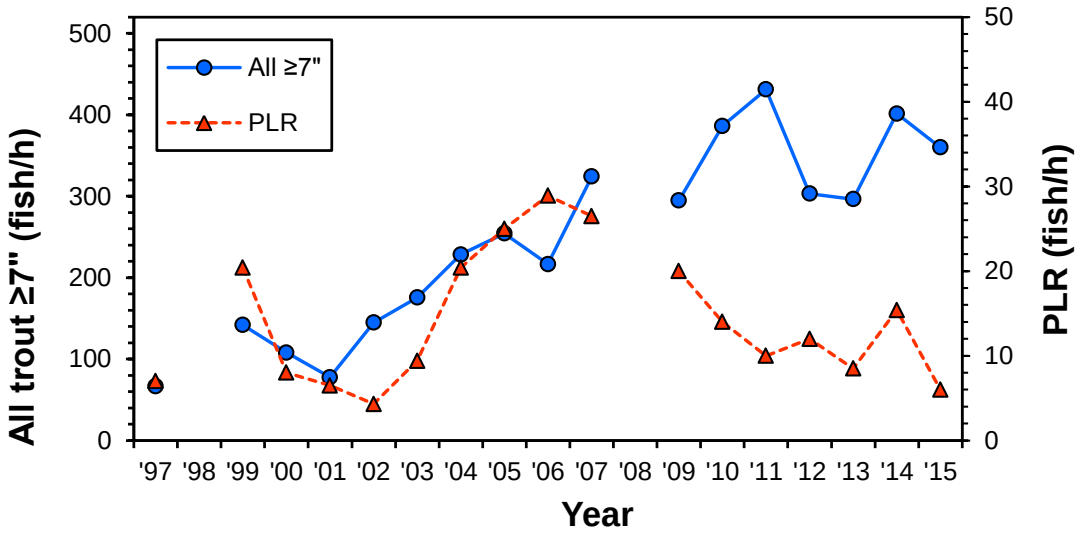

Figure 7. Comparison of mean electrofishing catch rates for all trout ≥7 in. and trout in the 16-22 in. PLR for the South Holston tailwater. Catch rates generally coincided until about 250 fish/h for all trout ≥7 in. was reached; PLR catch rates declined afterward. Preliminary data for 2015 are included.

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