

Fisheries Report 07-07

SURVEYS OF THE TROUT FISHERIES IN THE WATAUGA RIVER AND SOUTH FORK OF THE HOLSTON RIVER

March – October 2006



A Final Report Submitted To

**Tennessee Wildlife Resources Agency
Nashville, Tennessee**

By

**Phillip W. Bettoli, Ph.D.
Tennessee Cooperative Fishery Research Unit
Tennessee Technological University
Cookeville, Tennessee
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EXECUTIVE SUMMARY

Watauga River Survey

1. The fishery in the 28 km of the Watauga River below Wilbur Dam was investigated between March and October 2006 using a roving creel survey. The river was previously surveyed in 1998 and 2002.
2. Fishing pressure over the 8-month survey in 2006 totaled 66,988 h (90% confidence interval $\pm 9,006$), which was a significant reduction in pressure over the same eight-month period compared to 2002 (108,584 h; $\pm 11,437$). Pressure in 2006 was similar to pressure in 1998 over comparable 7-month periods (61,653 versus 65,188 h, respectively). The estimated number of fishing trips in 2006 was 11,451 trips, compared to 20,882 in 2002.
3. The catch rate for trout (rainbow and brown trout combined) was 1.16 fish/h (SE = 0.05) in 2006. The harvest rate of trout in 2006 was 0.18 fish/h (SE = 0.02).
4. The estimated catch of rainbow trout during the 2006 survey period was 64,104 fish, less than half of what anglers caught in 2002 (146,795 fish) but comparable to what anglers caught over seven months in 1998 (67,186 fish). The number of rainbow trout harvested in the 2006 survey (11,837) was only 18% of the total number caught. Only 1,727 brown trout were harvested in 2006, or 11% of the 15,417 brown trout caught during the survey period.
5. The number of trout harvested by anglers who had completed fishing when interviewed averaged 0.19 (SE = 0.06) trout per trip. Those same anglers reported catching an average of 9.2 (SE = 0.51) trout per trip.
6. No brook trout were observed in the creel; anglers reported catching (and releasing) 25 brook trout (which is an unexpanded estimate).
7. Sixty-nine percent of the 1,616 anglers interviewed on the Watauga River in 2006 were Tennessee residents, similar to the percentage of residents observed in 2002. As in previous surveys, North Carolina residents outnumbered non-residents from 29 other states combined. As in previous surveys, most Tennessee anglers fishing the Watauga River lived in Carter (41%) and Washington counties (38%).

EXECUTIVE SUMMARY

Watauga River Survey - continued

8. The percentage of interviewed anglers using flyfishing gear (47%) remained unchanged between 2002 and 2006. Similarly, the percentage of interviewed anglers using artificial lures or flies (as opposed to some form of bait) remained similar (64 – 65%) between the 2002 and 2006 surveys. In the 1998 survey, most (68%) anglers fished with bait and fly fishermen represented only 18% of all interviewed anglers.

9. Guided fishing activity, and drift boat fishing in general, remained high during the 2006 survey.

EXECUTIVE SUMMARY

South Fork of the Holston River Survey

1. The fishery in the South Fork of the Holston River was investigated between March and October 2006 using a roving creel survey. The river was last surveyed in 1997 and 2002.
2. Fishing pressure over the 8-month survey in 2006 totaled 64,440 h (90 % confidence interval \pm 5,483), a significant increase in pressure since 2002 (48,190h \pm 6,282) but not as high as fishing pressure in 1997 (100,844). Anglers took an estimated 19,293 trips to the tailwater in 2006, compared to 17,782 trips in 2002 and 29,028 trips in 1997.
3. As in previous surveys, catch rates were high in 2006; the pooled catch rate (rainbow and brown trout combined) averaged 1.43 trout/h (SE = 0.08; n = 711). Conversely, the harvest rate was low (as in previous surveys), averaging only 0.20 trout/h (SE = 0.02).
4. The estimated catch of rainbow trout was 70,073 fish, much more than the number of catchable rainbow trout stocked each year. The number of rainbow trout harvested in 2006 was 9,237 fish, or 13% of the number caught. The number of brown trout harvested in 2006 (1,467 fish) was 9% of the number reportedly caught (16,551 fish).
5. The mean number of trout harvested by complete-trip anglers (n = 171 parties) was 0.59 fish per angler per trip. Only 14% of complete-trip parties were observed harvesting trout. Although harvest rates were low, catch rates were high, averaging 4.97 fish per angler per trip. About 22% of complete-trip anglers failed to catch a fish in 2006, similar to the 20% who failed to catch a fish in 2002.
6. Seventy-one percent of the 1,128 anglers in 711 parties interviewed on the South Fork of the Holston River in 2006 were Tennessee residents. As in previous surveys, most out-of-state anglers interviewed in 2006 were residents of Virginia (16% of all anglers) and North Carolina (9%). Residents of Sullivan County, Tennessee, accounted for 74% of the Tennessee residents who fished the river.
7. In 1997, 62% of anglers were fishing with bait; that percentage rose to 74% in 2002 but fell to 51% in 2006. The percentage of interviewed anglers using flyfishing gear rose from 21% to 37% between 2002 and 2006.

FOREWORD

The Tennessee Wildlife Resources Agency (TWRA) manages the trout fisheries in the Watauga River below Wilbur Dam and the South Fork of the Holston River below South Holston Dam in east Tennessee. A roving creel survey was performed on both rivers between March and October 2006 to estimate fishing pressure and rates of catch and harvest by trout anglers. Attributes of the anglers using each resource for that 8-month period were also examined. Both tailwaters were last surveyed in 2002 (Bettoli 2003a, 2003b). Additional biological information on both fisheries can be found in Bettoli (1999), Bettoli et al. (1999) and Holbrook and Bettoli (2006).

Creel survey results are presented separately for each river, beginning with the Watauga River.

Chapter I

WATAUGA RIVER CREEL SURVEY

2006



Photo Courtesy of M. Widener

STUDY AREA

The Watauga River trout fishery is located below Wilbur Dam, which is located at river kilometer 55 in northeast Tennessee near the town of Elizabethton. Wilbur Dam is located just 4 km below Watauga Dam; thus, discharges from Wilbur Dam mirror the discharge patterns from Watauga Dam. Wilbur Dam is equipped with three turbines, each capable of releasing 8.6 m³/s (305 cfs) and an additional turbine that releases 50 m³/s (1,765 cfs). The Watauga River flows northwest and empties into one arm of Boone Lake.

The Watauga River below Wilbur Dam was severely polluted from industrial sources in the 1960s and 1970s. When water quality improved in the 1980s, TWRA biologists initiated a trout-stocking program. Historically, dissolved oxygen (DO) concentrations in the discharge from Watauga Dam (and Wilbur Dam) were seasonally depressed (Scott et al. 1996); thus, TVA initiated a program to improve water quality in the Watauga River. Hub baffles were installed on the Watauga Dam turbines in 1991 and turbine venting helped elevate DO concentrations in the Watauga Dam discharges, which then run through Wilbur Dam. In years when DO concentrations fell below 6.0 mg/l, they usually did not drop below 4.0 mg/L in the river below Wilbur Dam. Beginning in 1991 and through 2005, a minimum flow of 3 m³/s (107 cfs) was established in the Watauga River by pulsing one of Wilbur Dam's four turbines for one hour every four hours. The TVA usually met (and exceeded) the minimum flow requirement in 2006 by running a small turbine (225 cfs discharge) continuously between periods of peaking power generation.

The Watauga River is managed for trout between Wilbur Dam and the town of Watauga, a distance of 26 river kilometers (16.5 miles). In 2006 alone, the TWRA and the U.S. Fish and Wildlife Service stocked 40,181 adult rainbow trout *Oncorhynchus mykiss* and 14,010 adult brown trout *Salmo trutta*. Fingerling rainbow trout (n = 50,000) and fingerling brook trout *Salvelinus fontinalis* (n = 68,924) were also stocked in 2006. The Watauga River is managed with special trout regulations. The reach of river between Smalling Bridge and the bridge at the town of Watauga (~ 4 km) was established as a Quality Zone in 1988 (Bivens et al. 1997) and anglers are required to use only

artificial lures. The creel limit is two trout per day and the minimum size limit is 356 mm (14") total length in that zone. In other reaches of the river, statewide trout regulations apply.

The Watauga River is low in dissolved ions; conductivity below Wilbur Dam ranged from 53-78 S/cm and alkalinity was about 40 ppm as CaCO₃ (Bivens et al. 1997; Bivens et al. 1998). Conductivity increased to 130 - 170 S/cm below the confluence of Stony Creek and the Doe River and alkalinity increased to 50-65 ppm. The macroinvertebrate community is dominated by tolerant ephemeropteran and trichopteran species downriver and ephemeropteran and dipteran species closer to the dam (Bivens et al. 1998). In 1993-1995, TVA's Tailwater Benthic Index rated the macroinvertebrate community of the Watauga River below Wilbur Dam as "fair/good" or "good" (Scott et al. 1996).

Trout dominate the fish community of the Watauga River, although large populations of suckers *Hypentelium nigricans*, *Catostomus commersoni*, and sculpins *Cottus carolinae*, *C. bairdi* are present (Bivens et al. 1998). In addition to sculpins, other forage species include western blacknose dace *Rhinichthys atratulus*, logperch *Percina caprodes* and gizzard shad *Dorosoma cepedianum*.

Rainbow trout and brown trout reproduce in the Watauga River, especially brown trout (Holbrook and Bettoli 2006). Although water quality and discharge patterns are conducive to spawning, the substrate in the river is heavily armored and comprised of a poor distribution of particle sizes relative to what salmonids need for redd construction and egg incubation (Banks and Bettoli 2000); thus, the river must be stocked to maintain fishable populations.

As on other east Tennessee tailwaters, guided float fishing trips are common on the Watauga River. In addition, several outfitters provide rafts and shuttle service for clients who wish to float the river and engage in non-fishing activities. Boating activities on the river are promoted by special recreational releases provided by TVA. Between Memorial Day and Labor Day, at least one turbine runs continuously each afternoon, Monday through Saturday.

In February 2000, a fire in a factory along the banks of the Watauga River led to the discharge of toxic chemicals into the river at a point about 14 km below Wilbur Dam.

The resultant fish kill was complete and extended at least 12 km into the headwaters of Boone Lake. The reach of river that suffered the fish kill included the Quality Zone. Within several weeks of the spill, the TWRA initiated an aggressive stocking program to help the fishery recover faster than might otherwise happen. Annual monitoring by TWRA indicated that the trout fishery in the river reach affected by the fish kill had fully recovered by 2006 (Habera et al. 2007).

METHODS

A stratified, uniform probability roving creel survey of the Watauga River was conducted between March 1 and October 31, 2006. The survey was designed to collect information about the amount of fishing pressure the tailwater was receiving, the catch and harvest rates of rainbow trout and brown trout, and the catch per unit of effort by anglers. The sample design was modeled closely after the survey design used by TVA to monitor fishing pressure on the Watauga River between the late 1980s and 1997; the present survey followed the same general design employed in the 1998 and 2002 surveys. In fact, the same clerk performed survey duties in 2002 and 2006.

The survey was stratified by month and kind-of-day. An average of 9 weekdays and 7 weekend days were surveyed each month. Sampling days were divided into equal work periods based on sunrise and sunset times with equal probabilities of sampling the AM or PM work shifts. The clerk counted anglers on the river once each work shift. The time to start the count was randomly selected from a list of possible start times for each shift, beginning at daylight (or midday) and every 30 minutes thereafter until 1 h before the end of the shift. Each work shift, whether AM or PM, was limited to a maximum of five hours. Counts were adjusted upwards when more boat trailers were counted than boats by adding two anglers for each boat that was presumed to be on the river, but was not observed during the instantaneous count (note: the mean number of anglers per boat based on exit interviews was 1.9).

In the 1998 survey, access to the Quality Zone was restricted principally to float-through anglers; private property lined the banks of the river in the Quality Zone and shore and wading anglers were scarce. A private campground opened in 2002 just

downstream of Smalling Bridge, at the head of the Quality Zone. More importantly, a day-use area associated with that campground allowed anglers who were not camping to park their vehicles (for a daily or annual fee) and fish the Quality Zone. This day-use area got heavy use, but most anglers parked and walked downstream and out of sight of the clerk. Therefore, in the 2002 and 2006 surveys the number of vehicles parked in the day-use area was used to estimate the number of anglers fishing but not visible to the clerk when he visited the day-use parking area. Based on exit interviews at that day-use area, the average party size was 1.8 anglers; therefore, the number of cars at the day-use area was multiplied by two (assuming one party per vehicle) and that product was added to the number of anglers the clerk saw on the entire river. The number of anglers that were observed fishing the river above the day-use parking area was recorded in the usual manner.

During the instantaneous count, the clerk separately tallied anglers as to whether or not they were using flyfishing gear. Using 7 X 50 Steiner military-grade binoculars, the clerk was able to easily see what type of fishing method (spinning tackle or fly rods) anglers employed, even from great distances

Before and after the count, the clerk interviewed anglers. If anglers agreed to be interviewed, they were asked how long they had been fishing, whether they were finished fishing, and how many trout they had caught. Anglers were asked their state of residency and Tennessee residents were also asked for their county of residence. The clerk also recorded the method of fishing being used by each angler. Finally, the clerk measured the total lengths (nearest cm) of any trout harvested. A copy of the interview sheet is provided in Appendix I.

Mean daily counts were expanded to estimate effort in each stratum (i.e., kind-of-day) and then pooled to estimate effort each month following the methods of Pollock et al. (1994). Average catch and harvest rates were measured using the mean of ratios method, which is recommended for roving creel surveys (Pollock et al. 1997). Catch and harvest rates were calculated for all parties that had been fishing for at least 30 minutes before being interviewed. The catch and harvest of each trout species was then estimated each month. Standard errors of catch, harvest, and effort each month were calculated according to Pollock et al. (1994). A spreadsheet performed all necessary calculations

and generated 90% confidence intervals around each estimate. The pooled variance for total pressure, total harvest, and total catch of each species was calculated using the mean-square-successive-difference-between-periods procedure. The square root of the variance was multiplied by 1.6 to estimate 90% confidence intervals.

RESULTS and DISCUSSION

Pressure

Fishing pressure on the Watauga River over the eight-month survey totaled 66,988 h (90% confidence limits $\pm 9,006$; Table I-1), which was a significant reduction in pressure compared to the same eight-month period in 2002 (108,584 h; $\pm 11,437$). Pressure in 2006 was statistically similar to pressure in 1998 over comparable 7-month periods (61,653 versus 65,188 h, respectively). Average trip length in 2006 was 5.85 hours (SE = 0.20), continuing a trend of increasing trip lengths since 1998 (3.2 h) and 2002 (5.2 h). Anglers made an estimated 11,451 trips to the tailwater in 2006, down from 20,882 trips in 2002 over the same 8-month periods.

The spike in fishing pressure in 2002, and subsequent drop in pressure in 2006 to 1998 levels, may have been due, in part, to a much higher stocking rate preceding and during the 2002 survey to mitigate for the fish kill in 2000. However, the influence of river flows each year must be considered. Whereas average daily discharges from Wilbur Dam between March and October in 1998 and 2006 were above or near the 10-year average of 697 cfs, the 2002 survey occurred during a drought and average daily discharges were much less (which would favor bank fishing and wading):

Average daily discharge (cfs) from South Holston Dam, March – October

| Year | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|----------|------|------|------|------|------|------|------|------|------|------|
| Mean cfs | 835 | 985 | 540 | 525 | 563 | 396 | 988 | 809 | 713 | 620 |

In 2002 and 2006 the clerk recorded the discharge from Wilbur Dam when he began his count of anglers each survey day. That record of over 125 random observations of discharge reflected the low flows in 2002 (mean discharge during counts

= 677 cfs) and high flows in 2006 (mean = 842 cfs). More importantly, those random observations of discharge revealed that baseflow (i.e., river discharge between periods of peaking hydropower generation) varied nearly two-fold between 2002 (modal baseflow discharge was ~125 cfs) and 2006 (modal discharge was ~ 225 cfs). Baseflow discharges were achieved by pulsing one turbine for one hour out of every four hours in 2002 and by running one small turbine continuously when power was not being generated in 2006. Although anglers were not classified as to whether they were in boats or on the bank (or wading) when instantaneous counts were taken, bank and wade fishermen were clearly less numerous in 2006 compared to 2002.

As in earlier surveys, drift boat traffic on the river in 2006 was heavy, although down from 2002. The clerk observed 280 boats and 604 trailers during 132 instantaneous counts in 2006, compared to 424 boats and 640 trailers during 129 instantaneous counts in 2002. During the 1998 survey the clerks observed only 101 boats during 122 instantaneous counts.

During the 2006 survey, the clerk observed 205 *different* boat/raft trailers, of which 74 were known to be associated with guides, 56 were private, and 75 could not be designated as commercial or private. Of those 205 different trailers, 102 were observed two or more times. Most (n = 107) of the trailers observed during the 2006 survey were registered in Tennessee, followed by trailers registered in North Carolina (76), South Carolina (6) and seven other states (16). The clerk observed 129 different and recurring trailers (i.e., observed at least twice) during the 2002 survey, of which 53 (41%) were known to be associated with guides, 14 were private, and the remaining 62 trailers could not be designated as private or commercial.

Catch and Harvest

The clerk interviewed 1,616 anglers in 960 parties during the 2006 survey of the Watauga River. Thirty percent of interviewed parties had finished fishing (i.e., complete trips) when interviewed. About 36% of interviewed anglers were fishing from boats or rafts. Anglers claimed to have caught (unexpanded estimates) 5,529 rainbow trout and 1,353 brown trout, but only 25 brook trout. The clerk observed 387 rainbow trout and 61

brown trout in the creel, but no brook trout. Due to the low incidence of brook trout in the creel, the catch data for brook trout were not expanded to estimate the total number caught over the survey period.

The catch rate (CPUE; number of trout per hour; all species combined) was high in 2006, but not as high as in previous surveys:

| Statistic | Survey Year | | |
|-----------|--------------------------|--------------------------|--------------------------|
| | 1998 | 2002 | 2006 |
| CPUE (SE) | 1.40 ^B (0.06) | 1.59 ^A (0.06) | 1.16 ^C (0.05) |
| HPUE (SE) | 0.32 ^A (0.02) | 0.17 ^B (0.01) | 0.18 ^B (0.02) |

* Means in a row sharing the same letter were statistically similar ($P \geq 0.05$).

The expanded estimate of the number of rainbow trout caught in the Watauga River over the eight-month survey in 2006 was 64,104 fish, of which only 11,828 fish were harvested (Table I-1). The catch of rainbow trout during the 2006 survey period was less than half of what anglers caught in 2002 (146,795 fish) but similar to what anglers caught over seven months in 1998 (67,186 fish). The difference between the number of rainbow trout harvested in 2006 and the number caught represented a release rate of 82%, intermediate to the release rates observed in 2002 (85%) and 1998 (75%).

Only 1,727 brown trout were harvested in 2006, or 11% of the 15,417 brown trout caught. Over comparable seven-month periods (April-October), the catch of brown trout was lowest in 2006 (14,638 fish) compared to 2002 (22,919 fish) and 1998 (26,151 fish).

The length-frequency distribution for rainbow trout harvested by anglers in 2006 (Figure I-1) did not change from 2002; the percentage of harvested trout between 20 and 30 cm TL was 88-92% in both years, which reflected the sizes of rainbow trout stocked each year. Only two harvested rainbow trout in 2006 were longer than 40 cm and they represented only 0.7% of all fish creeled and measured. Thus, 83 rainbow trout (0.007 x 11,828) longer than 40 cm TL were harvested during the 2006 survey period, compared to 183 trout that long or longer in 2002.

As in the 2002 survey, brown trout harvested in 2006 were longer on average (29.7 cm TL; SE = 1.4) than harvested rainbow trout (25.9 cm TL;[0.2]) (Mann-Whitney

U-test; $P = 0.04$). Seven brown trout longer than 40 cm TL were observed in the creel, representing 13% of all brown trout that were measured. Thus, about 224 ($0.13 \times 1,727$) brown trout longer than 40 cm TL were harvested during the survey period, which is exactly four times more than the 56 large brown trout harvested during the 2002 survey.

The mean number of trout harvested by complete-trip anglers in 2006 was only 0.19 fish per angler per trip ($n = 291$ parties; Figure I-2). Only 5% of complete-trip parties were observed harvesting trout (down from 9% in 2002) and only one party was observed with more than the legal creel limit of 7 trout per angler. Although harvest rates were low, catch rates in 2006 were high and averaged 9.2 fish per angler per trip (Figure I-2), comparable to the 10.1 fish caught per angler per trip in 2002. Only 11% of complete-trip parties in 2006 failed to catch a fish, the same percentage observed in 2002.

Most (56%) of the brown trout observed in the creel in 2006 were harvested by anglers fishing upstream of the 19E bridge (Table I-2); in 2002, most of the brown trout harvest occurred downstream of the bridge, particularly at the Elizabethton ballfield and park. The spatial distribution of the rainbow trout harvest remained similar between 2002 and 2006; most rainbow trout were harvested by anglers at Blevins Bend, followed by fish harvested by anglers fishing the upper reaches of the tailwater.

Angler Characteristics

State residency of anglers interviewed on the Watauga River in 2006 did not change between 2002 and 2006. Sixty-nine percent of the 1,616 anglers interviewed on the Watauga River in 2006 were Tennessee residents (Figure I-3), similar to the percentage in 2002 (68%). The percentage of North Carolina residents did not change appreciably between 2002 and 2006 (16 and 18%, respectively). Virginians rarely fished the Watauga River; despite its proximity, less than 2% of anglers were from Virginia.

As in 2002, nearly all (84%) of the Tennessee anglers who fished the Watauga River in 2006 lived in the three counties closest to the river, particularly Carter and Washington counties (Figure I-3). This percentage has dropped slightly since the original survey in 1998, when 90% of Tennessee residents interviewed on the river were from those same three counties.

The percentage of interviewed anglers using flyfishing gear (47%) remained unchanged between 2002 and 2006 (Note: anglers using flyfishing gear accounted for 43% of all anglers *counted* by the clerk during the instantaneous counts). Similarly, the percentage of interviewed anglers using artificial lures or flies (as opposed to some form of bait) remained similar (64-65%) between the 2002 and 2006 surveys. These findings are in stark contrast to what was observed in 1998, when most anglers fished with bait (68%) and fly fishermen represented only 18% of all interviewed anglers.

Anglers were overwhelmingly positive about TWRA's management of the Watauga River fishery (Figure I-4). The responses did not differ between non-residents and Tennessee residents (Fisher's Exact Test; $P = 0.779$).

CONCLUSIONS

Despite a significant drop in fishing pressure since 2002, the Watauga River was still a popular trout fishery in 2006, particularly among anglers using flyfishing gear and with anglers fishing from drift boats and rafts. Guided fishing activity has also remained very popular on the river, with most guides hailing from either Tennessee or North Carolina. As in previous surveys, catch rates were high in 2006 and anglers who harvested all (or some) of the trout they caught were greatly outnumbered by those who released most (or all) of the trout they caught. The significant drop in fishing pressure between 2002 and 2006 may have been linked to higher baseflows in 2006. If those higher baseflows (~ 225 cfs) remain in effect, fishing pressure from bank anglers and wading anglers may remain depressed until those anglers explore new areas of the river or employ different fishing techniques when the water is high.

The fate of brook trout stocked into the Watauga River at different sizes and at different times of the year is the subject of an ongoing investigation. However, the creel survey results reported herein correspond to the observations made by TWRA Region IV biologists, who did not collect the first brook trout in their annual electrofishing surveys until 2007. The brook trout stocking program that began in 2001 has not been successful in establishing a population (fishable or otherwise) of brook trout in the Watauga River.

Table I-1. Fishing pressure and number of rainbow trout and brown trout caught and harvested by anglers fishing the Watauga River, Tennessee, March – October 2006.

| Month | Pressure | SE | Rainbows Caught | SE | Rainbows Harvested | SE | Browns Caught | SE | Browns Harvested | SE |
|-----------|----------|-------|-----------------|-------|--------------------|-------|---------------|-------|------------------|-----|
| March | 5,335 | 1,259 | 4,166 | 1,617 | 793 | 320 | 779 | 290 | 221 | 179 |
| April | 9,361 | 2,209 | 5,697 | 1,455 | 1,484 | 762 | 1,535 | 480 | 296 | 250 |
| May | 8,470 | 1,809 | 8,980 | 2,835 | 1,897 | 903 | 2,640 | 900 | 111 | 91 |
| June | 9,150 | 1,739 | 9,239 | 1,859 | 1,215 | 821 | 4,191 | 1,469 | 552 | 525 |
| July | 13,032 | 1,796 | 12,647 | 2,508 | 2,317 | 1,246 | 2,531 | 553 | 102 | 43 |
| August | 8,884 | 1,488 | 9,854 | 2,007 | 2,311 | 810 | 1,483 | 525 | 251 | 156 |
| September | 6,509 | 857 | 7,014 | 1,470 | 1,420 | 379 | 1,448 | 360 | 65 | 49 |
| October | 6,247 | 1,465 | 6,507 | 2,466 | 391 | 139 | 810 | 349 | 129 | 74 |
| Total | 66,988 | 5,629 | 64,104 | 4,836 | 11,828 | 1,546 | 15,417 | 2,199 | 1,727 | 533 |

Table I-2. Number of trout observed in the creel at each access area in the 2006 Watauga River creel survey, March-October. Note: Total lengths were not available for all fish observed in the creel.

| Access Area | Rainbow Trout | Brown Trout |
|---|---------------|-------------|
| 1. Wilbur Dam - to - Stony Creek | 49 | 14 |
| 2. Stony Creek - to - 19E bridge | 99 | 21 |
| 3. 19E Bridge - to - Ballfield | 60 | 4 |
| 4. VFW and vicinity | 11 | 2 |
| 5. Blevins Bend and vicinity | 134 | 11 |
| 6. Smalling Bridge and Campground | 0 | 1 |
| 7. The Steps - to - Persinger Bridge and vicinity | 21 | 5 |
| 8. Watauga Flats and vicinity | 13 | 3 |

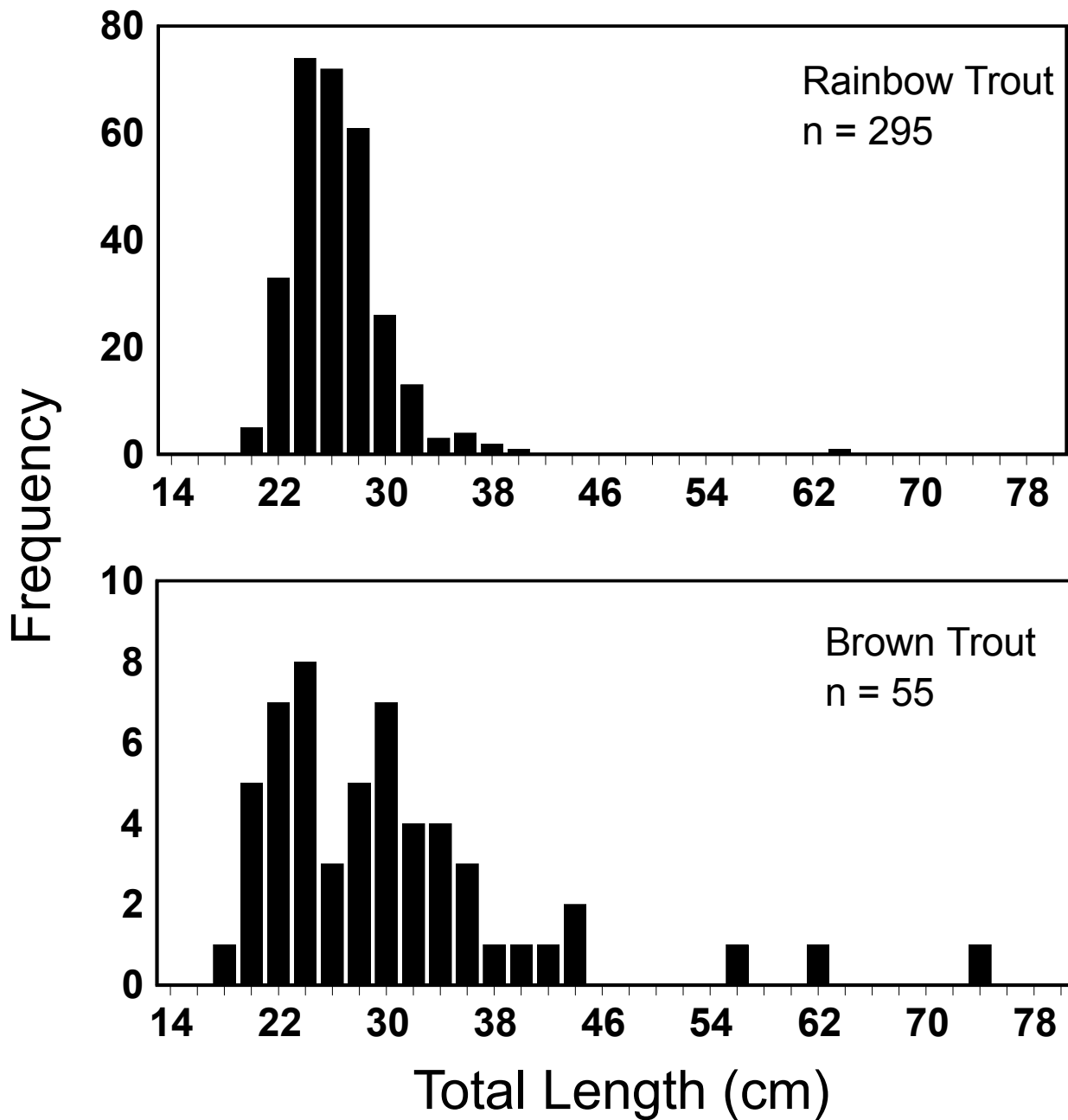


Figure I-1. Length-frequency distributions for trout observed in the creel of anglers in the Watauga River, March - October 2006.

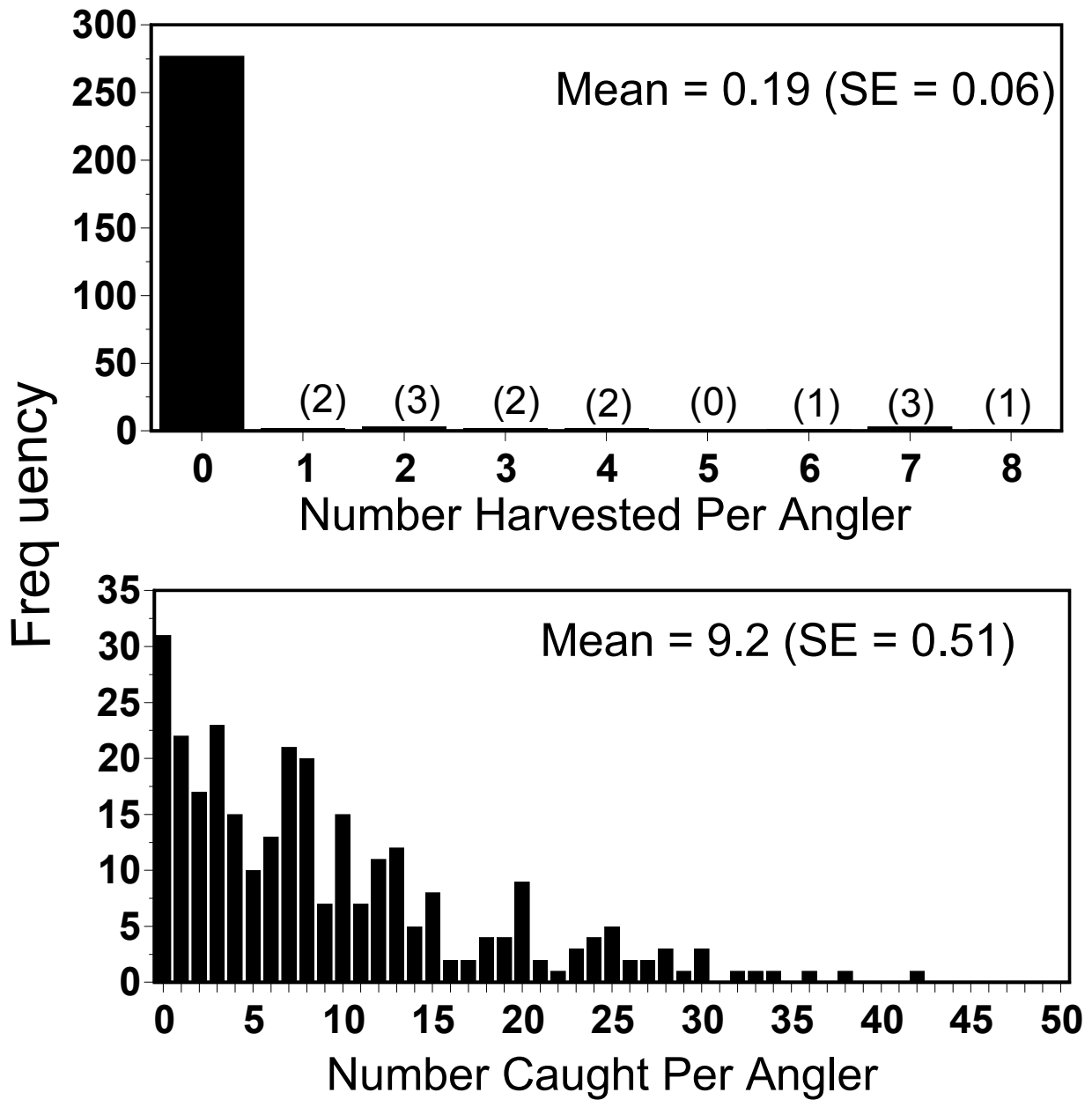
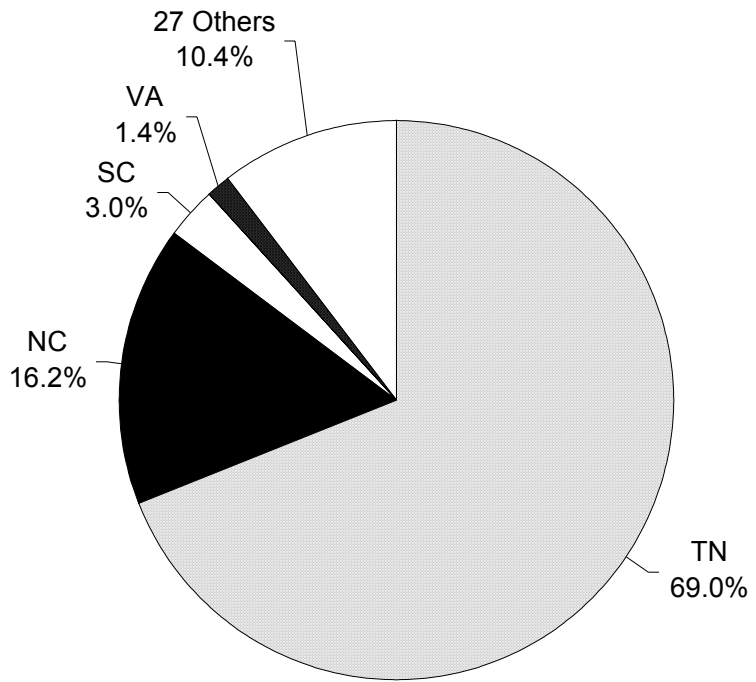


Figure I-2. Frequency distribution for the average number of trout harvested and caught by each member of parties that had completed fishing when interviewed on the Watauga River, March - October 2006. N = 291 parties.

State Residency



TN Counties

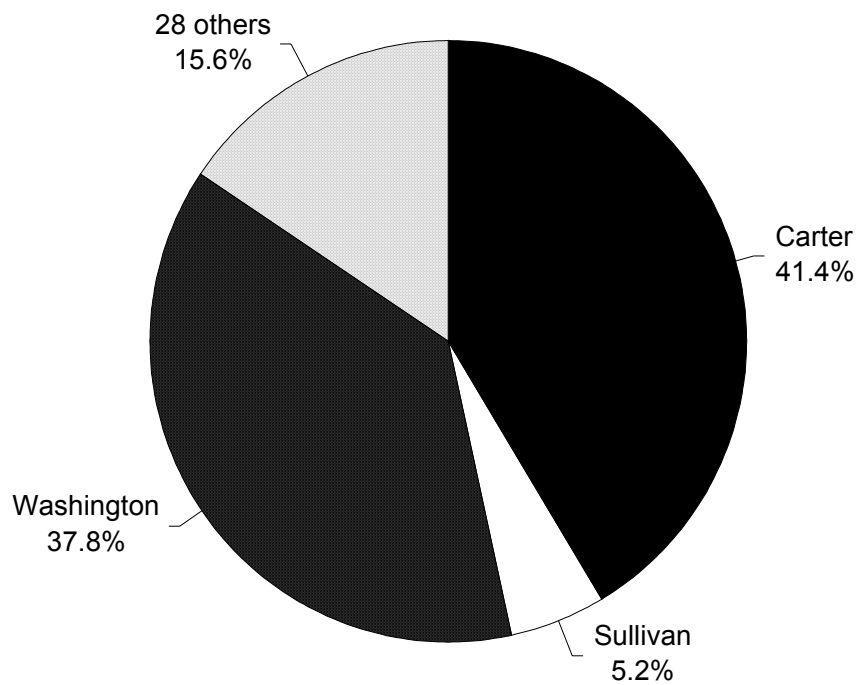


Figure I-3. State residency and Tennessee county residency for anglers interviewed on the Watauga River, March - October 2006.

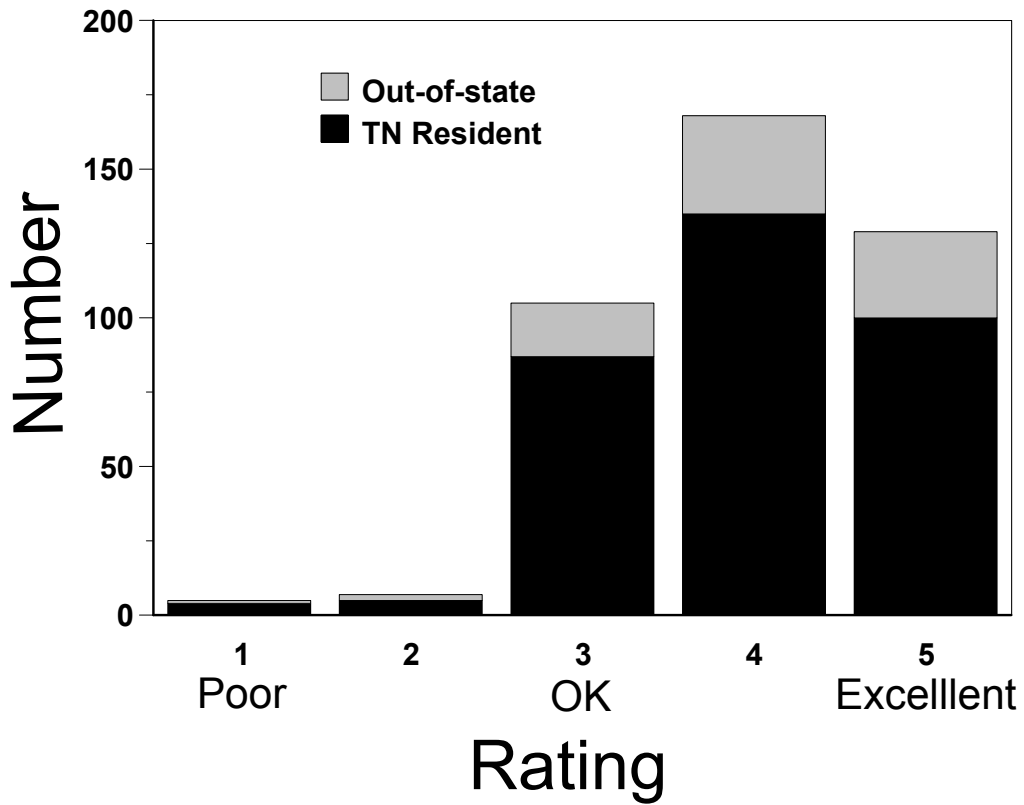


Figure I-4. Responses by anglers when asked, “On a scale of 1 to 5, how would you rate TWRA’s management of this fishery, where 1 = poor, 3 = OK, and 5 = excellent”. Data are for complete-trip anglers who had not been interviewed before.

APPENDIX I

Survey forms used during the creel survey on the Watauga River, 2006.

DAILY SHEET - WATAUGA 2006

Date (mm/dd/yr): _____

Day Type: _____
01 = Wk Day 02 = Weekend

Begin Time: _____

End Time: _____

River Stage: _____ 0 = No Generation 1 = Generation

| Access Point: | Anglers | | Cars | Boats | Trlr/Crs | Leg End Time |
|------------------------|---------|-------|-------|-------|----------|--------------|
| | Spin | Fly | | | | |
| 1. Dam-to-Stony Creek | _____ | _____ | _____ | _____ | _____ | _____ |
| 2a. Stony Creek-to-19E | _____ | _____ | _____ | _____ | _____ | _____ |
| 3. 19E-to-Ballfield | _____ | _____ | _____ | _____ | _____ | _____ |
| 4. VFW | _____ | _____ | _____ | _____ | _____ | _____ |
| 5. Blevins Bend | _____ | _____ | _____ | _____ | _____ | _____ |
| 6. Smalling Bridge | _____ | _____ | _____ | _____ | _____ | _____ |
| 7. Steps-to-Persinger | _____ | _____ | _____ | _____ | _____ | _____ |
| 8. Watauga Flats | _____ | _____ | _____ | _____ | _____ | _____ |

Totals: _____
Spin Fly Cars Boats Trlr/Crs Leg Time

Adjusted Angler Count: (Leave Blank) _____

Daily Mileage / Time:
Begin Mileage: _____ On-Station Time: _____

End Mileage: _____ Off-Station Time: _____

INTERVIEW SHEET - WATAUGA RIVER 2006

DATE (mm/dd) _____ INTERVIEW NUMBER _____

KIND-OF-DAY _____ ACCESS POINT (1 - 8) _____
Weekday = 1 Weekend / holiday = 2 (River reach)

NUMBER IN PARTY _____

START OF FISHING _____ END OF FISHING _____
(or time of interview)

Time Fishing _____ Hours _____ minutes _____
By Party

COMPLETED TRIP ? _____ SPECIES FISHED FOR _____
Yes = 1 No = 2 Trout = 1; Any/Other = 2

Number of **Rainbows CAUGHT** = _____ Number of **Rainbows KEPT** = _____

Total Lengths of Rainbows Kept (nearest cm): _____

Number of **Browns CAUGHT** = _____ Number of **Browns KEPT** = _____

Total Lengths of Browns Kept (nearest cm): _____

Number of **Brookies CAUGHT** = _____ Number of **Brookies KEPT** = _____

Total Lengths of Brookies Kept (nearest cm): _____

For METHOD, TERMINAL GEAR, and LOCATION, the numbers entered in each line should equal the number in the party.

METHOD → STILLFISHING _____ SPINFISHING _____ FLYFISHING _____

TERMINAL GEAR → ARTIFICIAL LURES or FLIES _____ BAIT _____

LOCATION → BOAT _____ OTHER _____

STATE _____ AND COUNTY (Tennessee residents only) _____

Chapter II

South Fork of the Holston River Survey 2006



Photo courtesy of J. Habera

STUDY AREA

South Holston Dam is located at South Fork of the Holston River km 80.1 in Sullivan County, Tennessee, about 10 km southeast of Bristol, TN-VA. The 22-km long reach managed for trout is bounded upstream by the South Holston Dam and downstream by the headwaters of Boone Reservoir (Bivens et al. 1996). South Holston Dam was constructed by the Tennessee Valley Authority (TVA) for flood control, power generation, and other related benefits.

South Holston Dam was closed in November 1950. The dam has a maximum height of 87 m and a length of 488 m (Davis and Brock 1994). The water intake is located at an elevation of 488 m msl, 39 m below the surface at full pool. Water may be released through the turbine, sluiceway, or spill gates. The dam has one generating turbine with a maximum capacity of 38,500 kW and a mean discharge of 68 m³/s (Davis and Brock 1994). A base flow of 2.5 m³/s is maintained by an aerating labyrinth weir, which was constructed in 1991 about 2 km downstream of the dam (Scott et al. 1996). The weir pool is maintained with twice-daily 40-min pulses of water from South Holston Dam during periods of non-generation.

During periods of generation the river is approximately 1.5 m - 2.0 m deep, 61 m wide, and covers about 133 ha (Bivens et al. 1996). At base flow the river averages 0.5 m deep, 40 m across, and has a surface area of 88 ha. The pool-to-riffle ratio at base flow is 1: 2 and the percent by area of riffle, pool, and run habitats is 43%, 32%, and 25%, respectively (Bettoli et al. 1999). The river has a gradient of 1.5 m/km between the dam and the headwaters of Boone Reservoir.

The number of trout stocked into the South Fork of the Holston River by the Tennessee Wildlife Resources Agency (TWRA) varies from year to year. In 2006, TWRA stocked adult (> 225 mm total length) rainbow trout (n = 47,200) and fingerling rainbow trout (n = 50,000). The brown trout stocking program ceased after 2003 once it was determined that spawning activity and recruitment was sufficient to maintain fishable stocks of that population.

The trout fishery in the South Fork of the Holston River is currently managed with a protected slot limit. No trout between 406 mm and 559 mm total length (16 – 22

inches) may be possessed and only one trout of the daily 7-fish creel may exceed 559 mm. The river also contains two spawning refuges where fishing is prohibited between November 1 and January 31 to protect spawning aggregations of trout and their redds.

METHODS

A stratified, uniform probability roving creel survey was conducted between March 1 and October 31, 2006. The survey was stratified by month and kind-of-day. An average of 9 weekdays and 7 weekend days were surveyed each month. Sample days (sunrise – to – sunset) were divided into three equal work shifts with equal probabilities of sampling the first, second, or third shifts. The clerk counted anglers on the river once each work shift. The time to start the count was randomly selected from a list of possible start times for each shift, beginning at daylight (or midday) and every 30 minutes thereafter until 1 h before the end of the shift. The counts were adjusted upwards when more boat (or raft) trailers were counted than boats (or rafts) by assuming two anglers were present for each vessel that was presumed to be on the river, but was not observed during the instantaneous count. Counts were also adjusted upwards when more cars than anglers were observed along the Rockhold Church Road, which ran along the lowest reach of the river surveyed. It was not uncommon in that reach of the river for anglers to wade out to the far side of several islands and be out of sight of the clerk. When cars that could not be associated with anglers were present, the count was adjusted upwards by multiplying the number of cars by 1.6 (the mean size of all interviewed parties). Finally, counts were adjusted upwards by multiplying the number of cars at the two cul-de-sacs along the route by 1.6 anglers per car. The first cul-de-sac was on a short spur off the TVA access road that runs along the left-bank-descending of the river, alongside Osceola Island (just upstream of the labyrinth weir); the second cul-de-sac was at the end of River Bend Road. Anglers would park their cars at these locations and hike down paths through woods to the river (and not be visible to the clerks).

Before and after the count, the clerk interviewed anglers. If anglers agreed to be interviewed, they were asked how long they had been fishing, whether they were finished fishing, and how many trout they had caught. Anglers were asked their state residency

and Tennessee residents were also asked for their county of residence. The clerk recorded the method of fishing being used by each angler and the clerk measured the total lengths (nearest cm) of any trout harvested. Finally, the clerk asked anglers who had not been interviewed before three questions relating to the special regulations that applied to the South Fork of the Holston River (Appendix II); they were also asked to rate TWRA's management of the fishery on a 5-point scale.

Mean daily counts were expanded to estimate effort in each stratum (i.e., kind-of-day) and then pooled to estimate effort each month following the methods of Pollock et al. (1994). Average catch and harvest rates were measured using the mean of ratios method, which is recommended for roving creel surveys (Pollock et al. 1997). Catch and harvest rates were calculated for all parties that had been fishing for at least 30 minutes before being interviewed. The catch and harvest of each trout species was then estimated each month. Standard errors of catch, harvest, and effort each month were calculated according to Pollock et al. (1994). A spreadsheet performed all necessary calculations and calculated 90% confidence intervals around each estimate. The pooled variance for total pressure, total harvest, and total catch of each species was calculated using the mean-square-successive-difference-between-periods procedure. The square root of the variance was multiplied by 1.6 to estimate 90% confidence intervals.

RESULTS and DISCUSSION

Pressure

Fishing pressure over the eight-month survey totaled 64,440 h (90% confidence limits $\pm 8,772$; Table 3), which was a significant ($P = 0.10$) increase in pressure from 2002 (48,190 h; $\pm 6,282$). Average trip length also increased from 2.71 h ($n = 196$ complete-trip parties; $SE = 0.11$) in 2002 to 3.34 h ($n = 171$; $SE = 0.15$) in 2006. Thus, anglers made an estimated 19,293 trips to the tailwater in 2006, compared to 17,782 trips in the 2002 survey. The higher fishing pressure in 2006 did not equal the pressure the tailwater received in 1997, when an estimated 29,028 trips were made and anglers expended 100,844 h of fishing pressure.

The amount of water discharged from South Holston Dam in two of the last three surveys (2002 and 2006) was below the 10-year daily average of about 940 cfs:

Average daily discharge (cfs) from South Holston Dam, March – October.

| Year | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|----------|------|------|------|------|------|------|------|------|------|------|
| Mean cfs | 1132 | 1449 | 616 | 689 | 765 | 622 | 1549 | 1047 | 820 | 713 |

The clerks on the South Fork of the Holston River observed 94 boats (with anglers onboard) during 120 instantaneous counts in 2006, or three times more than the 31 boats observed during 117 counts in 2002. In comparison, the Watauga River experienced much higher pressure from boat anglers over comparable survey periods in 2002 and 2006 (280-424 boats during 129-132 counts).

Catch and Harvest

As in previous surveys, catch rates on the South Fork of the Holston River were high in 2006; the pooled catch rate (both trout species combined for all parties fishing more than 0.5 hour) averaged 1.43 trout/h (SE = 0.08; n = 711). Catch rates among the three surveys varied significantly (Kruskal-Wallis test; P = 0.001), but were similar between 2002 and 2006 (P = 0.230). Harvest rates were low each year, but varied significantly (Kruskal-Wallis test; P = 0.001).

| Statistic | Survey Year | | |
|-----------|--------------------------|--------------------------|--------------------------|
| | 1997 | 2002 | 2006 |
| CPUE (SE) | 1.11 ^B (0.05) | 1.71 ^A (0.09) | 1.43 ^A (0.08) |
| HPUE (SE) | 0.35 ^A (0.02) | 0.32 ^A (0.02) | 0.20 ^B (0.02) |

* Means in a row sharing the same letter were statistically similar (P ≥ 0.05).

The estimated catch of rainbow trout in the 2006 survey period was 70,073 fish, of which only 9,237 were harvested (Table II-1). The difference between the number of rainbow trout harvested and the number caught represented a release rate of 87% (compared to 77% in 2002). Anglers reported catching 16,551 brown trout in 2006 (compared to 13,565 in 2002), of which only 1,467 were harvested. The release rate for

brown trout in 2006 (91%) was unchanged from 2002. It is interesting to note that brown trout represented nearly identical percentages (19.1-19.4%) of the total trout catch in both the Watauga River and South Fork of the Holston River in 2006.

The clerk measured 384 rainbow trout that anglers harvested (Figure I-1). All were shorter than the lower end of the protected slot limit (41 cm; 16 inches). Forty-three brown trout were observed in the creel and only two were longer than the lower end of the protected slot limit and one of those fish was within the protected slot. Thus, an estimated 33 brown trout (2.3% non-compliance rate x 1,467 harvested brown trout) were illegally harvested. Many of the brown trout were wild fish because TWRA last stocked browns into the river in 2003. Harvested brown trout were larger, on average, than the harvested rainbows (Kruskal-Wallis test; $P = 0.0001$).

The mean number of trout harvested by complete-trip anglers was 0.59 fish per angler per trip ($n = 171$ complete-trip parties; Figure II-2). Only 14% of complete-trip parties were observed harvesting trout and only one party was observed with more than the legal creel limit of 7 trout per angler per trip. Although harvest rates were low, catch rates were high, averaging 4.97 fish per angler per trip (Figure II-2). About 22% of anglers failed to catch a fish in 2006, similar to the 20% who did not catch a fish in 2002.

Angler Characteristics

Seventy-one percent of the 1,128 anglers in 711 parties interviewed on the South Fork of the Holston River in 2006 were Tennessee residents (Figure II-3), up from the 63% rate in 2002, but the same percentage as in 1997. As in previous surveys, most out-of-state anglers were Virginia residents (16% of all anglers). North Carolina residents represented 9% of all anglers interviewed, and the remainder came from 11 other states. Residents of Sullivan County, which wholly encompasses the river, accounted for 74% of the Tennessee resident who fished the river (compared to 84% in 2002). Residents of nearby Washington County represented 15% of all Tennessee residents interviewed in 2006. In 1997, 62% of anglers were fishing with some form of bait; that percentage rose to 74% in 2002 but fell to 51% in 2006. Flyfishing on the South Fork of the Holston has become more popular in recent years; the percentage of interviewed anglers using

flyfishing gear rose from 21% to 37% between 2002 and 2006 (the 1997 survey did not distinguish between anglers using spinning gear or flyfishing gear).

When asked to assign a numerical response to the question “How would you rate TWRA’s management of this fishery” on a scale of 1 (poor) to 5 (excellent), 77% of anglers (n = 279) on the South Fork of the Holston River gave scores of 4 or 5 and only 2 anglers rated the management as “poor” (Figure II-4). Those same anglers were asked if they were for or against (or had no opinion) the three special regulations on the river:

| Regulation | For | Against | No opinion |
|--------------------------|-----|---------|------------|
| Spawning Refuges | 86% | 4% | 10% |
| 406-559 mm TL Slot Limit | 82% | 14% | 4% |
| Only 1 fish > 559 mm TL | 88% | 9% | 4% |

The regulations that mandated the release of fish of certain sizes were more strongly opposed than the regulation prohibiting fishing in two reaches during the winter spawning season. However, support for all regulations was overwhelmingly positive.

CONCLUSIONS

The South Fork of the Holston River remains a premier Tennessee trout fishery based on its production of wild trout (Bettoli et al. 1999) and the sizes and number of trout inhabiting the system (Habera et al. 2003). Catch rates were excellent and fishing pressure in 2006 recovered from the precipitous drop detected between 1997 and 2002. As in most Tennessee tailwaters, anglers on the South Fork of the Holston River have shifted over time from being harvest-oriented to releasing most of their catch. More so than the Watauga River, much of the land along the South Fork of the Holston River is privately-owned and most fishing pressure is limited to a few TVA access points. A recent decision by the Tennessee Wildlife Resources Commission to purchase land along the banks of the South Fork of the Holston River will provide additional access to bank, wading, and drift-boat anglers and may result in more fishing pressure.

Table II-1. Fishing pressure and number of rainbow trout and brown trout caught and harvested by anglers fishing the South Fork of the Holston River, March - October 2006.

| Month | Pressure | SE | Rainbows | | Rainbows | | Browns | | Browns | |
|-----------|----------|-------|----------|-------|-----------|-------|--------|-------|-----------|-----|
| | | | Caught | SE | Harvested | SE | Caught | SE | Harvested | SE |
| March | 6,086 | 1,072 | 3,455 | 1,179 | 813 | 386 | 1,066 | 437 | 139 | 71 |
| April | 10,549 | 2,151 | 8,537 | 2,366 | 528 | 198 | 2,335 | 704 | 156 | 87 |
| May | 8,235 | 1,221 | 7,425 | 2,459 | 1,827 | 773 | 478 | 249 | 16 | 11 |
| June | 8,465 | 1,012 | 6,296 | 1,738 | 804 | 402 | 2,202 | 510 | 127 | 90 |
| July | 8,986 | 1,213 | 11,263 | 2,289 | 1,523 | 492 | 1,863 | 560 | 58 | 58 |
| August | 7,892 | 1,097 | 14,606 | 4,724 | 1,858 | 508 | 2,881 | 1,335 | 259 | 159 |
| September | 9,520 | 1,250 | 13,803 | 1,299 | 1,407 | 345 | 3,953 | 910 | 405 | 217 |
| October | 4,707 | 1,226 | 4,688 | 950 | 477 | 308 | 1,773 | 391 | 307 | 307 |
| Total | 64,440 | 5,483 | 70,073 | 9,194 | 9,237 | 1,606 | 16,551 | 2,936 | 1,467 | 249 |

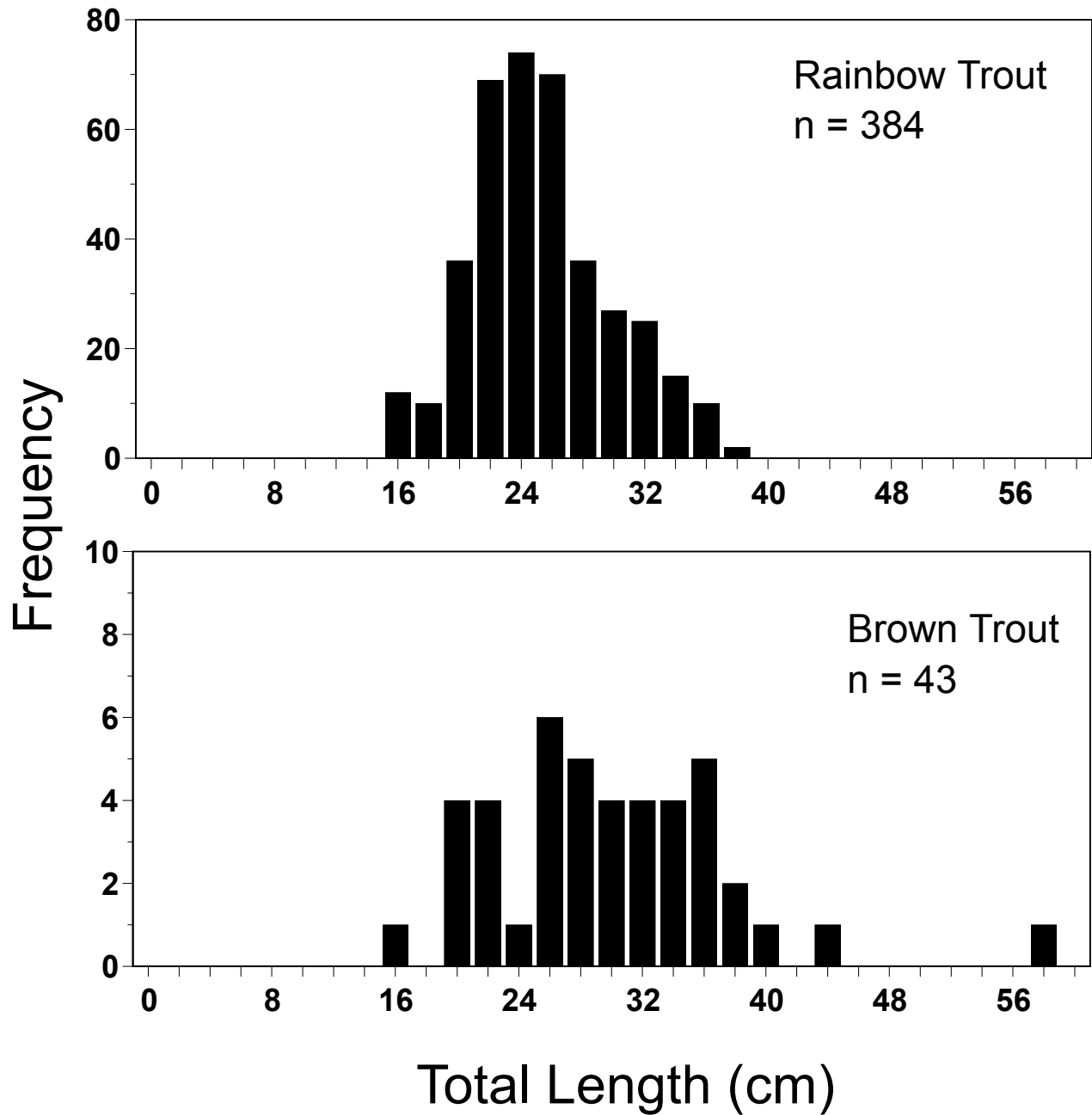


Figure II-1. Length-frequency distributions for trout observed in the creel of anglers on the South Fork of the Holston River, March - October 2002.

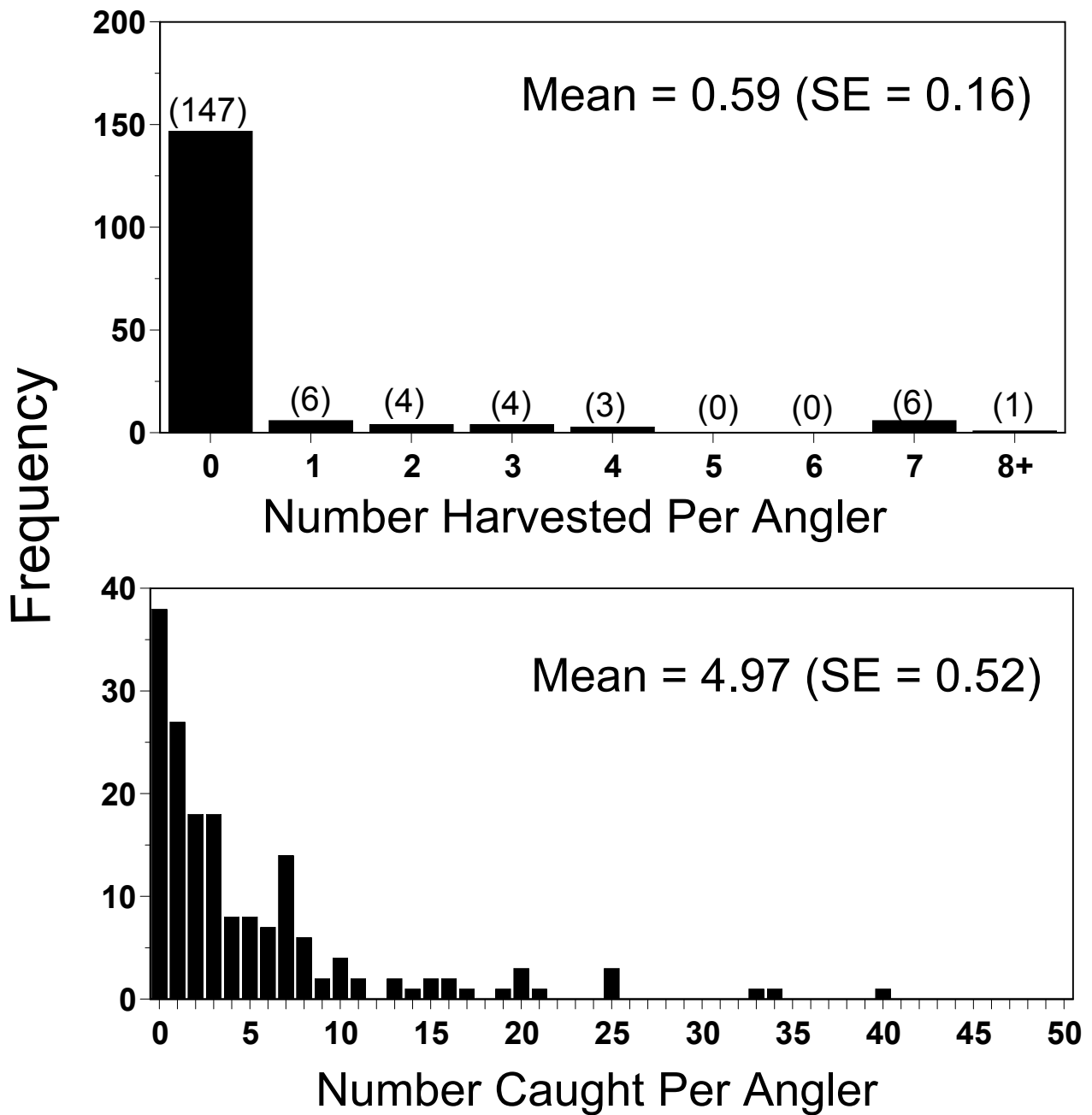


Figure II-2. Frequency distribution for the average number of trout harvested and caught by each member of parties that had completed fishing when interviewed on the South Fork of the Holston River, March - October 2006. N = 171 parties.

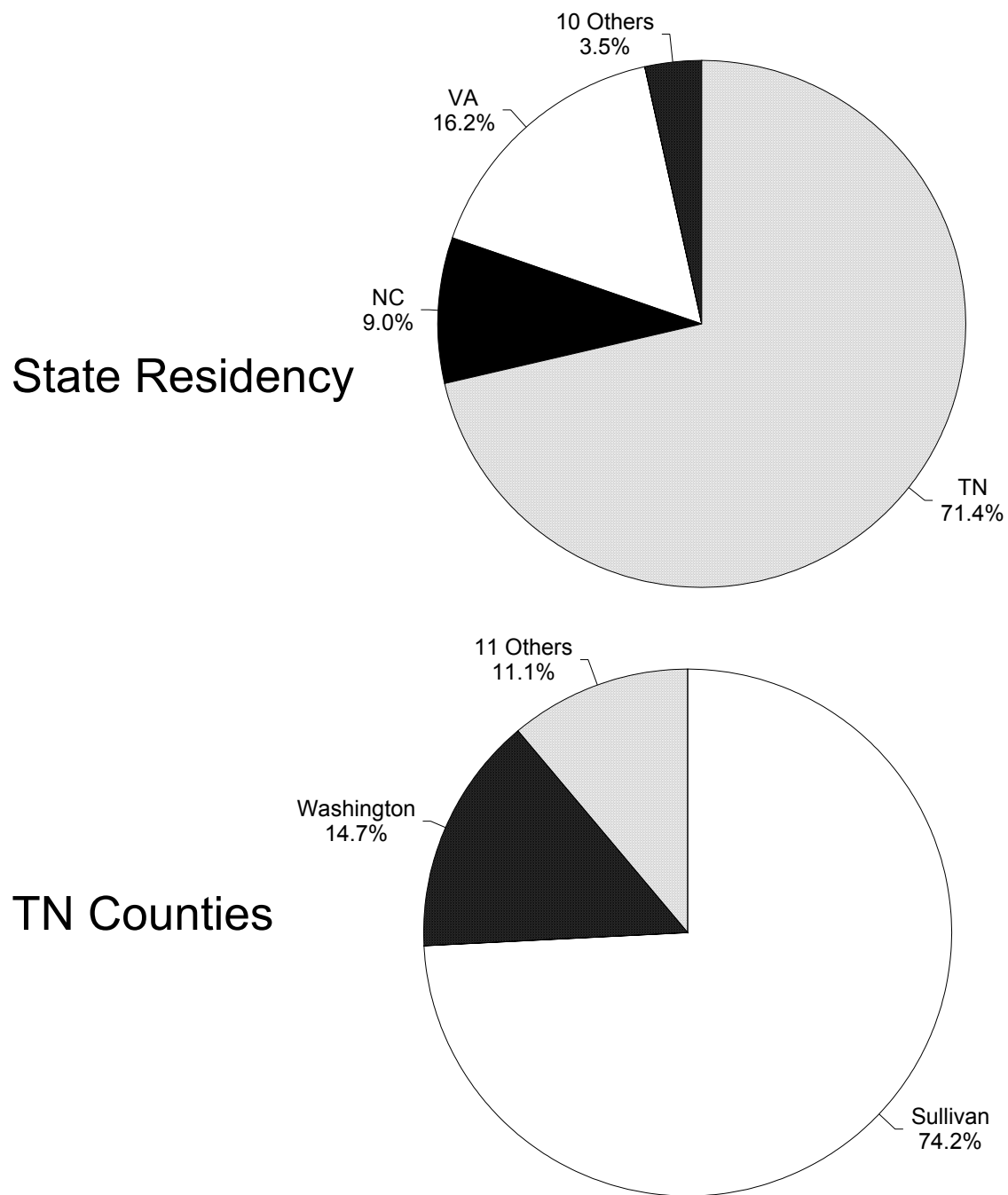


Figure II-3. State residency and Tennessee county residency for anglers interviewed on the South Fork of the Holston River, March - October 2006.

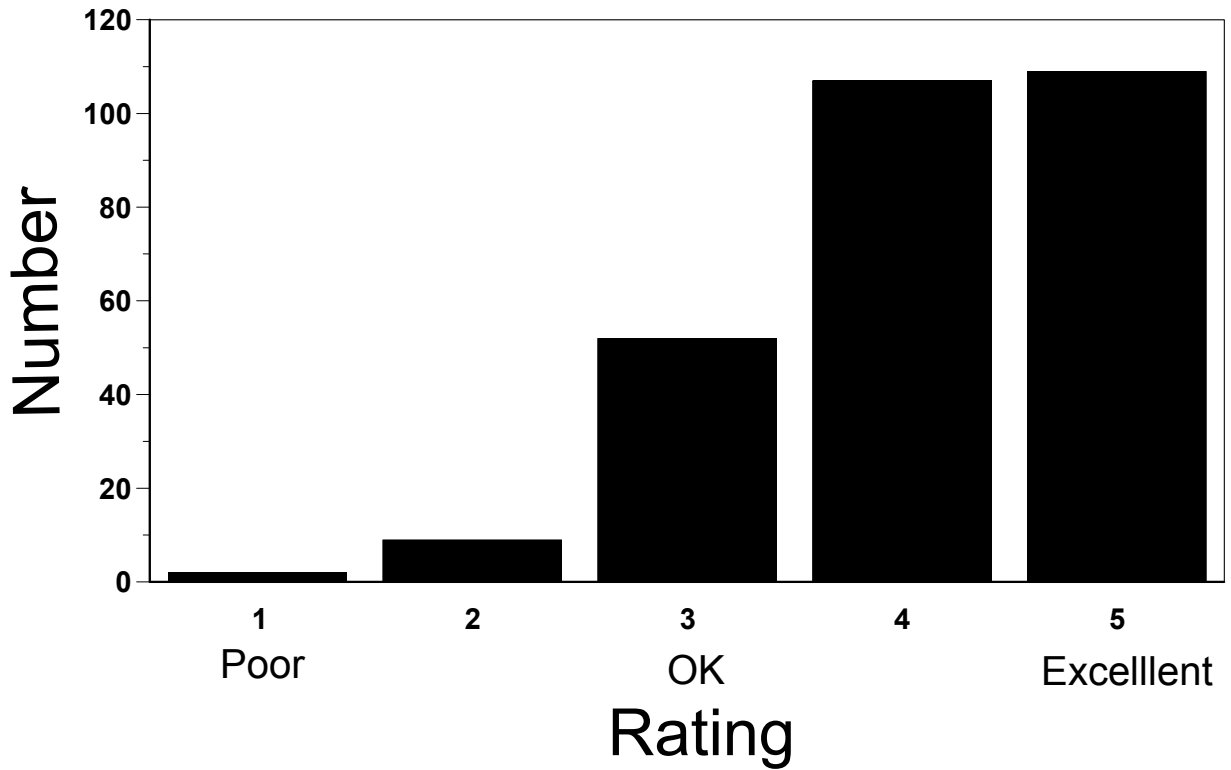


Figure II-4. Responses by anglers on the South Fork of the Holston River when asked, “On a scale of 1 to 5, how would you rate TWRA’s management of this fishery, where 1 = poor, 3 = OK, and 5 = excellent?” Anglers were not posed this question if they had already participated in the survey.

APPENDIX II

Survey forms used during the creel survey on the South Fork
of the Holston River, 2006.

DAILY COUNT SHEET – SF HOLSTON 2006

DATE (mm/dd/yy) _____ KIND OF DAY _____
 01 = weekday 02= weekend or holiday

SHIFT (1ST, 2ND, or 3RD) _____ TIME COUNT BEGAN _____

RIVER STAGE WHEN COUNT BEGAN (0 = no generation 1 = generation) _____

| ACCESS POINT | Number of ANGLERS | Number of BOATS | Number of TRAILERS | Number of CARS |
|---------------------------------------|-------------------|-----------------|--------------------|--|
| 1. Above labyrinth weir dam | | blank | blank | blank |
| 1b. First cul de sac | blank | blank | blank | |
| 2. Below labyrinth weir dam | | | | blank |
| 2b. Second cul de sac | blank | blank | blank | |
| 3. Hickory Tree Bridge and Rivers Way | | | | Blank |
| 4. River Road | | | | Blank |
| 5. Webb & Weaver Pike Bridges | | | | Blank |
| 6. Rockhold Church Road | | | | For this stretch of the river, count only those cars that can't be associated with anglers visible to you |
| TOTALS | | | | |

ADJUSTED ANGLER COUNT (leave blank) _____

INTERVIEW SHEET - SF HOLSTON RIVER 2006

DATE (mm/dd) _____ INTERVIEW NUMBER _____

KIND-OF-DAY _____ ACCESS POINT (1 - 6) _____
Weekday = 1 Weekend / holiday = 2

NUMBER IN PARTY _____

START OF FISHING _____ END OF FISHING _____
(or time of interview)

Time Fishing by Party Hours _____ minutes _____

COMPLETED TRIP? _____ SPECIES FISHED FOR _____
Yes = 1 No = 2 Trout = 1; Any/Other = 2

Number of **Rainbows CAUGHT** = _____ Number of **Rainbows KEPT** = _____

Total Lengths of Rainbows Kept (nearest inch): _____

Number of **Browns CAUGHT** = _____ Number of **Browns KEPT** = _____

Total Lengths of Browns Kept (nearest inch): _____

For METHOD, TERMINAL GEAR, and LOCATION, the numbers entered in each line should equal the number in the party. Use fractions if an angler used multiple methods.

METHOD → STILLFISHING ___ SPINFISHING ___ FLYFISHING ___

TERMINAL GEAR → ARTIFICIAL LURES or FLIES ___ BAIT ___

LOCATION → BOAT _____ OTHER _____

STATE _____ AND COUNTY (Tennessee residents only) _____

South Fork of the Holston River Creel Survey – 2006

1. **Have you been interviewed before? *If the answer is “YES”, terminate the interview.***

2. ***The Tennessee Wildlife Resources Agency would like to know how you feel about some of the trout fishing regulations on this river.***

Are you FOR, AGAINST, or INDIFFERENT to:

| Regulation | For | Against | No Strong Opinion |
|---------------------------------------|-----|---------|-------------------|
| Spawning Refuges | | | |
| Protective Slot Limit (16-22”) | | | |
| Only One Fish > 22” | | | |

3. ***On a scale of 1 (= poor) to 5 (= excellent), how would you rate TWRA’s management of this fishery?***

| <i>(Poor)</i> 1 | 2 | <i>(OK)</i> 3 | 4 | <i>(Excellent)</i> 5 |
|--------------------|---|------------------|---|-------------------------|
| | | | | |

Start Date for this tally sheet _____ End date _____

REFERENCES

- Banks, S.M., and P.W Bettoli. 2000. Reproductive potential of brown trout in Tennessee tailwaters. Fisheries Report 00-19, Tennessee Wildlife Resources Agency, Nashville, Tennessee.
- Bettoli, P.W. 1999. Creel survey and population dynamics of salmonids stocked into the Watauga River below Wilbur Dam. Fisheries Report No. 99-41. Tennessee Wildlife Resources Agency, Nashville, Tennessee.
- Bettoli, P.W. 2003 a. Survey of the trout fishery in the Watauga River, March – October 2002. Fisheries Report No. 03-05. Tennessee Wildlife Resources Agency, Nashville, Tennessee.
- Bettoli, P.W. 2003 b. Survey of the trout fishery in the South Fork of the Holston River. Fisheries Report 03-06, Tennessee Wildlife Resources Agency, Nashville. 19 pages.
- Bettoli, P.W., Owens, S.J., and M. Nemeth. 1999. Trout habitat, reproduction, survival, and growth in the South Fork of the Holston River. Fisheries Report No. 99-3. Tennessee Wildlife Resources Agency, Nashville, Tennessee.
- Bivens, R.D., B.D. Carter, and C.E. Williams. 1997. Region IV trout fisheries report, 1996. Report 97-2, Tennessee Wildlife Resources Agency, Nashville.
- Bivens, R.D., B.D. Carter, and C.E. Williams. 1998. Region IV trout fisheries report, 1997. Report 98-3, Tennessee Wildlife Resources Agency, Nashville.
- Bivens, R.D., Carter, B.D., and C.E. Williams. 1996. Trout Fisheries Report; Region IV 1995. Fisheries Report 96-5, Tennessee Wildlife Resources Agency.
- Davis, J.L. and W.G. Brock. 1994. Status of TVA's reservoir releases improvement efforts. Pages 147-152 in M.J. Sale and R.O. Wadlington, editors. Proceedings of Symposium on Responses to Changing Multiple-Use Demands: New Directions for Water Resources Planning and Management. Nashville, Tennessee.
- Habera, J.W., R.D. Bivens, B.D. Carter, and C.E. Williams. 2003. Region IV trout fisheries report, 2002. Fisheries Report 03-03, Tennessee Wildlife Resources Agency, Nashville.
- Habera, J.W., R.D. Bivens, B.D. Carter, and C.E. Williams. 2007. Region IV trout fisheries report, 2006. Fisheries Report 07-02, Tennessee Wildlife Resources Agency, Nashville

- Holbrook, C., and P.W. Bettoli. 2006. Spawning habitat, length at maturity, and fecundity of brown trout in Tennessee tailwaters. Fisheries Report No. 06-11. Tennessee Wildlife Resources Agency, Nashville, Tennessee.
- Pollock, K.H., J.M. Hoenig, C.M. Jones, D.S. Robson, and C.J. Greene. 1997. Catch rate estimation for roving and access point surveys. North American Journal of Fisheries Management 17:11-19.
- Pollock, K.H., C.M. Jones, and T.L. Brown. 1994. Angler survey methods and their applications in fisheries management. American Fisheries Society Special Publication 25.
- Scott, E.M., K.D. Gardner, D.S. Baxter, and B.L. Yeager. 1996. Biological and water quality responses in tributary tailwaters to dissolved oxygen and minimum flow improvements. Water Management Resource Group, Tennessee Valley Authority, Norris, Tennessee.

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