CREEL SURVEYS OF SANTEETLAH, CHEOAH, CALDERWOOD, AND CHILHOWEE RESERVOIRS, 1998-99

Final Report

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Abstract —We used a roving-access design to survey the recreational boat fishery on Santeetlah, Cheoah, Calderwood, and Chilhowee reservoirs during 1998 and 1999. Primary survey objectives were estimating and characterizing boat angling effort, catch, and harvest, and obtaining angler opinion on an array of reservoir management issues. Secondary objectives included characterizing bank angling effort on surveyed reservoirs, and estimating fishing effort on the Cheoah River bypass reach below Santeetlah Reservoir. Clerks intercepted 34.5% of observed boating parties, with greater survey efficiency on reservoirs with fewer access points. Total estimated fishing effort on Santeetlah Reservoir was 55,789 angler hours/year, mostly directed at black bass (40.7%) and walleye *Stizostedion vitreum* (23.9%). Trout anglers expended 71.2% of 11,687 angler hours/year of estimated effort on Cheoah Reservoir and 81.1% of 30,979 angler hours/year on Calderwood Reservoir. Angling effort for black bass and trout constituted 42.3% and 27.1% of 33,080 angler hours/year estimated for Chilhowee Reservoir, based on Tapoco, Inc. observations. Estimated annual effort on the Cheoah River bypass reach was 1,059 angler hours, and occurred from April through October. In all cases, sport fish species that received the majority of directed angling effort also predominated in annual catch and harvest estimates. Catch rates of warmwater fish species on Santeetlah and Chilhowee reservoirs were comparable to those reported from other western North Carolina reservoirs. Trout catch rates on Cheoah and Calderwood reservoirs were equal to or higher than warmwater fisheries, but lower than regional averages for stocked trout streams. Harvest rates were higher for trout and walleye than for black bass and sunfish, and illegal harvest was rarely observed. Bank anglers were relatively uncommon, but caught and harvested fish at rates equal to or greater than boat anglers. Boat and bank anglers were typically local North Carolina or Tennessee residents and primarily fished the reservoirs within their state of residence. Trip expenditures were highest for non-local boat anglers and lowest for bank anglers. Boat angler perception of crowding was low on all reservoirs, particularly Cheoah and Calderwood. Based on survey findings and angler opinion on fisheries management, we recommend continued management of Santeetlah Reservoir for black bass and walleye under existing regulations, with emphasis on forage enhancement and water quality improvements. Current trout stocking and regulations should continue on Cheoah Reservoir. State agencies should cooperatively evaluate optimal trout management on Calderwood. Based on observed use and angler opinion, we recommend boating access improvements on Santeetlah, Cheoah, and Calderwood reservoirs. Future roving-access surveys of multi-species reservoir fisheries should more intensively sample afternoon and evening work periods and sample multiple access points where possible.

Reservoirs in the southern Appalachian region provide diverse recreational opportunities to an increasingly demanding public. These impoundments were constructed between 1915 and 1960 to control flooding and produce electric power, and now exhibit a wide array of aquatic habitats and fishing opportunities. Reservoir fishing is a prominent recreational activity in the region, and was the preferred angling experience of one third of western North Carolina respondents in a survey of licensed anglers (Finke and Van Horn 1993).

As part of its management of fishery resources and angling opportunities on inland waters, the North Carolina Wildlife Resources Commission (NCWRC) routinely surveys sport fish populations. Wherever possible, biological data are augmented with information on the recreational experiences of anglers using these resources. However, little sport fishing information is available for western North Carolina reservoirs. Borawa (1986) surveyed anglers on Fontana Reservoir, but no other quantitative creel surveys have occurred on reservoirs of the upper Little Tennessee River basin. Because of increasing public interest in mountain reservoir fisheries and anticipated informational needs associated with Federal hydropower relicensing, the NCWRC initiated the current study to assess angler experiences and preferences on Santeetlah Reservoir, a popular reservoir fishery associated with the hydropower facility

operated by the Tapoco Division of Alcoa Power Generating Inc. (Tapoco). Tapoco also sought information on recreational resources on its other hydropower projects and funded concurrent creel surveys on Cheoah, Calderwood, and Chilhowee reservoirs. In addition to survey funding, Tapoco (1997) conducted recreational use studies on all four project impoundments. These data provided the basis for the creel survey scope and sample allocation on the additional reservoirs. Both NCWRC and Tapoco also desired information on angling use of the bypass reach of the Cheoah River between Santeetlah and Calderwood reservoirs.

The creel surveys were primarily focused on daily angling use associated with public access points on Tapoco project reservoirs. Reservoir creel survey objectives were: 1) to quantify and characterize boat angling effort, catch, and harvest; 2) to estimate bank angling trip lengths, catch, and harvest; 3) to collect information on angler residency, motivations, and trip-related expenses; 4) to characterize the quality and species composition of reservoir sport fisheries; and 5) to obtain on-site angler opinions on reservoir fisheries management, access area quality, crowding, and other recreational issues of interest to Tapoco and NCWRC. Because these creel surveys represented the first of multiple survey years on mountain reservoirs, an additional objective of the NCWRC was to evaluate the efficiency of the survey design. For the bypass reach of the Cheoah River, the sole objective was to estimate the magnitude and temporal distribution of angling effort.

Study Area

Tapoco Hydropower Projects and Affected Resources

The creel surveys encompassed four hydropower reservoirs and the bypass reach of the Cheoah River (Figure 1). The study area is primarily forested, and includes substantial areas of Nantahala and Cherokee National Forests, Great Smoky Mountains National Park, and Tapoco-owned lands. Tributary streams typically exhibit good water quality with temperatures supporting trout and other coldwater aquatic species.

Santeetlah Reservoir, an impoundment of the Cheoah River near Robbinsville, North Carolina, was built in 1928. At normal full pond elevation of 592 m above mean sea level (msl), it has a surface area of 1,160 ha, a mean depth of 17 m, and a maximum depth of 65 m. Estimated hydraulic retention time of Santeetlah Reservoir is 161 d, and stratification typically occurs from July through October. The reservoir is oligotrophic, although localized seasonal algal blooms result from high phosphorus concentrations caused by commercial aquaculture operations on tributaries (NCDEHNR 1994). Aquatic habitat consists of bedrock, boulder/cobble, and clay substrates, with moderate to abundant woody cover at or near full pond elevations, particularly in areas associated with publicly-owned shorelines. Aquatic vegetation consists of small areas of emergent macrophytes in shallow cove areas and more widespread filamentous algae on substrates in littoral waters. Under the current Tapoco operating guide implemented in 1991, the water level in Santeetlah Reservoir is usually kept within 2 m of full pond elevation during May and June, with annual winter drawdowns averaging 6 m (Tapoco 1999).

Cheoah, Calderwood, and Chilhowee reservoirs are run-of-river hydropower impoundments operated in series on the main stem of the Little Tennessee River immediately below Fontana Dam, a much larger Tennessee Valley Authority (TVA) development. Cheoah Reservoir (249 ha, 389 m above msl, mean depth 40 m, maximum depth 60 m) was built in 1919, and receives all releases and spillage from Fontana Dam immediately upstream. In addition, the Santeetlah powerhouse is situated on Cheoah Reservoir, and all flow diverted through its penstock from the Cheoah River is also released into Cheoah Reservoir. Calderwood Reservoir (217 ha, 332 m above msl, mean depth 30 m, maximum depth 45 m) was built in 1930 immediately downstream of Cheoah Reservoir and lies mainly in Tennessee, with only the upper 3 km in North Carolina. Chilhowee Reservoir (707 ha, 266 m above msl, mean depth 6 m, maximum depth 18 m) was completed in 1957 and lies entirely in Tennessee, immediately downstream of Calderwood Reservoir. Water levels are largely driven by operations at Fontana, and all three reservoirs have daily fluctuations of less than 2 m, with estimated retention times of 5-7 d. The reservoirs are narrow, riverine, and oligotrophic, with only mild stratification occurring periodically in deeper waters near the dams. Substrates are dominated by bedrock, boulder/cobble, and clay; Cheoah Reservoir has extensive clay/silt areas in the uplake portion. Chilhowee Reservoir is not as deep as the two upstream impoundments and is substantially broader, particularly in the downlake portion. Lakefront development is limited to hydropower and transportation facilities and campsites, and reservoir shorelines are primarily forested. Stable lake levels have allowed extensive aquatic and emergent macrophyte growth in shallower areas of the reservoirs, primarily in the more riverine uplake portions and on silt deposits. Steep shorelines in other areas limit available macrophyte habitat. Uplake water temperatures are heavily influenced by coldwater releases from upstream powerhouses, whereas seasonally warmer conditions exist downlake, particularly in Chilhowee Reservoir.

The Cheoah River below Santeetlah Reservoir consists of a partially dewatered stream reach extending 14 km to its confluence with the Little Tennessee River at the head of Calderwood Reservoir. Because river flow has been diverted to the Santeetlah Project powerhouse on Cheoah Reservoir, flows within the former river channel consist of less than 0.1 m^3/s of dam leakage, supplemented progressively by small downstream tributaries. Due to low flows, vegetative encroachment has occurred along the river channel, and substrates of irregular bedrock and large boulders predominate.

Fishery Resources

Early surveys of Santeetlah Reservoir (Tebo 1961; Messer 1966; Davies 1981) described a diverse sport fishery, including rainbow trout *Oncorhynchus mykiss* and various coolwater and warmwater species. Fish stocking (Appendix 1) focused on sport fish introductions prior to 1970, while threadfin shad *Dorosoma petenense* have been stocked periodically since 1965 in attempts to enhance the forage base in the reservoir. White bass *Morone chrysops* have appeared in the system from unknown sources and now are taken regularly in gill net samples (NCWRC, unpublished data). Trout stocking continues in several major tributary streams, and although Santeetlah Reservoir is not stocked or managed as Designated Public Mountain Trout Waters (DPMTW), a trout fishery exists in the reservoir. Other sport fisheries include largemouth bass *Micropterus salmoides*, smallmouth bass *Micropterus dolomieu*, walleye *Stizostedion vitreum*, and sunfish *Lepomis* spp.

The NCWRC has installed extensive fish habitat improvements (primarily tree and brush structures) in Santeetlah Reservoir in cooperation with Tapoco and the U. S. Forest Service, Cheoah Ranger District. Aside from TVA review of water quality of Fontana Dam releases, no fish habitat enhancements have occurred on the other reservoirs.

Tebo (1961) reported an assemblage of coolwater and warmwater sport fish in Cheoah Reservoir, including bluegill *L. macrochirus*, rock bass *Ambloplites rupestris*, smallmouth bass, crappie *Pomoxis* spp., and muskellunge *Esox masquinongy*, in addition to channel catfish *Ictalurus punctatus* and flathead catfish *Pylodictus olivaris*. Because of coldwater powerhouse releases and high water quality, the NCWRC now manages Cheoah Reservoir as DPMTW, with multiple annual stockings of catchable-sized trout supplementing presumed natural reproduction in the reservoir and its tributaries. Fingerling trout stockings have occurred intermittently, most recently in 1997 (Appendix 1).

At the time of this study, little information was available on the fish assemblage in Calderwood Reservoir. Both NCWRC and Tennessee Wildlife Resources Agency (TWRA) manage the reservoir as a stocked trout fishery (Appendix 1). Currently, NCWRC stocks fingerling trout based on availability, whereas TWRA stocks catchable-sized rainbow trout annually. In December 1997, TWRA stocked approximately 40,000 lake trout *Salvelinus namaycush* fingerlings in Calderwood Reservoir (R. Bivens, TWRA, unpublished data).

Because of its variability in thermal habitats, Chilhowee Reservoir is managed by TWRA for two distinct fisheries objectives (R. Bivens, TWRA, personal communication). The uplake portion of the reservoir is managed as a stocked trout fishery similar to Calderwood Reservoir, whereas the downlake waters are managed as a combined cool- and warmwater fishery that includes bluegill, catfish, walleye and black bass. Threadfin shad have been stocked periodically since 1967 to enhance the forage base for these fishery resources. The reservoir was under a fish consumption advisory from 1987 through 1991 because of elevated polychlorinated biphenyl (PCB) levels in some fish species (TNDHE 1991).

Recent surveys of the bypass reach of the Cheoah River (S. Loftis, NCWRC, unpublished data) found a diverse community of coolwater fish species, including rock bass and smallmouth bass. While past management has included trout stocking, the river is not currently managed for trout.

Appendix 2 lists the North Carolina and Tennessee fishing regulations for waters in the study area. By reciprocal agreement, licensed anglers from either state are permitted to fish Calderwood Reservoir by boat under the regulations of their state of residence.

Recreational Access

Santeetlah Reservoir lies immediately adjacent to the town of Robbinsville, North Carolina. The other three reservoirs, particularly Cheoah and Calderwood, are relatively remote from populated areas. All reservoirs in the study area have public boat ramps maintained by Tapoco in cooperation with state and federal agencies (Table 1; Figure 1). On Santeetlah Reservoir, there is also access from a commercial marina and numerous privately-owned boat docks associated with lakefront residences. No private or commercial access exists on the other

reservoirs. Bank fishing access is widely dispersed on public and private lands throughout the study area, including road bridge abutments and causeways, roadside pull-offs, boating access areas, tributary cove shorelines, lakefront campsites, and private docks. Fishing trails have enhanced bank fishing access in some areas of Santeetlah Reservoir. Steep, rugged terrain limits bank fishing access on the other reservoirs, particularly on Calderwood Reservoir. Bank fishing access to the bypass reach of the Cheoah River consists of roadside pull-offs along US 129; boating is not possible because of high gradient and low flows.

Methods

Creel Survey Design

The Santeetlah creel survey covered the period from 7 September 1998 through 5 September 1999. All Saturdays and Sundays were sampled as well as Good Friday, Memorial Day, Independence Day, and Labor Day (sampling probability = 1.00); other holidays falling on weekdays were assigned normal weekday probability (0.60) for sampling. Within each week, the remaining three sample days (two during holiday weeks) were allocated randomly and with equal probability to remaining weekdays.

Creel surveys of Cheoah, Calderwood, and Chilhowee reservoirs were conducted concurrently by Tapoco from 1 June 1998 through 31 May 1999. Stratified weekend/holiday and weekday sample days were allocated among the three reservoirs in random rotation, so that each reservoir received one weekend/holiday ($P = 0.33$) and one weekday ($P = 0.20$) for every three sample days allocated within each stratum. Monthly strata corresponded with those of the Santeetlah creel, except that the summer season of the Cheoah/Calderwood/Chilhowee creels occurred in 1998.

The creel surveys employed a roving-access design (Palsson 1991; Pollock et al. 1994), using lakewide counts to expand angling effort, catch, and harvest information obtained from interviews with exiting boat anglers at established boating access points. On each sample day, sampling was allocated to one boating access area, using unequal probabilities derived from Tapoco (1997) use data and observations of use by NCWRC law enforcement personnel (Table 1). Sample days were divided into work periods of equal duration (4.53-6.90 h depending on solar day length), one of which was randomly assigned for data collection (Appendix 3). From 26 October 1998 through 25 April 1999, sample days began at sunrise and ended 0.5 h after sunset, with two work periods (morning and evening) assigned equal probability (0.50) for sampling. During the remainder of the creel survey, sample days began at sunrise and ended 2.5 h after sunset and were divided into three work periods, with the morning and evening work periods each assigned twice the sampling probability (0.40) of the midday period (0.20) to target cooler portions of the day. Once each sample day on Santeetlah, Cheoah, and Chilhowee reservoirs, a lakewide instantaneous count of boat trailers was performed to estimate total lake use for the work period. One hour was allocated for the instantaneous count, the midpoint of which was randomly assigned within the work period. Direction of the count circuit (clockwise or counterclockwise) was also randomly chosen. A single instantaneous count (40 min) of the Cheoah River between Santeetlah and Calderwood reservoirs was randomly conducted within each work period allocated to Calderwood Reservoir.

Field Data Collection

All boating parties were identified and classified as anglers or non-anglers when exiting the reservoir, but only angling parties were interviewed. For each boat angling party, the date, time and location of the interview were recorded. All boat angling parties were asked to provide a starting time for the fishing trip, the number of party members fishing, the zip code of the boat operator, the particular type of fish species sought (if any), the number of fish harvested and released by species, and the total estimated expenditures of the party for the fishing trip. Harvested fish were identified to species, counted, measured for total length (mm), and weighed (g) whenever possible. When constrained by time or weather, the clerk did not obtain length and weight data. On North Carolina waters, anglers who released black bass were asked if released fish exceeded 305 mm, the minimum length for legal harvest beyond the two fish exempted from the size limit. Interview data were recorded on standard forms (Appendix 4 Figures A4.1, A4.2). On Cheoah, Calderwood, and Chilhowee reservoirs, all interviews occurred at the boating access area designated for each sample day. On Santeetlah Reservoir, additional interviews were obtained at other access points whenever possible, and the clerk was allowed to relocate to different access area if initially assigned to an unused area. Exiting bank angling parties were interviewed whenever encountered along reservoir shorelines. Angler interviews were not conducted on the Cheoah River.

In addition to these trip data, opinion questions were asked of angling parties during only their first interview on each reservoir (Appendix 4 Figure A4.3), with the boat operator or other party leader providing responses. Angler opinions were solicited on estimated frequency and purpose of fishing trips, perceptions of and reactions to crowding, assessment of access area quality, and assessment of fishery resource quality. Each party was also given the opportunity to make additional comments at the end of their first interview. Responses to open-ended questions were categorized and coded by the creel clerk where applicable. Responses and comments not fitting available codes were noted on the interview form.

During lakewide instantaneous counts for each reservoir, boat trailers and bank anglers were counted at all established boating access areas. Boat trailers were counted only if they appeared to be associated with active use of the reservoir. Trailers in storage at Santeetlah Marina or clearly associated with beached boats at campsites were not included in counts. Personal watercraft were not included among trailer or exit counts. No attempt was made to count boating trips originating from rented slips at Santeetlah Marina, although returning boats were counted as exiting parties and interviewed if angling. Boating trips associated with private docks on Santeetlah Reservoir were not included in the creel survey. Lakewide counts of bank anglers were not attempted because of limited road access to bank fishing sites. Count data were recorded on the first interview form for each sample day (Appendix 4 Figures A4.1, A4.2). At the end of each sample day, the clerk recorded the total number of exiting boating parties and the number of exiting boat angling parties observed during the work period. For sample days involving evening work periods, the clerk recorded the number of boat trailers still present on the access area at the end of the work period.

During the Cheoah River instantaneous counts, the number of anglers using the river and vehicles occupying pull-off parking spots adjacent to river fishing sites were recorded.

Effort, Catch, and Harvest Estimation

Effort, catch, and harvest estimates were stratified by day type (weekday or weekend/holiday). Whenever possible, monthly estimates were computed. When monthly sample sizes were too small to calculate sample variance, bimonthly or quarterly estimates were developed from pooled data. Monthly, bimonthly, and quarterly estimates and variances were summed to obtain totals for the survey year.

Effort (angler hours), catch and harvest estimation followed roving-access procedures described by Pollock et al. (1994). For each work period (i), lakewide boat angling party count estimates were determined by multiplying the sum of trailer counts for all access areas on the reservoir by the ratio of boat angling parties to total boating parties observed exiting by the creel clerk. Party count estimates were further expanded by the mean party size to determine instantaneous angler count estimates (I_i). Mean party size and ratio of angling parties were based on daily totals when this information could be obtained from more than 10% of observed boaters; otherwise substitute multipliers based on the mean values from all work periods within the sample stratum were used.

Effort (e) for a work period of T_i hours was estimated as

$$\hat{e_i} = I_i \times T_i,$$

and expanded to total effort (E) as

$$\hat{E} = \sum_{i=1}^{n} \left(\hat{e_i} / \pi_i \right)$$

with π_i representing the total probability of sampling for each work period, including the probabilities of sampling the work period within the day and the day within the sample stratum (weekday or weekend/holiday). Approximate standard error (SE) of each effort estimate was computed as

$$\hat{SE}\left(\hat{E} \right) = \sqrt{N^2 \left(\frac{s^2}{n} \right)},$$

where s^2 = variance of effort observations, n = number of days sampled, and N = number of days available for sampling. Standard error approximations for effort expansions were calculated with and without substituted data, and the greater values were reported as conservative estimates of confidence in the expanded estimates. In addition to total effort, directed effort was estimated for black bass on Santeetlah and Chilhowee reservoirs, walleye on Santeetlah Reservoir, and trout on Cheoah, Calderwood, and Chilhowee reservoirs. Directed effort expansions included only parties listing the target species as the object of their fishing trip, but were otherwise calculated similarly to total effort estimates.

Catch (C) and harvest (H) were estimated from boat angling effort and daywise catch (harvest) rates as

$$\hat{C} = \hat{E} \times \hat{R}_1,$$

where

$$\hat{R}_1 = \sum_{i=1}^{n} c_i / \sum_{i=1}^{n} L_i,$$

with c_i = catch and L_i = hours of fishing reported by each party (i) interviewed during the work period. Expansions were based only on sample days when boat angler interviews were obtained. On days when boat angler interviews were obtained, but no trailers were observed during counts, lakewide effort was assumed to be 0.5 angling party per interview to allow calculation of non-zero catch and harvest estimates. Trip lengths were calculated as the difference between the time of the interview and the start time reported by the angling party. Approximate SE of each catch and harvest estimate was computed from sample variance based on number of days sampled among all available days, applying the same formulae used with effort estimates. In addition to total catch and harvest, expansions were calculated for catch and harvest of black bass and sunfish (including crappie and rock bass) on Santeetlah and Chilhowee reservoirs, walleye on Santeetlah Reservoir, yellow perch *Perca flavescens* on Cheoah Reservoir, and trout on all four reservoirs. No expansions of effort, catch, or harvest from bank angling data were attempted because of incomplete coverage of bank fishing areas during data collection.

Mean partywise catch and harvest rates were calculated using unexpanded boat and bank angler interview data. In addition to total catch and harvest rates, annual and seasonal estimates were computed for major sportfish species sought on each reservoir. Catch and harvest rates of target species were calculated for boat anglers directing effort toward black bass on Santeetlah and Chilhowee reservoirs, walleye on Santeetlah Reservoir, and trout on Cheoah, Calderwood, and Chilhowee reservoirs. For Santeetlah Reservoir anglers, the percentage of legal-sized black bass released was determined.

Length-frequency distributions were developed for major species harvested on each reservoir, and mean or modal lengths or weights at harvest were compared to values reported from other reservoirs in the region. Because Cheoah Reservoir is stocked with three species of trout by NCWRC, percent contribution of each trout species to angler harvest was estimated for this reservoir.

Characteristics of Recreational Fisheries

Point of origin for fishing trips, as determined by angler zip code, was categorized by state residency and proximity to project reservoirs. Anglers were classified as “local” if they resided in a county adjacent to one or more of the reservoirs (Blount, Monroe, Graham, or Swain counties) or in a comparably proximal portion of an adjoining county (Loudon County southeast of Ft. Loudon and Tellico reservoirs; Cherokee County north of the Hiwassee River; Nantahala

River portion of Macon County). Non-local anglers were classified as "regional" if they resided in or west of Charlotte or Winston-Salem, North Carolina, in or east of Chattanooga or Cookeville, Tennessee, or in or north of Atlanta or Athens, Georgia. Mean trip expenditures were estimated for bank anglers and for local and regional boat anglers.

Angler responses to first-interview questions on trip frequency and purpose, reservoir crowding, access area quality, and fishery resource quality were tabulated by reservoir. Area-specific opinions on access area quality and season-specific opinions on reservoir crowding were also tabulated. Fishery resource quality responses were categorized by major target species of boat anglers. Percentages of category totals were calculated for all angler responses.

Results and Discussion

Survey Efficiency and Patterns of Reservoir Use

A total of 3,083 boating parties were observed on the four reservoirs surveyed (Table 2), of which 1,063 (34.5%) were intercepted by creel clerks. Among intercepted parties, 809 (76.1%) reported fishing during their boating trip. Incidence of angling was higher on Cheoah (94.8%) and Calderwood (92.0%) than on Santeetlah (72.8%) or Chilhowee (70.2%). Cooler waters, remoteness, and the narrow nature of the smaller reservoirs likely reduced their attractiveness for skiing, swimming, and other non-angling uses. Interviews were obtained from 761 (94.1%) of the intercepted boat angling parties. Interviews were missed only at access areas with high use, and typically resulted from multiple or rushed exits preceding nightfall or rainstorms. Estimated percentage of daily effort sampled ranged from 30.0% on Santeetlah to 47.4% on Calderwood. By comparison, Palsson (1991) reported 20.7% to 69.8% of daily effort sampled in multiple years of roving-access survey of discrete fisheries in Puget Sound. Observed use of access areas was consistent with projected use based on Tapoco (1997) observations, except at Panel Branch (Cheoah) and Pear Tree (Chilhowee), where camping and non-angling day use represented a greater proportion of total use than anticipated. Additionally, boat anglers likely avoided the single ramp at Panel Branch because it is located in a small backwater area of the Fontana Dam tailrace, where accessibility is affected by rapid changes in water depth and velocity that occur during hydropower operations. Only one boat angling party was intercepted at a location other than a boating access area, a campsite near Cheoah Point on Santeetlah Reservoir.

Survey efficiency varied within and among reservoirs, with higher rates of interception on the smaller reservoirs (Cheoah and Calderwood) and at access areas with higher overall use. Reduced interception rates on the larger reservoirs resulted from partitioning of sampling among more numerous access areas. Of the boating parties observed but not intercepted for interview on Chilhowee Reservoir, 57.8% were missed because they exited at an access point not selected for interview sampling that day. Similarly, 63.1% of boating parties on Santeetlah Reservoir used areas not initially selected for survey, although interviews were obtained from 46 of these parties by roving multiple access areas. By comparison, only 39.7% of Cheoah Reservoir boat angling parties used the access area not selected for interception, and no alternative access was available on Calderwood Reservoir.

Bank anglers were rarely encountered near boating access areas. Bank and dock fishing was not allowed at Santeetlah Marina, and bank fishing access was limited by terrain at most other areas. On Cheoah Reservoir, 25 bank anglers were observed and 5 were interviewed. No bank anglers were interviewed on Calderwood Reservoir, although 15 were observed during the creel survey. Similarly, no interviews were obtained from 30 bank anglers observed on Chilhowee. As with boat anglers, most bank anglers not interviewed on Cheoah and Chilhowee reservoirs were observed during count circuits, using areas not selected for interception. Twenty Chilhowee bank anglers were not interviewed for this reason, as were 18 of the 20 Cheoah bank anglers not interviewed. Of the remaining bank anglers, 9 of 15 on Calderwood and 7 of 10 on Chilhowee were observed near or after nightfall, when the clerk was instructed not to approach bank angling parties. Roving for additional interviews was conducted only on Santeetlah Reservoir and improved efficiency of interception of bank anglers; 25 party interviews representing 32 anglers were obtained of 53 bank anglers observed at boating access areas, and an additional 24 interviews representing 64 bank anglers were obtained at other sites. Because reservoir creel surveys did not include all potential bank fishing areas, observed use does not reflect total bank fishing activity.

Survey efficiency was also affected by seasonal variation in boating use patterns (Appendix 5). The cooler half of the survey year (26 October 1998 through 25 April 1999) was characterized by reduced overall boating activity (29.9% of total observed) and increased concentration of boating activity at high-use ramps. Redistribution of use among ramps was most pronounced on Santeetlah Reservoir, where boating activity at Massey Branch increased from 47.3% during the warm season to 76.0% of lakewide activity during cooler months. The effect of this seasonal shift in use on survey efficiency was partially mitigated on Santeetlah by roving for boat angler interviews at multiple access areas.

In contrast to ramp probabilities, work period allocation was poorly matched to both warm and cool season use patterns. While monthly mean trailer counts (Appendix 6) showed no consistent time-of-day trend on any of the four reservoirs, exits of angling parties (Appendix 5) were heavily skewed toward afternoon and evening work periods. The only exception to this trend was on Cheoah Reservoir, where cool season activity was very low in both morning and afternoon periods. Oversampling of morning work periods reduced overall interception rates on all reservoirs, and was the greatest source of survey inefficiency on Calderwood Reservoir. Late night and overnight use was observed on all reservoirs. Angling parties most frequently exited during the evening work period, which extended past 2300 hours from early May through mid-August. Trailers often remained on access areas at the end of evening work periods on all reservoirs. In most cases, these boating parties camped overnight, particularly during summer holiday weekends and late fall hunting seasons. However, a portion of late night boaters were likely engaged in fishing and exited following conclusion of evening work periods, as overnight fishing trips were occasionally reported by parties exiting during morning work periods.

Intensity of boating use and proportion of angling parties among boaters varied by season on all four reservoirs (Appendix 6). On Santeetlah (Table A6.1), boating use was lowest in January but increased steadily through late winter and spring, peaking in May. The proportion of angling parties among all boaters was reduced in summer months on Santeetlah. On Cheoah and Calderwood reservoirs (Tables A6.2, A6.3), angling parties constituted a high proportion of total

boating use in all months. On Cheoah, boating use was lowest in February and highest in August, while on Calderwood it was lowest in March and peaked in September. Boating activity remained low on both reservoirs until April, possibly driven by angler expectations regarding stocked trout fisheries. March closure of Hatchery Supported trout streams in North Carolina also may have reduced fishing activity on Cheoah and Calderwood reservoirs. Although Hatchery Supported hydropower reservoirs remain open to trout fishing during March, some anglers may be unaware of this exception to trout fishing regulations. On Chilhowee Reservoir (Table A6.4), boating use was lowest in March and highest in August. However, high boating use in warmer months consisted largely of non-angling parties. Summer weekend fishing was particularly reduced on Chilhowee Reservoir from July through September, when angling parties represented less than half of boating use.

Angling Effort

Variability was high among effort estimates within the survey year for all reservoirs and the Cheoah River. While overall effort estimates on all four reservoirs were relatively precise, proportional standard error (PSE = SE/estimate) values exceeded 0.20 for Cheoah River, and for most day type and target species estimates on Cheoah, Calderwood, and Chilhowee reservoirs. Precision was improved on Santeetlah Reservoir due to larger sample sizes, and sampling intensity applied there was sufficient for estimation of directed effort on major sport fisheries. A similar or greater amount of sampling intensity should be incorporated in future investigations of fishing effort, particularly where multi-species fisheries are involved, or where rigorous comparisons among temporal or spatial strata are desired. The level of sampling intensity applied to the other three reservoirs was sufficient for characterization of sport fisheries, but would limit statistical evaluation of directed effort, seasonal patterns, or other elements. Effort estimates for the Cheoah River were imprecise because of extremely low levels of fishing effort relative to creel sampling intensity, and should be considered only as baseline information for design of future investigations. At existing levels of use, costs of an on-site roving creel survey of the Cheoah River fishery would likely outweigh benefits of the limited amount of angler data obtained, even if sampling were limited to the April-October period of observed use.

Santeetlah Reservoir—Santeetlah boat anglers expended an estimated 55,788 angler hours (PSE = 0.09) or 48.1 angler hours/ha of total fishing pressure during the survey year, apportioned equally between weekdays (27,413 angler hours, PSE = 0.12) and weekends/holidays (28,375 angler hours, PSE = 0.13). Mean party size was 1.88 anglers/party, with a mean trip length of 5.3 h. Monthly fishing effort (Table 3) on Santeetlah was highest in May, June, and October, and lowest in January, February, and December. Estimated angling effort directed at black bass was 22,688 angler hours (PSE = 0.16, 19.6 angler hours/ha), and constituted 40.7% of total annual boat angling effort. Black bass angling peaked in June and was lowest in December. Estimated annual walleye effort (13,341 angler hours, PSE = 0.20, 11.5 angler hours/ha; 23.9% of total) was highest in May and lowest in February. Remaining boat angling effort on Santeetlah was largely undirected, with minimal effort targeting trout, sunfish, crappie, and catfish. Comparable effort data were not available from other mountain reservoirs at the time of survey; however, annual fishing pressure estimates were nearly four times the 13 angler hours/ha estimated for Fontana Reservoir in 1984-85 (Borawa 1986), but less than half of the 118 angler hours/ha reported by Jones et al. (2000) in a 1997-98 survey of Harris Lake in a heavily populated area of Piedmont North Carolina. Borawa (1989) also reported relatively high annual

fishing pressure (109 angler hours/ha) in a 1987-88 creel survey of Lake James, a large hydropower impoundment with fishery resources similar to those of Santeetlah Reservoir. Although ongoing changes in recreational use of mountain reservoirs prevent direct comparisons with other systems, Santeetlah Reservoir is heavily fished considering its location in a sparsely populated county. Fishing and other types of recreational boating probably will continue to increase with expanded highway access and associated population growth in surrounding counties. The focus of anglers on black bass and walleye fisheries is consistent with observed effort on Fontana Reservoir (Borawa 1986) and reflects current NCWRC management of Santeetlah Reservoir and similar hydropower impoundments in the region. In contrast to the Fontana fishery, little or no boat angling effort was directed at crappie or white bass, although these species are present in the reservoir. Directed effort represented approximately two thirds of total effort on Santeetlah Reservoir. By comparison, nearly all observed effort on Fontana (Borawa 1986) and Harris reservoirs (Jones et al. 2000) was directed at a particular species, whereas Borawa (1989) reported nearly half of effort on Lake James was undirected.

Bank anglers were encountered on Santeetlah Reservoir during all months surveyed but were concentrated only during white bass spawning migrations in early to mid-April, when 21 of 49 bank angler interviews were obtained at or above the US 129 bridge on the Cheoah River arm of the reservoir near Robbinsville. Surprisingly, no bank anglers reported white bass as a target species, even when it was the primary species being caught and harvested; 90.2% of observed bank angling effort was undirected, with the remainder targeting a variety of species, including black bass, catfish, sunfish, trout, and walleye. Mean reported length of bank angling trips was 3.4 h, although it is likely that a portion of interviewed bank anglers continued to fish on the day interviewed, particularly during the April white bass run.

Cheoah Reservoir—Estimated annual boat angling effort on Cheoah Reservoir (Table 4) was 11,687 angler hours (PSE = 0.16) or 46.9 angler hours/ha of fishing pressure. Mean party size was 1.84 anglers/party, and mean trip length was 5.3 h. Directed effort for trout was estimated at 8,326 angler hours (PSE = 0.21, 33.4 angler hours/ha) or 71.2% of total annual effort. Aside from two parties targeting yellow perch, remaining effort was undirected. As on Santeetlah Reservoir, overall weekday (6,422 angler hours, PSE = 0.26) and weekend/holiday effort levels (5,265 angler hours, PSE = 0.18) were similar; Jones (1983a) also reported equality of weekday and weekend fishing pressure on a stocked trout fishery on the Nantahala River. Because of small sample sizes, monthly effort estimates were available only for May and August, with bimonthly estimates for June-July and September-October, and quarterly estimates for the remainder of the survey year. Fishing effort was highly concentrated in warmer months, with 86.9% of total effort and 81.6% of trout angling effort occurring from May through October. Intensified late spring and summer effort was likely influenced by angler expectations of higher success rates following trout stocking, and is similar to angling effort patterns observed on put-and-take trout streams (Mickey and Wingate 1981; Jones 1983a).

Bank anglers on Cheoah Reservoir also concentrated their efforts in the warmer months; 22 of 25 bank anglers were observed in summer 1998 (June-September) or April and May 1999. Three of five bank anglers interviewed targeted trout, and two stated no target species. Mean reported length of bank angling trips was 2.7 h.

Calderwood Reservoir—On Calderwood Reservoir, annual boat angling effort (Table 5) was 30,979 angler hours (PSE = 0.18). At 142.8 angler hours/ha, fishing pressure was more than triple that of other reservoirs in the current survey, and exceeded levels of 109 and 118 angler hours/ha reported for Lake James (Borawa 1989) and Harris Lake (Jones et al. 2000), both of which are located in more heavily populated areas. Mean party size (1.99 anglers/party) was higher than other reservoirs, whereas mean trip length was shorter at 4.3 h. Estimated annual directed effort for trout was 26,227 angler hours (PSE = 0.18, 120.9 angler hours/ha) or 84.7% of total annual effort. As on other reservoirs, yearly effort was equally apportioned between weekdays (14,965 angler hours, PSE = 0.24) and weekends/holidays (16,014 angler hours, PSE = 0.26). Monthly effort estimates were available for all months except November and December, when a pooled bimonthly estimate was computed. Total fishing effort and trout fishing effort were highest in September, May, and June, and lowest in March. As on Cheoah Reservoir, spring and early summer patterns of fishing effort are probably influenced by trout stocking.

Observations of bank angling on Calderwood Reservoir were rare overall and not concentrated in any time of year. No information was obtained on trip lengths or target species of bank anglers.

Chilhowee Reservoir—Annual boat angling effort on Chilhowee Reservoir (Table 6) was estimated at 33,080 angler hours (PSE = 0.18) or 46.8 angler hours/ha of fishing pressure. While effort was comparable to Calderwood Reservoir, fishing pressure was similar to levels observed on Santeetlah and Cheoah reservoirs. Mean party size (1.84 anglers/party) and mean trip length (5.0 h) were also comparable to other reservoirs. Annual directed effort toward black bass was estimated at 14,009 angler hours (PSE = 0.26, 19.8 angler hours/ha) and represented a proportion of total annual effort (42.3%) comparable to that of the Santeetlah black bass fishery. Annual directed effort toward trout was estimated at 8,976 angler hours (PSE = 0.35, 12.7 angler hours/ha, 27.1% of total) and was lowest of the three stocked reservoirs relative to surface area. As on other reservoirs surveyed, overall annual fishing effort was equally distributed among weekdays (16,941 angler hours, PSE = 0.24) and weekends/holidays (16,139 angler hours, PSE = 0.26). Bimonthly effort estimates showed consistently high levels of fishing effort from May through September, with lowest effort in December and January. Trout fishing effort generally reflected this trend, but was also reduced in August and September as water temperatures peaked. In contrast, black bass fishing effort (primarily targeting smallmouth bass) peaked in April and May and was heavily concentrated in warmer months through September. No black bass fishing was reported in February or March.

As on Calderwood, no trip length or target species information was obtained from Chilhowee bank anglers. Bank angling was widely dispersed across all times of the year, with no observed concentration of activity.

Cheoah River—Annual angling effort on the bypass reach of the Cheoah River (Appendix 7) was estimated at 1,059 angler hours (PSE = 0.41), or approximately 75 angler hours/km of fishing pressure. No anglers were observed from November through March, and summer effort remained too low to allow comparisons among months. Maximum instantaneous counts (three anglers each) occurred in April and October. Anglers were most often encountered during

midday counts, and were evenly distributed among weekdays and weekends/holidays. While river anglers were usually associated with vehicles at roadside pull-offs, vehicles in these areas were often associated with non-angling uses and did not reliably indicate angling activity. No trip length or target species information was obtained from Cheoah River anglers.

Catch and Harvest Estimates

Catch and harvest estimates on all reservoirs exhibited poor precision, particularly on Cheoah and Chilhowee reservoirs, where sampling was dispersed among multiple access points and target species. Palsson (1991) used a PSE of 0.30 as a target threshold for precision of catch estimates in a roving-access survey design, and PSEs of estimates from Cheoah and Chilhowee typically exceeded this value, ranging from 0.28 to 0.49. On Calderwood Reservoir, an identical intensity of sampling achieved greater precision, both because access was contained to one point on the reservoir, and due to the concentration of Calderwood anglers on a single target fishery. Because Santeetlah Reservoir was allocated as many sample days as the other three reservoirs combined, multiple access points were sampled with the desired precision; PSEs exceeded desired thresholds only on catch and harvest estimates for relatively minor fisheries (sunfish and trout). Future roving-access surveys seeking catch and harvest characteristics of multi-species reservoir fisheries should sample at an intensity equal to or greater than that applied to Santeetlah, particularly where multiple access points are available to boat anglers.

Santeetlah Reservoir—Santeetlah boat anglers caught an estimated annual total of 9,641 fish (PSE = 0.12), of which 5,443 (PSE = 0.16, 56.4% of total) were black bass, 1,770 (PSE = 0.35, 18.4% of total) were bluegill or other centrarchid species, and 1,413 (PSE = 0.28, 14.7% of total) were walleye (Table 7). Overall annual trout catch was low compared to warmwater and coolwater species (499, PSE = 0.44, 5.2% of total). The remaining 5.4% of annual catch included white bass, channel catfish, flathead catfish, gizzard shad *D. cepedianum* and yellow perch. Monthly estimates showed variability within and among major fisheries; total monthly estimated catch exceeded 1,000 fish from May through October, except in September when fishing was likely affected by high water temperatures and reservoir stratification. Lowest estimated catch (158 fish, PSE = 0.53) was observed in February. Black bass catch reflected patterns in overall estimates, except that reduced catch was observed in July. Conversely, sunfish catch peaked in July and was minimal during winter months. Walleye catch was highest in mid-summer and late fall, and minimal in late summer and late winter. October estimates represented 54.1% of total annual estimated trout catch. Estimated total annual catch of 8.31 fish/ha compares favorably with the 1984-85 estimate of 5.91 fish/ha for Fontana (Borawa 1986), but is much lower than the 64.12 fish/ha reported in 1987-88 for Lake James (Borawa 1989). Annual species catch estimates for Santeetlah were intermediate compared to total values from other surveys, with 4.69 black bass/ha and 1.21 walleye/ha compared to respective estimates of 1.79 and 1.19 for Fontana, and 11.23 and 7.27 for James. While these reservoirs represent a range of limnological environments and relative abundances of target species, differences in catch estimates primarily reflected differences in fishing effort.

Total estimated harvest by Santeetlah boat anglers was 3,765 fish (PSE = 0.18), or approximately one third of catch (Table 8). Annual harvest of black bass was estimated at 1,406 fish (PSE = 0.30) or 37.3% of total harvest. An estimated 975 walleye (PSE = 0.23, 25.9% of total) and 775 sunfish (PSE = 0.58, 20.6% of total) were harvested during the survey year.

Estimated annual trout harvest was 423 fish (PSE = 0.42, 11.2% of total). The remaining 5.0% of annual harvest included white bass, channel catfish, flathead catfish, and gizzard shad. Monthly harvest estimates closely resembled catch figures, particularly for walleye, sunfish, and trout. In contrast, black bass harvest varied considerably relative to catch. High black bass harvest in June and minimum harvest in September reflected catch patterns, but harvest was also reduced in May, largely because of a higher percentage of bass <305 mm in the catch for this period.

Although bank angling catch and harvest expansions were not obtainable due to incomplete survey coverage of bank fishing areas, Santeetlah bank anglers caught white bass most frequently (47.9% of observed catch, again due to the April spawning run), followed by black bass (36.3%), sunfish (11.3%), and catfish (1.7%). Harvest of these species reflected catch, with respective percentages of observed total catch of 55.4, 31.3, 8.1, and 2.0. Walleye and trout represented <1% each of bank angler catch and harvest.

Cheoah Reservoir—On Cheoah Reservoir, estimated annual boat angler catch totaled 5,805 fish (PSE = 0.36), of which 4,508 (PSE = 0.43, 77.7% of total) were trout and 324 (PSE = 0.37, 5.6% of total) were yellow perch (Table 9). The remaining 16.8% of annual catch included rock bass, smallmouth bass, walleye, bluegill, muskellunge, and white sucker *Catostomus commersoni*. Total annual harvest was estimated at 4,945 fish (PSE = 0.43), of which 4,325 (PSE = 0.45, 87.5% of total) were trout and 198 (PSE = 0.48, 4.0% of total) were yellow perch (Table 9). The remaining 8.5% of annual harvest included rock bass, smallmouth bass, walleye, bluegill, and white sucker. Monthly, bimonthly and quarterly estimates indicate that catch and harvest are heavily concentrated in early summer. An estimated 73.4% of total catch and 72.2% of trout catch occurred in June and July, as did 70.5% of total harvest and 71.1% of trout harvest. Yellow perch were mainly caught and harvested during May, when an estimated 61.4% and 72.7% of annual catch and harvest for this species occurred. As with effort patterns, catch and harvest on Cheoah Reservoir reflected scheduled trout stockings; of 12,220 catchable-sized trout stocked between June 1997 and May 1999, 7,920 (64.8%) were stocked between 15 April and 31 July (NCWRC, unpublished data).

Calderwood Reservoir—Calderwood Reservoir boat anglers caught an estimated 18,057 fish (PSE = 0.25) during the survey year (Table 10), including 11,613 trout (PSE = 0.23, 64.3% of total). The remaining 35.7% of estimated catch included largemouth and smallmouth bass, yellow perch, walleye, rock bass, river chub *Nocomis micropogon*, and an unknown sucker species (probably white sucker). Collectively, these species represented a substantial portion of the total catch, but no single species predominated as a secondary sport fishery. Annual harvest was dominated by coldwater species; of an estimated 10,590 fish harvested (PSE = 0.23), 9,610 or 90.7% were trout (PSE = 0.25). Yellow perch and river chub were the only other species harvested, totaling 9.3% of estimated annual harvest. Monthly catch and harvest estimates indicate that Calderwood differs from Cheoah Reservoir and other stocked trout fisheries in the area, with these statistics being more evenly distributed throughout the year. Although overall fishing effort was high during the warmer months of July-October, reduced trout catch and harvest and increased catch of coolwater and warmwater species was observed.

Chilhowee Reservoir—Total estimated annual boat angler catch on Chilhowee Reservoir (Table 11) was 12,151 fish (PSE = 0.36). Catch of sunfish, primarily bluegill and rock bass, was estimated at 5,754 (PSE = 0.42, 47.4% of total), whereas annual black bass catch was 4,599 (PSE = 0.47, 37.8% of total). Estimated annual trout catch was 1,466 (PSE = 0.39, 12.1% of total). Remaining estimated catch (2.7%) was distributed among a variety of species including yellow perch, walleye, white bass, yellow bass *Morone mississippiensis*, river chub, and an unidentified minnow species. Bimonthly estimates showed catch of warmwater species heavily concentrated in warmer months, with trout catch more evenly distributed throughout the survey year. Total estimated annual harvest (Table 12) was 2,019 fish (PSE = 0.28). In contrast to catch, the estimated 935 trout harvested (PSE = 0.43) accounted for 46.3% of annual totals for the reservoir. Estimated annual harvest of warmwater species was relatively low: 292 black bass (PSE = 0.32, 14.5% of total) and 703 sunfish (PSE = 0.49, 34.8% of total).

Angling Success

Catch and harvest rates of boat anglers (Table 13) showed that overall boat angling catch rate was highest on Calderwood Reservoir at 0.753 fish/h and lowest on Cheoah Reservoir at 0.539 fish/h, with Santeetlah and Chilhowee reservoirs intermediate at 0.569 and 0.695 fish/h. By comparison, Borawa (1986) reported an overall catch rate of 0.34 fish/h on Fontana Reservoir in 1984-85. More recent observations on Chatuge Reservoir (R. Weaver, Georgia Department of Natural Resources, unpublished data) estimated overall catch at 0.609 fish/h, based only on warm season fishing (March-July 2001). Overall harvest rates were higher on Calderwood (0.520 fish/h) and Cheoah (0.387 fish/h) than on Santeetlah (0.272 fish/h) or Chilhowee (0.275 fish/h), and compared to an overall harvest rate of 0.24 fish/h for Fontana (Borawa 1986). Few violations of harvest regulations were observed by clerks on any reservoir, and daily catches of most species rarely exceeded established creel limits. However, angling parties that knowingly violated harvest regulations would likely avoid clerks or report inaccurate harvest information; creel survey results may therefore overestimate boat angler compliance with fishing regulations.

Bank anglers had overall catch and harvest rates of 1.068 and 0.858 fish/h on Santeetlah, largely influenced by the high catch rate (1.605 fish/h) and 100% harvest of white bass during their April spawning run. Because 21 of 49 total bank angler interviews obtained on Santeetlah occurred during the white bass run, the reported mean catch rate likely overestimates bank angling success throughout the remainder of the year, when both bank anglers and target fish species were more widely dispersed over the survey area. Insufficient data were available for computing bank angler catch rates on other reservoirs. As with boat anglers, violations of length or creel limits were rarely observed among bank anglers during the creel survey.

Santeetlah Reservoir—Among all Santeetlah boat anglers, black bass were caught at the highest rate (0.313 fish/h), followed by walleye (0.123 fish/h) and sunfish (0.066 fish/h), while harvest rate was low (<0.100 fish/h) for all species (Table 13). Santeetlah black bass anglers achieved the highest catch rate of any non-trout boat fishery on the reservoirs surveyed (0.482 fish/h), with a relatively low rate of harvest (0.112 fish/h). This catch rate was substantially higher than reported values of 0.123-0.257 black bass/h for Lake James (Borawa 1989) and 0.29 for Harris Lake (Jones et al. 2000). However, a March-July catch rate of 0.634 bass/h was estimated in 2001 for Chatuge Reservoir, a black bass fishery that currently exhibits high catch rates due to recent growth of a spotted bass *M. punctulatus* fishery (R. Weaver, Georgia

Department of Natural Resources, unpublished data). Black bass harvest rate on Santeetlah resembled the 0.111 black bass/h observed by Borawa (1986) on Fontana.

Santeetlah bank anglers rarely targeted black bass but caught them at a rate of 0.430 fish/h, the same approximate catch rate reported by boat anglers seeking black bass. Bank anglers harvested black bass at a rate (0.317 fish/h) over three times that of boat anglers. Smallmouth bass represented a greater portion of bank angler catch, but were not selectively harvested (48.0% of catch, 44.8% of harvest). Bank anglers reported a higher release rate of legal-sized largemouth (66.7%) and smallmouth (58.8%) bass than boat anglers, although released fish accounted for only 23.2% of bank angler catch.

Santeetlah Reservoir was the only system surveyed with a substantial walleye fishery. While overall walleye catch rate among all boat angling parties (0.123 fish/h) was less than half of the overall black bass catch rate, walleye anglers caught 0.329 fish/h (Table 13), exceeding observed directed effort catch rates of 0.161 for Fontana (Borawa 1986) and 0.202 fish/h for Lake James (Borawa 1989). Harvest rate of 0.220 fish/h for Santeetlah walleye anglers was also higher than observed rates on other reservoirs. While more recent data from other waters are not available for comparison, observed catch and harvest rates suggest that Santeetlah Reservoir equals or exceeds other western North Carolina walleye fisheries in terms of angler success.

"Sunfish", including bluegill, rock bass, crappie, and all centrarchids other than black bass, were a relatively minor component of sport fisheries on Santeetlah Reservoir. Collectively, they were caught at a rate of 0.066 fish/h and harvested at a rate of 0.025 fish/h. Crappie (primarily black crappie *P. nigromaculatus*) were uncommon on Santeetlah and rare or absent elsewhere in the study area.

Santeetlah Reservoir is unique among those surveyed because it is not managed as a stocked trout fishery resource. However, a "naturalized" trout fishery is sustained in the reservoir by natural reproduction and NCWRC stocking programs on tributary streams, and escapement from commercial trout farms. While trout were targeted and caught by too few anglers to develop meaningful rates of catch or harvest, 79.0% of reported catch was harvested.

Cheoah Reservoir—Trout catch and harvest rates by Cheoah Reservoir boat anglers (Table 13) were 0.304 and 0.295 fish/h respectively, with slightly lower rates of catch (0.277 fish/h) and harvest (0.273 fish/h) among anglers reporting trout as a target species. Trout were regularly caught and harvested by anglers that did not specify trout as a target species, which may have resulted in the reduced catch and harvest rates associated with directed effort. Trout catch rates on Cheoah were lower than rates of 0.92 to 3.73 fish/h reported for unstocked trout streams (Jones 1983b; Borawa et al. 1995; Borawa and Clemmons 1998). However, angling effort on Cheoah and other reservoirs stocked with trout is more widely dispersed than on stream fisheries, and estimated annual harvest on Cheoah (Table 9) accounts for 70.8% of the annual mean number of 6,110 catchable-sized trout stocked by NCWRC between June 1997 and May 1999. Because stocked trout were not marked or otherwise verified in the creel survey, contributions to the harvest of wild fish and carryover fish from earlier stockings are unknown. Cheoah Reservoir anglers caught (0.073 fish/h) and harvested (0.059 fish/h) yellow perch at a higher rate

than on other reservoirs, either as incidental catch while trout fishing or as a seasonal secondary fishery.

Calderwood Reservoir—Calderwood Reservoir supported the highest catch (0.662 fish/h) and harvest (0.495 fish/h) rates of trout fisheries surveyed; anglers targeting trout did not differ appreciably in either catch (0.645 fish/h) or harvest (0.533 fish/h) rates (Table 13). While still lower than rates observed on trout streams (Jones 1983b; Borawa et al. 1995; Borawa and Clemmons 1998), catch and harvest rates of the Calderwood trout fishery exceeded those of other fisheries on the reservoirs surveyed. Both North Carolina and Tennessee incorporate fingerling trout stocking as a management strategy on the reservoir, but survival and contribution of these fish to the creel is unknown. However, estimated harvest (Table 10) represented a 79.3% return rate for 12,116 catchable-sized rainbow trout stocked by TWRA between February 1998 and February 1999. As with the Cheoah fishery, contributions to the harvest of natural reproduction and carryover fish from prior stockings are unknown.

Chilhowee Reservoir—Chilhowee boat anglers had similar catch rates for black bass (0.232 fish/h), sunfish (0.215 fish/h), and trout (0.226 fish/h), but harvested trout at a higher rate (0.178 fish/h) than black bass (0.037 fish/h) or sunfish (0.054 fish/h) (Table 13). Chilhowee anglers directing their effort at black bass achieved a catch rate (0.476 fish/h) similar to Santeetlah Reservoir, but harvested bass at 0.065 fish/h, approximately half of the rate observed on Santeetlah. Although trout catch and harvest rates among all Chilhowee Reservoir anglers were the lowest of the stocked reservoirs, anglers targeting trout faired substantially better, with both catch (0.397 fish/h) and harvest (0.277) rates equaling or exceeding those observed on Cheoah Reservoir. Because of the diversity of thermal habitats and associated sport fisheries in Chilhowee, the directed effort catch and harvest rates are more appropriate for comparison with the cooler upstream reservoirs. In contrast to the high observed return rates on Cheoah and Calderwood, however, estimated trout harvest on Chilhowee Reservoir (Table 12) represented only 3.5% of the 26,593 catchable rainbow trout stocked by TWRA between February 1998 and February 1999.

Harvest Characteristics

Black bass—Boat anglers on Santeetlah showed no harvest selectivity between largemouth and smallmouth bass, which constituted 66.1% and 33.9% respectively of both catch and harvest. However, undersized smallmouth bass were more frequently harvested (41.9% < 305 mm), occasionally in excess of the two-fish length limit exemption. By comparison, only 11.2% of observed largemouth bass harvest was undersized. Similarly, 55.4% of released largemouth bass were reported by anglers as meeting or exceeding the 305 mm length limit, compared to 41.0% for smallmouth bass. Santeetlah black bass anglers occasionally harvested more than five fish/angler; this usually occurred when both species were creeled, and may indicate a misunderstanding of the aggregate limit. Overall, illegal harvest of black bass represented less than 1% of observed harvest. Occasional angler reports of spotted bass in Santeetlah Reservoir could not be corroborated, and were treated as unidentified black bass when estimating catch totals.

Size structure of Santeetlah black bass harvest (Figure 2) showed a modal length at harvest of approximately 320 mm for both species, with no smallmouth and few largemouth over 420 mm.

The similarity of size at harvest between both species, and the larger size of harvested largemouth bass compared to concurrent NCWRC electrofishing samples (S. Loftis, unpublished data), indicates that Santeetlah boat anglers are selectively harvesting large bass, and that current harvest rates are sustainable by the fishery. However, Santeetlah bass anglers had a release rate of approximately 77%, compared to a 90% release rate reported for Harris Lake bass anglers (Jones et al. 2000). Although substantial increase in bass angling pressure could affect black bass size structure on Santeetlah, growth rates on this oligotrophic reservoir would limit the utility of more restrictive length limits. Mean weights of harvested largemouth and smallmouth bass were 598 g and 341 g respectively, projecting an annual total harvest weight for the Santeetlah black bass fishery of 718 kg, based on species ratio and boat angler harvest estimates.

In contrast to Santeetlah, 85.4% of the black bass harvest on Chilhowee Reservoir was composed of smallmouth bass. Length distribution of black bass harvested on Chilhowee Reservoir (Figure 2) showed a modal length of approximately 330 mm with few fish >420 mm, comparable to Santeetlah. However, mean and maximum lengths of harvested smallmouth bass were greater on Chilhowee. Annual black bass total harvest weight on Chilhowee was projected at 180 kg, based on mean weights of largemouth (804 g) and smallmouth (563 g) bass, species ratio, and estimated harvest.

Trout—Trout harvested by Santeetlah anglers (Figure 3) consisted mainly of rainbow trout ≥300 mm. Length distribution and species composition of trout harvest on Cheoah Reservoir was reflective of hatchery stock, with rainbow and brook trout outnumbering brown trout. Rainbow trout constituted 41.1% of catchable-sized trout stocked in Cheoah Reservoir between June 1997 and May 1999, but represented 59.6% of observed trout harvest. Conversely, brook trout represented 41.0% of stocked catchables, but only 25.3% of trout harvest. Brown trout represented roughly similar percentages of stocked (17.9%) and harvested (15.1%) trout. Overall modal length of trout was approximately 290 mm, with occasional harvest of rainbow trout >400 mm. Mean weight of harvested trout was 313 g and produced an estimated annual total harvest weight of 1,354 kg for the Cheoah Reservoir trout fishery, and represented a substantial increase in size from the mean weight at stocking of 216 g. Among the three trout species, rainbow trout showed the greatest difference (52.4%) between mean weight of stocked trout (216 g) and observed harvest (341 g), while brook trout showed the least difference (23.4%) between stocked (220 g) and harvested (271 g) mean weights. As was the case with numbers harvested, brown trout mean weight at harvest was intermediate between the other two species, exhibiting a 46.9% difference between stocked (193 g) and harvested (283 g) mean weights. Although the greater numbers and weights of harvested rainbow trout appear to indicate better performance of stocked fish, natural reproduction or carryover from earlier stockings likely contributed to the observed differences among trout species. An underlying naturalized population of rainbow trout, similar in size structure to that observed in the harvest from Santeetlah Reservoir, would account for the greater numbers and harvest weights of this species on Cheoah Reservoir. The apparent high rate of return of rainbow trout to the Cheoah creel may therefore represent better adaptation of this species to long-term survival in the reservoir environment, rather than higher rates of growth, catchability, or survival within the stocking season.

In contrast to the diversity of the Cheoah Reservoir trout fishery, rainbow trout dominated the harvest on Calderwood Reservoir (Figure 3), again reflecting species composition of recent catchable trout stockings (Appendix 1). At approximately 250 mm, modal length was less than that observed on Cheoah Reservoir. Annual total harvest weight of trout on Calderwood Reservoir was projected at 1,853 kg, based on estimated annual harvest and a mean trout weight of 193 g.

Size structure of Chilhowee trout harvest (Figure 3) was similar to that of the Calderwood trout fishery, although few fish >360 mm were creeled. Rainbow trout were the only species observed in the harvest by the creel clerk. Lake trout fingerlings had been stocked in the two winters preceding the creel survey, but may not have recruited to the fishery. No catch and release of lake trout was reported, although it is possible that the species was not recognized by anglers. Mean weight of rainbow trout harvested on Chilhowee was 198 g, projecting a relatively low annual total harvest weight of 179 kg.

Walleye—Size structure of walleye harvest (Figure 4) showed a modal length of approximately 360 mm, and fish >400 mm were frequently harvested. Mean walleye weight was 397 g, projecting an annual total harvest weight of 388 kg for the walleye fishery. In contrast to catch rates, length and weight of harvested walleye were low compared to other reservoirs surveyed. Modal length of harvested walleye on Lake James (Borawa 1989) was approximately 380 mm, while a mean weight of 570 g was reported for Fontana walleye (Borawa 1986). Although size at harvest of walleye was influenced by the 381-mm length limit on Lake James, smaller size of Santeetlah walleye also may be related to lower abundance of forage; NCWRC (D. Yow, unpublished data) forage surveys found no yellow perch and significantly lower densities of threadfin and gizzard shad in Santeetlah Reservoir than in Fontana or James. Independent data on walleye age and growth were not available from Santeetlah for comparison with Lake James; however, such data would help determine the relative influence of forage abundance and selective angler harvest on size of walleye harvested by Santeetlah anglers.

Other species—Yellow perch have become established in most southern Appalachian hydropower impoundments, and were regularly encountered by anglers on Cheoah, Calderwood, and Chilhowee reservoirs. Harvest of yellow perch occurred primarily on Cheoah Reservoir (Figure 4) and mainly consisted of fish <250 mm.

Size and species composition of sunfish harvest (Figure 5) differed considerably between Santeetlah and Chilhowee reservoirs. Although bluegill and other lepomids were common in creels of both systems, Santeetlah fish were larger on average than those harvested on Chilhowee. Crappie comprised approximately one third of the Santeetlah sunfish harvest, whereas nearly half of the harvested sunfish on Chilhowee were rock bass. On the cooler, trout-dominated reservoirs, rock bass were most common among centrarchids caught by anglers.

White bass are known to occur in both Chilhowee and Santeetlah reservoirs, although recreational boat fisheries targeting the species have not developed on either system. Aside from the spring bank fishery on Santeetlah, white bass catch and harvest was incidental to angling effort directed at other species. Mean weight of 861 g for harvested Santeetlah white bass compares to 940 g reported in 1984-85 for Fontana (Borawa 1986).

Catfish were rarely targeted by Santeetlah Reservoir anglers, although both flathead and channel catfish were occasionally caught. No catfish were reported in catch or harvest on other reservoirs.

Muskellunge are known to occur in Cheoah Reservoir (Tebo 1961), and "pike" encounters were reported by two boat angling parties who distinguished the term from the more common local application to walleye. No esocids were observed in the creels on any reservoir.

Origin, Expense, Frequency, and Motivation of Angling Trips

Residency of boat anglers differed with location of reservoirs (Table 14). Santeetlah and Cheoah reservoirs were fished mainly by North Carolina residents, only Tennessee anglers were encountered on Chilhowee, and Calderwood Reservoir was heavily fished by anglers of both states. Local residents predominated among recreational anglers on the reservoirs surveyed; 76.0% of boat anglers and 96.1% of bank anglers resided in the defined surrounding counties. All but 2.1% of boat anglers resided in western North Carolina, eastern Tennessee, or northern Georgia. Santeetlah and Chilhowee were primarily fished by residents of nearby populated areas, whereas fishing by non-locals was proportionally higher on the more remote reservoirs, likely associated with seasonal camping and other vacation activities.

Mean trip expenditures of non-local boat anglers were higher than for local angling parties (Table 14). Among all boat anglers on all reservoirs, non-local angling parties on Santeetlah reported the highest mean trip costs ($43.39), whereas locals fishing Cheoah Reservoir incurred the least expenses ($8.67). Local anglers were responsible for the bulk of the economic impact of recreational fisheries on Santeetlah and Chilhowee reservoirs, because their greater numbers relative to non-local anglers outweighed the reported differences in trip-related spending. Conversely, non-local angling parties reported a mean expenditure ($21.04) more than double that of locals on Cheoah Reservoir, where occurrence of local and non-local angling parties was roughly equivalent. On Calderwood Reservoir, higher mean trip expenditure of non-local angling parties ($27.57) relative to locals ($10.74) was offset by the greater percentage (68.6%) of local anglers, and overall economic impact of the two groups was roughly equivalent. Santeetlah bank angling parties spent an average of $10.47, or slightly over half the mean reported trip cost of local boat anglers. By comparison, Swanson and McCollum (1991) summarized adjusted daily values of North American recreational fishing activity ranging from $14.08 to $69.91 for warmwater fisheries, and from $10.07 to $138.96 for coldwater fisheries.

Boat anglers fished more frequently on Santeetlah Reservoir than on other reservoirs surveyed (Table 14), probably because the majority of Santeetlah boat anglers resided locally and could easily schedule fishing trips. While more than half of all anglers surveyed on the other three reservoirs reported two or fewer trips/month, 60.9% of Santeetlah anglers reported three or more. Santeetlah Reservoir also had the highest incidence of repeat interviews, although the greater sampling intensity applied there contributed to the probability of multiple interviews during the survey year. While only 27 of 49 bank angling parties on Santeetlah reported multiple interviews, 20 of 22 first-time respondents reported fishing three or more times during the month interviewed.

Boat anglers cited the quality of fishing as the primary reason for fishing the reservoir (Table 14); good fishing was the most common response in this category on all four reservoirs, ranging from 35.6% of total responses on Chilhowee to 53.6% on Cheoah. Local accessibility was important to 35.8% of Santeetlah and 17.8% of Chilhowee respondents. Avoidance of crowded conditions was an important motivation for anglers on Cheoah (28.6%), Calderwood (18.3%), and Chilhowee (13.3%) reservoirs. Scenic value of the fishing experience motivated anglers on all four reservoirs, particularly Calderwood, where it was the primary motivating factor for 15.9% of respondents. Good water quality was mentioned by 15.6% of Chilhowee respondents as a reason for their choice of fishing destinations. Unlike boat anglers, 71.4% of Santeetlah bank angling parties reported local accessibility as the motivation for their choice of fishing site, with only 23.8% listing the quality of fishing as their primary motivation. The importance of local access to bank anglers may indicate lower mobility of this portion of the angling public compared to boat anglers, and a need for fishing access development in populated areas, such as Santeetlah Reservoir. Few bank anglers were observed on more remote reservoirs such as Calderwood, most likely because of the lack of bank fishing sites.

Effects of Reservoir Crowding on Anglers

Boat angler perceptions of reservoir crowding on the four reservoirs (Table 15) reflected observed use, with highest incidence of reported crowding impact (9.5%) on Santeetlah and lowest (3.3%) on Cheoah Reservoir. Fewer than 10% of respondents perceived a crowding problem on the day of interview. Very few safety problems from crowding were reported on interview days. However, anglers frequently indicated that crowding had affected either the time or location of at least some of their fishing trips. Crowding impacts on angler behavior were not related to angling pressure; Calderwood Reservoir, with approximately three times the fishing effort per hectare of the other three reservoirs, had the lowest reported incidence of spatial or temporal displacement of anglers. Rates of crowding impacts were progressively higher on Cheoah, Chilhowee, and Santeetlah reservoirs, although these three reservoirs had similar levels of fishing pressure. Crowding impacts on boat anglers more likely resulted from non-angling watercraft, with Santeetlah and Chilhowee reservoirs showing substantially higher rates of non-angling boating use (Appendix 6) and angler displacement (Table 15) than the smaller reservoirs.

Santeetlah and Chilhowee boat anglers differed in their method of response to crowding (Table 15). As on the other small reservoirs surveyed, Chilhowee anglers rarely reported changing the time, day, or season of their fishing trips to avoid crowds, responding instead by relocating to either a different fishing spot or another reservoir, or by terminating their fishing trip on crowded days. In contrast, nearly half of Santeetlah anglers reported avoiding fishing during times of reservoir crowding, and one in four Santeetlah respondents indicated that they ceased or reduced their fishing activity during warmer months, when recreational use of the reservoir was at its peak. The shift toward temporal displacement of boat anglers on Santeetlah may indicate some threshold of crowding beyond which anglers were unable to find suitable fishing areas on high-use days. However, some flexibility in scheduling fishing trips was afforded by the local residency of Santeetlah anglers, and their increased selectivity of fishing days may result from the convenience of the fishery resource rather than competing uses. While night fishing was frequently observed on Santeetlah Reservoir, relatively few respondents indicated that they fished nights as a response to crowding.

Angler Assessment of Reservoir Access

Angler satisfaction with boating access areas (Table 16) was high overall, with >80% good-excellent ratings for all areas on Santeetlah, Farley Branch on Cheoah, Magazine Branch on Calderwood, and Happy Valley on Chilhowee Reservoir. Only two of these areas had >10% fair-poor ratings: Massey Branch and Avey Branch on Santeetlah Reservoir. When asked to recommend most needed improvements to access areas, the modal response for most areas was that no improvements were needed, again with the exception of Massey Branch and Avey Branch on Santeetlah. Lighting was the most recommended (9 of 13 respondents) improvement for Avey Branch, a remote and lightly-used area on the Santeetlah Creek arm of the reservoir. Respondents at Massey Branch (42.6%) recommended increasing the size of the access area. Massey Branch received 47.3% of warm season use for the entire reservoir (Appendix 5), and parking demand exceeded capacity on high-use days. Expansion of access area capacity was also recommended by respondents on Cheoah (37.9%) and Calderwood (27.5%) reservoirs, whereas Chilhowee anglers desired a dock at Happy Valley (27.6%). Happy Valley respondents also frequently recommended repairs to a damaged ramp, but this condition was likely unique to the survey year and unrelated to overall quality of access area design. Insufficient interviews (<10) were obtained on smaller areas to develop ratings or recommendations from angler opinion.

Angler Assessment of the Fishery Resource

Among 185 Santeetlah survey respondents, 57.9% rated the quality of fishing favorably compared to other reservoirs; 20.0% gave an average rating, and 10.8% rated the fishing below average; 11.4% expressed no opinion regarding fishery resource quality (Table 17). Supplemental forage fish stockings were the most often recommended (23.2%) management improvement on Santeetlah, although many anglers (18.9%) were also concerned about water quality problems; 13.5% of respondents said that no improvements were needed in fishery management. Among black bass angling parties, 57.6% gave an above average rating for the fishery; 17.5% rated it average, 12.5% rated it below average, and 12.5% had no opinion. Forage fish management was most recommended (33.8%) by bass anglers, and 16.3% felt that no improvements were needed. Among walleye anglers, 51.8% gave an above average rating, the remaining opinion was evenly split (22.2% each) between average and below average ratings; 3.7% had no opinion regarding fishery resource quality. Walleye anglers were more interested in water quality improvements, walleye or smallmouth bass stocking, and more stringent harvest regulations (14.8% each) than other management options, and 7.4% felt that no improvements were needed.

The overall satisfaction rating of 65.2% (excluding parties with no opinion) for the Santeetlah fishery resource compares with NCWRC (D. Yow, unpublished data) estimates for nearby hydroelectric project reservoirs as follows: Nantahala Reservoir, 51.2%; Thorpe Reservoir, 46.8%; Bear Lake, 47.2%. Overall public opinion of Santeetlah fishery resource quality is favorable, although walleye anglers are somewhat less satisfied. While ongoing NCWRC efforts to stock forage fish in Santeetlah will likely address primary angler concerns, additional investigations may be needed to evaluate the appropriateness of current walleye fishery management strategies. Persistent angler concerns regarding water quality may also warrant further study; although such investigations are not within the scope of NCWRC

management authority, continued interagency coordination to improve tributary water quality is a high priority among Santeetlah anglers.

Among 27 Cheoah Reservoir respondents, 59.2% rated the quality of fishing favorably, 22.2% gave an average rating, and 7.4% rated the fishing below average; 11.1% expressed no opinion (Table 17). Trout stocking was the most often recommended (30.8%) management; 42.3% of respondents said that no improvements were needed in fishery management. Among 20 respondents directing their efforts at trout, 60.0% rated the quality of fishing favorably, 25.0% gave an average rating, and 5.0% rated the fishing below average; 10.0% expressed no opinion. Among Cheoah Reservoir trout anglers, 31.6% recommended trout stocking as the preferred management strategy, and 42.1% said that no improvements were needed.

Among 68 Calderwood Reservoir respondents, 44.1% rated the quality of fishing favorably, 25.0% gave an average rating, and 10.3% rated the fishing below average; 20.6% had no opinion (Table 17). Trout stocking was the most recommended (47.1%) management; 42.6% of respondents said that no improvements were needed in fishery management. Among 60 respondents directing their efforts at trout, 48.3% rated the quality of fishing favorably, 21.7% gave an average rating, and 8.3% rated the fishing below average; 21.7% expressed no opinion. Among Calderwood trout anglers, 46.7% recommended trout stocking as the preferred management strategy, and 43.3% said that no improvements were needed.

Currently, North Carolina stocks three species of catchable-sized trout in Cheoah and rainbow trout fingerlings in Calderwood, and Tennessee stocks catchable rainbow trout and fingerling lake trout in Calderwood. Angler satisfaction on the two reservoirs was apparently unrelated to catch rates; Calderwood anglers rated the fishery resource substantially lower than Cheoah anglers, even though Calderwood exhibited a trout catch rate (Table 13) more than double the estimated value for Cheoah. In spite of an overall catch rate that ranks lowest among the four reservoirs surveyed, angler satisfaction is somewhat higher for Cheoah; it receives less pressure than Calderwood and produces larger trout. Cheoah also has a secondary yellow perch fishery that enhances overall catch rates somewhat, but the higher satisfaction of Cheoah Reservoir anglers more likely is related to the diversity and larger size of trout creeled. Although survey respondents on both reservoirs clearly favored continuation or expansion of existing trout stocking programs, angler satisfaction ratings indicate that trout size at harvest, not numbers stocked or harvested, may be the preferred objective of NCWRC and TWRA trout programs on Calderwood Reservoir.

Among 73 Chilhowee Reservoir respondents, 42.5% rated the quality of fishing favorably compared to other reservoirs; 27.4% gave an average rating, and 20.5% rated the fishing below average; 9.6% had no opinion (Table 17). Stocking (primarily trout) was the most recommended (30.1%) management; 47.9% of respondents said that no improvements were needed in fishery management. Among 25 angling parties seeking black bass, 48.0% gave the fishery resource a favorable rating, 16.0% gave an average rating, and 36.0% rated the fishing below average. Among 22 trout angling parties, 45.5% gave an above average rating for the fishery, 27.3% rated it average, and 13.6% rated it below average; 13.6% had no opinion. Both bass and trout anglers reflected overall opinion in favoring gamefish stocking as a management strategy for Chilhowee Reservoir.

Summary

Santeetlah Reservoir

As expected, black bass and walleye were the primary sport fishery resources on Santeetlah Reservoir. Catch and harvest rates for these species equaled or exceeded the majority of known values for comparable western North Carolina reservoirs. Angler satisfaction was also relatively high, although forage management and water quality protection were identified as areas needing improvement, particularly regarding the walleye fishery. Local residents constituted the majority of angling use and associated economic activity, particularly during the cooler half of the year. Although anglers did not perceive lake crowding as a safety problem, nearly half of respondents indicated that they had modified fishing behavior in response to crowding. A majority of respondents rated access quality as good to excellent. Those desiring improvements recommended expansion of boating access facilities, particularly in the vicinity of Massey Branch Access Area, the most heavily used access area on the reservoir.

Cheoah Reservoir

Cheoah Reservoir received a relatively low level of fishing effort compared to other reservoirs surveyed. Rainbow trout predominated in the catch and harvest, followed by brook and brown trout. While catch and harvest rates were relatively low, angler satisfaction was high, and a large number of quality fish were creeled compared to numbers stocked, particularly for rainbow trout. Boat anglers primarily used Farley Branch Access Area, while the few bank anglers observed primarily used Panel Branch Access Area. Lake crowding did not affect most Cheoah boat anglers, nearly half of whom traveled from other areas to fish the reservoir. Continued or expanded trout stocking was the most recommended fishery management need. A majority of respondents rated access as good to excellent; among respondents recommending improvements, expansion of boating access was the primary need expressed.

Calderwood Reservoir

Calderwood Reservoir, the smallest of the four reservoirs surveyed, received the greatest amount of fishing pressure. The stocked rainbow trout fishery produced the highest catch and harvest rates observed for any species on the reservoirs surveyed, although mean size of trout and angler satisfaction were lower than on Cheoah Reservoir. Calderwood Reservoir was fished by residents of nearby counties in Tennessee and North Carolina. Crowding concerns were rarely expressed, and the majority of anglers were satisfied with access conditions; expansion of parking at Magazine Branch Access Area was the most common response among those recommending improvements. Continued or expanded trout stocking was recommended by a majority of respondents.

Chilhowee Reservoir

Chilhowee Reservoir supports fisheries for trout, black bass, and sunfish. While overall catch rates for the three species groups are comparable to each other and relatively low, anglers targeting black bass or trout achieved catch rates comparable to those observed on other reservoirs surveyed. Angler satisfaction was low relative to other reservoirs, possibly due to the seasonal and partitioned nature of the fishery resources on Chilhowee. Most respondents recommended no improvements to access; however, many anglers recommended a dock at

Happy Valley Access Area. Crowding concerns were not prevalent among Chilhowee anglers, although a minority reported changes in fishing behavior in response to crowding.

Cheoah River

Angler use of the bypass reach of the Cheoah River is low under existing conditions. Fishing is largely confined to warmer months, and most activity occurs the early afternoon period of both weekends and weekdays.

Recommendations

Santeetlah Reservoir

1. Continue to manage the reservoir for black bass and walleye; continue fish habitat structure installation for bass; stock threadfin shad as needed to supplement forage for walleye and other sport fisheries, pending availability of threadfin shad source stocks that do not contain alewife or blueback herring.
2. Collect age and growth information on walleye to compare with other reservoirs and evaluate effects of forage supplements and current regulations.
3. Increase boating access capacity on the south side of the reservoir, at or near the existing location of Massey Branch Boating Access Area.
4. Periodically monitor effects of reservoir crowding on temporal patterns of boat fishing use.
5. Construct additional bank fishing access, including barrier-free access.
6. Install lighting at Avey Branch Boating Access Area.
7. Continue interagency efforts to mitigate water quality impairment of major tributaries.

Cheoah Reservoir

1. Continue to manage the reservoir for trout under current Hatchery Supported regulations, with no closed season.
2. Consider increasing trout stocking rate, particularly for rainbow trout; stock brook trout at a rate equal to brown trout.
3. Increase parking capacity at or near Farley Branch Boating Access Area.
4. Extend or relocate the ramp at Panel Branch Boating Access Area.

Calderwood Reservoir

1. Continue to manage the reservoir for trout under current Hatchery Supported regulations, with no closed season.
2. Cooperate with TWRA in evaluating existing stocking programs.
3. Increase parking capacity at or near Magazine Branch Boating Access Area.
4. Construct additional bank fishing access, including barrier-free access.

Chilhowee Reservoir

1. Provide creel survey results to Tapoco and TWRA by copy of this report.
2. Provide electronic and hard copies of creel survey data to Tapoco and TWRA.

Cheoah River

1. Consider alternatives to traditional roving creel survey designs to more efficiently obtain angler data.
2. Focus future recreational surveys on midday periods and months of April through October.
3. Use direct angler counts rather than vehicle counts to quantify angling activity.

Future Reservoir Creel Surveys

1. Allocate a minimum of five sample days per seven-day week to future roving-access creel surveys of reservoirs, particularly for fishing effort estimates on multi-species fisheries.
2. Maximize sampling on weekends and summer holidays.
3. Allocate more sampling to later times of day, particularly in winter months.
4. Reallocate sampling from empty ramps as needed, with established daily contingent rankings for access areas.

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TABLE 1.—Tapoco (1997) trailer counts, wildlife enforcement officer (WEO) rankings (Santeetlah only), and resulting sampling probabilities for boating access areas on Tapoco project reservoirs, used in the design of 1998-1999 creel surveys.

Reservoir	Access area (WEO ranking)	Mean trailer count	Multiple use modifier[a]	Proportion of lakewide use	Sampling probability
Santeetlah					
	Massey Branch (1)	6.95	1.0	0.489	0.50
	Santeetlah Marina (3)	5.85	0.5	0.206	0.20
	Cheoah Point (2)	2.92	1.0	0.206	0.20
	Avey Branch (4)	1.40	1.0	0.099	0.10
Cheoah					
	Panel Branch	0.61	1.0	0.353	0.35
	Farley Branch	1.12	1.0	0.647	0.65
Calderwood					
	Magazine Branch	6.27	0.5	1.000	1.00
Chilhowee					
	Tabcat	1.44	1.0	0.077[b]	0.10[b]
	Gravel Pile	3.29	1.0	0.177[b]	0.15[b]
	Happy Valley	8.21	1.0	0.442	0.45
	Pear Tree	11.29	0.5	0.304	0.30

[a] Multiple use modifier = 1.0 for ramps with dedicated parking areas, 0.5 for ramps that share parking areas with other resources (picnic areas, bait shops, swimming areas and rented docks).

[b] Sampling probabilities below 0.10 were avoided on Chilhowee Reservoir because of limited monthly sample days available for multiple access points. Probability levels were reallocated among low-use ramps to avoid reducing sampling probability of high-use areas.

TABLE 2.—Numbers of boating parties observed, intercepted, identified as anglers, and interviewed at access areas during 1998-1999 creel surveys. Percentages of projected and observed use are given for each reservoir.

Access area, by reservoir	Projected use (%)	Observed use (%)	Boating party frequency			
			Observed	Intercepted	Angling	Interviewed
Santeetlah						
Massey Branch	48.9	56.0	1,258	532	407	389
Santeetlah Marina	20.6	18.8	423	54	28	28
Cheoah Point	20.6	18.9	426	94	61	61
Avey Branch	9.9	6.3	141	19	13	13
Totals	100.0	100.0	2,248	699	509	491
Cheoah						
Panel Branch	35.3	12.9	15	1	1	1
Farley Branch	64.7	87.1	101	57	54	49
Totals	100.0	100.0	116	58	55	50
Calderwood						
Magazine Branch	100.0	100.0	273	138	127	119
Chilhowee						
Tabcat	7.7	9.9	44	5	2	2
Gravel Pile	17.7	11.4	51	17	12	12
Happy Valley	44.2	70.6	315	144	102	85
Pear Tree	30.4	8.1	36	2	2	2
Totals	100.0	100.0	446	168	118	101

TABLE 3.—Estimated boat angling effort, in angler hours, for Santeetlah Reservoir, 1998-1999. Approximate standard errors are given in parentheses.

Month	Total effort	Effort by day type		Directed effort	
		Weekday	Weekend/holiday	Black bass	Walleye
September	3,503.6 (1,218.5)	1,978.6 (1,043.6)	1,525.0 (629.0)	1,247.9 (577.1)	833.3 (1,189.2)
October	7,013.1 (1,716.8)	4,018.2 (1,150.9)	2,994.9 (1,273.8)	3,295.3 (1,390.7)	1,322.8 (897.6)
November	3,766.8 (1,096.3)	2,177.0 (455.8)	1,589.8 (997.1)	1,353.8 (1,137.6)	1,529.8 (508.4)
December	1,384.6 (459.2)	629.5 (185.1)	755.1 (420.3)	228.9 (152.8)	903.6 (459.0)
January	1,162.5 (368.1)	721.3 (348.6)	441.2 (118.3)	351.8 (145.0)	359.6 (124.7)
February	1,314.0 (600.0)	444.1 (160.9)	869.9 (578.0)	1,010.4 (606.3)	114.1 (40.3)
March	2,316.2 (891.0)	1,281.3 (391.3)	1,034.9 (800.4)	1,722.6 (888.7)	139.9 (64.6)
April	6,411.5 (1,996.4)	4,549.6 (1,752.0)	1,861.9 (957.1)	2,132.1 (1,430.7)	778.8 (505.9)
May	10,010.8 (2,213.0)	1,603.6 (430.2)	8,407.2 (2,170.8)	1,053.3 (575.0)	3,952.7 (1,423.7)
June	8,303.0 (1,694.6)	6,081.4 (1,518.6)	2,221.6 (752.1)	4,577.8 (1,559.8)	2,355.3 (1,264.8)
July	6,405.5 (1,543.8)	2,077.3 (972.5)	4,328.2 (1,199.1)	2,360.1 (782.6)	825.7 (495.1)
August	4,196.7 (1,862.8)	1,851.3 (1,431.5)	2,345.4 (1,192.0)	3,354.2 (1,922.3)	224.9 (91.9)
Totals	55,788.3 (4,974.2)	27,413.2 (3,392.9)	28,375.1 (3,637.4)	22,688.2 (3,725.8)	13,340.5 (2,616.6)

TABLE 4.—Estimated boat angling effort, in angler hours, for Cheoah Reservoir, 1998-1999. Approximate standard errors are given in parentheses.

Month(s)	Total effort	Effort by day type		Directed effort for trout
		Weekday	Weekend/holiday	
June-July	4,298.3 (1,571.4)	2,110.0 (1,496.1)	2,188.3 (480.5)	2,854.8 (1,576.6)
August	2,714.1 (650.5)	1,352.2 (264.3)	1,361.9 (594.4)	1,205.5 (202.5)
September-October	1,821.8 (507.2)	1,377.7 (470.7)	444.1 (189.0)	1,640.9 (484.1)
November-January	618.5 (314.1)	529.4 (301.2)	89.1 (89.1)	618.5 (314.1)
February-April	915.8 (306.7)	534.7 (229.0)	381.1 (204.0)	915.8 (306.7)
May	1,318.1 (553.8)	517.9 (319.4)	800.2 (452.3)	1,090.6 (479.2)
Totals	11,686.6 (1,910.2)	6,421.9 (1,665.8)	5,264.7 (934.9)	8,326.1 (1,784.2)

TABLE 5.—Estimated boat angling effort, in angler hours, for Calderwood Reservoir, 1998-1999. Approximate standard errors are given in parentheses.

Month(s)	Total effort	Effort by day type		Directed effort for trout
		Weekday	Weekend/holiday	
June	4,708.2 (1,949.5)	1,405.7 (1,102.9)	3,302.5 (1,607.6)	3,692.4 (1,660.4)
July	3,253.1 (704.2)	1,736.2 (587.9)	1,516.9 (387.6)	2,977.4 (654.0)
August	1,215.1 (411.5)	829.6 (379.3)	385.5 (159.7)	1,001.2 (407.1)
September	7,976.2 (3,794.4)	3,894.1 (2,221.2)	4,082.1 (3,076.3)	6,904.1 (3,449.7)
October	2,148.0 (2,128.9)	1,846.1 (2,112.0)	301.9 (267.7)	2,148.0 (2,128.9)
November-December	1,407.0 (759.0)	608.2 (673.8)	798.8 (349.4)	1,075.2 (590.9)
January	1,631.2 (680.6)	1,140.0 (656.4)	491.2 (179.7)	1,558.4 (625.8)
February	999.8 (370.3)	850.6 (339.8)	149.2 (147.1)	940.2 (351.1)
March	419.7 (233.1)	237.7 (145.6)	182.0 (182.0)	419.7 (233.1)
April	1,616.7 (292.0)	516.9 (255.0)	1,099.8 (142.2)	1,616.7 (292.0)
May	5,604.2 (2,352.5)	1,899.9 (486.4)	3,704.3 (2,301.7)	3,893.5 (941.2)
Totals	30,979.2 (5,499.6)	14,965.0 (3,524.6)	16,014.2 (4,221.7)	26,226.8 (4,655.4)

TABLE 6.—Estimated boat angling effort, in angler hours, for Chilhowee Reservoir, 1998-1999. Approximate standard errors are given in parentheses.

Months	Total effort	Effort by day type		Directed effort	
		Weekday	Weekend/holiday	Black bass	Trout
June-July	9,257.5 (2,407.9)	5,261.2 (1,420.2)	3,996.3 (1,944.4)	4,093.7 (1,440.2)	2,048.3 (752.1)
August-September	9,156.0 (4,821.7)	5,879.7 (3,703.9)	3,276.3 (3,087.0)	4,232.7 (3,215.8)	802.3 (699.1)
October-November	3,156.6 (886.8)	1,663.6 (598.1)	1,493.0 (654.7)	521.3 (488.7)	1,633.5 (750.6)
December-January	1,173.6 (428.9)	404.6 (161.5)	769.0 (397.3)	102.2 (67.0)	539.2 (183.9)
February-March	1,410.2 (512.3)	1,104.3 (485.1)	305.9 (164.7)	0.0 (0.0)	1,410.2 (512.3)
April-May	8,926.0 (2,202.3)	2,627.1 (837.2)	6,298.9 (2,036.9)	5,059.4 (1,052.5)	2,542.6 (2,794.6)
Totals	33,079.9 (5,927.0)	16,940.5 (4,129.9)	16,139.4 (4,251.3)	14,009.3 (3,710.3)	8,976.1 (3,121.7)

TABLE 7.—Estimated numbers of major sport fish species caught by boat anglers, Santeetlah Reservoir, 1998-1999. Approximate standard errors are given in parentheses.

Month	Catch				
	All species	Black bass	Other sunfish[a]	Walleye	Trout
September	531 (134)	336 (126)	19 (18)	104 (42)	31 (31)
October	1,271 (297)	738 (279)	135 (91)	43 (23)	270 (196)
November	838 (289)	371 (121)	105 (74)	326 (191)	8 (4)
December	387 (155)	190 (125)	0 (0)	143 (71)	29 (26)
January	259 (120)	183 (120)	3 (3)	42 (23)	0 (0)
February	158 (84)	53 (29)	0 (0)	21 (20)	83 (83)
March	356 (245)	332 (221)	0 (0)	0 (0)	25 (25)
April	652 (195)	428 (140)	23 (16)	65 (38)	0 (0)
May	1,070 (478)	718 (490)	182 (88)	100 (44)	22 (14)
June	1,254 (268)	869 (235)	125 (56)	148 (100)	17 (11)
July	1,838 (735)	418 (372)	990 (587)	407 (316)	1 (2)
August	1,027 (385)	807 (389)	188 (118)	14 (11)	13 (13)
Totals	9,641 (1,150)	5,443 (890)	1,770 (619)	1,413 (397)	499 (220)

[a] Other sunfish category includes all centrarchid species other than black bass, including rock bass, crappie, bluegill, and other panfish.

TABLE 8.—Estimated numbers of major sport fish species harvested by boat anglers, Santeetlah Reservoir, 1998-1999. Approximate standard errors are given in parentheses.

Month	Harvest				
	All species	Black bass	Other sunfish[a]	Walleye	Trout
September	130	3	0	75	31
	(72)	(3)	(0)	(39)	(31)
October	466	157	12	24	207
	(145)	(58)	(7)	(13)	(150)
November	310	37	0	241	6
	(136)	(15)	(0)	(133)	(4)
December	226	34	0	141	29
	(75)	(19)	(0)	(71)	(26)
January	168	131	3	33	0
	(120)	(120)	(3)	(22)	(0)
February	130	26	0	21	83
	(86)	(20)	(0)	(20)	(83)
March	252	228	0	0	25
	(218)	(194)	(0)	(0)	(25)
April	175	97	0	60	0
	(79)	(51)	(0)	(36)	(0)
May	130	19	4	84	12
	(50)	(10)	(4)	(40)	(8)
June	542	298	76	137	16
	(197)	(131)	(44)	(100)	(12)
July	957	193	609	148	1
	(550)	(287)	(442)	(113)	(2)
August	279	183	71	11	13
	(112)	(118)	(58)	(11)	(13)
Totals	3,765	1,406	775	975	423
	(695)	(415)	(448)	(226)	(179)

[a] Other sunfish category includes all centrarchid species other than black bass, including rock bass, crappie, bluegill, and other panfish.

TABLE 9.—Estimated numbers of major sport fish species caught and harvested by boat anglers, Cheoah Reservoir, 1998-1999. Approximate standard errors are given in parentheses.

	Catch			Harvest		
Month(s)	All species	Trout	Yellow perch	All species	Trout	Yellow perch
June-July	4,261	3,255	89	3,486	3,075	18
	(2,026)	(1,887)	(67)	(2,083)	(1,893)	(18)
August	901	878	0	878	878	0
	(492)	(491)	(0)	(491)	(491)	(0)
September-October	102	73	29	102	73	29
	(43)	(32)	(29)	(43)	(32)	(29)
November-January	120	113	7	120	113	7
	(68)	(67)	(7)	(68)	(67)	(7)
February-April	76	76	0	76	76	0
	(76)	(76)	(0)	(76)	(76)	(0)
May	345	113	199	283	110	144
	(153)	(41)	(93)	(152)	(40)	(88)
Totals	5,805	4,508	324	4,945	4,325	198
	(2,093)	(1,954)	(119)	(2,149)	(1,959)	(95)

TABLE 10.—Estimated total catch, trout catch, total harvest, and trout harvest by boat anglers, Calderwood Reservoir, 1998-1999. Approximate standard errors are given in parentheses.

	Catch		Harvest	
Month(s)	All species	Trout	All species	Trout
June	2,840 (1,629)	1,715 (1,006)	1,340 (1,013)	1,340 (1,013)
July	1,035 (274)	775 (293)	745 (297)	738 (297)
August	122 (115)	122 (115)	122 (115)	122 (115)
September	355 (222)	52 (52)	92 (57)	26 (26)
October	725 (704)	21 (21)	725 (704)	21 (21)
November-December	2,289 (1,032)	2,231 (1,034)	1,428 (524)	1,370 (503)
January	945 (492)	909 (486)	797 (417)	797 (417)
February	1,628 (631)	1,628 (631)	1,437 (490)	1,437 (490)
March	336 (220)	336 (220)	134 (88)	134 (88)
April	1,855 (1,440)	1,622 (1,208)	1,423 (1,129)	1,423 (1,129)
May	5,927 (3,753)	2,202 (1,695)	2,347 (1,549)	2,202 (1,695)
Totals	18,057 (4,604)	11,613 (2,683)	10,590 (2,449)	9,610 (2,439)

TABLE 11.—Estimated numbers of major sport fish species caught by boat anglers, Chilhowee Reservoir, 1998-1999. Approximate standard errors are given in parentheses.

Months	Catch			
	All species	Black bass	Other sunfish[a]	Trout
June-July	2,468	664	1,653	15
	(1,417)	(404)	(986)	(11)
August-September	2,590	441	1,773	271
	(940)	(299)	(921)	(271)
October-November	759	40	0	630
	(477)	(40)	(0)	(448)
December-January	99	0	0	99
	(59)	(0)	(0)	(59)
February-March	334	0	11	323
	(198)	(0)	(11)	(202)
April-May	5,901	3,454	2,317	128
	(4,063)	(2,119)	(1,975)	(102)
Totals	12,151	4,599	5,754	1,466
	(4,435)	(2,178)	(2,392)	(573)

[a] Other sunfish category includes all centrarchid species other than black bass, including rock bass, crappie, bluegill, and other panfish.

TABLE 12.—Estimated numbers of major sport fish species harvested by boat anglers, Chilhowee Reservoir, 1998-1999. Approximate standard errors are given in parentheses.

Months	Harvest			
	All species	Black bass	Other sunfish[a]	Trout
June-July	449	103	270	9
	(280)	(66)	(211)	(9)
August-September	448	0	428	0
	(291)	(0)	(273)	(0)
October-November	434	0	0	434
	(322)	(0)	(0)	(322)
December-January	79	0	0	79
	(48)	(0)	(0)	(48)
February-March	287	0	0	287
	(208)	(0)	(0)	(208)
April-May	322	189	5	126
	(110)	(68)	(3)	(103)
Totals	2,019	292	703	935
	(569)	(94)	(345)	(400)

[a] Other sunfish category includes all centrarchid species other than black bass, including rock bass, crappie, bluegill, and other panfish.

TABLE 13.—Major sport fish species catch and harvest rates (fish/h) for boat anglers, by reservoir, 1998-1999. Where appropriate, separate catch and harvest rates are given for directed angling effort. Standard deviations are given in parentheses.

Species or group	Santeetlah	Cheoah	Calderwood	Chilhowee
Black bass				
Catch, all anglers	0.313 (0.031)			0.232 (0.096)
Harvest, all anglers	0.099 (0.021)			0.037 (0.009)
Catch, directed effort	0.482 (0.048)			0.476 (0.115)
Harvest, directed effort	0.112 (0.030)			0.065 (0.017)
Trout				
Catch, all anglers		0.304 (0.062)	0.662 (0.108)	0.226 (0.078)
Harvest, all anglers		0.295 (0.061)	0.495 (0.102)	0.178 (0.071)
Catch, directed effort		0.277 (0.059)	0.645 (0.123)	0.397 (0.122)
Harvest, directed effort		0.273 (0.059)	0.533 (0.104)	0.277 (0.080)
Walleye				
Catch, all anglers	0.123 (0.031)			
Harvest, all anglers	0.094 (0.019)			
Catch, directed effort	0.329 (0.111)			
Harvest, directed effort	0.220 (0.051)			
Sunfish[a]				
Catch	0.066 (0.017)			0.215 (0.063)
Harvest	0.025 (0.010)			0.054 (0.022)
Yellow perch				
Catch		0.073 (0.022)		
Harvest		0.059 (0.021)		
All species combined				
Catch	0.569 (0.045)	0.539 (0.114)	0.753 (0.106)	0.695 (0.141)
Harvest	0.272 (0.033)	0.387 (0.061)	0.520 (0.103)	0.275 (0.075)

[a] Sunfish category includes rock bass, crappie, bluegill, and other panfish.

TABLE 14.—Residency, mean trip expenditures, angling frequency, and motivation for fishing reported by boat angling parties, by reservoir, 1998-1999. Percentages of column subtotals are given in parentheses where applicable.

Response, by category	Response frequency or trip cost			
	Santeetlah	Cheoah	Calderwood	Chilhowee
Residency				
North Carolina	516 (95.6)	40 (83.3)	60 (50.8)	0
Tennessee	11 (2.0)	6 (12.5)	52 (44.1)	99 (100.0)
Georgia	7 (1.3)	1 (2.1)	3 (2.5)	0
Other	6 (1.1)	1 (2.1)	3 (2.5)	0
Local	429 (79.4)	25 (52.1)	81 (68.6)	77 (77.8)
Regional	101 (18.7)	21 (43.7)	32 (27.1)	22 (22.2)
Other	10 (1.9)	2 (4.2)	5 (4.2)	0
Mean trip expenditure (US$)[a]				
Local anglers	18.89	8.67	10.74	15.13
Regional anglers	43.39	21.04	27.57	25.64
All boat anglers	24.61	14.37	16.13	17.34
First time interview				
Yes	193 (39.5)	31 (62.0)	82 (68.9)	90 (89.1)
No	296 (60.5)	19 (38.0)	37 (31.1)	11 (10.9)
Fishing trips/month[b]				
One or fewer	39 (20.9)	11 (36.7)	45 (54.9)	39 (43.3)
Two	34 (18.2)	6 (20.0)	16 (19.5)	12 (13.3)
Three	29 (15.5)	3 (10.0)	11 (13.4)	12 (13.3)
Four	30 (16.0)	3 (10.0)	5 (6.1)	11 (12.2)
Five or more	55 (29.4)	7 (23.3)	5 (6.1)	16 (17.8)
Reason for fishing reservoir				
Good fishing	78 (41.1)	15 (53.6)	33 (40.2)	32 (35.6)
Scenic value	14 (7.4)	1 (3.6)	13 (15.9)	8 (8.9)
Less crowded	11 (5.8)	8 (28.6)	15 (18.3)	12 (13.3)
Locally accessible	68 (35.8)	3 (10.7)	5 (6.1)	16 (17.8)
Clean water	5 (2.6)	1 (3.6)	4 (4.9)	14 (15.6)
Good facilities	1 (0.5)	0	3 (3.7)	0
Prox. to resources	6 (3.2)	0	2 (2.4)	1 (1.1)
Other	7 (3.7)	0	7 (8.5)	7 (7.7)

[a] Total expenditures of anglers in party.

[b] Based upon angler estimate of frequency of fishing trips during month interviewed.

TABLE 15.—Response frequencies for perceptions of reservoir crowding, safety concerns, and resulting changes in fishing habits reported by boat angling parties, by reservoir, 1998-1999. Changes in fishing habits are categorized as spatial or temporal modifications. Percentages of column subtotals are given in parentheses.

Response, by category	Santeetlah	Cheoah	Calderwood	Chilhowee
Perception of crowding on day of interview				
Not crowded	171 (90.5)	29 (96.7)	78 (95.1)	85 (94.5)
Moderately crowded	8 (4.2)	1 (3.3)	3 (3.7)	2 (2.2)
Crowded	10 (5.3)	0	1 (1.2)	3 (3.3)
Very crowded	0	0	0	0
Concern for safety on day of interview				
Safety concern	7 (3.7)	0	1 (1.2)	1 (1.1)
No safety concern	182 (96.3)	30 (100.0)	81 (98.8)	89 (98.9)
Fishing habits ever changed by reservoir crowding				
Changed	87 (47.5)	3 (10.3)	5 (6.6)	21 (24.7)
Never changed	96 (52.5)	26 (89.7)	71 (93.4)	64 (75.3)
Method to avoid crowding				
Spatial				
Fish coves	21 (24.1)	0	1 (20.0)	4 (19.0)
Go to other lakes	7 (8.0)	0	1 (20.0)	2 (9.5)
Go home	13 (14.9)	0	0	5 (23.8)
Other	7 (8.0)	2 (66.7)	3 (60.0)	9 (42.9)
Totals	48 (55.2)	2 (66.7)	5 (100.0)	20 (95.2)
Temporal				
Avoid weekends	10 (11.5)	0	0	0
Fish at night	6 (6.9)	0	0	0
Avoid busy season	22 (25.3)	0	0	0
Other	1 (1.1)	1 (33.3)	0	1 (4.8)
Totals	39 (44.8)	1 (33.3)	0	1 (4.8)

TABLE 16.—Boat angler opinions on quality of boating access areas and recommended improvements, by reservoir, 1998-1999. Access areas are as follows: MB = Massey Branch, SM = Santeetlah Marina, CP = Cheoah Point, AB = Avey Branch, PB = Panel Branch, FB = Farley Branch, TC = Tabcat, GP = Gravel Pile, HV = Happy Valley, PT = Pear Tree; Calderwood Reservoir has only one access area (Magazine Branch). Percentages of column subtotals are given in parentheses.

Response,	Santeetlah				Cheoah		Calder-	Chilhowee			
by category	MB	SM	CP	AB	PB	FB	wood	TC	GP	HV	PT
Quality of area											
Excellent	21 (17.2)	12 (54.5)	18 (54.5)	1 (7.7)	0	8 (27.6)	26 (32.5)	0	1 (10.0)	11 (14.8)	0
Good	84 (68.9)	9 (40.9)	14 (42.4)	10 (76.9)	0	19 (65.5)	49 (61.3)	1 (50.0)	7 (70.0)	59 (77.6)	1 (50.0)
Fair	11 (9.0)	1 (4.5)	1 (3.0)	2 (15.4)	0	1 (3.4)	4 (5.0)	1 (50.0)	1 (10.0)	3 (3.9)	0
Poor	5 (4.1)	0	0	0	1 (100.0)	1 (3.4)	1 (1.3)	0	1 (10.0)	3 (3.9)	1 (50.0)
No Opinion	1 (0.8)	0	0	0	0	0	0	0	0	0	0
Recommended improvement											
Larger lot/ more ramps	52 (42.6)	4 (18.2)	7 (21.2)	2 (15.4)	0	11 (37.9)	22 (27.5)	1 (50.0)	0	3 (3.9)	0
Paving/ grading	20 (16.4)	3 (13.6)	0	1 (7.7)	0	2 (6.9)	0	0	0	2 (2.6)	0
Docks	11 (9.0)	0	7 (21.2)	0	0	0	1 (1.3)	0	0	21 (27.6)	1 (50.0)
Low water access	3 (2.5)	1 (4.5)	2 (6.1)	0	1 (100.0)	0	1 (1.3)	0	0	0	0
Trash cans	0	0	0	0	0	1 (3.4)	0	0	0	0	0
Lighting	1 (0.8)	3 (13.6)	1 (3.0)	9 (69.2)	0	0	1 (1.3)	1 (50.0)	0	0	0
Signs	1 (0.8)	0	0	0	0	0	2 (2.5)	0	0	0	0
No improve- ments needed	30 (24.6)	7 (31.8)	15 (45.5)	1 (7.7)	0	13 (44.8)	50 (62.5)	0	8 (80.0)	33 (43.4)	1 (50.0)
Other	4 (3.3)	4 (18.2)	1 (3.0)	0	0	2 (6.9)	3 (3.8)	0	2 (20.0)	17 (22.4)	0

TABLE 17.—Boat angler opinions on quality of fishery resources and recommended improvements, by reservoir, 1998-1999. Percentages of column subtotals are given in parentheses.

Response, by category	Angler group, by reservoir									
	Santeetlah			Cheoah		Calderwood		Chilhowee		
	All	Bass	Walleye	All	Trout	All	Trout	All	Bass	Trout
Quality of fishery										
Best in region	24 (13.0)	9 (11.3)	7 (25.9)	3 (11.1)	3 (15.0)	6 (8.8)	6 (10.0)	7 (9.6)	2 (8.0)	2 (9.1)
Good/better than most others	83 (44.9)	37 (46.3)	7 (25.9)	13 (48.1)	9 (45.0)	24 (35.3)	23 (38.3)	24 (32.9)	10 (40.0)	8 (36.4)
Average for region	37 (20.0)	14 (17.5)	6 (22.2)	6 (22.2)	5 (25.0)	17 (25.0)	13 (21.7)	20 (27.4)	4 (16.0)	6 (27.3)
Poor/worse than most others	20 (10.8)	10 (12.5)	6 (22.2)	2 (7.4)	1 (5.0)	7 (10.3)	5 (8.3)	13 (17.8)	9 (36.0)	2 (9.1)
Worst in region	0	0	0	0	0	0	0	2 (2.7)	0	1 (4.5)
Don't know/ no opinion	21 (11.4)	10 (12.5)	1 (3.7)	3 (11.1)	2 (10.0)	14 (20.6)	13 (21.7)	7 (9.6)	0	3 (13.6)
Recommended improvement										
Water quality protection	35 (18.9)	11 (13.8)	3 (11.1)	0	0	1 (1.5)	1 (1.7)	1 (1.4)	0	0
Fish habitat structures	20 (10.8)	12 (15.0)	1 (3.7)	0	0	0	0	0	0	0
Lake level stabilization	13 (7.0)	2 (2.5)	3 (11.1)	4 (15.4)	3 (15.8)	1 (1.5)	1 (1.7)	4 (5.5)	3 (12.0)	0
Shoreline protection	1 (0.5)	0	0	0	0	0	0	0	0	0
Forage fish stocking	43 (23.2)	27 (33.8)	4 (14.8)	0	0	0	0	1 (1.4)	0	1 (4.5)
Game fish stocking	14 (7.6)	4 (5.0)	4 (14.8)	8 (30.8)	6 (31.6)	32 (47.1)	28 (46.7)	22 (30.1)	8 (32.0)	8 (36.4)
More law enforcement	8 (4.3)	3 (3.8)	3 (11.1)	1 (3.8)	0	0	0	0	0	0
New fishing regulations	13 (7.0)	4 (5.0)	4 (14.8)	0	0	1 (1.5)	0	3 (4.1)	3 (12.0)	0
No improve-ments needed	25 (13.5)	13 (16.3)	2 (7.4)	11 (42.3)	8 (42.1)	29 (42.6)	26 (43.3)	35 (47.9)	8 (32.0)	10 (45.5)
Other/ don't know	13 (7.0)	4 (5.0)	3 (11.1)	2 (7.7)	2 (10.5)	4 (5.9)	4 (6.7)	7 (9.6)	3 (12.0)	3 (13.6)

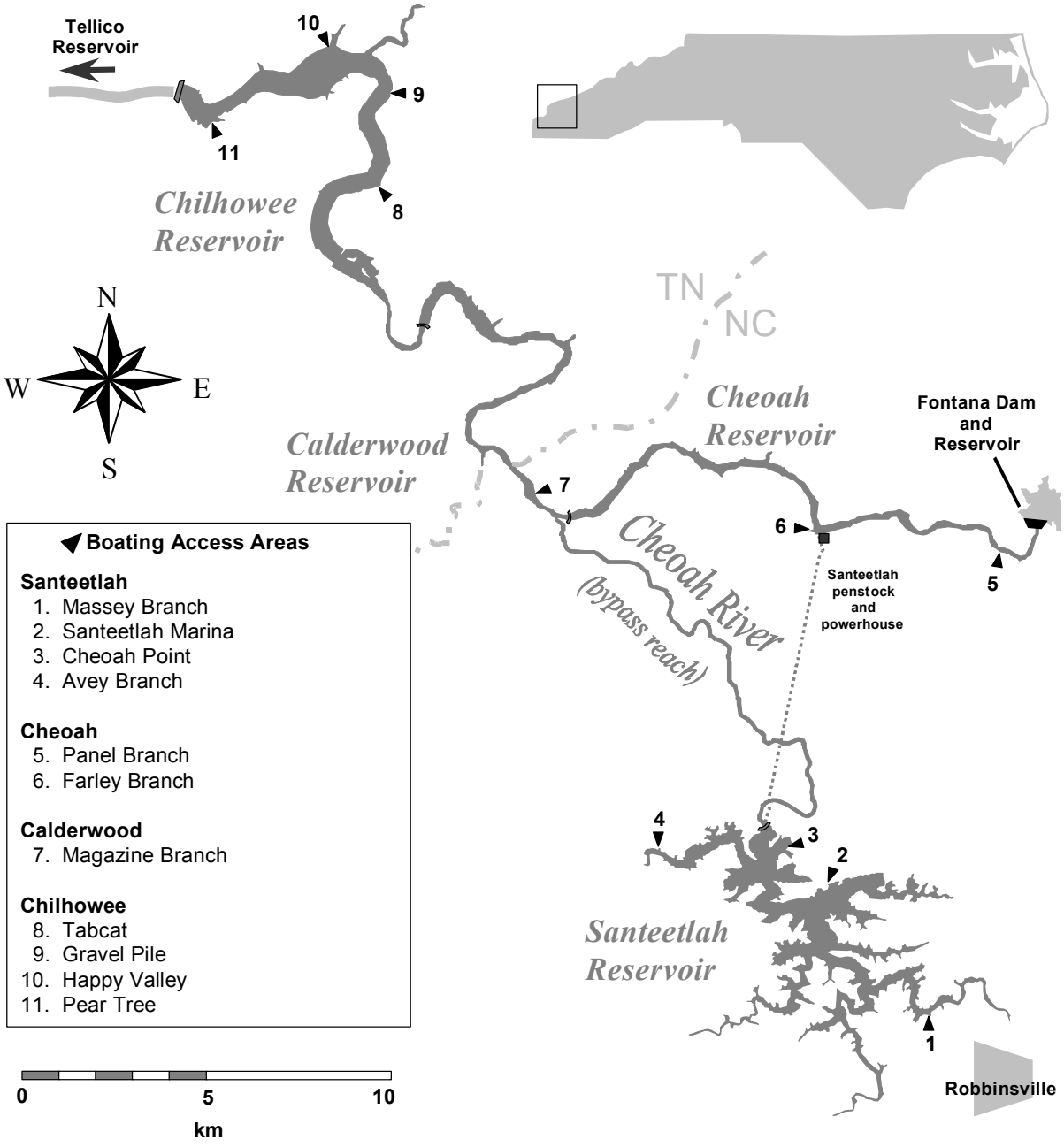

FIGURE 1.—Map of study area showing hydropower impoundments, Cheoah River bypass reach, and boating access areas included in 1998-1999 creel surveys.

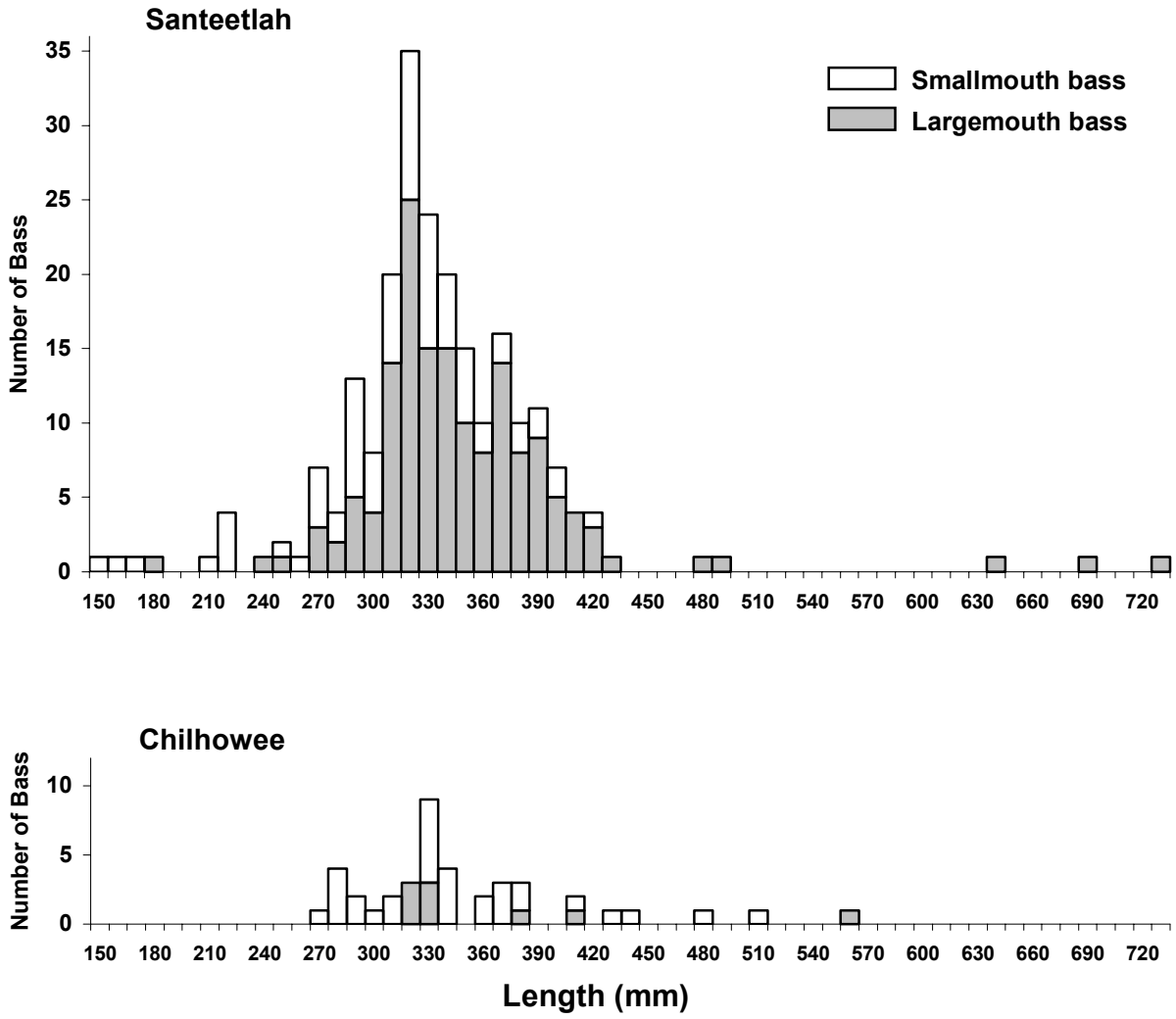

FIGURE 2.—Length-frequency distributions for harvested largemouth and smallmouth bass measured by clerks during creel surveys on Santeetlah and Chilhowee reservoirs, 1998-1999.

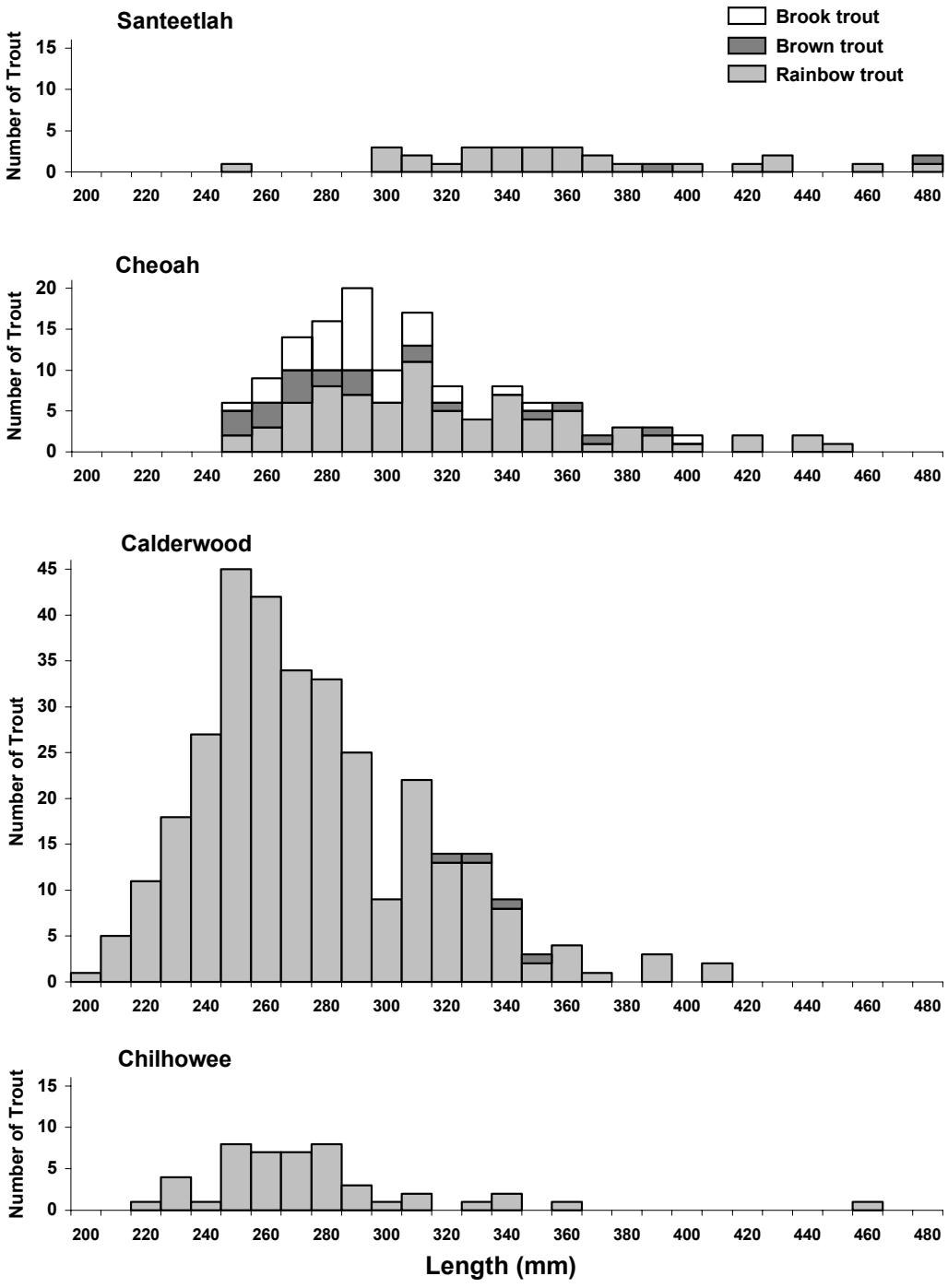

FIGURE 3.—Length-frequency distributions for harvested trout measured by clerks during creel surveys on Santeetlah, Cheoah, Calderwood, and Chilhowee reservoirs, 1998-1999.

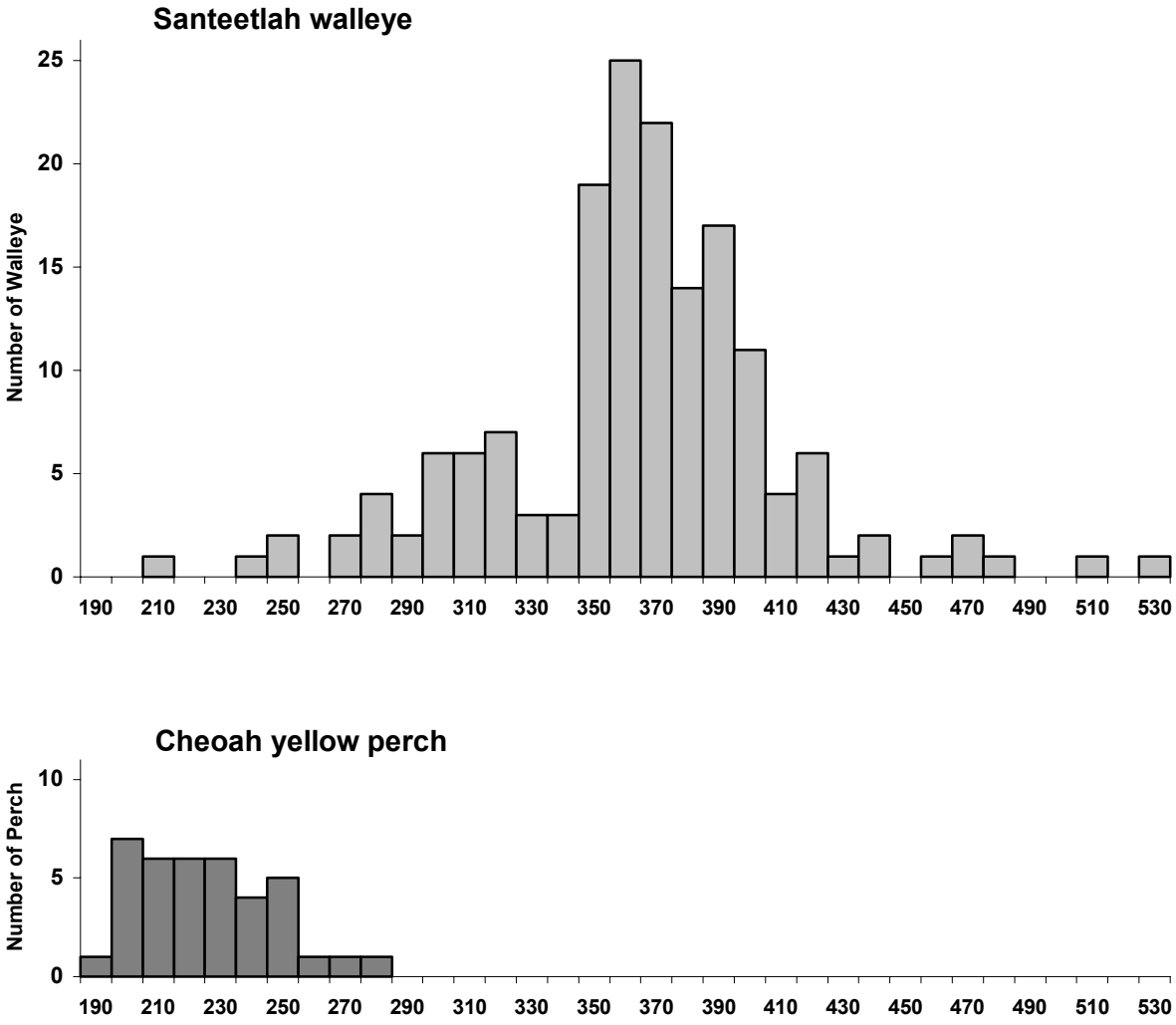

FIGURE 4.—Length-frequency distributions for walleye harvested on Santeetlah Reservoir and yellow perch harvested on Cheoah Reservoir, measured by clerks during creel surveys, 1998-1999.

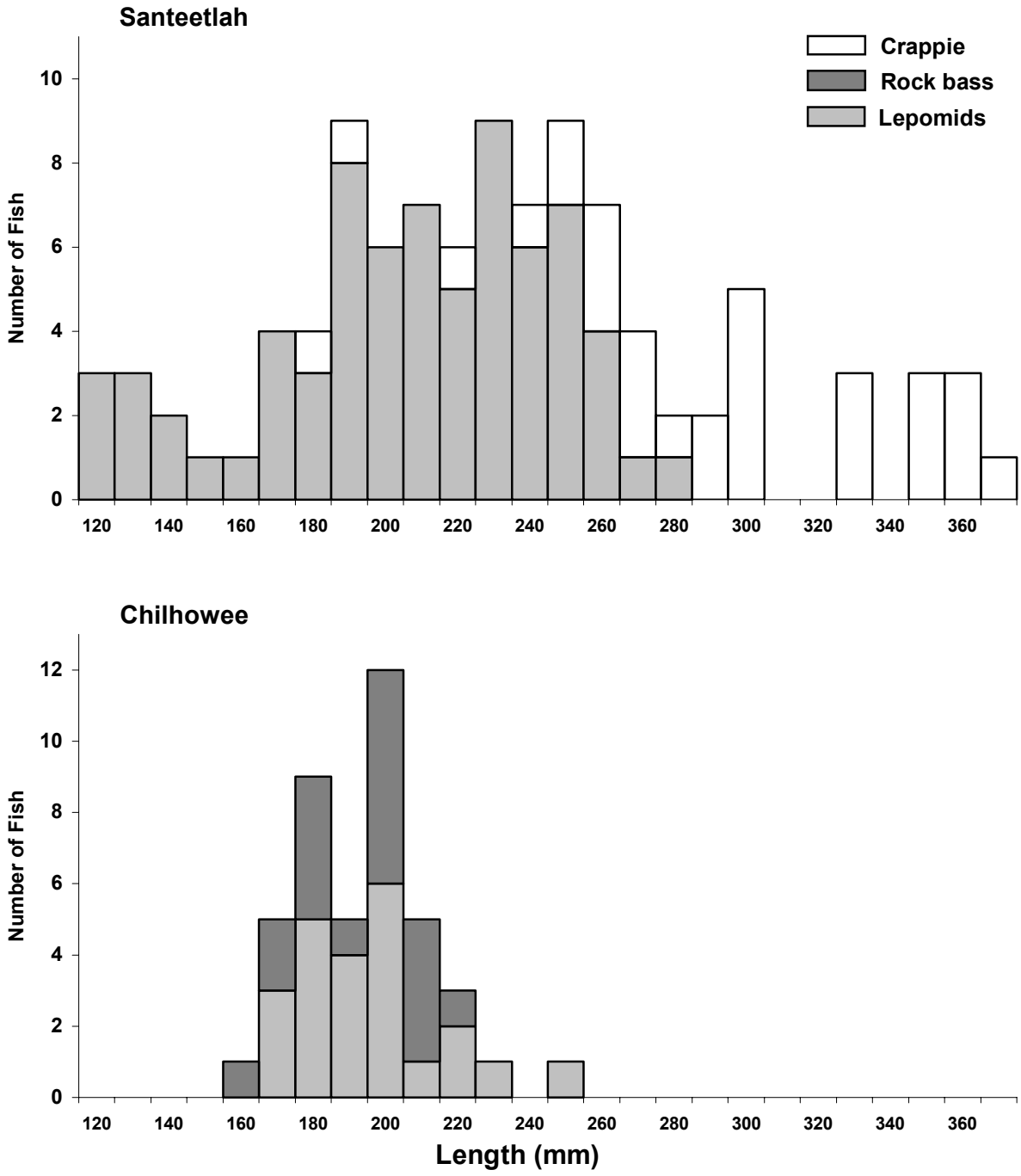

FIGURE 5.—Length-frequency distributions for harvested crappie, rock bass, and sunfish species measured by clerks during creel surveys on Santeetlah and Chilhowee reservoirs, 1998-1999.

Appendix 1: Stocking history of Santeetlah, Cheoah, Calderwood, and Chilhowee reservoirs.

TABLE A1.1.—Fish species stocked in Santeetlah, Cheoah, Calderwood, and Chilhowee reservoirs by North Carolina Wildlife Resources Commission (NCWRC) and Tennessee Wildlife Resources Agency (TWRA), with dates of most recent stockings. Where known, recent stockings are identified as adults (A), catchables (C) or fingerlings (F).

Reservoir	Species	Source	Size	Last stocked	Years stocked 1990-1999
Santeetlah	Bass, largemouth	NCWRC	-	1952	None
	Bass, smallmouth	NCWRC	-	1955	None
	Crappie (sp. unknown)	NCWRC	-	1944	None
	Shad, gizzard	NCWRC	-	1946	None
	Shad, threadfin	NCWRC	A	1999	1992, 1995, 1997-1999
	Trout, brook	NCWRC	-	1968[a]	None
	Trout, rainbow	NCWRC	-	1962	None
	Walleye	NCWRC	-	1954	None
Cheoah	Trout, brook	NCWRC	F	1989	None
	Trout, brook	NCWRC	C	2001	1993-1999
	Trout, brown	NCWRC	F	1997	1992, 1997
	Trout, brown	NCWRC	C	2001	1990-1999
	Trout, lake	NCWRC	-	1948[a]	None
	Trout, rainbow	NCWRC	F	1992	1990, 1992
	Trout, rainbow	NCWRC	C	2001	1990-1999
Calderwood	Trout, brook	NCWRC	F	1989	None
	Trout, brook	NCWRC	C	1993	1993
	Trout, brown	NCWRC	F	1994	1991-1992, 1994
	Trout, brown	NCWRC	C	1993	1990, 1993
	Trout, lake	TWRA	F	1997	1997
	Trout, rainbow	NCWRC	F	2000	1990, 1992-1994, 1997
	Trout, rainbow	NCWRC	C	1993	1990, 1993
	Trout, rainbow	TWRA	C	2001	1990-1993, 1995-1999
Chilhowee	Shad, threadfin	TWRA	A	1967[b]	None
	Trout, lake	TWRA	F	2000	1990, 1997, 1998
	Trout, rainbow	TWRA	C	2001	1990-1993, 1995-1999

[a] Species not confirmed; NCWRC stocking records incomplete prior to 1985.

[b] Last documented year of threadfin shad stocking. More recent TWRA threadfin shad stockings have occurred, but electronic records are not available.

Appendix 2: North Carolina and Tennessee fishing regulations in effect during 1998-1999 creel surveys.

TABLE A2.1.—Fishing regulations in effect on Santeetlah, Cheoah, Calderwood, and Chilhowee reservoirs at the time of creel survey. Recent regulation changes are noted. North Carolina and Tennessee residents may fish Calderwood Reservoir under licenses and regulations of their home state.

Reservoirs	Species	Creel limit	Length limit (mm)	Exceptions
Santeetlah,	Crappie[a]	None[b]	None	None
Cheoah, and	Muskellunge	2	762	None
Calderwood (NC)	Sauger	8	381	None
	Trout	7	None	None[c]
	White bass	25	None	None
	All others	None	None	None
Santeetlah and	Black bass[a]	5	305	Two fish under size may be harvested
Cheoah	Walleye	8	None	None
Calderwood (NC)	Black bass[a,d]	10	None	None
	Walleye[d]	10	None	None
Calderwood (TN)	Walleye	5	406	None
Chilhowee and	Black bass[a]	5	None	None
Calderwood (TN)	Crappie[a]	30	254	None
	Muskellunge	1	762	None
	Rock bass	20	None	None
	Sauger	10	381	None
	Trout	7	None[e]	Two lake trout may be harvested
	White bass	30	None	None
	All others	None	None	None
Chilhowee	Walleye	10	381	None

[a] Creel limits for black bass are total daily harvest limits for all black bass species combined; similarly, creel limits for crappie apply to black and white crappie in aggregate.

[b] A creel limit of 20 becomes effective 1 July 2002 for crappie (both species combined) in all western North Carolina public waters, pending final NCWRC review.

[c] Santeetlah Reservoir is not Designated Public Mountain Trout Water (DPMTW) and has no closed season for trout; Cheoah and Calderwood reservoirs are Hatchery Supported DPMTW but have no closed season due to an exception that applies to hydropower reservoirs.

[d] At the time of creel survey, black bass and walleye in Calderwood Reservoir were managed under special regulations by North Carolina. Walleye are currently managed under statewide regulations (8 fish, no length limit); a creel limit of 5 now applies to black bass, although there is still no length limit.

[e] Tennessee anglers may not harvest brook trout under 152 mm.

Appendix 3: Work periods used in 1998-1999 creel surveys.

TABLE A3.1.—Duration and start/end times of work periods, Santeetlah Reservoir creel survey. EST = Eastern Standard Time (25 October 1998 through 3 April 1999); EDT = Eastern Daylight Time.

Dates	Duration (min)	Period 1 start	Period 2 start	Period 3 start	End
1998 September 7 – 13	303	0714 (EDT)	1217	1720	2223
14 – 20	298	0719	1217	1715	2213
21 – 27	293	0724	1217	1710	2203
Sep 28 – October 4	288	0729	1217	1705	2153
5 – 11	282	0736	1218	1700	2142
12 – 18	277	0742	1219	1656	2132
19 – 25	272	0748	1220	1652	2124
Oct 26 – November 1	341	0654 (EST)	1235	------	1816
2 – 8	334	0701	1235	------	1809
9 – 15	328	0708	1236	------	1804
16 – 22	322	0714	1236	------	1758
23 – 29	317	0721	1238	------	1755
Nov 30 – December 6	313	0727	1240	------	1753
7 – 13	310	0733	1243	------	1753
14 – 20	308	0739	1247	------	1755
21 – 27	308	0742	1250	------	1758
Dec 28 – January 3	309	0745	1254	------	1803
1999 4 – 10	311	0746	1257	------	1808
11 – 17	314	0746	1300	------	1814
18 – 24	319	0743	1302	------	1821
25 – 31	325	0739	1304	------	1829
February 1 – 7	331	0734	1305	------	1836
8 – 14	338	0727	1305	------	1843
15 – 21	345	0720	1305	------	1850
22 – 28	352	0712	1304	------	1856
March 1 – 7	360	0703	1303	------	1903
8 – 14	368	0653	1301	------	1909
15 – 21	376	0643	1259	------	1915
22 – 28	384	0633	1257	------	1921
Mar 29 – April 4	391	0624	1255	------	1926
5 – 11	399	0714 (EDT)	1353	------	2032
12 – 18	407	0704	1351	------	2038
19 – 25	414	0656	1350	------	2044
Apr 26 – May 2	321	0647	1208	1729	2250
3 – 9	325	0640	1205	1730	2255
10 – 16	329	0634	1203	1732	2301
17 – 23	333	0628	1201	1734	2307
24 – 30	336	0624	1200	1736	2312
May 31– June 6	339	0621	1200	1739	2318
7 – 13	340	0620	1200	1740	2320
14 – 20	341	0620	1201	1742	2323
21 – 27	341	0622	1203	1744	2325
Jun 28– July 4	341	0623	1204	1745	2326
5 – 11	339	0628	1207	1746	2325
12 – 18	337	0631	1208	1745	2322
19 – 25	334	0637	1211	1745	2319
Jul 26– August 1	330	0642	1212	1742	2312
2 – 8	326	0648	1214	1740	2306
9 – 15	322	0653	1215	1737	2259
16 – 22	318	0658	1216	1734	2252
23 – 29	313	0704	1217	1730	2243
Aug 30 – September 5	308	0709	1217	1725	2233

Appendix 3: Continued.

TABLE A3.2.—Duration and start/end times of work periods, Cheoah, Calderwood, and Chilhowee creel surveys. Standard and Daylight times are indicated as in Table A3.1.

Dates		Duration (min)	Period 1 start	Period 2 start	Period 3 start	End
1998	June 1 – 7	339	0621 (EDT)	1200	1739	2318
	8 – 14	340	0620	1200	1740	2320
	15 – 21	341	0620	1201	1742	2323
	22 – 28	341	0622	1203	1744	2325
	Jun 29 – July 5	341	0623	1204	1745	2326
	6 – 12	339	0628	1207	1746	2325
	13 – 19	337	0631	1208	1745	2322
	20 – 26	334	0637	1211	1745	2319
	Jul 27 – August 2	330	0642	1212	1742	2312
	3 – 9	326	0648	1214	1740	2306
	10 – 16	322	0653	1215	1737	2259
	17 – 23	318	0658	1216	1734	2252
	24 – 30	313	0704	1217	1730	2243
	Aug 31 – September 6	313	0704	1217	1730	2243
	7 – 13	298	0719	1217	1715	2213
	14 – 20	298	0719	1217	1715	2213
	21 – 27	293	0724	1217	1710	2203
	Sep 28 – October 4	288	0729	1217	1705	2153
	5 – 11	282	0736	1218	1700	2142
	12 – 18	277	0742	1219	1656	2132
	19 – 25	272	0748	1220	1652	2124
	Oct 26 – November 1	341	0654 (EST)	1235	------	1816
	2 – 8	334	0701	1235	------	1809
	9 – 15	328	0708	1236	------	1804
	16 – 22	322	0714	1236	------	1758
	23 – 29	317	0721	1238	------	1755
	Nov 30 – December 6	313	0727	1240	------	1753
	7 – 13	310	0733	1243	------	1753
	14 – 20	308	0739	1247	------	1755
	21 – 27	308	0742	1250	------	1758
	Dec 28 – January 3	309	0745	1254	------	1803
1999	4 – 10	311	0746	1257	------	1808
	11 – 17	314	0746	1300	------	1814
	18 – 24	319	0743	1302	------	1821
	25 – 31	325	0739	1304	------	1829
	February 1 – 7	331	0734	1305	------	1836
	8 – 14	338	0727	1305	------	1843
	15 – 21	345	0720	1305	------	1850
	22 – 28	352	0712	1304	------	1856
	March 1 – 7	360	0703	1303	------	1903
	8 – 14	368	0653	1301	------	1909
	15 – 21	376	0643	1259	------	1915
	22 – 28	384	0633	1257	------	1921
	Mar 29 – April 4	391	0624	1255	------	1926
	5 – 11	399	0714 (EDT)	1353	------	2032
	12 – 18	407	0704	1351	------	2038
	19 – 25	414	0656	1350	------	2044
	Apr 26 – May 2	321	0647	1208	1729	2250
	3 – 9	325	0640	1205	1730	2255
	10 – 16	329	0634	1203	1732	2301
	17 – 23	333	0628	1201	1734	2307
	24 – 30	336	0624	1200	1736	2312
	May 31	339	0621	1200	1739	2318

Appendix 4: Sample pages from 1998-1999 creel surveys.

SANTEETLAH CREEL DATE _____ INT. NO. _____ DAY TYPE (WE WD)

ACCESS AREA_____ TIME OF INTERVIEW_____ WORK PERIOD (1 2 3)

TYPE OF ANGLER (BOAT BANK) NUMBER IN PARTY ____ ANGLER'S ZIP CODE_____

1. What time did you begin fishing today? _____

2. What kind of fish are you fishing for? _____

3. What have you caught today?

Species	Kept	Released	LMB/SMB over 12" rel.
_____	____	____	____
_____	____	____	____
_____	____	____	____
_____	____	____	____
_____	____	____	____

4. How much will you spend on today's fishing trip (gas, food, etc.)? $_____

5. Is this the first time we have interviewed you on this lake? yes (go to page 2)
no (go to 6)

6. May I measure and weigh the fish you have kept?

Species _____ Length/wt. ____/____ ____/____ ____/____ ____/____ ____/____

Species _____ Length/wt. ____/____ ____/____ ____/____ ____/____ ____/____

Species _____ Length/wt. ____/____ ____/____ ____/____ ____/____ ____/____

Species _____ Length/wt. ____/____ ____/____ ____/____ ____/____ ____/____

Species _____ Length/wt. ____/____ ____/____ ____/____ ____/____ ____/____

Species _____ Length/wt. ____/____ ____/____ ____/____ ____/____ ____/____

Species _____ Length/wt. ____/____ ____/____ ____/____ ____/____ ____/____

. BOATS OBSERVED EXITING DURING PERIOD_____ (PM only) NUMBER OF TRAILERS
. OBS. EXITING BOATS ENGAGED IN FISHING_____ PRESENT AT END OF PERIOD_____

Y CODE: SEASON ___ WEEK ___ ___ DAY TYPE ___ DAY NO. ___

CESS AREA COUNTS

OUNT TIME_____

MASSEY BRANCH: _____ TRAILERS, _____ BANK ANGLERS
MARINA: _____ TRAILERS, _____ BANK ANGLERS
CHEOAH POINT: _____ TRAILERS, _____ BANK ANGLERS
AVEY CREEK: _____ TRAILERS, _____ BANK ANGLERS

FIGURE A4.1.—First page of interview sheet used for creel survey of Santeetlah Reservoir, September 1998 to September 1999. Upper portion contains questions asked of all angling parties. Lower portion contains count data entry fields.

Appendix 4: Continued.

TAPOCO LAKES CREEL DATE _____ INT. NO. _____ DAY TYPE (WE WD)

ACCESS AREA_____ TIME OF INTERVIEW_____ WORK PERIOD (1 2 3)

TYPE OF ANGLER (BOAT BANK) NUMBER IN PARTY _____ ANGLER'S ZIP CODE_____

1. What time did you begin fishing today? _____

2. What kind of fish are you fishing for? _____

3. What have you caught today?

Species	Kept	Released	LMB/SMB over 12" rel.
_____	____	____	____
_____	____	____	____
_____	____	____	____
_____	____	____	____
_____	____	____	____

4. How much will you spend on today's fishing trip (gas, food, etc.)? $_____

5. Is this the first time we have interviewed you on this lake? yes (go to page 2)
no (go to 6)

6. May I measure and weigh the fish you have kept?

Species _____ Length/wt. ____/____ ____/____ ____/____ ____/____ ____/____

Species _____ Length/wt. ____/____ ____/____ ____/____ ____/____ ____/____

Species _____ Length/wt. ____/____ ____/____ ____/____ ____/____ ____/____

Species _____ Length/wt. ____/____ ____/____ ____/____ ____/____ ____/____

Species _____ Length/wt. ____/____ ____/____ ____/____ ____/____ ____/____

Species _____ Length/wt. ____/____ ____/____ ____/____ ____/____ ____/____

Species _____ Length/wt. ____/____ ____/____ ____/____ ____/____ ____/____

NUMBER OF BOATS EXITING DURING PERIOD_____ (PM only) NUMBER OF TRAILERS
NUMBER OF EXITING BOATS ENGAGED IN FISHING_____ PRESENT AT END OF PERIOD_____

ACCESS AREA COUNTS COUNT TIME_____

PANEL BRANCH:	_____ TRAILERS,	_____ BANK ANGLERS
FARLEY BRANCH:	_____ TRAILERS,	_____ BANK ANGLERS
MAGAZINE BRANCH:	_____ TRAILERS,	_____ BANK ANGLERS
CHEOAH RIVER:	_____ VEHICLES,	_____ BANK ANGLERS
TAB CAT:	_____ TRAILERS,	_____ BANK ANGLERS
GRAVEL PILE:	_____ TRAILERS,	_____ BANK ANGLERS
HAPPY VALLEY:	_____ TRAILERS,	_____ BANK ANGLERS
PEAR TREE:	_____ TRAILERS,	_____ BANK ANGLERS

FIGURE A4.2.—First page of interview sheet used for creel surveys of Cheoah, Calderwood, and Chilhowee reservoirs, June 1998 through May 1999. Upper portion contains questions asked of all angling parties. Lower portion contains count data entry fields.

Appendix 4: Continued.

Recreational Survey Data, Tapoco Project Reservoirs

1. How many times per month do you fish this lake this time of year? ☐

2. How crowded do you think the lake is today? ☐
   1=not crowded, 2=moderately crowded, 3=crowded, 4=very crowded

3. Does the number of watercraft on the lake today pose a boating safety concern for you? ☐
   Y or N

4. Has the crowding ever caused you to change when or where you fish on this lake? ☐
   Y or N

5. (If Yes to #4) What do you do when crowding affects you? ☐
   AW=avoid weekends, FN=fish nights, AB=avoid busy season
   CV=fish coves, GO=go to other lakes, HM=go home when lake gets crowded
   OT=other_____

6. What is your main reason for fishing this particular lake? ☐
   FI=good fishing, SN=scenic value, LC=less crowded
   LO=locally accessible, WQ=clean water, FA=good facilities (ramps, etc.)
   RE=proximity to other resources, OT=other_____

7. How would you rate the quality of this access area? ☐
   1=excellent, 2=good, 3=fair, 4=poor, 0=no opinion

8. What single improvement, if any, is most needed at this access area? ☐
   LA=larger lot/more ramps, PA=paving/grading, DO=docks
   LO=low water access, TR=trash cans, LT=lighting, SN=signs
   NO=no improvements needed, OT=other_____

9. How would you rate the quality of fishing at this lake compared to other lakes in the region? ☐
   1=best lake in region for fishing, 2=good lake for fishing/better than most others
   3=average quality of fishing for region, 4=poor lake for fishing/poorer than most others
   5=worst lake in region for fishing, 0=don't know/no opinion

10. What single improvement, if any, is most needed in fishery management at this lake? ☐
    WQ=water quality protection/pollution control, ST=add fish habitat structures
    LL=lake level stabilization, SH=shoreline protection, FO=stock forage/bait fish
    ST=stock game fish (species_____), EN=more law enforcement
    RG=change fishery regulations (recommended change_____)
    NO=no improvements needed, OT=other_____

11. Would you like to make any other comments regarding management of this lake?_____
    _____
    _____

GO TO PAGE 1 NO. 6

FIGURE A4.3.—Second page of interview sheet used for creel surveys of Santeetlah, Cheoah, Calderwood, and Chilhowee reservoirs, June 1998 to September 1999. Responses were obtained only from angling parties being interviewed for the first time on each reservoir.

Appendix 5: Temporal effects on boating use observed during 1998-1999 creel surveys.

TABLE A5.1.—Seasonal reservoir boating use (total trailer counts), mean angling party exits per work period (by time of day), and mean number of boat trailers remaining at end of evening work periods (by day type), observed during 1998-1999 creel surveys.

Access area, by reservoir	Season[a]	Observed use		Angling party exits/work period			Trailers remaining[b]	
		Frequency	Percent for season	Morning	Midday	Evening	Weekday	Weekend
Santeetlah								
Massey Branch	Warm	742	47.3					
	Cool	516	76.0					
Santeetlah Marina	Warm	338	21.5					
	Cool	85	12.5					
Cheoah Point	Warm	362	23.1					
	Cool	64	9.4					
Avey Branch	Warm	127	8.1					
	Cool	14	2.1					
Overall	Warm	1,569	100.0	1.46	4.84	5.07	1.3	2.8
	Cool	679	100.0	1.11		2.88	1.0	1.6
Cheoah								
Panel Branch	Warm	10	10.5					
	Cool	5	23.8					
Farley Branch	Warm	85	89.5					
	Cool	16	76.2					
Overall	Warm	95	100.0	0.13	1.22	1.53	0.3	2.1
	Cool	21	100.0	0.37		0.25	0.0	0.2
Calderwood								
Magazine Branch	Warm	172	100.0	0.95	2.25	2.75	3.1	2.8
	Cool	101	100.0	0.63		1.52	2.1	1.8
Chilhowee								
Tabcat	Warm	29	8.9					
	Cool	15	12.4					
Gravel Pile	Warm	37	11.4					
	Cool	14	11.6					
Happy Valley	Warm	227	69.9					
	Cool	88	72.7					
Pear Tree	Warm	32	9.8					
	Cool	4	3.3					
Overall	Warm	325	100.0	0.71	0.86	1.89	1.2	0.8
	Cool	121	100.0	0.38		2.75	0.0	0.9

[a] Warm season includes work periods prior to 26 October 1998 or after 25 April 1999; cool season includes work periods from 26 October 1998 through 25 April 1999. No midday work periods were defined during cool season.

[b] Mean trailers remaining (after evening work periods) were counted only at the access area where work period concluded, to provide a seasonal index of overnight or late night reservoir use.

Appendix 6: Summary of instantaneous trailer counts, 1998-1999 reservoir creel surveys.

TABLE A6.1.—Monthly mean and maximum trailer counts, mean trailer counts by time of day, and proportion of angling parties among total observed boating parties, Santeetlah Reservoir, September 1998 to September 1999. Weekday (WD), weekend/holiday (WE), and combined totals are given. Sample sizes are given in parentheses where applicable.

Month	Day type	Mean trailer count	Maximum trailer count	Mean trailers by time of day			Proportion of boats fishing
				Morning	Midday[a]	Evening	
September 1998[b]	WD (13)	3.85	11	4.71 (7)	1.00 (2)	3.75 (4)	0.778 (18)
	WE (8)	12.38	28	16.75 (4)	10.00 (1)	7.33 (3)	0.514 (35)
	Total (21)	7.10	28	9.09 (11)	4.00 (3)	5.29 (7)	0.604 (53)
October	WD (12)	7.08	12	7.40 (5)	7.50 (2)	6.60 (5)	0.903 (31)
	WE (9)	11.11	16	12.00 (2)	13.00 (1)	10.50 (6)	0.947 (19)
	Total (21)	8.81	16	8.71 (7)	9.33 (3)	8.73 (11)	0.920 (50)
November	WD (13)	7.39	17	4.80 (5)		9.00 (8)	0.929 (42)
	WE (9)	11.67	29	8.00 (3)		13.50 (6)	0.810 (21)
	Total (22)	9.14	29	6.00 (8)		10.93 (14)	0.889 (63)
December	WD (14)	3.21	7	3.88 (8)		2.33 (6)	0.692 (13)
	WE (8)	5.00	18	1.75 (4)		8.25 (4)	0.960 (25)
	Total (22)	3.86	18	3.17 (12)		4.70 (10)	0.868 (38)
January	WD (11)	3.09	9	1.67 (3)		3.63 (8)	0.950 (20)
	WE (10)	3.20	10	2.40 (5)		4.00 (5)	1.000 (17)
	Total (21)	3.14	10	2.13 (8)		3.77 (13)	0.973 (37)
February	WD (12)	2.58	6	3.20 (5)		2.14 (7)	0.750 (4)
	WE (8)	4.88	27	7.25 (4)		2.50 (4)	1.000 (18)
	Total (20)	3.50	27	5.00 (9)		2.27 (11)	0.955 (22)
March	WD (13)	2.77	10	2.13 (8)		3.80 (5)	0.923 (13)
	WE (8)	6.63	30	6.33 (6)		7.50 (2)	0.950 (20)
	Total (21)	4.24	30	3.93 (14)		4.86 (7)	0.939 (33)
April	WD (13)	6.92	26	3.20 (5)	13.67 (3)	6.60 (5)	1.000 (37)
	WE (9)	8.89	23	5.25 (4)	no data	11.80 (5)	0.676 (34)
	Total (22)	7.73	26	4.11 (9)	13.67 (3)	9.20 (10)	0.704 (71)
May	WD (12)	5.83	15	6.36 (11)	no data	0.00 (1)	0.667 (9)
	WE (11)	42.27	98	46.00 (4)	70.00 (1)	35.17 (6)	0.523 (92)
	Total (23)	23.26	98	16.93 (15)	70.00 (1)	30.14 (7)	0.535 (101)
June	WD (14)	8.64	20	3.60 (5)	10.50 (2)	11.71 (7)	0.891 (46)
	WE (8)	19.88	35	18.25 (4)	31.00 (1)	18.33 (3)	0.481 (54)
	Total (22)	12.73	35	10.11 (9)	17.33 (3)	13.70 (10)	0.670 (100)
July	WD (11)	8.09	16	5.40 (5)	14.00 (2)	8.50 (4)	0.600 (25)
	WE (10)	19.90	52	20.00 (2)	21.67 (6)	14.50 (2)	0.517 (60)
	Total (21)	13.71	52	9.57 (7)	19.75 (8)	10.50 (6)	0.541 (85)
August 1999	WD (13)	3.59	14	3.50 (4)	2.50 (4)	4.40 (5)	0.750 (24)
	WE (9)	9.33	20	10.17 (6)	16.00 (1)	3.50 (2)	0.813 (16)
	Total (22)	5.91	20	7.50 (10)	5.20 (5)	4.14 (7)	0.775 (40)

[a] No midday work period from 26 October 1998 through 25 April 1999.
[b] September values based on pooled data from 7 through 30 September 1998 and 1 through 6 September 1999.

Appendix 6: Continued.

TABLE A6.2.—Monthly mean and maximum trailer counts, mean trailer counts by time of day, and proportion of angling parties among total observed boating parties, Cheoah Reservoir, June 1998 through May 1999. Weekday (WD), weekend/holiday (WE), and combined totals are given. Sample sizes are given in parentheses where applicable.

Month	Day type	Mean trailer count	Maximum trailer count	Mean trailers by time of day			Proportion of boats fishing
				Morning	Midday[a]	Evening	
June 1998	WD (3)	0.67	2	no data	2.00 (1)	0.00 (2)	1.000 (5)
	WE (3)	3.33	5	4.00 (1)	5.00 (1)	1.00 (1)	1.000 (3)
	Total (6)	2.00	5	4.00 (1)	3.50 (2)	0.33 (3)	1.000 (8)
July	WD (4)	1.50	4	1.50 (4)	no data	no data	1.000 (1)
	WE (3)	5.33	7	7.00 (1)	no data	4.50 (2)	1.000 (8)
	Total (7)	3.14	7	2.60 (5)	no data	4.50 (2)	1.000 (9)
August	WD (4)	3.00	4	3.50 (2)	3.00 (1)	2.00 (1)	1.000 (3)
	WE (3)	4.00	6	6.00 (1)	1.00 (1)	5.00 (1)	1.000 (5)
	Total (7)	3.43	6	4.33 (3)	2.00 (2)	3.50 (2)	1.000 (8)
September	WD (5)	1.80	3	2.00 (2)	3.00 (1)	1.00 (2)	1.000 (1)
	WE (4)	1.25	3	3.00 (1)	0.00 (1)	1.00 (2)	1.000 (4)
	Total (9)	1.56	3	2.33 (3)	1.50 (2)	1.00 (4)	1.000 (5)
October	WD (4)	1.50	4	2.50 (2)	no data	0.50 (2)	0.500 (2)
	WE (3)	0.67	2	2.00 (1)	no data	0.00 (2)	1.000 (2)
	Total (7)	1.14	4	2.33 (3)	no data	0.25 (4)	0.750 (4)
November	WD (4)	0.75	3	3.00 (1)		0.00 (3)	1.000 (1)
	WE (3)	0.00	0	0.00 (2)		0.00 (1)	1.000 (2)
	Total (7)	0.50	3	1.50 (3)		0.00 (4)	1.000 (3)
December	WD (5)	0.20	1	0.25 (4)		0.00 (1)	1.000 (3)
	WE (2)	1.00	2	no data		1.00 (2)	0.500 (2)
	Total (7)	0.43	2	0.25 (4)		0.67 (3)	0.800 (5)
January	WD (4)	0.50	2	0.00 (2)		1.00 (2)	1.000 (2)
	WE (3)	0.00	0	0.00 (2)		0.00 (1)	NA (0)
	Total (7)	0.29	2	0.00 (4)		0.67 (3)	1.000 (2)
February	WD (4)	0.25	1	1.00 (1)		0.00 (3)	1.000 (1)
	WE (3)	0.00	0	0.00 (1)		0.00 (2)	1.000 (1)
	Total (7)	0.14	1	0.50 (2)		0.00 (5)	1.000 (2)
March	WD (4)	0.25	1	0.25 (4)		no data	NA (0)
	WE (3)	0.33	1	0.00 (1)		0.50 (2)	NA (0)
	Total (7)	0.29	1	0.20 (5)		0.50 (2)	NA (0)
April	WD (4)	0.50	1	no data	no data	0.50 (4)	NA (0)
	WE (3)	1.00	2	1.00 (1)	no data	1.00 (2)	1.000 (1)
	Total (7)	0.71	2	1.00 (1)	no data	0.67 (6)	1.000 (1)
May 1999	WD (4)	1.50	3	2.00 (1)	1.50 (2)	1.00 (1)	0.800 (5)
	WE (4)	2.50	4	no data	3.00 (1)	2.33 (3)	1.000 (6)
	Total (8)	2.00	4	2.00 (1)	2.00 (3)	2.00 (4)	0.909 (11)

[a] No midday work period from 26 October 1998 through 25 April 1999.

Appendix 6: Continued.

TABLE A6.3.—Monthly mean and maximum trailer counts, mean trailer counts by time of day, and proportion of angling parties among total observed boating parties, Calderwood Reservoir, June 1998 through May 1999. Weekday (WD), weekend/holiday (WE), and combined totals are given. Sample sizes are given in parentheses where applicable.

Month	Day type	Mean trailer count	Maximum trailer count	Mean trailers by time of day			Proportion of boats fishing
				Morning	Midday[a]	Evening	
June 1998	WD (4)	1.50	3	no data	3.00 (1)	1.00 (3)	1.000 (4)
	WE (2)	6.00	9	no data	6.00 (2)	no data	1.000 (7)
	Total (6)	3.00	9	no data	5.00 (3)	1.00 (3)	1.000 (11)
July	WD (5)	2.80	4	1.50 (2)	4.00 (1)	3.50 (2)	0.889 (9)
	WE (4)	6.00	8	7.50 (2)	no data	4.50 (2)	1.000 (18)
	Total (9)	4.22	8	4.50 (4)	4.00 (1)	4.00 (4)	0.963 (27)
August	WD (4)	2.50	4	2.50 (2)	no data	2.50 (2)	1.000 (7)
	WE (3)	2.33	4	2.33 (3)	no data	no data	1.000 (4)
	Total (7)	2.43	4	2.40 (5)	no data	2.50 (2)	1.000 (11)
September	WD (3)	5.00	10	no data	4.00 (1)	5.50 (2)	1.000 (9)
	WE (2)	6.00	9	6.00 (2)	no data	no data	1.000 (2)
	Total (5)	5.40	10	6.00 (2)	4.00 (1)	5.50 (2)	1.000 (11)
October	WD (5)	4.00	8	5.00 (4)	0.00 (1)	no data	1.000 (3)
	WE (3)	5.33	10	6.50 (2)	no data	3.00 (1)	0.500 (6)
	Total (8)	4.50	10	5.50 (6)	0.00 (1)	3.00 (1)	0.667 (9)
November	WD (4)	2.25	5	1.00 (1)		2.67 (3)	0.833 (6)
	WE (3)	1.33	2	no data		1.33 (3)	1.000 (3)
	Total (7)	1.86	5	1.00 (1)		2.00 (6)	0.889 (9)
December	WD (3)	3.00	4	2.50 (2)		4.00 (1)	0.000 (2)
	WE (3)	5.00	7	3.00 (1)		6.00 (2)	0.500 (4)
	Total (6)	4.00	7	2.67 (3)		5.33 (3)	0.333 (6)
January	WD (5)	3.60	7	5.00 (1)		3.25 (4)	0.900 (10)
	WE (3)	2.00	3	no data		2.00 (3)	1.000 (3)
	Total (8)	3.00	7	5.00 (1)		2.71 (7)	0.923 (13)
February	WD (4)	2.00	4	1.33 (3)		4.00 (1)	1.000 (7)
	WE (3)	1.00	2	1.00 (1)		1.00 (2)	1.000 (3)
	Total (7)	1.57	4	1.25 (4)		2.00 (3)	1.000 (10)
March	WD (5)	0.80	2	0.80 (5)		no data	1.000 (2)
	WE (3)	0.67	2	0.00 (1)		1.00 (2)	1.000 (4)
	Total (8)	0.75	2	0.67 (6)		1.00 (2)	1.000 (6)
April	WD (4)	2.25	3	2.00 (3)	no data	3.00 (1)	0.750 (4)
	WE (2)	5.00	6	6.00 (1)	no data	4.00 (1)	1.000 (6)
	Total (6)	3.17	6	3.00 (4)	no data	3.50 (2)	0.900 (10)
May 1999	WD (4)	3.75	4	4.00 (2)	no data	3.50 (2)	1.000 (6)
	WE (4)	6.25	17	no data	10.00 (2)	2.50 (2)	1.000 (9)
	Total (8)	5.00	17	4.00 (2)	10.00 (2)	3.00 (4)	1.000 (15)

[a] No midday work period from 26 October 1998 through 25 April 1999.

Appendix 6: Continued.

TABLE A6.4.—Monthly mean and maximum trailer counts, mean trailer counts by time of day, and proportion of angling parties among total observed boating parties, Chilhowee Reservoir, June 1998 through May 1999. Weekday (WD), weekend/holiday (WE), and combined totals are given. Sample sizes are given in parentheses where applicable.

Month	Day type	Mean trailer count	Maximum trailer count	Mean trailers by time of day			Proportion of boats fishing
				Morning	Midday[a]	Evening	
June 1998	WD (4)	2.50	5	0.00 (1)	3.00 (1)	3.50 (2)	1.000 (3)
	WE (3)	9.67	14	14.00 (1)	no data	7.50 (2)	0.833 (12)
	Total (7)	5.57	14	7.00 (2)	3.00 (1)	5.50 (4)	0.867 (15)
July	WD (4)	5.75	9	5.00 (2)	no data	6.50 (2)	0.818 (11)
	WE (2)	15.00	21	no data	21.00 (1)	9.00 (1)	0.000 (5)
	Total (6)	8.83	21	5.00 (2)	21.00 (1)	7.33 (3)	0.563 (16)
August	WD (4)	9.25	18	8.00 (2)	no data	10.50 (2)	0.667 (21)
	WE (4)	16.75	28	7.50 (2)	26.00 (2)	no data	0.286 (21)
	Total (8)	13.00	28	7.75 (4)	26.00 (2)	10.50 (2)	0.476 (42)
September	WD (5)	4.60	10	no data	6.00 (1)	4.25 (4)	1.000 (3)
	WE (2)	6.50	7	6.00 (1)	no data	7.00 (1)	0.000 (1)
	Total (7)	5.14	10	6.00 (1)	6.00 (1)	4.80 (5)	0.750 (4)
October	WD (4)	2.25	4	0.00 (1)	no data	3.00 (3)	0.750 (4)
	WE (3)	3.33	7	3.00 (1)	7.00 (1)	0.00 (1)	1.000 (1)
	Total (7)	2.71	7	1.50 (2)	7.00 (1)	2.25 (4)	0.800 (5)
November	WD (5)	3.20	5	3.00 (4)		4.00 (1)	1.000 (2)
	WE (3)	4.00	7	5.00 (2)		2.00 (1)	1.000 (1)
	Total (8)	3.50	7	3.67 (6)		3.00 (2)	1.000 (3)
December	WD (4)	0.25	1	0.00 (2)		0.50 (2)	NA (0)
	WE (3)	3.00	5	no data		3.00 (3)	0.733 (15)
	Total (7)	1.43	5	0.00 (2)		2.00 (5)	0.733 (15)
January	WD (4)	1.50	3	2.00 (2)		1.00 (2)	1.000 (1)
	WE (4)	2.50	7	3.00 (3)		1.00 (1)	0.600 (5)
	Total (8)	2.00	7	2.60 (5)		1.00 (3)	0.667 (6)
February	WD (4)	2.00	4	2.00 (4)		no data	NA (0)
	WE (2)	2.00	3	1.00 (1)		3.00 (1)	1.000 (1)
	Total (6)	2.00	4	1.80 (5)		3.00 (1)	1.000 (1)
March	WD (4)	0.75	3	3.00 (1)		0.00 (3)	1.000 (3)
	WE (2)	0.50	1	no data		0.50 (2)	1.000 (1)
	Total (6)	0.67	3	3.00 (1)		0.20 (5)	1.000 (4)
April	WD (5)	2.00	4	2.25 (4)	no data	1.00 (1)	1.000 (2)
	WE (4)	9.75	13	10.00 (1)	no data	9.67 (3)	0.776 (49)
	Total (9)	5.44	13	3.80 (5)	no data	7.50 (4)	0.784 (51)
May 1999	WD (4)	4.25	9	3.50 (2)	1.00 (1)	9.00 (1)	1.000 (2)
	WE (3)	19.00	22	19.00 (3)	no data	no data	1.000 (3)
	Total (7)	10.57	22	12.80 (5)	1.00 (1)	9.00 (1)	1.000 (5)

[a] No midday work period from 26 October 1998 through 25 April 1999.

Appendix 7: Summary of instantaneous angler and vehicle counts, Cheoah River bypass reach, June 1998 through May 1999.

TABLE A7.1.—Observed use (anglers fishing and vehicles parked at pull-offs) and estimated angling effort (angler hours) on bypass reach of Cheoah River, June 1998 through May 1999.

Month	Day type (N)	Angler counts		Mean no. vehicles	Mean anglers, by time of day (N)			Estimated effort (approx. SE)	
		Mean	Max		Morning	Midday[a]	Evening		
June 1998	WD (4)	0.50	2	0.50	no data	2.00 (1)	0.00 (3)	312.6	(312.6)
	WE (2)	0.00	0	0.00	no data	0.00 (2)	no data	0.0	(0.0)
	Total (6)	0.33	2	0.33	no data	0.67 (3)	0.00 (3)	312.6	(312.6)
July	WD (5)	0.00	0	0.00	0.00 (2)	0.00 (1)	0.00 (2)	0.0	(0.0)
	WE (4)	0.00	0	0.25	0.00 (2)	no data	0.00 (2)	0.0	(0.0)
	Total (9)	0.00	0	0.11	0.00 (4)	0.00 (1)	0.00 (4)	0.0	(0.0)
August	WD (4)	0.00	0	0.75	0.00 (2)	no data	0.00 (2)	0.0	(0.0)
	WE (3)	1.00	2	0.67	1.00 (3)	no data	no data	134.2	(77.5)
	Total (7)	0.43	2	0.71	0.60 (5)	no data	0.00 (2)	134.2	(77.5)
September	WD (3)	0.00	0	0.00	no data	0.00 (1)	0.00 (2)	0.0	(0.0)
	WE (2)	0.00	0	1.00	0.00 (2)	no data	no data	0.0	(0.0)
	Total (5)	0.00	0	0.40	0.00 (2)	0.00 (1)	0.00 (2)	0.0	(0.0)
October	WD (5)	0.80	3	0.60	1.00 (4)	0.00 (1)	no data	208.4	(153.7)
	WE (3)	0.00	0	0.00	0.00 (2)	no data	0.00 (1)	0.0	(0.0)
	Total (8)	0.50	3	0.38	0.67 (6)	0.00 (1)	0.00 (1)	208.4	(153.7)
November	Total (7)	0.00	0	0.29	0.00 (1)		0.00 (6)	0.0	(0.0)
December	Total (6)	0.00	0	0.17	0.00 (3)		0.00 (3)	0.0	(0.0)
January	Total (8)	0.00	0	0.00	0.00 (1)		0.00 (7)	0.0	(0.0)
February	Total (7)	0.00	0	0.00	0.00 (4)		0.00 (3)	0.0	(0.0)
March	Total (8)	0.00	0	0.00	0.00 (6)		0.00 (2)	0.0	(0.0)
April	WD (4)	0.25	1	0.25	0.33 (3)	no data	0.00 (1)	70.2	(70.2)
	WE (2)	1.50	3	0.50	0.00 (1)	no data	3.00 (1)	179.6	(179.6)
	Total (6)	0.67	3	0.33	0.25 (4)	no data	1.50 (2)	249.8	(192.8)
May 1999	WD (4)	0.00	0	0.00	0.00 (2)	no data	0.00 (2)	0.0	(0.0)
	WE (4)	0.50	2	0.25	no data	1.00 (2)	0.00 (2)	154.0	(154.0)
	Total (8)	0.25	2	0.13	0.00 (2)	1.00 (2)	0.00 (4)	154.0	(154.0)
Overall	WD (50)	0.14	3	0.20	0.20 (25)	0.50 (4)	0.00 (21)	591.2	(355.3)
	WE (35)	0.23	3	0.26	0.23 (13)	0.50 (4)	0.17 (18)	467.7	(248.9)
	Total (85)	0.18	3	0.22	0.21 (38)	0.50 (8)	0.08 (39)	1,058.9	(433.8)

[a] No midday work period from 26 October 1998 through 25 April 1999.