CREEL SURVEYS OF NANTAHALA AND QUEENS CREEK RESERVOIRS, 1999 – 2000

FINAL REPORT

MOUNTAIN FISHERIES INVESTIGATIONS

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Abstract.—Roving-access creel surveys assessed recreational fisheries on Nantahala and Queens Creek reservoirs from June 1999 through May 2000. Survey objectives were estimating and characterizing angling effort, catch, and harvest, and obtaining angler opinion on an array of reservoir management issues. Total estimated boat fishing effort on Nantahala Reservoir was 18,960 angler hours/year, with the majority of directed effort focused on black bass *Micropterus spp*. (4,018 angler hours) and walleye *Sander vitreus* (2,635 angler hours). Trout anglers expended 544 boat angler hours/year on Nantahala Reservoir. Black bass and other centrarchids constituted 82.9% of the estimated 10,980 fish caught. Nantahala boat anglers caught fish at a higher overall rate (0.74 fish/h) but caught generally smaller fish than on other reservoirs in the region. Harvest generally reflected patterns of effort and catch but included more sunfish than on other reservoirs surveyed. Trout angling effort, catch, and harvest was remarkably high for an unstocked reservoir. Total estimated boat angling effort on Queens Creek Reservoir was 1,666 angler hours. Incomplete creel clerk access to shorelines prevented expansion of bank angling effort estimates on both reservoirs. The majority of anglers on both reservoirs were North Carolina residents from the counties surrounding the project area and fished less frequently than anglers surveyed on other reservoirs in the region. Trip expenditures were highest for non-local boat anglers. Boat angler impacts from crowding were low on both reservoirs. Angler opinions on access needs were addressed through subsequent access area and water level management improvements. Based on survey results and angler opinion, we recommend continued management and routine survey of black bass and walleye and evaluation of the potential of salmonid management on Nantahala Reservoir. Trout stocking should continue on Queens Creek Reservoir, and fish habitat enhancements should continue on both reservoirs.

As an integral part of management of fishery resources and angling opportunities on inland waters, North Carolina Wildlife Resources Commission (NCWRC) biologists routinely survey sport fish populations. Wherever possible, biological data are augmented with information on the recreational experiences of anglers using these resources. However, little information on reservoir sport fishing experiences is available for western North Carolina waters. Borawa (1986) surveyed anglers on Fontana Reservoir, and Yow et al. (2002) conducted a comprehensive survey of hydropower reservoirs operated by the Tapoco Division of Alcoa Power Generating, Inc. in the Cheoah and lower Little Tennessee basins. Before 1999, no quantitative creel surveys had occurred on reservoirs of the greater Little Tennessee River Basin above Fontana Reservoir. Because of increasing public interest in mountain reservoir fisheries and anticipated informational needs associated with Federal hydropower relicensing, the NCWRC initiated creel surveys to assess angler experiences and preferences on reservoirs in the upper Nantahala (1999–2000) and Tuckasegee (2000–2001) river basins. These creel surveys were primarily focused on daily angling use associated with public access points on hydropower reservoirs, with objectives of quantifying and characterizing angler effort, catch, and harvest, and of obtaining angler opinions on an array of reservoir management topics. Yow and Grooms (2001) summarized temporal and spatial patterns of boating access area use for seven reservoirs in the project area. Supplemental effort expansions and data sets on angler opinion and fish harvest (NCWRC, unpublished data) were developed to inform hydropower operators and consultants during relicensing activities, and to assist in decisions by NCWRC district staff regarding reservoir trout stocking. Yow et al. (2008) incorporated angler opinion data from Nantahala and Tuckasegee basin creel surveys with data from other reservoirs to characterize boat angler behavior patterns related to competing reservoir uses. However, full analyses of directed effort, catch and harvest expansions were not completed, and angler opinions gathered during these creel surveys were not fully summarized.

This report provides a comprehensive summary of effort, catch, and harvest estimates from creel surveys of Nantahala and Queens Creek reservoirs surveyed from June 1999–May 2000, and summarizes all angler opinion data collected during those creel surveys. Both of these reservoirs are operated by Duke Power Company's Nantahala Area of operations (DPNA), formerly Nantahala Power and Light Company (NP&L).

Study Area

Hydropower Projects and Affected Resources

The creel surveys encompassed two hydropower reservoirs on headwaters of the Nantahala River (Figure 1). The upper Nantahala River watershed is primarily forested, and includes substantial areas of Nantahala National Forest as well as small areas of DPNA-owned lands. Tributary streams throughout the study area typically exhibit good water quality with temperatures supporting trout and other coldwater aquatic species.

Nantahala Reservoir impounds the Nantahala River, creating a highly oligotrophic 650-ha reservoir with a full pool elevation of 881 m above mean sea level and estimated mean and maximum depths of 24 and 76 m respectively. At the time of the creel survey, annual winter drawdowns averaged 13 m below full pool, and average hydraulic retention time was estimated at 166 days (Borawa 2001). Water from the reservoir is diverted to a downstream powerhouse, bypassing and partially dewatering the Nantahala River downstream of the dam. Aquatic habitat consists of bedrock, boulder/cobble, and clay substrates, with sparse to moderate amounts of woody cover at or near full pond elevations, particularly in areas associated with undeveloped shorelines. Aquatic vegetation consists of small areas of emergent macrophytes in shallow cove areas and more widespread filamentous algae on substrates in littoral waters.

Queens Creek Reservoir is a 15-ha impoundment of Queens Creek, a tributary of the Nantahala River downstream of Nantahala Reservoir. It is situated near the rim of the upper Nantahala Gorge at a full pool elevation of approximately 920 m, with estimated mean and maximum depths of 6 and 21 m respectively. Water level management of Queens Creek Reservoir at the time of the creel survey targeted averaged annual winter drawdowns of 5 m (Borawa 2001), although more severe drawdowns occurred on some occasions due to hydropower generation schedules. Hydraulic retention time was estimated at 33 days (Borawa 2001). As with Nantahala Reservoir, water from Queens Creek Reservoir is diverted to a powerhouse, partially dewatering the downstream reach of Queens Creek.

Fishery Resources

Surveys of Nantahala and Queens Creek reservoirs prior to 2000 are summarized by Borawa (2001). A three-year electrofishing survey of Nantahala Reservoir was completed immediately prior to commencement of the creel survey (Loftis and Yow 2004) and found a diverse low-density littoral sport fishery, including largemouth *Micropterus salmoides* and smallmouth bass *M. dolomieu*, rock bass *Ambloplites rupestris*, redbreast sunfish *Lepomis auritus*, bluegill *L. macrochirus*, and black crappie *Pomoxis nigricans*. Nantahala Reservoir also supports fisheries for walleye *Sander vitreus* and yellow perch *Perca flavescens*, and rainbow *Oncorhynchus mykiss* and brown trout *Salmo trutta* are regularly encountered during routine electrofishing and gillnetting surveys (Loftis and Yow 2004; NCWRC, unpublished data). Channel catfish *Ictalurus punctatus* were collected as bycatch during gillnet surveys (NCWRC, unpublished data) but no fishing activity for catfish had been reported at the time of the creel survey. No clupeid forage has been documented from Nantahala Reservoir; forage likely consists of invertebrates, juvenile gamefish species, and minnows, particularly whitetail shiner *Notropis galacturus*.

Fish stocking of Nantahala Reservoir by the NCWRC focused on sport fish introductions prior to 1980, and included walleye introduction in 1954 and stockings of bluegill, crappie, and largemouth and smallmouth bass between 1942 and 1956 (Borawa 2001). Kokanee *O. nerka* were stocked from 1960 through 1965 in an attempt to provide a new forage fish species (Messer 1967), but grew too large and persisted in too few numbers to provide appreciable forage for game species in the reservoir. A reproducing kokanee population remains in Nantahala Reservoir, and large specimens appear in gillnet surveys (NCWRC, unpublished data) and are reported by anglers in the reservoir and in a small autumnal run in the upstream reach of the Nantahala River. In 1970–1971, opossum shrimp *Mysis relicta* were stocked in another unsuccessful attempt to supplement forage. Threadfin shad *Dorosoma petenense* were stocked periodically beginning 1972 in a further attempt to enhance the forage base in the reservoir, but an intensive gillnetting effort in 1997–1999 failed to document any success from these stockings (NCWRC, unpublished data) and stocking was discontinued. Rainbow, brown, and brook trout *Salvelinus fontinalis* were stocked in various years from the time of the reservoir's construction in 1942 until trout stocking was discontinued in 1971 (Borawa 2001). In 1983, steelhead rainbow trout were stocked in an attempt to establish a run of large trout in the upstream reach of the Nantahala River, but subsequent sampling failed to demonstrate successful establishment of these fish (Jones 1985). Trout stocking continues in several major tributary streams, and although Nantahala Reservoir is not stocked or managed as Public Mountain Trout Waters (PMTW), water quality conditions supporting trout exist year-round in the reservoir (DWQ 2000). Warmwater fishing regulations on Nantahala Reservoir reflected statewide rules in place at the time of the creel survey. A total of five largemouth or smallmouth bass could be harvested, two of which could be less than 305 mm in length. No other length limits applied to game fish species occurring in the reservoir, but creel limits of eight fish per day for walleye and 7 fish per day for kokanee were in place during the creel survey.

At the time of the creel survey, Queens Creek Reservoir was managed as PMTW with annual spring and early summer stockings of brook, brown, and rainbow trout at an approximate 40:20:40 species ratio. Brook and rainbow trout stocking began in 1949, with brown trout added in 1993. Shoreline electrofishing before the creel survey (Loftis and Goudreau 2000) collected a littoral assemblage of largemouth and smallmouth bass and other centrarchids, as well as yellow perch and goldfish *Carassius auratus*, both of the latter species presumably introduced by anglers. Queens Creek Reservoir is managed under Hatchery Supported regulations with a creel limit of 7 trout per day (all species combined) and no minimum length limit. As a hydropower reservoir, Queens Creek has no closed season for trout fishing. No special regulations applied to warmwater fish species in the reservoir, all of which were managed under similar regulations to Nantahala Reservoir at the time of the creel survey.

The NCWRC installed brush structures to improve fish habitat in Nantahala Reservoir, periodically since 1986 and annually from 1995 through 2000; in 1998, cut-and-cabled tree structures were constructed in cooperation with NP&L and the U. S. Forest Service (Borawa 2001). At the time of the creel survey, no NCWRC fish habitat enhancements had occurred in Queens Creek Reservoir.

Recreational Access

Nantahala and Queens Creek reservoirs are high-elevation impoundments surrounded by rural and forested terrain; the nearest town is Andrews, North Carolina. Other large towns within a 1-h drive are Franklin, Hayesville, Murphy, and Bryson City. Nantahala Reservoir has two public boat ramps maintained by the NCWRC (Figure 1), with some limited additional access from road shoulders and private properties. Queens Creek reservoir had no developed boating access areas at the time of the creel survey, although shoreline gradients allowed the launch of small boats at several points. Bank fishing access is widely dispersed on public and private lands throughout the study area, including roadside pull-offs, boating access areas, tributary cove shorelines, lakefront campsites, and private docks. At the time of the creel survey, Queens Creek Reservoir had numerous primitive trails and campsites between Winding Stairs Road and the adjacent shoreline.

Methods

Creel Survey Design

Nantahala and Queens Creek reservoirs were surveyed simultaneously from 1 June 1999 through 31 May 2000, comprising twelve month-long sample segments. All Saturdays (except Christmas Day) 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 segment, the remaining sample days were allocated randomly and with equal probability to remaining weekdays.

During each month, Queens Creek Reservoir was given top sampling priority on three weekdays and three weekend/holidays, selected randomly from the available sample days. The remaining effort was directed at Nantahala Reservoir. If no angling use (boat trailers or bank anglers) was observed at the initial site, the creel clerk was instructed to shift sampling effort to a lower-priority access area and/or reservoir using daily random priority rankings of access areas.

A roving-access design (Palsson 1991; Pollock et al. 1994) used 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 targeting Nantahala Reservoir, survey effort was allocated to one of two improved public boating access areas using unequal probabilities (Rocky Branch, 0.65; Choga Creek, 0.35) based on historical angler used levels estimated by NP&L staff and NCWRC biological and law enforcement personnel. Sample days were divided into work periods of equal duration (4.78-7.23 h depending on solar day length), one of which was randomly assigned for data collection (Yow and Grooms 2001). From 1 November 1999 through 30 April 2000, sample days began at sunrise and ended 1.0 h after sunset, with sampling probabilities of 0.25 for morning and 0.75 for afternoon periods. During the remainder of the creel survey, sample days began at sunrise and ended 3.5 h after sunset and were divided into three work periods, with sampling probabilities of 0.20 for morning, 0.20 for midday, and 0.60 for evening periods. Once each sample day, a lakewide count circuit of both reservoirs was performed to estimate total lake use for the work period. The count circuit was allocated 1.25 h, the midpoint of which was randomly assigned within the work period. The daily priority ranking used for initial sample allocation was also used to sequence access areas during the count circuit.

Field Data Collection

During prescheduled count circuits, the creel clerk counted boat trailers and bank anglers at two established boating access areas on Nantahala Reservoir and at primitive boating and portage access points on both reservoirs. Boat trailers were counted only if they appeared to be associated with active use of the reservoir; trailers clearly associated with beached boats at campsites were not included in counts. Personal watercraft were not counted as boating parties because their numbers were assumed to be irrelevant to expansion of fishing effort estimates. Canoes could be directly observed in most cases on Queens Creek Reservoir, and were counted as boat fishing parties when fishing activity was noted. Boating trips associated with private docks (only on Nantahala Reservoir) could not be intercepted, and therefore were not included in the creel survey. Road access to bank angling sites was assumed adequate for lakewide counts only during November–April on Queens Creek Reservoir; tree and shrub growth prevented complete and accurate bank angler counts at other times. On Nantahala Reservoir, lakewide counts of bank anglers were assumed to be incomplete because of limited road access to bank fishing sites; however, all bank anglers and boat trailers observed at unimproved access sites were noted during counts. Count data were recorded on the first interview form for each sample day (Appendix 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.

On each sample day, interviews were obtained at multiple access points whenever possible. Bank angling parties were interviewed whenever encountered along reservoir shorelines, and interviews representing incomplete trips were noted on the interview form. All boating parties were identified as anglers or non-anglers when exiting the reservoir. Angling parties and non-angling boating parties were counted, 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, total time spent fishing, the number of party members fishing, the county of residence 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.

Additional survey questions were asked of angling parties during only their first interview on each reservoir (Appendix 2); anglers were asked to estimate the number of times they would fish the reservoir during the current month, and to give their primary motivation for the day’s fishing trip. All first-time respondents were also asked to rate the quality of fishing in relation to other reservoirs in the region, and to recommend the most needed fishery management activity for the reservoir; they were also asked if they owned property adjacent to the reservoir, if they preferred to fish near natural or developed shoreline, and if they wished to see the hydropower operator take an active role in protecting natural shoreline. Boat anglers were asked to rate the quality of the access area where the interview was conducted, and to recommend the most needed improvement to the access area. Boat anglers were also asked if they had ever modified their fishing behavior due to crowding on the reservoir where the interview was conducted, and if so, what they did in response to reservoir crowding; crowding responses were categorized into spatial (changed fishing location) or temporal (changed fishing time) responses. Finally, each party was given the opportunity to make additional comments at the end of their first interview. For all interview questions, responses were categorized and coded by the creel clerk where applicable; responses and comments not fitting available codes were transcribed onto the interview form.

Harvested fish were identified to species, counted, measured (mm) and weighed (g) whenever possible; when constrained by time or weather the clerk did not obtain length and weight data. Anglers who released black bass were asked if released fish exceeded 305 mm, the minimum length for legal harvest beyond the two-fish exemption.

Effort, Catch, and Harvest Estimation

Boat angling effort 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, pooled estimates were developed from multiple months of data. Estimates and variances from all day-type and monthly strata 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 total of trailer counts for all access areas on each 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 on Nantahala Reservoir, quarterly and annual estimates were calculated for undirected boat angling effort and directed boat angling effort for black bass, walleye, and trout. Boat angling effort directed at sunfish, yellow perch, and crappie was combined into one “other species” category, and quarterly and annual estimates were calculated. Directed and undirected 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. For Queens Creek Reservoir, annual effort estimates were calculated only for total boat angling effort.

For Nantahala Reservoir, 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

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

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. Approximate SE of each catch and harvest estimate was computed from sample variance using the same formulae used with effort estimates. Additional rates and expansions were calculated for black bass, walleye, trout, yellow perch, and sunfish (including crappie and rock bass) catch and harvest. For black bass, walleye, and trout anglers, directed-effort catch and harvest rates were also calculated. No expansions of effort, catch, or harvest from bank angling data were attempted because of incomplete coverage of bank fishing areas during data collection.

Annual and seasonal mean catch and harvest rates were calculated from boat- and bank angler interview data on Queens Creek Reservoir. In addition to total catch and harvest rates, estimates were calculated for trout, black bass, yellow perch, and sunfish (including rock bass); directed-effort catch and harvest rates were calculated for trout anglers. As on Nantahala Reservoir, incomplete survey coverage of bank fishing areas did not allow expansion of effort, catch, or harvest data for Queens Creek Reservoir.

Length-frequency distributions were developed for major species harvested on Nantahala Reservoir and compared to contemporaneous electrofishing or gillnet data where available, and the percentage of legal-sized (≥305 mm) black bass among all bass reported released was calculated.

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. Queens Creek Reservoir and the majority of Nantahala Reservoir lie in Macon County, and the southern part of Nantahala Reservoir lies in Clay County; portions of Cherokee, Graham, and Swain counties are less than ten kilometers from either reservoir and contain many of the nearest population centers. Therefore, anglers were classified as “local” if they resided in Macon, Clay, Cherokee, Graham, or Swain counties. Mean trip expenditures were tabulated for local, non-local in-state, and out-of-state boat and bank anglers.

Percentages of angler responses to first-interview questions on trip frequency and purpose, behavioral responses to reservoir crowding, access area quality, fishery resource quality, and shoreline management were tabulated by reservoir. Area-specific opinions on access area quality were also tabulated. Fishery resource quality responses were categorized by major target species of boat anglers (>10% of boat angling effort); trout angler responses were also categorized on both reservoirs, irrespective of existing effort, to attempt to gauge associated angler experiences. Total sample sizes were determined for all angler response categories.

Results and Discussion

Survey Efficiency

Interviews were obtained from 318 boat angling parties and 16 bank angling parties on Nantahala Reservoir. Bank angling party encounters were rare but occasionally occurred at or near boating access areas and near Wine Spring Creek, a tributary cove with primitive vehicular access. No boat angling parties were intercepted at any location other than the two NCWRC boating access areas on Nantahala Reservoir. At Queens Creek Reservoir, interviews were obtained from 13 boat angling parties and 22 bank angling parties. Survey efficiency was affected by the division of sampling effort between the two reservoirs, particularly at Queens Creek where only three weekdays and three weekend days per month were allocated for angler interviews. This was expected based on the creel survey design which prioritized angler counts at both reservoirs and angler interviews at Nantahala over Queens Creek interviews. Loss of interview opportunities was minimized by allowing the creel clerk to relocate from an unused ramp or reservoir on low-use days. Again, because of the lower priority of Queens Creek Reservoir in contingent ramp assignments, effort was more likely to be reallocated to Nantahala Reservoir than to Queens Creek, further reducing opportunities for angler interviews at the smaller reservoir. Although it was not a high priority in this creel survey, any future survey of recreational fishing at Queens Creek Reservoir should employ a greater amount of sampling effort for angler interviews.

Due to the severity of the winter of 1999–2000, angler activity was restricted by road and access area conditions. Ice on the surface of both reservoirs prevented launching of watercraft in late January and early February 2000. As a result of reduced access, no angling activity was observed on either reservoir from 16 January until 7 February, when light activity resumed on Nantahala Reservoir. Extremely low water levels also occurred throughout mid-winter on Queens Creek Reservoir, and access to the reservoir from the north end of Winding Stairs Road was prevented by closure of that portion of the road throughout the winter months; consequently, no angling activity was observed from 3 January until 12 February. Boating activity ceased on Queens Creek Reservoir in early October 1999 and did not resume until late February 2000, again due to especially low water levels. It is therefore likely that winter angling effort estimates from this survey underestimate predicted lake use in years with less severe winter weather, and future survey designs should anticipate potentially higher use levels during winter sampling.

Creel survey work period allocation was well matched to both warm- and cool-season use patterns, and as predicted, boat angling activity was heavier during afternoon and evening work periods. Late night and overnight use was observed on both reservoirs. Angling parties most frequently exited during the evening work period, which extended past 2300 from early May through September and past midnight from mid-May through early August (Yow and Grooms 2001). Future reservoir creel surveys should continue to assign uneven probabilities to work periods within sample days, with higher probability of sampling afternoon and evening work periods. In particular, creel surveys of high-elevation reservoirs should minimize sampling of morning work periods during winter.

Trailers often remained on access areas at the end of evening work periods. In many 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. Although angling trips were likely missed by the creel survey due to late-night exits, they represented an insufficient proportion of total angling effort to warrant extension of night work periods beyond those employed in this creel survey.

Although shoreline development on Nantahala Reservoir at the time of the creel survey was limited to road-accessible areas of the eastern shoreline and portions of the Big Choga Creek and Jarrett Creek arms of the reservoir, an undetermined amount of fishing effort originating from private docks was not captured in the creel survey. This was anticipated in the survey design, which focused on fishing activity associated with public access. Although the loss of private-dock sampling was recognized, the proportion of fishing trips associated with dock-accessed watercraft was assumed to be too small to warrant the necessary staff and equipment costs of a roving survey of the reservoir. Therefore, the estimates of fishing effort, catch, harvest, and angler opinion obtained during this creel survey apply only to anglers using public access areas.

As expected, limited road access to bank fishing areas prevented complete sampling of bank anglers or expansion of bank angling effort estimates. Although bank angling remains a relatively minor component of the recreational fishery on Nantahala, the greater number of bank angling interviews obtained on Queens Creek Reservoir indicates that fishing activity there is substantially underestimated our data analysis, which only allowed expansion of boat angling estimates. However, time and staff limitations prevented a thorough roving count of bank anglers. Any future survey of the recreational fishery on Queens Creek Reservoir should employ a roving count circuit, on foot or by watercraft, of the shoreline areas accessible from Winding Stairs Road.

Nantahala Reservoir Fisheries

Boat angling effort—Nantahala Reservoir boat anglers expended an estimated 18,960 angler hours (approximate SE = 2,433 angler hours) or 29.2 angler hours/ha of total fishing pressure during the survey year (Table 1). Boat anglers more often fished weekdays than weekends and holidays (10,556 and 8,404 angler hours respectively), and nearly half (9,321 angler hours) of yearly angling effort occurred during June–August. Estimated fishing pressure on Nantahala Reservoir was substantially less than the 48.1, 46.9, and 142.8 angler hours/ha estimated respectively for Santeetlah, Cheoah, and Calderwood reservoirs during the previous year (Yow et al. 2002), and was the lightest fishing pressure reported to date for a major western North Carolina hydropower reservoir. Nearly half (8,323 angler hours) of total estimated angling effort was not directed at a particular target species. Among fish species receiving directed effort, black bass were most frequently sought by Nantahala anglers (4,018 angler hours), followed by walleye (2,635 angler hours). Trout received an estimated 544 angler hours of directed effort, with the remaining boat angling effort (1,738 angler hours) directed at other species, including sunfish, yellow perch, and crappie.

Daily and seasonal patterns of directed fishing effort on Nantahala Reservoir (Table 1) generally reflected those of overall effort, with a few notable exceptions. Walleye fishing was heavily concentrated on summer weekdays, presumably because the open-water nature of walleye fishing caused these anglers to avoid the heavier boat traffic of weekends and holidays and the rougher lake conditions prevalent during other seasons. Conversely, no summer fishing effort was observed for trout anglers, who concentrated their fishing effort in March–May. Although favorable water quality conditions likely persisted in the reservoir throughout most or all of the summer months, trout may have remained too deep and widely dispersed to attract angling effort during this period. The concentration of trout fishing effort in spring, three-fourths of which occurred during the month of April, may reflect traditional stream trout fishing patterns. Fishing effort for 'other' species, primarily sunfish, was concentrated on summer weekends and holidays, likely associated with increased overall recreational activity and opportunities for family- and youth-oriented fishing trips.

Boat angling catch and harvest—The overall weighted mean catch rate of 0.74 fish/h (Table 2) was substantially higher than the 0.57, 0.54, and 0.58 fish/h catch rates estimated respectively for Santeetlah and Cheoah reservoirs (Yow et al. 2002) and Lake James (Yow 2005), and was comparable to the 0.75 fish/h estimated for Calderwood Reservoir (Yow et al. 2002). However, catch rates differed substantially among fish species groups and anglers' species preferences. The black bass catch rate of 0.34 fish/h among all anglers was similar to the rate of 0.31 fish/h estimated in the previous year for Santeetlah Reservoir (Yow et al. 2002), but black bass anglers on Nantahala experienced a substantially higher catch rate at 0.68 fish/h than the 0.48 fish/h estimated for Santeetlah anglers. The combined catch rate of 0.28 for rock bass, crappies, and sunfish on Nantahala Reservoir also exceeded estimates of 0.07 fish/h for Santeetlah Reservoir (Yow et al. 2002) and 0.18 fish/h for Lake James (Yow 2005). Conversely, walleye catch rate among all Nantahala anglers was only 0.05 fish/h compared to 0.12 fish/h estimated for Santeetlah Reservoir (Yow et al. 2002) and Lake James (Yow 2005), and the directed-effort walleye angler catch rate of 0.21 fish/h was also lower than the 0.25 and 0.33 fish/h estimated respectively for Lake James and Santeetlah walleye anglers. The disparity of angling success for walleye compared to other game fish on Nantahala, and to walleye catch rates on other reservoirs, has been reflected in the frequency of angler complaints and requests for more protective regulations and walleye stocking in Nantahala Reservoir. However, subsequent gillnet surveys (NCWRC, unpublished data) found ongoing recruitment, slow growth rates, and exceptionally long-lived individuals in the Nantahala walleye population, indicating that neither fingerling stocking nor further harvest restrictions would improve size or number of walleyes caught by anglers.

Trout angling by Nantahala boat anglers was remarkably successful, considering the lack of recent NCWRC trout stocking activity (Borawa 2001) in Nantahala Reservoir or the upper Nantahala River basin; although catch rate for trout was low (0.03 fish/h) among boat anglers in general, those seeking trout experienced a catch rate of 0.23 fish/h, slightly higher than that of walleye anglers. Although reservoirs stocked with trout have exhibited higher trout catch rates (Yow et al. 2002; NCWRC, unpublished data), creel surveys of unstocked mountain reservoirs have typically documented little or no angler success for trout. Earlier reservoir creel surveys did not address trout angling specifically, but Borawa (1986) observed no catch of "steelhead" rainbow trout and estimated a catch rate of less than 0.01 fish per hour for species other than the major warmwater species caught by Fontana anglers; similarly, Yow (2005) estimated a catch rate of 0.02 for species other than major warmwater species caught by boat anglers on Lake James. On Santeetlah Reservoir, trout catch was somewhat higher (5.2% of total annual boat-angler catch), but directed effort for trout was not sufficient to allow reliable estimation of catch rate (Yow et al. 2002). Given the existence in Nantahala Reservoir of a directed trout fishery with relatively high catch rates, the potential may exist to improve angler success for trout through stocking, because unlike walleye trout may be stocked at catchable size. Cheoah Reservoir, nearly half the surface area of Nantahala, exhibited a return to the creel of 70.8% of the number of trout stocked, with an estimated increase of 23.4–52.4% in weight of creeled trout from weight measured at the time of stocking (Yow et al. 2002). Although the Cheoah creel survey did not track growth and survival of individual stocked trout, the potential for similar performance of a hatchery-supported trout fishery may exist on Nantahala Reservoir.

Overall estimated boat-angler catch on Nantahala of 10,980 fish consisted mainly of black bass (4,171 fish) and other centrarchids (4,927 fish); centrarchid species collectively constituted 82.9% of the total estimated annual catch for the reservoir. Estimated annual walleye catch was 996 fish or 9.1% of total catch, whereas the estimated annual trout catch of 525 fish accounted for 4.8%; the only other species regularly caught by Nantahala anglers was yellow perch with an estimated 327 fish (3.0% of total) caught. Channel catfish were occasionally reported in boat angler catch.

The overall weighted mean harvest rate of 0.39 fish/h for Nantahala boat angling parties (Table 2) was higher than the rates of 0.27 and 0.21 fish/h estimated for Santeetlah (Yow et al. 2002) and James (Yow 2005) and was equal to the harvest rate estimated by Yow et al. (2002) for the stocked trout fishery on Cheoah Reservoir; among reservoirs surveyed to date, only Calderwood Reservoir exhibited a higher harvest rate at 0.52 fish/h (Yow et al. 2002). The presence of multiple harvest-oriented fisheries (walleye, trout, and yellow perch) was partially responsible for the higher overall harvest rate on Nantahala Reservoir. Also, the collective harvest rate of 0.16 fish/h for sunfish, crappie, and rock bass was substantially higher than the rates of 0.10 and 0.02 fish/h estimated for Santeetlah (Yow et al. 2002) and James (Yow 2005), possibly due to angler perceptions of better water quality in Nantahala Reservoir than in lower-elevation systems. As on other reservoirs surveyed, harvest rate of black bass was low relative to other species, particularly among anglers targeting black bass.

Estimated boat angler harvest of 4,223 fish (approximate SE = 696 fish) consisted of black bass (1,106 fish, 26.2%), other centrarchids (1,848 fish, 43.8%), walleye (502 fish, 11.9%), trout (427 fish, 10.1%), and yellow perch (307 fish, 7.3%). Two channel catfish were observed in boat angler harvest. The high level of fishing effort for black bass relative to other species led to substantial total harvest in spite of the relatively low mean black bass harvest rate; harvest estimates for other species generally reflected harvest rates. Many harvested fish had been filleted by the time anglers exited the reservoir, limiting the amount of weight data that could be collected. However, based on available mean weights of harvested fish, annual weight estimates of major species groups were 624 kg of black bass, 387 kg of other centrarchids, 266 kg of walleyes, 333 kg of trout, and 167 kg of yellow perch.

Seasonal patterns of catch and harvest (Table 2) reflected patterns of fishing effort in most cases. However, catch and harvest of trout continued through summer months in spite of the lack of observed directed effort, again indicating that year-round habitat exists for trout in Nantahala Reservoir. Also, harvest of sunfish, crappie, and rock bass species was slightly higher in fall than in summer months when nearly three times as many fish were caught, possibly reflecting a shift toward harvest-oriented fall angling for these species from the more release-oriented generalist angling by summer recreationists.

Black bass harvest on Nantahala Reservoir was dominated by smallmouth bass, many of which were smaller than the 305-mm length limit (Figure 2); however, the majority of undersized black bass were harvested in compliance with the two-fish exemption to the length limit, and only one boat angling party was observed exiting the reservoir with one undersized black bass more than allowable under the regulation. Of 19 largemouth bass observed in angler harvest, only four were undersized and all were legally harvested under the two-fish exemption. On multiple occasions during the creel survey, anglers exited the reservoir with black bass that had been filleted, preventing accurate measurement of fish lengths and weights. Aside from the one occasion of excessive harvest of undersized fish and the incidences of filleting length-regulated fish while still afield, no other violations of fishing regulations were observed. Among black bass released by anglers, 54.7% of smallmouth and 58.2% of largemouth were reported to be 305 mm or larger; by comparison, 41.0% of smallmouth and 55.4% of largemouth bass released Santeetlah Reservoir anglers were 305 mm or larger (Yow et al. 2002). The high black bass release rate among Nantahala anglers would limit the direct management benefit of more restrictive harvest regulations.

Comparison of black bass length distributions from the creel survey and shoreline electrofishing survey (Figure 2) revealed the limitations of the latter as a stock assessment technique on Nantahala Reservoir. Night electrofishing of shoreline transects (Loftis and Yow 2004) yielded harvestable-sized (≥305 mm) largemouth bass in a range and general distribution of lengths similar to that harvested by Nantahala anglers, and could be used in the future as an indicator of the quality of the largemouth portion of the black bass fishery. However, largemouth bass represented less than 15% of black bass harvest on Nantahala Reservoir. In contrast, smallmouth bass were frequently harvested by Nantahala anglers, but harvestable-sized smallmouth bass were rarely captured during electrofishing. More recent gillnet surveys on Nantahala and other mountain reservoirs (NCWRC, unpublished data) have successfully captured large numbers of smallmouth bass representing a full range of harvestable lengths, and gillnetting likely has greater utility than shoreline electrofishing for future evaluations of the black bass fishery on Nantahala Reservoir.

Length distribution of walleye harvest (Figure 3) was comparable to that observed on Santeetlah Reservoir (Yow et al. 2002), with the majority of fish falling between 350 and 400 mm in length. Nantahala Reservoir walleyes were smaller on average at harvest than those of larger, lower-elevation reservoirs, although direct comparisons were not possible. Lake James anglers harvested walleyes primarily in the 400- to 450–mm range, but a 381-mm length limit restricted harvest of smaller walleyes on that reservoir. Borawa (1986) did not provide comparable length-frequency data for Fontana walleyes but reported a mean weight of 570 g, compared to the mean weight of 531 g for Nantahala walleyes. The relatively low mean fish weight, along with low angler catch for the species, collectively indicate the limited recreational potential of the Nantahala walleye fishery; the estimated annual yield was 0.41 kg of walleyes/ha. Comparison of angler harvest with gillnet data (Figure 3) indicated that walleye anglers were selecting fish of 350 mm or larger for harvest, and this selectivity may explain the relatively low percentage of reported walleye catch (50.4%) appearing in harvest. No angling parties were observed harvesting walleyes in excess of the eight-fish daily creel limit; however, only two parties reported catching more than eight walleyes, and both consisted of multiple anglers.

Although yellow perch data were not recorded during 2001 gillnet samples, the species was frequently harvested by anglers on Nantahala Reservoir (Figure 3). Again as with black bass and walleyes, anglers commonly filleted their catch before exiting the reservoir, preventing accurate measurements in most cases. However, 19 of 20 yellow perch measured by creel clerks exceeded 305 mm, and one 410-mm, 1,040-g fish was harvested; by comparison, all yellow perch harvested by Cheoah Reservoir anglers (Yow et al. 2002) were under 290 mm in length. Based on estimated catch and the limited data on mean harvest weight, annual yield of yellow perch (0.26 kg/ha) was more than half that of walleyes.

Trout harvested by Nantahala Reservoir anglers (Figure 4) were substantially larger than those harvested on stocked reservoirs surveyed by Yow et al. (2002); all trout measured by creel clerks on Nantahala were 380 mm or larger, whereas less than 8% of trout on Cheoah and less than 2% of trout on Calderwood were of comparable size at harvest. As with other species, anglers had filleted many trout before exiting the reservoir. An estimated 81.3% of caught trout were harvested, indicating that the observed length distribution was more representative of catch and less the result of selective harvest than among walleye anglers. Total annual yield of trout, estimated at 0.51 kg/ha, exceeded that of walleyes.

Angler harvest of centrarchids other than black bass consisted primarily of sunfish and crappie species 180 mm or larger, in contrast to electrofishing samples (Loftis and Yow 2004) that consisted of sunfish and rock bass smaller than 180 mm (Figure 5). These small centrarchids were abundant along the rocky shorelines of Nantahala Reservoir and constituted nearly half (44.9%) of the total estimated annual boat-angler catch. Size selectivity by anglers may partially explain the low estimated percentage of small centrarchids harvested (37.5%), although many angling parties reported releasing all centrarchids caught.

Bank angling catch and harvest—Bank anglers were rarely encountered on Nantahala Reservoir. Unlike most lower-elevation mountain reservoirs, Nantahala has very little tributary stream shoreline that can be easily accessed on foot, and it lacks the white bass *Morone chrysops* fisheries and riverine walleye spawning runs that concentrate bank anglers during early spring on other reservoirs in the region. Aside from boating access areas, the only bank angling activity observed was near Wine Spring Creek, a small coldwater stream, and three of the 16 bank angling party interviews occurred at this site. Ten of 16 bank angling parties were encountered in warmer months (June–August 1999 or May 2000). Only three of 16 bank angling parties were targeting a particular fish species, with one party each targeting black bass, walleye, and sunfish. Although the small number of party interviews did not allow meaningful estimation of seasonal or directed-effort catch and harvest rates, seven of 16 parties reported catching fish; the mean catch rate was 0.91 fish/h. Of 38 fish reported caught by bank anglers, 33 were sunfish or rock bass, all of which were released. Five fish were observed in bank angler harvest, including three smallmouth bass, one brown trout, and one yellow perch; the mean harvest rate was 0.07 fish/h.

Queens Creek Reservoir Fisheries

Boat angling effort—Queens Creek Reservoir boat anglers expended an estimated 1,666 angler hours (approximate SE = 393 angler hours) or 111.1 angler hours/ha of total fishing pressure during the survey year; estimated fishing pressure was intermediate between the 46.9 and 142.8 angler hours/ha estimated respectively for similar stocked trout fisheries on Cheoah and Calderwood reservoirs (Yow et al. 2002). Although small sample sizes prevented expansion of seasonal or species-directed effort expansions, boating angling activity was largely restricted to warmer months; less than 4% of boating activity observed on the reservoir during the survey year occurred between 1 October 1999 and 31 March 2000, due in part to low water levels throughout most of the winter months. Based on angler interviews, the majority of observed boat angling effort on Queens Creek Reservoir was not directed at a particular target species.

Bank angling effort—As on Nantahala Reservoir, creel survey design did not allow complete coverage of Queens Creek Reservoir for bank angler counts during count circuits. Although most of the shoreline was visible from Winding Stairs Road during winter months, and all bank areas of Queens Creek Reservoir could be accessed on days when angler interview survey effort was dedicated to that reservoir, the lack of comprehensive counts prevented expansion of total bank angling effort. However, bank angling parties were generally more numerous than boat angling parties (Table 3). Based on direct observation of anglers, bank angling activity was less concentrated in warmer months than boat angling activity, with over 40% of bank anglers observed between 1 October 1999 and 31 March 2000.

Boat and bank angling catch and harvest—The mean catch rate for Queens Creek Reservoir anglers was 2.75 fish/h; the mean harvest rate was 1.70 fish/h (Table 3). Although few angling parties directed their fishing effort at trout specifically, those that did caught trout at nearly twice the rate of all anglers combined, and harvested trout at over four times the overall rate. Among other species, yellow perch were caught at a higher rate than black bass or other centrarchids, and were the only other species besides trout that were harvested in appreciable numbers. Bank anglers caught and harvested fish at a substantially higher rate than boat anglers. Catch and harvest rates were higher during warmer months for all species except yellow perch, but overall catch and harvest rates were higher in the cooler months of October–March because of the relatively large number of yellow perch caught by cool-season anglers. Trout were caught mainly during summer months, with over 95% of trout catch and 100% of trout harvest reported in June–August 1999, thus providing anglers with a trout fishing opportunity between the popular spring and fall stockings of nearby streams. Black bass were rarely caught on Queens Creek Reservoir, and only one 168-mm largemouth bass was observed in angler harvest.

Residency of Anglers and Expense of Angling Trips

Both Nantahala and Queens Creek reservoirs were fished mainly by North Carolina residents (Table 4). On Nantahala Reservoir, 97.8% of boat anglers and 87.5% of bank anglers were North Carolina residents; only seven boat angling parties and two bank angling parties were from states other than North Carolina. On Queens Creek Reservoir, local residents constituted 91.7% of boat anglers and 95.4% of bank anglers, with only one boat angling party and one bank angling party from other states. The high percentages of in-state anglers are consistent with those observed on other western North Carolina reservoirs (Yow et al. 2002; Yow 2005). However, the percentage of non-local North Carolina boat anglers on Nantahala Reservoir (6.7%) was substantially lower than the 40.1% observed on Lake James (Yow 2005), and although angler residencies on Santeetlah Reservoir were classified differently due to its proximity to Tennessee anglers (Yow et al. 2002), the percentage of non-local Santeetlah anglers (21.6%) was also higher than that observed on Nantahala Reservoir. The infrequent use of Nantahala Reservoir by non-local boat anglers is likely due to its remote location; both Santeetlah and James are directly accessible from state highways and James lies near Interstate 40, whereas Nantahala is only accessible by secondary roads through mountainous terrain.

Mean trip expenditures of non-local boat anglers were higher than for local boat-angling parties on Nantahala Reservoir (Table 4), but local anglers were responsible for the majority of reported expenditures associated with recreational fisheries on both reservoirs because their greater numbers outweighed the reported differences in trip-related spending. Among all party types on both reservoirs, non-local North Carolina boat angling parties on Nantahala reported the highest mean trip costs ($48.75). Local bank anglers reported lower average trip costs than local boat anglers on both reservoirs, but small sample sizes prevented further assessment of spending patterns.

Frequency and Motivation of Angling Trips

The percentage of angling parties that were interviewed multiple times during the survey year (Table 5) was higher on Nantahala Reservoir (61.4%) than Queens Creek Reservoir (40%), probably because the greater sampling intensity applied at Nantahala contributed to the probability of multiple interviews during the survey year.

Anglers reported fewer fishing trips per month on Nantahala Reservoir (Table 5) than on larger reservoirs; 33.3% reported one or fewer trips, compared to 20.9% on Santeetlah Reservoir (Yow et al. 2002) and 11.2% on Lake James (Yow 2005). Also, the percentage of anglers reporting five or more fishing trips per month on Nantahala (22.5%) was lower than the 29.4% reported for Santeetlah and substantially lower than the 45.2% reported for James. This reduced avidity is counterintuitive given the predominantly local residency of Nantahala anglers, but may result from the greater difficulty of accessing Nantahala Reservoir from nearby populated areas compared to the other reservoirs. In the case of Lake James, the higher reported trip frequencies also may be an artifact of the sampling method; unlike more recent creel surveys, Lake James anglers were asked about trip frequency during repeat interviews (Yow 2005), increasing the likelihood of multiple responses from more avid anglers.

Quality of fishing was the most commonly stated reason for fishing both reservoirs, cited by 34.6% of Nantahala anglers and 36.8% of Queens Creek anglers (Table 5). Local accessibility, less crowded lake conditions, and good water quality were also reported as motivating factors by multiple anglers on both reservoirs.

Effects of Reservoir Crowding on Anglers

On Nantahala Reservoir 21.4% of boat anglers indicated that reservoir crowding had affected either the time or location of at least some of their fishing trips (Table 6), compared to 47.5% on Santeetlah Reservoir (Yow et al. 2002) and 71.4% on Lake James (Yow 2005); no boat anglers on Queens Creek Reservoir reported crowding impacts. The lower fishing pressure on Nantahala Reservoir compared to larger, more accessible reservoirs may be partially responsible for the lower frequency of crowding impacts; however, a larger-scale comparison of crowding impacts on western North Carolina reservoir anglers (Yow et al. 2008) found that the density of non-angling boaters had greater influence than fishing pressure on angler perceptions of reservoir crowding. Non-angling boaters were observed on Nantahala Reservoir during all months of the creel survey and constituted nearly half of the total boat traffic during summer months (Yow and Grooms 2001), likely contributing to the frequency of avoidance behaviors by boat anglers.

Unlike other reservoirs surveyed (Yow et al. 2002; Yow 2005), boat anglers on Nantahala Reservoir (Table 6) more frequently reported temporal modifications to fishing behavior (changing the time, day, or season of their fishing trips) to avoid crowds, rather than spatial modifications (relocating to either a different fishing spot or another reservoir, or terminating their fishing trip on crowded days). The greater tendency toward temporal displacement of boat anglers may indicate some threshold of crowding beyond which anglers were unable to find suitable fishing areas on high-use days (Yow et al. 2008). However, the predominantly local residency of Nantahala boat anglers likely contributed to their flexibility in scheduling fishing trips, and may have had more effect than competing uses on their selection of fishing days. Avoiding the busy summer season was the most common temporal modification, reported by 40% of respondents. Night fishing was frequently observed on Nantahala Reservoir, and 28.0% of respondents indicated that they fished nights as a response to crowding.

Boat Angler Assessment of Reservoir Access

Angler satisfaction with boating access areas was generally high for Nantahala Reservoir and low for Queens Creek Reservoir (Table 7), with ≥60% good-excellent ratings for both access areas on Nantahala, and none on Queens Creek. At Rocky Branch Boating Access Area on Nantahala, expansion of ramps and parking areas was the most frequently requested improvement, followed by paving or grading of lots and ramps, improved lighting, improvement of the floating dock, extension of ramps to improve low-water access, and installation of trash cans. At Choga Road Boating Access Area on Nantahala, improved lighting was the most frequently requested improvement, followed by expansion of ramps and parking areas and installation of trash cans. On Queens Creek Reservoir, construction of access ramps and parking areas, or improvement of existing makeshift access areas, was requested by boat anglers.

Since the conclusion of the creel survey, access improvements requested by boat anglers on both reservoirs have been addressed though cooperative efforts of NCWRC and DPNA. Subsequent NCWRC construction projects have enlarged parking areas, resurfaced and widened ramps, and installed floating docks at both access areas on Nantahala Reservoir. As part of the conditions of the Federal Energy Regulatory Commission’s relicensing of the Nantahala Project, reservoir water levels will be maintained at higher levels, and other planned improvements for both access areas include lighting, trash cans, rest rooms, bank fishing areas, and paved parking lots (DPNA 2004). As part of a settlement agreement between DPNA and resource management agencies, a new reservoir operating schedule was implemented to maintain higher water levels on Queens Creek Reservoir, and a handicapped-accessible fishing pier and a portage access area were constructed adjacent to Winding Stairs Road (NCOAH 2000).

Angler Assessment of Fishery Resources

Among Nantahala Reservoir anglers, 47.3% rated the quality of fishing favorably compared to other reservoirs; 30.2% gave an average rating, and 14.5% rated the fishing below average, with 7.0% expressing no opinion regarding fishery resource quality; 73.7% of Queens Creek Reservoir anglers had a favorable opinion of that fishery, 21.0% gave an average rating, and none rated it below average, with one respondent offering no opinion (Table 8). Fishery quality ratings by black bass and walleye anglers generally reflected overall patterns. However, walleye anglers were more polarized in their opinions, having the highest percentage of both favorable (52.2%) and unfavorable (21.7%) fishery ratings; relatively few walleye anglers (26.1%) rated the Nantahala fishery as average, and none reported having no opinion. Trout anglers were encountered in small numbers on both reservoirs, and typically rated fishing as average or good compared to other reservoirs in the region. The overall angler satisfaction rating of 47.3% for the Nantahala fishery was somewhat lower than the 57.9% and 59.2% reported respectively for

Santeetlah and Cheoah reservoirs (Yow et al. 2002), and angler telephone complaints and administrative inquiries about the quality of the fishery, particularly regarding walleye fishing, were more common for Nantahala than for the other reservoirs at the time of the creel survey.

Forage fish stockings were the most often recommended (24.8%) management improvement on Nantahala Reservoir, followed by game fish stocking (21.7%) and placement of fish habitat structures (13.2%); forage fish (27.8%) and game fish (22.2%) stocking were also the most common recommendations on Queens Creek Reservoir, although some anglers (16.7%) were also concerned about lake level stabilization (Table 8).

Threadfin shad stockings were attempted on Nantahala Reservoir for many years without measurable success. An intensive monitoring of success of regional threadfin shad stocking effort was conducted from 1997 through 1999 to assess the effectiveness of the stocking program (NCWRC, unpublished data). Annual fall surface-set gillnet samples demonstrated that spring stocking successfully established temporary threadfin shad populations in all reservoirs surveyed except Nantahala, where no threadfin shad were collected in any year of the evaluation. As a result, no further stocking of threadfin shad has been attempted there. Although threadfin shad stocking was not attempted on Queens Creek Reservoir, its higher elevation, cooler water temperatures, and much shorter hydrologic retention times (Borawa 2001) make it a poor candidate for clupeid forage management. On both reservoirs, improvement of littoral habitat, also a recommendation of many anglers, may increase abundance or concentrate distribution of juvenile centrarchids and yellow perch, thereby indirectly addressing forage availability for game fish.

Although a common recommendation on both reservoirs, management potential of game fish stocking is limited on Nantahala Reservoir by low reservoir productivity, as evidenced by the relatively poor condition and low growth rates exhibited by all game fish species surveyed (Loftis and Yow 2004; NCWRC, unpublished data). Walleye and black bass stocking would involve fingerlings that would encounter the same limitations of forage availability and resulting growth rates, and would be unlikely to contribute significantly to the number of harvestable game fish. Stocking of catchable-sized game fish could potentially enhance angler catch rates, but cannot be produced in sufficient numbers with currently available hatchery resources. On Queens Creek Reservoir, the ongoing trout stocking program is likely the most effective means of directly enhancing the quality of the sport fishery.

Angler Ownership of Shoreline and Support for Shoreline Protection

Among angling parties interviewed on Nantahala Reservoir, only 9.4% owned property adjacent to the reservoir; only one of 19 respondents on Queens Creek Reservoir owned adjacent property (Table 9). The low percentages of lakefront property owners among survey respondents was expected as a consequence of our access-point survey design, which did not allow for interception of angling trips originating from the small number of docks present on Nantahala Reservoir at the time of the creel survey. Queens Creek Reservoir by contrast had no private docks, but its small size relative to the number of parcels of surrounding private property likely limited the number of angling landowners available for survey. The majority of anglers on both reservoirs preferred to fish natural shoreline, with 82.8% of Nantahala anglers and 78.9% of Queens Creek anglers indicating this preference. All other respondents indicated no preference; no anglers preferred developed shoreline for fishing. When asked if the hydropower operator should take an active role in protecting reservoir shoreline habitat, 87.6% of Nantahala respondents and 89.5% of Queens Creek respondents indicated that they agreed or strongly agreed that an active role was needed. No respondents on Queens Creek and only three respondents on Nantahala indicated that they disagreed or strongly disagreed with active shoreline protection by the hydropower operator. Because of the low percentages of lakefront property owners interviewed and the very low percentages of negative responses to the questions regarding preferences for shoreline fishing and habitat protection, it was not possible to relate property ownership to opinions regarding shoreline habitat protection. However, of the 13 lakefront property owners interviewed during the survey, all either preferred natural shoreline for fishing or had no preference, and all but one agreed or strongly agreed that the hydropower operator should take an active role in shoreline protection. As result of negotiations with resource agencies, shoreline residents, and other stakeholders, DPNA enacted shoreline management guidelines for all of its hydropower reservoir projects defining permissible uses by public recreationists and adjacent property owners and establishing standards for vegetation clearing, shoreline armoring, and construction of docks and other structures, and prohibiting docks on Queens Creek Reservoir and other small hydropower projects (DPNA 2003).

Summary

Nantahala Reservoir

As expected, black bass and walleye were the primary sport fishery resources on Nantahala Reservoir, although a surprising number of rainbow trout were caught by the few anglers who directed their effort at the species. Anglers caught fewer trout than walleyes but harvested the species in nearly equal numbers due to the larger average size of trout caught. Yellow perch were also frequently caught, and exceptionally large perch were observed in angler harvest. Local residents constituted the majority of angling use and associated expenditures, particularly among boat anglers. Satisfaction with access to the reservoir was generally high, and all major improvements recommended by anglers have been implemented since the creel survey or scheduled for future completion under subsequent hydropower relicensing. In contrast, angler satisfaction with fishery quality was lower than for other reservoirs in the region, particularly regarding the walleye fishery. Although forage management and game fish stocking were identified by anglers as areas needing improvement, past efforts at threadfin shad and fingerling game fish stocking have failed on Nantahala; however, catchable-sized game fish stocking may hold potential for improving fishery quality, if future fish production technologies and capacities improve the feasibility of supporting large reservoirs.

Queens Creek Reservoir

Queens Creek Reservoir received a relatively low level of boat angling effort compared to Nantahala and other reservoirs previously surveyed. Bank angling effort could not be accurately estimated, but was also likely low based on the frequency of repeat encounters with survey respondents. Yellow perch predominated in the catch and harvest, followed by centrarchid species and trout; black bass were rarely caught or harvested. Local residents predominated among both boat and bank anglers. Crowding did not affect boat anglers, mainly due to the difficulty of accessing the reservoir with motorized watercraft. Continued or expanded trout stocking and improved boating and bank fishing access were the primary management needs expressed by anglers and subsequently implemented by DPNA and NCWRC.

Recommendations

Nantahala Reservoir

1. Continue to manage the reservoir for black bass and walleye.
2. Periodically collect age and growth information on walleye, smallmouth bass, and yellow perch to monitor performance of sport fisheries.
3. Evaluate the potential for further development of the pelagic salmonid fishery.
4. Discontinue shoreline electrofishing as a sampling method for smallmouth bass on Nantahala Reservoir.
5. Cooperate with DPNA and U. S. Forest Service to enhance littoral fish habitat, with increased focus on yellow perch spawning structure.

Queens Creek Reservoir

1. Continue to manage the reservoir for seasonal catchable-sized rainbow trout fishing under current Hatchery Supported regulations, with no closed season.
2. Cooperate with DPNA to enhance littoral fish habitat.

Future Reservoir Creel Surveys

1. Continue to maximize sampling on weekends and summer holidays.
2. Continue to allocate more sampling to later times of day, particularly in winter months.
3. Continue to reallocate sampling from empty ramps as needed, with established daily contingent rankings for access areas.
4. Whenever possible, conduct multiple angler/trailer count circuits per sample day to reduce likelihood of missing reservoir users due to early-morning or late-evening counts during low-use periods.

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TABLE 1.—Estimated boat angling effort (angler hours) for Nantahala Reservoir, June 1999–May 2000. Total (for all days in survey year), day-type (WD = weekday, WE = weekend/summer holiday), and seasonal estimates are given by target species and for overall effort. Other species targeted by boat anglers included sunfish, yellow perch, and crappie. Undirected effort represents angling parties that were not targeting a particular species. Overall effort expansions included angler counts for all sample days, including days when no target species data were available. Approximate standard errors are given in parentheses.

Target species	All days	Day type		Season			
		WD	WE	Jun–Aug	Sep–Nov	Dec–Feb	Mar–May
Black bass	4,018 (803)	1,782 (451)	2,236 (665)	1,419 (554)	874 (363)	42 (23)	1,683 (454)
Walleye	2,635 (1,058)	2,333 (1,046)	302 (161)	2,220 (1,045)	46 (46)	50 (28)	319 (160)
Trout	544 (208)	331 (175)	213 (112)	0	17 (12)	41 (26)	486 (205)
Other species	1,738 (1,523)	164 (81)	1,574 (1,520)	1,578 (1,521)	27 (27)	18 (18)	114 (57)
Undirected	8,323 (1,498)	4,111 (1,005)	4,212 (1,111)	3,268 (1,058)	2,153 (687)	131 (54)	2,771 (806)
Overall effort	18,960 (2,433)	10,556 (1,471)	8,404 (1,938)	9,321 (2,043)	3,307 (882)	455 (112)	5,877 (978)

TABLE 2.—Estimated catch rates (fish/h), catch, harvest rates (fish/h), and harvest, by target species, for boat angling parties interviewed on Nantahala Reservoir, June 1999–May 2000. Directed-effort catch and harvest rates are given for bass, walleye, and trout angling parties. Totals (for all days in survey year) and seasonal estimates are given by target species and for overall effort. Standard deviations for weighted mean catch and harvest rates, and approximate standard errors for catch and harvest estimates, are given in parentheses for annual values.

Estimates by target species	All days in survey year	Season			
		Jun–Aug	Sep–Nov	Dec–Feb	Mar–May
Black bass					
Catch rate, all anglers	0.34 (0.05)	0.21	0.55	0.17	0.43
Catch rate, bass anglers	0.68 (0.15)	0.49	0.65	0.58	0.98
Bass catch	4,171 (709)	1,285	912	56	1,918
Harvest rate, all anglers	0.12 (0.02)	0.09	0.19	0.06	0.15
Harvest rate, bass anglers	0.09 (0.02)	0.07	0.07	0.07	0.15
Bass harvest	1,106 (200)	163	251	18	674
Walleye					
Catch rate, all anglers	0.05 (0.02)	0.06	0.02	0.11	0.02
Catch rate, walleye anglers	0.21 (0.08)	0.13	0.30	0.30	0.10
Walleye catch	996 (504)	838	46	17	95
Harvest rate, all anglers	0.05 (0.02)	0.05	0.02	0.10	0.02
Harvest rate, walleye anglers	0.17 (0.08)	0.09	0.25	0.25	0.10
Walleye harvest	502 (140)	357	46	12	87
Trout					
Catch rate, all anglers	0.03 (0.01)	<0.01	<0.01	0.04	0.07
Catch rate, trout anglers	0.23 (0.08)	No data	0.11	0.29	0.40
Trout catch	525 (327)	21	4	11	489
Harvest rate, all anglers	0.03 (0.01)	<0.01	<0.01	0.04	0.06
Harvest rate, trout anglers	0.20 (0.08)	No data	0.11	0.29	0.28
Trout harvest	427 (293)	21	4	11	391
Yellow perch					
Catch rate, all anglers	0.03 (0.01)	0.04	0.03	0.03	0.02
Yellow perch catch	327 (93)	206	30	6	85
Harvest rate, all anglers	0.03 (0.01)	0.04	0.03	0.01*	0.02
Yellow perch harvest	307 (93)	206	30	0	71
Rock bass/crappie/sunfish					
Catch rate, all anglers	0.28 (0.04)	0.34	0.64	0.01*	0.14
Centrarchid catch	4,927 (1,132)	3,235	1,101	0	681
Harvest rate, all anglers	0.16 (0.04)	0.08	0.47	0.01*	0.10
Centrarchid harvest	1,848 (528)	670	690	0	488
All species					
Overall catch rate	0.74 (0.06)	0.65	1.25	0.36	0.69
Total catch	10,980 (1,800)	5,593	2,022	90	3,275
Overall harvest rate	0.39 (0.05)	0.26	0.71	0.23	0.34
Total harvest	4,223 (696)	1,425	1,041	41	1,716

* Winter perch and centrarchid catch and harvest rates obtained from interviews on days with "0" estimated effort.

TABLE 3.—Estimated catch and harvest rates (fish/h) for angling parties interviewed on Queens Creek Reservoir, June 1999–May 2000. Totals (for all days and party types in survey year), rates by party type (boat or bank), and seasonal estimates are given for major target species and for overall catch and harvest rates. Standard deviations for weighted mean catch and harvest rates are given in parentheses for annual values.

Estimated rates by target species	All days and party types	Party type		Season	
		Boat	Bank	Apr–Sep	Oct–Mar
Trout					
Catch rate, all anglers	0.23 (0.06)	0.14	0.27	0.33	0.01
Catch rate, trout anglers	0.45 (0.17)	0	0.45	0.91	0
Harvest rate, all anglers	0.07 (0.04)	0.08	0.06	0.11	0
Harvest rate, trout anglers	0.32 (0.21)	0	0.32	0.64	0
Black bass					
Catch rate	0.08 (0.06)	0.05	0.09	0.12	0
Harvest rate	<0.01 (<0.01)	<0.01	0	<0.01	0
Yellow perch					
Catch rate	1.97 (1.52)	0.22	2.84	0.50	4.90
Harvest rate	1.59 (1.53)	0.01	2.38	0.05	4.67
Rock bass/sunfish					
Catch rate	0.42 (0.16)	0.57	0.34	0.58	0.09
Harvest rate	0.03 (0.03)	0.10	0	0.05	0
All species					
Catch rate	2.75 (1.53)	0.99	3.62	1.62	5.00
Harvest rate	1.70 (1.54)	0.21	2.44	0.21	4.67
Sample size	34	12	22	26	8

TABLE 4.—Response percentages for angler residency and mean trip expenditures (2000 US$) reported by anglers interviewed during creel surveys of Nantahala and Queens Creek reservoirs, June 1999–May 2000. Sample sizes are given for each category.

Response, by category	Response frequency (%), sample size, or trip cost (US$)	
	Nantahala	Queens Creek
Boat angler residency (% of responses)		
NC, local	91.1	91.7
NC, other	6.7	0
Out-of-state	2.2	8.3
Number of responses	315	12
Bank angler residency (% of responses)		
NC, local	62.5	90.9
NC, other	25.0	4.5
Out-of-state	12.5	4.5
Number of responses	16	22
Mean trip expenditure by boat anglers ($)[a]		
NC, local	18.77	11.73
NC, other	48.75	No data
Out-of-state	36.43	10.00
Number of responses	303	13
Mean trip expenditure by bank anglers ($)[a]		
NC, local	12.22	7.68
NC, other	8.25	No data
Out-of-state	4.00	40.00
Number of responses	15	20

[a] Total expenditures of anglers in party.

TABLE 5.—Response percentages for repeated interviews, and for angling frequency and motivation for fishing reported by angling parties interviewed during creel surveys of Nantahala and Queens Creek reservoirs, June 1999–May 2000. Sample sizes are given for each category.

Response, by category	Response frequency (%) or sample size	
	Nantahala	Queens Creek
First time interviewed (% of responses)		
Yes	38.6	60.0
No	61.4	40.0
Number of responses	334	35
Fishing trips/month (% of responses)		
One or fewer	33.3	42.1
Two	14.0	15.8
Three	16.3	15.8
Four	14.0	10.5
Five or more	22.5	15.8
Number of responses	129	19
Reason for fishing reservoir (% of responses)		
Good fishing	34.6	36.8
Scenic value	9.4	5.3
Less crowded	14.2	15.8
Locally accessible	20.5	15.8
Clean water	13.4	10.5
Good facilities	0	0
Proximity to resources	2.4	0
Other	5.5	15.8
Number of responses	127	19

TABLE 6.—Percentages of boat angler responses to incidences of crowding and resulting changes in fishing habits, obtained during creel surveys of Nantahala and Queens Creek reservoirs, June 1999–May 2000. Changes in fishing habits are categorized as spatial or temporal modifications. Sample sizes are given for each category.

Response, by category	Nantahala	Queens Creek
Fishing habits ever changed by reservoir crowding (% of responses)		
Changed	21.4	0
Never changed	78.6	100.0
Number of responses	117	6
Method to avoid crowding (% of responses)		NA
Spatial		
Fish coves	12.0	
Go to other lakes	4.0	
Go home	0	
Other	0	
All spatial	16.0	
Temporal		
Avoid weekends	16.0	
Fish at night	28.0	
Avoid busy season	40.0	
Other	0	
All temporal	84.0	
Number of responses	25	0

TABLE 7.—Percentages of boat angler responses regarding opinion of quality of boating access areas and recommended improvements, obtained during creel surveys of Nantahala and Queens Creek reservoirs, June 1999–May 2000. Sample sizes are given for each category.

Response, by category	Nantahala		Queens Creek
	Rocky Branch	Big Choga	
Quality of area (% of responses)			
Excellent	25.0	10.0	0
Good	45.5	50.0	0
Fair	26.1	26.7	16.7
Poor	2.3	13.3	66.7
No Opinion	1.1	0	16.7
Number of responses	88	30	6
Recommended improvement (% of responses)			
Larger lot / more ramps	24.4	30.0	40.0
Paving / grading	18.6	0	40.0
Docks	5.8	0	0
Low water access	4.7	0	0
Trash cans	3.5	3.3	0
Lighting	10.5	43.3	0
Signs	0	0	0
No improvements needed	11.6	6.7	20.0
Other	20.9	16.7	0
Number of responses	86	30	5

TABLE 8.—Percentages of angler responses regarding opinion of quality of fishery resources and recommended improvements, obtained during creel surveys of Nantahala and Queens Creek reservoirs, June 1999–May 2000. Sample sizes are given for each category.

Response, by category	Angler group, by reservoir					
	Nantahala				Queens Creek	
	All	Bass	Walleye	Trout	All	Trout
Quality of fishery (% of responses)						
Best in region	7.0	2.8	17.4	0	0	0
Good/better than most others	40.3	38.9	34.8	16.7	73.7	40.0
Average for region	30.2	38.9	26.1	66.7	21.0	40.0
Poor/worse than most others	13.2	8.3	17.4	0	0	0
Worst in region	2.3	2.8	4.3	16.7	0	0
Don't know / no opinion	7.0	8.3	0	0	5.3	20.0
Number of responses	129	36	23	6	19	5
Recommended improvement (% of responses)						
Water quality protection	3.9	0	0	0	5.6	0
Fish habitat structures	13.2	5.6	8.7	16.7	5.6	0
Lake level stabilization	9.3	22.2	4.3	0	16.7	0
Shoreline protection	6.2	5.6	4.3	0	0	0
Forage fish stocking	24.8	36.1	21.7	50.0	27.8	0
Game fish stocking	21.7	16.7	30.4	0	22.2	75.0
More law enforcement	1.6	0	0	16.7	0	0
New fishing regulations	6.2	0	13.0	0	0	0
No improvements needed	4.7	11.1	0	0	5.6	0
Other / don't know	8.5	2.8	17.4	16.7	16.7	25.0
Number of responses	129	36	23	6	18	4

TABLE 9.—Response percentages for property ownership, preference of shoreline type for fishing, and opinion regarding need for active role of hydropower operator in shoreline protection, for angling parties interviewed during creel surveys of Nantahala and Queens Creek reservoirs, June 1999–May 2000. Sample sizes are given for each category.

Response, by category	Response frequency (%) or sample size	
	Nantahala	Queens Creek
Own property on reservoir (% of responses)		
Yes	9.4	5.3
No	90.6	94.7
Number of responses	127	19
Preferred shoreline type for fishing (% of responses)		
Natural	82.8	78.9
Developed	0	0
Both / no preference	17.2	21.1
Don't know	0	0
Number of responses	128	19
Active role by hydropower operator in shoreline protection is needed (% of responses)		
Strongly agree	62.0	63.2
Agree	25.6	26.3
Don't know / no opinion	10.1	10.5
Disagree	1.6	0
Strongly disagree	0.8	0
Number of responses	129	19

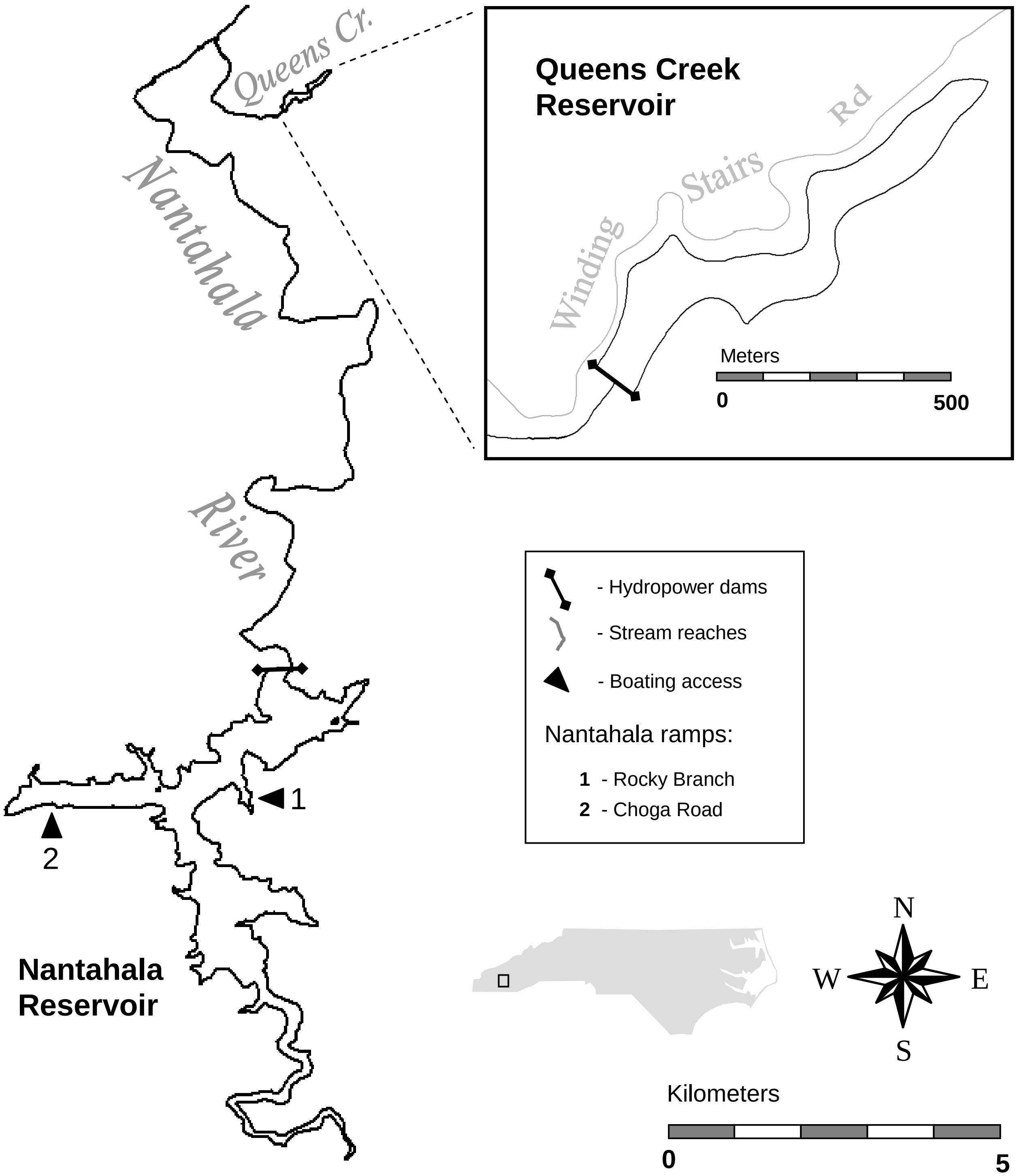

FIGURE 1.—Map of study area showing Nantahala and Queens Creek dams and reservoirs, downstream reaches of the Nantahala River and Queens Creek, and boating access points included in 1999–2000 creel surveys. At the time of the survey, Queens Creek Reservoir had only primitive access for small boat portage and bank fishing along Winding Stairs Road.

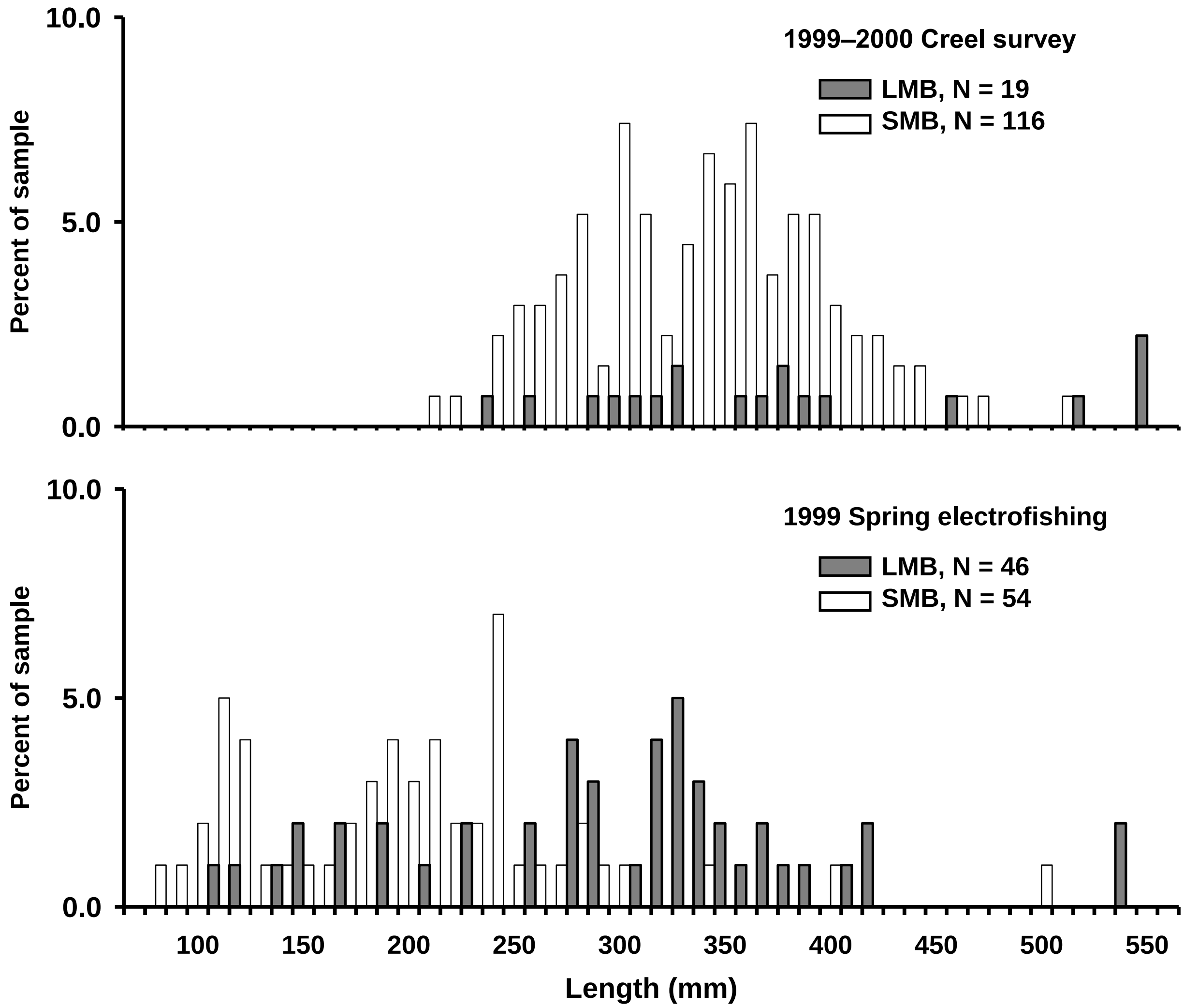

FIGURE 2.—Length-frequency distributions for largemouth and smallmouth bass measured by clerks during creel survey of Nantahala Reservoir, 1999–2000. Length-frequency distributions of black bass collected from Nantahala Reservoir in 1999 spring electrofishing surveys (Loftis and Yow 2004) are shown for comparison.

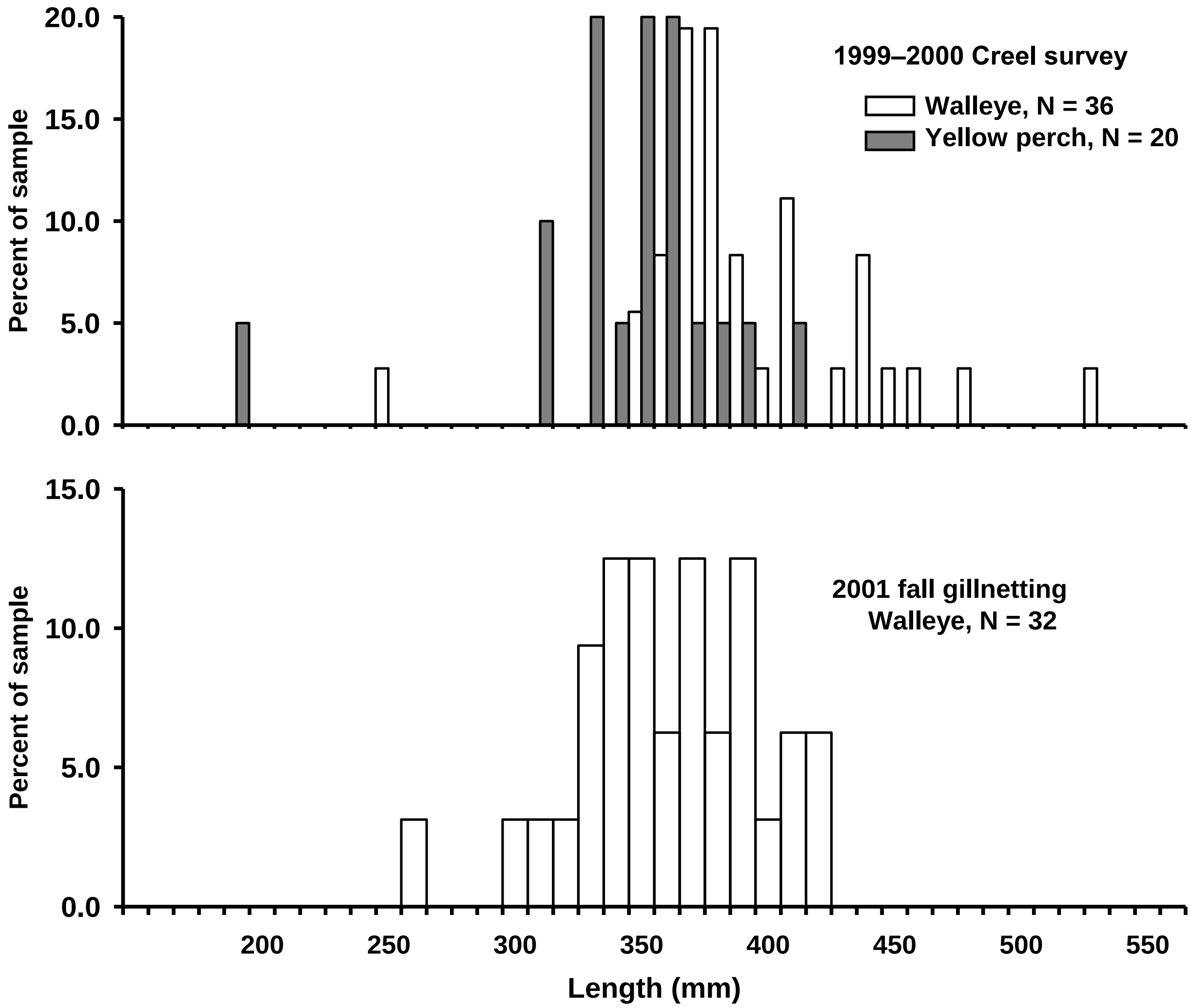

FIGURE 3.— Length-frequency distributions for walleyes and yellow perch harvested from Nantahala Reservoir, measured by clerks during 1999–2000 creel survey. Walleye length-frequency distribution from 2001 fall gillnetting on Nantahala Reservoir (NCWRC, unpublished data) is shown for comparison.

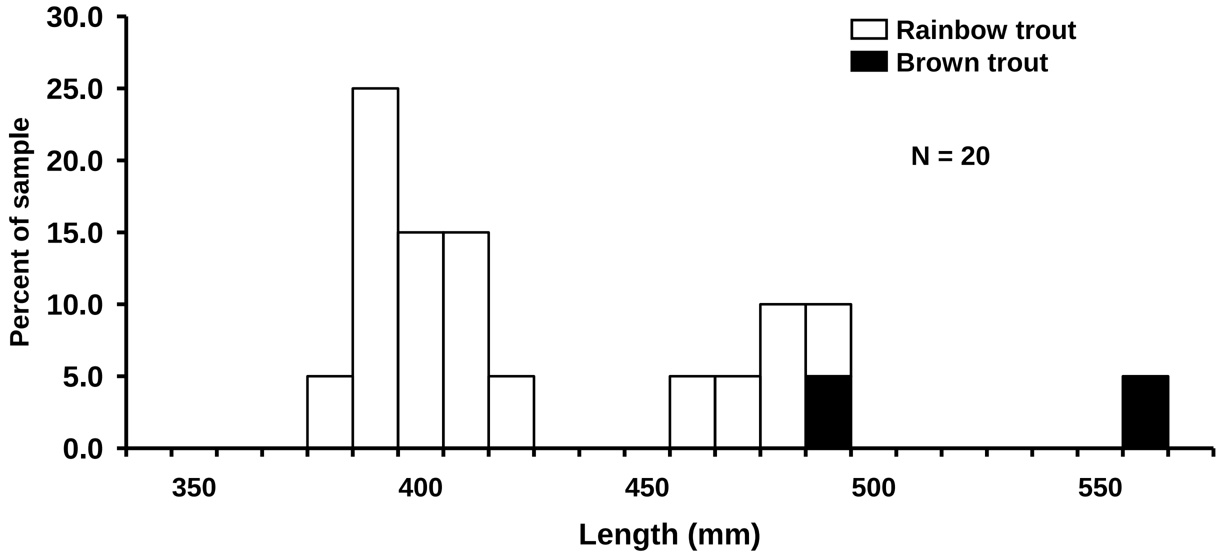

FIGURE 4.— Length-frequency distributions for harvested trout measured by clerks during creel survey of Nantahala Reservoir, 1999–2000.

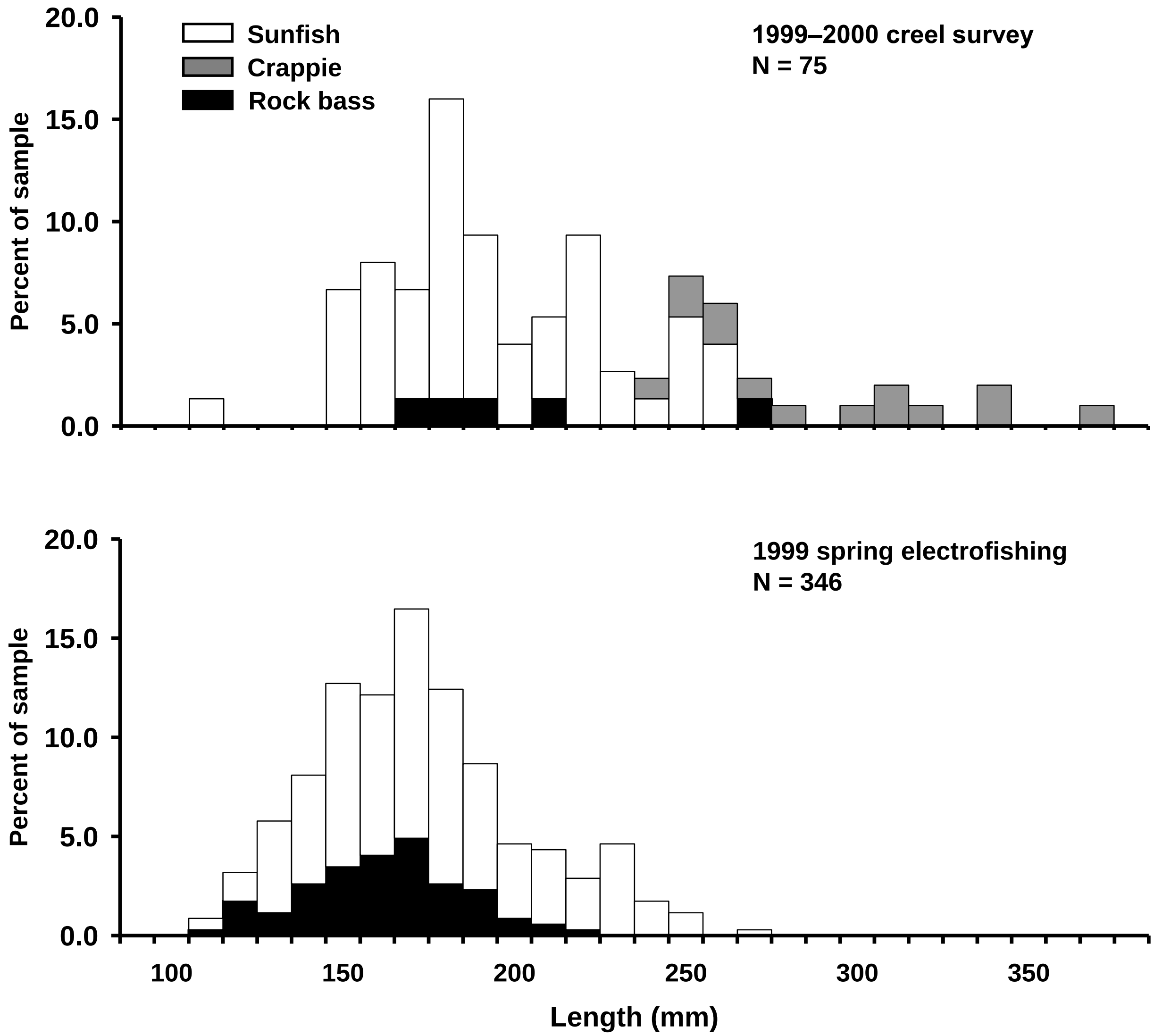

FIGURE 5.—Length-frequency distributions for harvested crappie, rock bass, and sunfish species measured by clerks during creel survey of Nantahala Reservoir, 1999–2000. Length-frequency distributions for rock bass and sunfish collected in 1999 spring electrofishing surveys (Loftis and Yow 2004) are shown for comparison. Small sunfish (<100mm, N = 5) measured during 1999 electrofishing surveys were not included in the histogram. No crappies were collected during 1999 electrofishing surveys.

Appendix: Sample interview forms, 1999–2000 creel surveys.

NP&L 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 _____ CO. OF RESIDENCE __________

1. What time did you begin fishing today? _________ TOTAL TIME FISHING (HRS) _______
2. What kind of fish are you fishing for? ________________
3. How much will you spend on today's fishing trip (gas, food, etc.)? $____________
4. What have you caught today?

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

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. ____/____ ____/____ ____/____ ____/____ ____/____

NO. BOATS OBSERVED EXITING DURING PERIOD________
NO. OBS. EXITING BOATS ENGAGED IN FISHING________

(PM only) NUMBER OF TRAILERS
PRESENT AT END OF PERIOD______

KEY CODE: **MONTH ___ ___ DAY TYPE ___ DAY NO. ___ ___ ☐ AM COUNT ONLY**

ACCESS AREA COUNTS

COUNT TIME________

ROCKY BRANCH:	________ TRAILERS,	________ BANK ANGLERS	
CHOGA CREEK:	________ TRAILERS,	________ BANK ANGLERS	
QUEENS CR RES:	________ TRAILERS,	________ BANK ANGLERS	

OTHER AREAS

1)	________________	________ TRAILERS,	________ BANK ANGLERS
2)	________________	________ TRAILERS,	________ BANK ANGLERS
3)	________________	________ TRAILERS,	________ BANK ANGLERS

FIGURE A1.—First page of interview sheet used for creel surveys of Nantahala and Queens Creek reservoirs, 1 June 1999–31 May 2000. Upper boxed portion contains questions asked of all angling parties. Lower portion contains count data entry fields.

Appendix: continued.

PAGE 2

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

2. 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______________________

3. How would you rate the quality of this access area? ____________
   1=excellent, 2=good, 3=fair, 4=poor, 0=no opinion/don't know

4. 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________________________

5. 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

6. 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________________________________

7. Has the number of watercraft on this lake ever caused you to change the time or location that you fish? Y or N ____________

8. (If Yes to #7) 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____________________________

9. Do you own property adjacent to this lake? Y or N ____________

10. Do you prefer to fish near natural or developed shoreline? ____________
    N=natural, D=developed, B=both, P=no preference, K=don't know

11. Do you think that Nantahala Power and Light should take an active role in the protection of natural shoreline on this lake? ____________
    1=strongly agree, 2=agree, 3=don't know/no opinion, 4=disagree, 5=strongly disagree

12. Would you like to make any other comments regarding management of this lake?
    ____
    ____
    ____

GO TO PAGE 1 NO. 6

FIGURE A2.—Second page of interview sheet used for creel surveys of Nantahala and Queens Creek reservoirs, 1 June 1999–31 May 2000. Responses were obtained only from angling parties being interviewed for the first time on each reservoir.