

Evaluation of an Experimental Brook Trout Fishery in Great Smoky Mountains National Park

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Executive Summary

The brook trout is a prominent part of southern Appalachian culture that has been a prized angling tradition since Great Smoky Mountains National Park (GRSM) was established in 1934. Major population losses associated with fire, logging, and non-native fish introductions during the early 1900's reduced the original range of brook trout in the Park by about 50%. By the 1970's, brook trout distribution surveys revealed that this native salmonid was only found in about 25% of its historic range. Based upon available information, biologists thought that brook trout were being systematically replaced and that the only places they would be found in GRSM by 2000 would be upstream of natural barriers, assuming trends were not reversed. Biologists believed that each individual angler was consistently harvesting 50-100 brook trout per day and that this was a contributing factor to brook trout range loss. In 1976, Park management took steps to initiate brook trout restoration in selected streams and made it illegal to harvest brook trout.

Research and restoration efforts from 1976 to 2001 have demonstrated that brook trout are resilient, have not lost additional range, and continue to thrive in many areas of the Park. Brook trout distribution data from surrounding states for this same time period also demonstrates that existing populations have remained relatively stable for the last 30 years. These findings refuted the 1970's predictions that brook trout range loss was a systematic and irreversible process.

Monitoring and research efforts during the last 25 years have shown that in the unproductive headwater streams in which most brook trout live, less than 5% of adult brook trout reach 178mm (7 inches) and very few live to 4 years of age. Mortality rates in these wild brook trout populations' range from 60-80% annually. Natural processes, such as food limitation, droughts, and major spring floods limit trout populations in the Park and in streams in surrounding states, regardless of fishing pressure. In fact, population dynamics for streams open to fishing outside the Park are identical to those of streams closed to fishing within the Park. This finding is substantiated by comparisons of rainbow trout population density, biomass, age structure and total mortality in streams closed to fishing and those open to a variety of fishing regulations. One potential reason for this is that trout angler attitudes have shifted from a harvest orientation to more emphasis on the outdoor experience in the last 30 years. Angler creel data from GRSM, surrounding states, and nationwide studies indicate that wild trout anglers place a much greater value on the wild trout fishing experience than the act of harvesting wild trout.

Based on the success of brook trout restoration efforts and comparisons of population monitoring data from GRSM and surrounding states, we are proposing that eight brook trout streams be opened to fishing on an experimental basis. Anglers will be allowed to fish eight study streams of varying accessibility for three years. Anglers will be required to adhere to existing size and creel limits. After the three-year fishing period, a variety of population parameters will be compared among pre-, during and post-fishing periods. The results of this study will provide us with the information necessary to determine if recreational angling incurs any negative population level impacts to our only native trout. The results of this study will be used to determine if brook trout fishing and harvest should be opened in all streams currently closed Parkwide.

Issue Statement

Brook trout (*Salvelinus fontinalis*) were a part of North American culture before the first European settlers established themselves in the Appalachian Mountains. Since that time, brook trout have been sought as an important native food source and leisurely as a magnificent sport fish (King 1938). Besides Atlantic salmon (*Salmo salar*) in the northeastern United States, brook trout are the only salmonid native to the coldwater streams east of the Mississippi River. However, due mainly to anthropogenic impacts and extensive stocking of rainbow and brown trout, brook trout today occupy less than a quarter of their native range (Trout Committee SD AFS 2002).

Changes in the distribution of brook trout since 1900 have been best documented in GRSM (King 1937, Lennon 1967, Kelly et al.1980). These findings, plus projections that, if the trends in range loss were not arrested or reversed, brook trout would be extirpated from the Park by 2000, disturbed Park managers. Steps were, therefore, immediately taken to prevent further range loss. In 1976, a graduate study was funded to determine if electrofishing could be used to eliminate non-native rainbow trout from stream sections upstream of waterfalls and cascades. At the same time, angling for brook trout was closed. The primary reasons for the closure was the perception that brook trout were more susceptible to angling than other trout species and increased angling (legal and illegal) had added to the decline in this fishery. This decision was highly controversial with the angling public and the need for this drastic action was questioned by some state agencies. However, Park managers defended their decision by stating that, based upon the available information, the decision was believed to be in the best interest of the resource but would be re-visited when and if scientific data became available that would affect the decision.

During the last three years, we have compared brook trout population monitoring data for streams open to fishing in TN and NC with data from streams closed to fishing in GRSM. These comparisons clearly demonstrate that angling has no effect on the population dynamics of wild brook trout. Based on these comparisons and the success of the Parks restoration program, we propose to open eight streams experimentally for recreational fishing for brook trout for a three-year period. The purpose of the brook trout fishing experiment (Appendix A) is to provide the information necessary to determine if brook trout populations in these streams are affected by three years of angling. The data generated from this project will be evaluated and the results will be used to make a recommendation regarding the future of brook trout fishing in GRSM. This proposal will provide a sound scientific basis to make such a recommendation as well as provide a useful piece of information to fishery managers throughout the southeastern U.S. who also manage wild brook trout populations.

We believe that, in addition to providing Park visitors an opportunity to experience these fish, the project would generate the following benefits: 1) public support for future restoration projects and protection of brook trout; and 2) educating the public about the history and future of brook trout management in GRSM. Given the historic and cultural stature of brook trout in the southeastern U.S., brook trout fishing opportunities are a valuable interpretive tool and greatly treasured by anglers. To date, GRSM has successfully met the intent of 1916 Organic Act by protecting and preserving brook trout in segments of their historic range. The implementation of the proposed experimental fishery will fulfill the last part of the act, which provides for use and enjoyment by present and future generations.

Background

Brook trout are the only salmonid native to GRSM and were once found in nearly every watershed, from its headwaters to roughly 1,250 m (2,000 ft) near the Park boundary (King 1937). Kelly et al. (1980) indicated that this native trout once occupied 680 km of the Park's 1,173 km of fishable streams. However today brook trout are usually isolated in small headwater streams 1,000 m above mean sea level (Moore et al. 1983). In 1980, brook trout were estimated to exclusively occupy 197 km of streams of which 64 km lie upstream of natural barriers (Alan Kelly personal communication).

Changes in the distribution of brook trout have been well-documented (King 1937, Lennon 1967, Kelly et al. 1980). King (1937) attributed many of the changes in brook trout distribution between the turn of the century and the mid-1930's to alterations of water quality and habitat caused by intensive logging and fires. King (1937) also attributed their decline to the use of explosives and nets to capture brook trout and the introduction of non-native rainbow trout (*Oncorhynchus mykiss*) into streams devoid of brook trout and in streams containing native species. Rainbow trout stockings were most extensive at lower elevations, but some middle- to high-elevation stockings occurred off of logging railroad trestles. Trout distribution surveys in the 1930's (King 1937), 1950's (Lennon 1967) and the 1970's (Kelly et al. 1980) demonstrated that brook trout range had declined significantly and that rainbow trout range expansion equaled the range loss (Larson and Moore 1985). Based on the available information, the range expansion of rainbow trout had occurred by upstream immigration into streams exclusively occupied by native brook trout. Fishery biologists for the US Fish and Wildlife Service stated that it appeared that brook trout were being systematically replaced by non-native salmonids.

These findings, plus projections that, if the trends in range loss were not arrested or reversed, brook trout would be extirpated from the Park by 2000. This omen disturbed Park managers. Steps were, therefore, immediately taken to prevent further range loss. In 1976, a graduate study was funded to determine if electrofishing could be used to eliminate non-native rainbow trout from stream sections upstream of waterfalls and cascades. At the same time, angling for brook trout was closed. The primary reasons for the closure was the perception that brook trout are more susceptible to angling than other trout species and increased angling (legal and illegal) had added to the decline of brook trout. This decision was highly controversial with the angling public and the need for this drastic action was questioned by some state agencies. However, Park managers defended their decision by stating that, based upon the available information, the decision was believed to be in the best interest of the resource but would be revisited when and if scientific data became available that could affect the decision.

Brook trout distributions surveys from 1992 to 2001 (58 % of watersheds surveyed) throughout GRSM have documented over 162 miles of streams containing brook trout populations. Sixty percent (97.6 miles) of this total is exclusively occupied by brook trout. Comparisons with historic data indicate that the distribution of brook trout in these streams has not changed since the 1970's and we predict that this same pattern will be documented in the remaining watersheds. Similar surveys conducted by the states of TN, NC, VA, GA, and SC have enabled regional managers to determine the current range of southern Appalachian brook trout has not changed in the last 25 years.

Brook trout restoration efforts since 1976 have expanded the range of native brook trout. Restoration efforts in GRSM have successfully restored 11.1 miles (17.8 km) of nine stream segments back to native allopatric brook trout populations. Local and non-local anglers,

regional conservation groups, federal and state agencies (i.e. US Forest Service, US Fish & Wildlife Service, TN Wildlife Resources Agency, NC Wildlife Resources Commission, VA Department of Game & Inland Fisheries), and other national parks recognize the success of brook trout restoration efforts in GRSM and endorse this work. However, they also question why the Park does not allow anglers to fish for brook trout. The reasons for this question are: 1) that western parks allow angling for federally listed cutthroat trout, 2) brook trout are not a federally listed species and 3) data from their streams demonstrates that recreational angling has no population level effects. They also point out that the success of the restoration program is another reason for allowing angling. These groups have encouraged the Park to evaluate the feasibility of allowing angling for brook trout again

Brook Trout Biology

Brook trout *Salvelinus fontinalis* are the only member of the Salmonidae family native to the southern Appalachians (Etnier and Starnes 1993). The native range of brook trout includes most of eastern Canada, the Great Lakes region, and the eastern United States throughout the Atlantic and Mississippi River drainage's into northern Georgia. Although members of the salmon family (Salmonidae), brook trout are actually char, closely related to lake trout *Salvelinus namaycush*, bull trout *Salvelinus confluentus*, arctic char *Salvelinus alpinus*, and dolly varden *Salvelinus malma*. Brook trout currently represent about one fourth of the wild trout resources found throughout the southern Appalachian Mountains (Habera and Strange 1993).

Extensive life history data has been collected throughout the southern range of brook trout, including GRSM. Brook trout in the Park and surrounding areas live about 3-4 years reaching 200-220mm (8-9 inches) maximum total length before they die (Lennon 1967; Kulp 1994). Annual mortality rates for GRSM brook trout from ages 1-4 range from 62-72% (Moore 1979; Kulp 1994). Brook trout reach reproductive maturity by age-2 at 125-175mm (5-7 inches). GRSM monitoring data from 1992 indicate that of all brook trout collected annually (3,000-3,500 fish), <5% reach the legal harvest size of 178mm (7 inches). Wild brook trout populations in surrounding state and federal waters mirror GRSM populations in terms of annual mortality, maximum total length, and reproductive maturity (Habera et al 2001; Borowa et al. 2001).

The productivity of southern Appalachian headwater streams is extremely low in comparison to other parts of the country (Cada et al. 1987). The low productivity, naturally occurring food limitations, extremes in temperature and stream flow, and high stream gradients inhibit brook trout from attaining larger sizes in southern Appalachian headwater streams (Lennon 1967; Ensign et al. 1990; Strange and Habera 1994; Borowa et al. 2001). In most areas, brook trout simply run out of food resources to maintain metabolic demands, begin to lose weight, and die (Ensign et al. 1990, Cada et al. 1987). Ensign et al. (1990) determined that minimum metabolic maintenance requirements of brook and rainbow trout in GRSM annually drop below minimum levels resulting in trout losing biomass. Visual implant (VI) tag data collected during GRSM surveys supports Ensign et al. (1990) and indicates net weight (g) of rainbow trout increases annually up to the 178-203mm (7-8 inches) size group, then declines in the 203 to 229mm (8-9 inches) size group, finally becoming negative in fish greater than 230mm (9 inches). Whereas all rainbow trout >177mm (7 inches) will grow 15 to 25mm and gain 15 to 32g from October to May, these same fish will only grow 1 to 16mm and gain 4 to 10g from May to September. Ensign et al. (1990) determined the critical period (i.e. negative growth) for brook and rainbow trout appears to be the June to October period. The combination of high

summer water temperatures (15-22°C), increased metabolic rate, and summer food limitation create a critical period for salmonids in GRSM, especially those >203mm (8 inches).

The effects of food limitations were demonstrated by Borowa et al. (1995) who found that supplemental feeding of a wild rainbow trout population resulted in numerous fish up to 406mm (16 inches), whereas few fish >177mm (7 inches) existed before. Furthermore, Borowa et al. (1995) found that less than 1 year after feeding began, roughly 60% of the fish >100mm were over 176mm. Only 12-20% of rainbow trout in GRSM headwater streams (< 3rd order) reach the 178mm size limit. In typical GRSM, NC, and TN wild brook trout populations, less than 5% of a given population reach 178mm (7 inches) (Kulp 1994; Habera et al. 2001; Borowa et al. 2001).

Given the limited natural productivity of southern Appalachian streams, mean standing crops of allopatric brook trout streams of GRSM streams were 21.2-31.7 kg/ha, well below that of western trout streams (34 kg/ha) (Platts and McHenry 1988). Mean standing crop of GRSM streams closely compare with those of brook trout in TN at 32 kg/ha (Strange and Habera 1995), Georgia 13 kg/ha (Durniak et al. 1997), and NC 34 kg/ha (Borowa et al. 2001). Annual standing crops and young-of-year (YOY) productivity may vary >50% depending upon annual and cumulative influences of droughts and floods. These variation patterns are very similar to those observed in populations outside of GRSM (Habera et al. 2001; Borowa et al. 2001).

Despite the highly dynamic drought and flood patterns of southern Appalachian headwater streams, brook trout are an extremely resilient species and have adapted to these changing environmental conditions by quickly repopulating depleted streams (GRSM 1995). Borowa et al. (2001) have documented this same phenomena in streams in NC. For example, in years following severe floods (i.e. 1995 and 1998), YOY production accounted for as much as 77% of the brook trout density in allopatric populations (GRSM 1995). Through reproduction and recruitment, brook trout quickly repopulate streams and populations are typically back to carrying capacity within two years (Figure 1). Despite short-term declines due to droughts and floods, most populations have remained relatively stable over a 12-15 year period in GRSM (Figure 2). Borowa et al. (2001) found that brook trout densities changed very little over a 60-year period despite numerous severe drought and flood episodes during the period.

The greatest threat to brook trout populations today and in the future is acid deposition impacts on high elevation forests. Brook trout range loss associated with acid deposition has been confirmed in two streams since the 1970's. Several studies (Larson et al. 1979; Smoot et al. 2000) have documented the effects and scope of acid deposition on the flora and fauna of GRSM, however the causes of acid deposition supercede Park boundaries. Public recognition of threats to brook trout and other aquatic fauna will benefit these and other resources effected by acid deposition.

Genetic Composition

Due to the loss of native brook trout during the early 1900's, over 800,000 brook trout from northeastern hatchery-reared strains were stocked throughout GRSM from 1934 to 1975. Holloway (1945) stated that Northern hatchery brook trout were stocked to meet angling demands were stocked because attempts to raise the native brook trout already living in GRSM streams were difficult and ineffective (Lennon 1967). In many cases, northern hatchery brook trout were stocked on top of existing remnant brook trout populations.

Local anglers and fishery managers immediately began to question the appearance and genetic composition of northern hatchery brook trout versus fish native to the southern

Appalachians. Lennon (1967) found southern Appalachian brook trout differed from northern hatchery strains in coloration, fecundity, disease resistance, and general performance. Several genetic studies were initiated prior to 1981 to determine if there were substantial genetic differences. Many of these early studies were generally flawed due to poor electrophoretic techniques, unknown source populations, and the lack of distinct genetic markers resulting in contradictory and inconclusive results (Brandes 1978; White 1978; Shipp 1979). Stoneking et al. (1981) provided genetic evidence that there were subspecific differences in the two strains, however, the issue went unresolved for many years. The discovery of GRSM stocking records in 1987 (S.E. Moore, personal communication) afforded geneticists the opportunity to distinguish stocked and unstocked populations and later enabled researchers to identify genetic markers unique to each strain (McCracken et al. 1993).

Recent genetic research has identified unique mitochondrial and nuclear markers that clearly distinguishes northern and southern genotypes on at least the sub-specific level (Guffey et al. 1999). In fact, genetic differences between southern Appalachian brook trout and northern hatchery strains are greater than those used to differentiate cutthroat trout in the western U.S. To date, limited morphometric comparisons have been completed for both strains, however more work needs to be done in order to decide if these two strains warrant taxonomic distinction.

Across the historic range of brook trout in the eastern U.S., there is a distinct genetic break between the strains at the New River watershed in Virginia. Brook trout north of New River, VA are northern strain and those in New River and south are southern genotype. Genetic variability, including greater haplotype diversity among southern populations than among northern populations, suggests very different biogeographical histories of the two groups (Hayes et al. 1996). Drainage and glaciation patterns support the model of Guffey et al. (1999) that suggests: (1) fixed genetic differences between northern and southern populations evolved in populations ancestral to the two groups prior to post-glacial recolonization of the northeast; (2) a small number of closely related lineage's founded current northern populations; and (3) divergence among native southern Appalachian populations is a consequence of the isolation and small effective size of headwater populations (Trout Committee SD AFS 2002).

Due to the widespread stocking of these northern hatchery stocks, GRSM brook trout populations today consist of pure native stocks, pure northern hatchery stocks, and/or hybrids of these two strains (McCracken et al. 1993; Kriegler et al. 1995; Guffey 1998; Dunham et al. 2001; Galbreath et al. 2001). As of January 2002, 47 brook trout populations (35% of total) have been genetically typed throughout GRSM. Of these populations, 30 (64%) are pure southern Appalachian, 2 (4%) are pure northern hatchery stocks, and 15 (32%) are intergrades (hybrid) of the two strains. Roughly 24% of all known southern Appalachian brook trout are found in GRSM, while NC contains 39%, VA (17%), TN (16%), GA (2%), and SC (1%) (Trout Committee, SD AFS 2002).

Does Angling Have Any Measurable Affect on Trout Populations?

During the last 75 years, the use of more restrictive angling regulations to control or eliminate harvest has become common in North America. Biologist and anglers have had emotional battles over the usefulness of restrictive regulations. In some cases the implementation of the special regulations have protected native stocks from being over harvested and in others, they have failed to achieve management goals (Behnke 1989). Based on his work, the primary reasons special regulations fail is a failure to understand the environmental

limitations for growth and sustenance of a population. For example, the number and size of fish a stream can support is controlled by environmental conditions. Because of these factors, self sustaining wild populations are relatively stable because the biomass lost to total annual mortality (natural mortality plus angling mortality) is replaced by annual recruitment (entry of new born fish into the population). Behnke's work clearly demonstrates that no angling rule can over come or modify the elimination of older fish by natural mortality once their growth ceases due to an inadequate food supply.

Evaluations of the effect of angler harvest on population structure in Southeastern streams has shown that angling mortality is only a small part of total annual mortality and that angling mortality is compensatory given the reproductive capacity (Durniak and England 1986, Habera et al. 2001). Angler harvest rates of wild trout in east TN and western NC typically range from 5-20% (Habera et al. 2001; Borowa et al. 2001). However, data from TN, NC, and within GRSM all indicate that natural mortality rates in fished populations of wild trout including brook trout, are identical despite a variety of angler harvest (Habera et al. 2001; Borowa et al. 2001). For example, TN utilizes both liberal (i.e. bait fishing, treble hooks) and restrictive regulations (i.e. single hook artificial lures) for wild brook trout fishing, including a 6 or 7-inch minimum size limit and 3-7 fish creel limits. Standing crops (kg/ha) and length frequency data are identical for both general and special regulation areas (Strange and Habera 1995). In addition, there are no differences in length frequency distributions among TWRA general, special regulation areas, or GRSM brook trout populations (both allopatric and sympatric) that are closed to fishing (Figure 2). Brook trout data from NC populations is very similar to those in TN.

In NC, Borowa et al. (2001) found 11 of 17 streams that were closed to fishing or under catch and release regulations did not contain any larger percentage of trout >177mm than streams where harvest was allowed. Furthermore, Borowa et al. (1995) found that harvest rates of trout (>177mm) in streams open to single-hook artificial lures was <15%, while in streams open to bait fishing, 53-77% of legal trout (>177mm) were harvested (Borowa and Clemmons 1998). However, even in the bait fishing areas, Borowa and Clemmons (1998) were unable to detect significant differences in trout densities (>177mm) or length frequencies between bait fishing, single-hook artificial, and closed streams.

The Virginia Department of Game and Inland Fisheries (VDGIF) recently conducted a creel survey on wild brook trout streams (Steve Reeser, VDGIF personal communication). Stream access varied from easy to difficult, regulations varied from bait fishing to artificial single hook regulations, and streams received a variety of fishing pressure. Most streams in the study utilized a 7 or 9-inch (178 or 229mm) minimum size limit. Despite the fact that many anglers caught legal brook trout (i.e. >7 or 9 inches), not one brook trout was harvested during the study. When asked about harvesting wild brook trout, 87% (181) of the anglers interviewed (N=208) indicated they had no desire to harvest brook trout, just to fish for them. Fishing pressure was generally low compared to stocked or other special regulations streams containing other trout, however anglers interviewed fished the wild brook trout streams an average of 18 times per year.

Comparisons made in the Park between Sams Creek, which is closed to fishing, and Little River, which is open to fishing, indicate no significant differences in standing crop, length frequencies, or total annual mortality. Review of data from TN, NC, and other surrounding states clearly demonstrates that food availability and total annual mortality are the critical

limiting factors and they are maintained almost entirely by natural mortality due to low productivity not angler harvest (Ensign et al. 1990; Borowa et al. 2001).

NPS Policy Regarding Fishing

Fishing has been a traditional recreational activity in most of the National Park system since congressional authorization of Yellowstone in 1872 (Panek 1994). Two years later, Congress amended Yellowstone's enabling legislation to provide the authority to regulate the taking of fish with hook and line (Panek 1994). During the early 20th century, Park management focused on resource use and visitors services (King 1937), whereas these values shifted towards resource preservation during the 1960's 1970's. Since that time, fisheries management goals in National Parks focused primarily on protection, preservation, and sustainability of native fisheries by closely regulating their fisheries (Panek 1994). To that end, the enabling legislation of many National Parks include specific legislative mandates directing the NPS to permit fishing in accordance with applicable federal and state laws (Panek 1994). In 1992, the National Park Service reaffirmed its commitment to quality recreational fishing and preservation of aquatic and marine habitats by adopting its Recreational Fisheries Program, "A Heritage of Fishing" (Panek 1994). Today, 158 out of 367 (43%) Park Service units have aquatic and marine resources supporting recreational fishing opportunities. In addition, many western Park units offer recreational fishing for Federally protected species with no population level impacts to the resource (i.e. greenback cutthroat trout in Rocky Mountain NP, Yellowstone cutthroat in Yellowstone NP).

The Superintendent can designate streams for experimental fishing (CFR 36. 7.14) and this proposal can be approved under this authority. Data suggesting that fishing is not detrimental to brook trout populations will demonstrate the success and value of brook trout restoration efforts and will be regarded as a tremendous success story by the angling public. This action will also eliminate current criticism that we are removing more fishing opportunities by implementing future restoration efforts (which will result in short-term closures of streams to fishing).

Compliance: NEPA and GRSM Fisheries Management Plan

The reopening of fishing for brook trout is a minor change in regulations pertaining to visitor services and therefore is classified as a categorical exclusion under NEPA 3-4.D (2). Furthermore, the Fisheries Management Plan, which was completed and approved subsequent to the Park's compliance process, states that the fishery management goals are to: 1) preserve and restore native species and aquatic habitats, and 2) to provide park visitors with recreational angling opportunities for their enjoyment. Both goals can be accomplished by continuing our brook trout restoration activities in selected stream segments and by allowing fishing to occur experimentally in carefully selected streams to evaluate the results of the exercise.

Public Acceptance

Annually, we receive about two dozen questions from angler groups asking, "... given the success of your program, when do you think we will be able to fish for brook trout again?" During the last two years, we have received an increasing number of calls (8-12/year) asking about opportunities to fish for brook trout. During public hearings for the proposed Sams Creek

project, we were repeatedly asked the same question. Anglers and the general public typically agree with our restoration work but wish to see streams reopened to fishing for brook trout.

Intra-Divisional Discussion

The proposal has been reviewed by the Park management team and discussed with personnel from Ranger Activities and Resource Education from Cades Cove, Little River, and Oconaluftee to make them aware of the proposal, solicit input, and to answer questions. In addition, the proposal has been individually discussed with personnel from the Maintenance Division. Based upon these discussions, there is unanimous support to reopen selected streams to allow for the experimental harvesting of brook trout. Park employees believe that the proper information has been collected and evaluated and that the cautious approach proposed is the correct one.

Casual conversations with other state and federal professionals indicate full support for this proposal. It likewise appears to us that the time is right biologically and politically to begin the process of reopening some streams to brook trout fishing, with the ultimate goal of opening them Parkwide. The brook trout fishing proposal would also garner public support by demonstrating the NPS mission of protecting, preserving, and restoring natural and cultural resources for the benefit of future generations.

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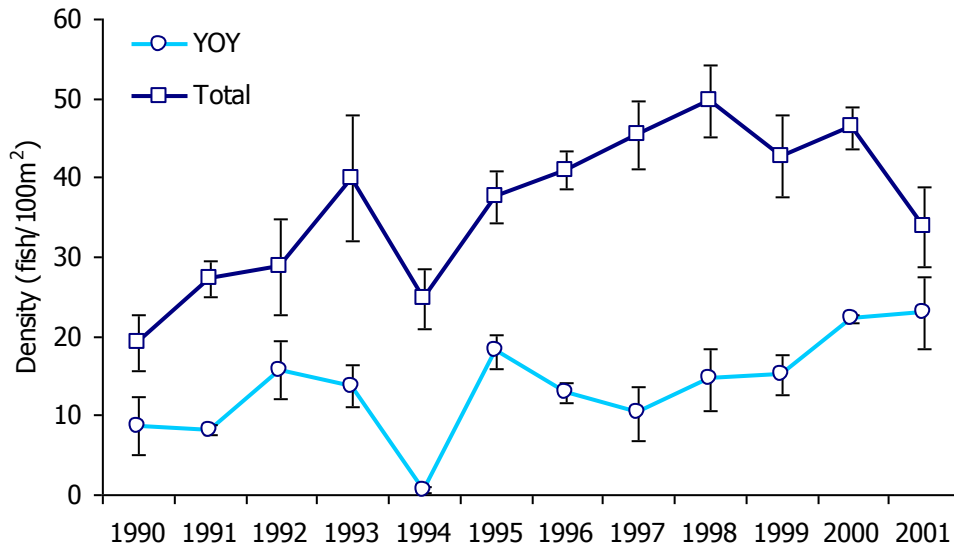


Figure 1. Brook trout density (# fish/100m²) and standard error (SE) (bars) trends for Bunches Creek, GRSM between 1990 and 2001 sampled during annual inventory and monitoring surveys. Note GRSM streams suffered a major flood event in March 1994 and severe drought conditions between 1998 and 2001.

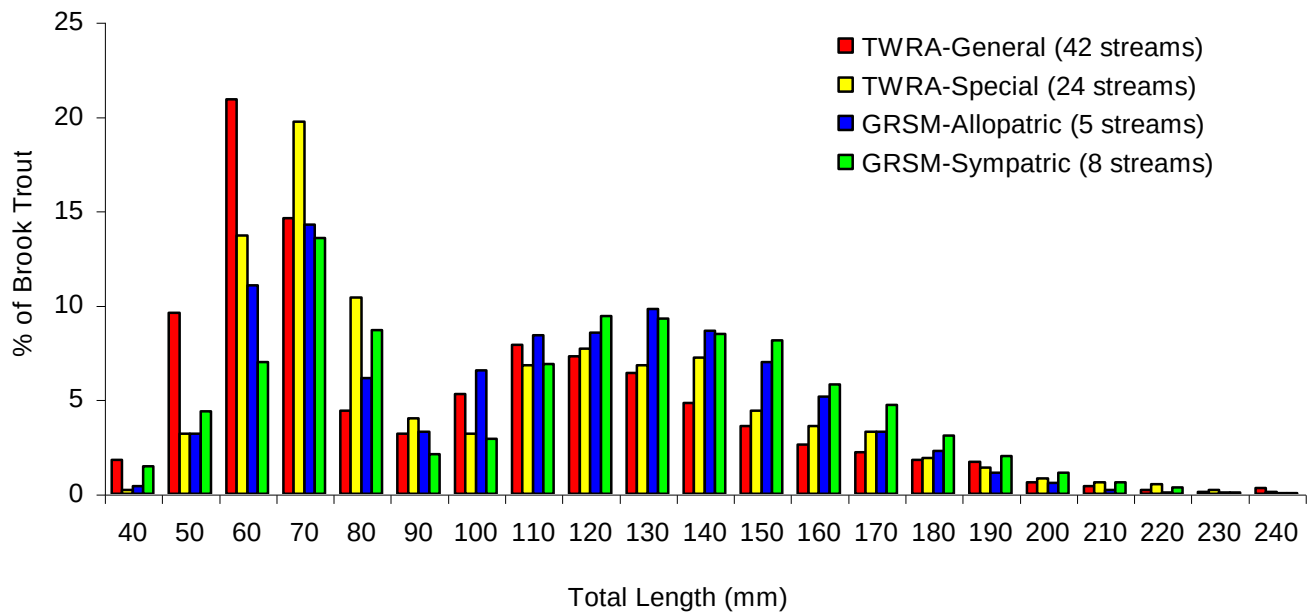


Figure 2-. Brook trout length frequency distributions for streams managed by Tennessee Wildlife Resources Agency (TWRA) under general (42 streams) and special regulations (24 streams) and thirteen streams managed by the National Park Service (GRSM) that are closed to fishing. Note that the 7-inch size limit corresponds to 178mm.

Appendix A

Brook Trout Fishing Proposal

Evaluation of an Experimental Brook Trout Fishery in Great Smoky Mountains National Park

Study Goal

Based on the information outlined above, we believe it is time to reconsider allowing brook trout angling and harvest in GRSM. The goal of this study will be to determine if fishing would impose a detrimental impact to brook trout populations in carefully selected Park streams. The results of this study will be evaluated to provide managers with the information necessary to determine if brook trout fishing and harvest can be opened Parkwide.

Study Plan

We propose to open 8 Park streams (4 in TN and 4 in NC) of varying accessibility and size to fishing beginning on July 1, 2002 (Table 1; Figure 3). Anglers will be allowed to fish the entire stream segment. A suite of 8 control streams will be closed to fishing and used to compare fished vs. un-fished populations in GRSM (Table 1). All streams in Table 1 will contain a minimum of 2 sites for monitoring purposes throughout the experiment. The time frame outlined in Table 2 will allow sufficient time to make changes to the Compendium (i.e. ~1 month per Bob Wightman, personal communication) and to re-sample the streams prior to them being opened to fishing. Current GRSM fishing regulations will be utilized: 5-fish creel per day, 7-inch size limit, single hook artificial lures only. The project will be evaluated for three years (Table 2).

Table 1. History of Inventory & Monitoring data for streams selected for brook trout fishing study. All control streams will be closed to fishing. Streams **open** to brook trout fishing and harvest are in **bold**, *controls* are in *italics*).

Stream Name	Watershed	State	Years of I&M Data	Control or Fishing	Specific Description
Beech Flats Creek	Oconaluftee River	NC	2	Fishing	Entire stream segment upstream of Kanati Fork
Bunches Creek	Raven Fork	NC	11	Fishing	Entire stream segment within GRSM
Hazel Creek	Hazel Creek	NC	5	Fishing	Entire stream segment upstream of Proctor Creek
Lost Bottom Creek	Cataloochee	NC	11	Fishing	Entire stream segment upstream of Palmer Creek
Cosby Creek	Cosby Creek	TN	11	Fishing	Entire stream segment upstream of Rock Creek
Indian Camp Creek	Indian Camp Creek	TN	9	Fishing	Entire stream segment within GRSM
Walker Prong	W. Prong Little Pigeon	TN	3	Fishing	Entire stream segment upstream of Alum Cave Creek
Fish Camp Prong	E. Prong Little River	TN	1*	Fishing	Upstream of Goshen Prong confluence, <i>excluding</i> Silers Creek
<i>Kanati Fork</i>	<i>Oconaluftee River</i>	<i>NC</i>	<i>3</i>	<i>Control</i>	
<i>Flat Creek</i>	<i>Raven Fork</i>	<i>NC</i>	<i>11</i>	<i>Control</i>	
<i>Walker Creek</i>	<i>Hazel Creek</i>	<i>NC</i>	<i>4</i>	<i>Control</i>	
<i>Beech Creek</i>	<i>Cataloochee</i>	<i>NC</i>	<i>11</i>	<i>Control</i>	
<i>Rock Creek</i>	<i>Cosby Creek</i>	<i>TN</i>	<i>9</i>	<i>Control</i>	
<i>Dunn Creek</i>	<i>M. Prong Little Pigeon</i>	<i>TN</i>	<i>2</i>	<i>Control</i>	
<i>Road Prong</i>	<i>WP Little Pigeon</i>	<i>TN</i>	<i>11</i>	<i>Control</i>	
<i>Silers Creek</i>	<i>EP Little River</i>	<i>TN</i>	<i>11</i>	<i>Control</i>	

* The first year of information will be collected prior to fishing.

Most streams were selected by having at least 2 years of pre-treatment data. In addition, 14 of the 16 streams selected are currently sampled annually as part of our annual I&M program. Given the streams selected, there will be no net increase in workload. Between 1-11 years of I&M data is available for the proposed study streams (Table 1). Each stream site will be sampled using 3-pass depletion protocols. Population estimates will be generated using the Microfish 3.0 software, which utilizes the Burnham maximum-likelihood estimate formula (Van Deventer and Platts 1989). The streams will be sampled between June and August of each year. All fish will be weighed and measured and returned to the site immediately following sampling.

Repeated measures ANOVA will be used to determine any population level differences between pre- and post-brook trout fishing density (# fish/100m²), biomass (kg/ha), and condition (K) following 3 years of fishing. The Kolmogorov-Smirnov test will be used to determine if there are any differences between pre- and post-brook trout fishing length frequency distributions (Statistix 1996). Angler creel surveys will be conducted annually by law enforcement, fisheries staff, and Park volunteers (VIP's) on each of the 8 study streams to assess brook trout catch and harvest. All personnel will be trained in appropriate angler creel techniques prior to conducting surveys.

Guidelines for determining significant effects include:

- >30% decline in adult brook trout density (# fish/100m²) and/or biomass (kg/ha) over a 3-year period due to fishing (pre vs. post treatment)
- >50% decline in YOY density over a 3-year period due to fishing (pre vs. post treatment)

Table 2. Proposed timeline for brook trout fishing study in Great Smoky Mountains NP.

Study Streams	2000	2001	2002	2003	2004	2005
Compendium Change			X			
Monitoring	X	X	X	X	X	X
Open Fishing			X	X	X	
Ranger Creel			X	X	X	X
Data Analysis			X	X	X	X
Final Report & Recommendations						X*

* After reviewing the results of the project, a recommendation will be made regarding the remaining brook trout streams in GRSM.

Summary

The southern Appalachian brook trout (or “specs”) is a species that captures the heritage of the southern Appalachian mountains and their people. The purpose of this proposal is to provide the information necessary to determine the effects, if any, of reopening brook trout fishing in GRSM. This proposal does *not* detract from the need to restore brook trout in stream segments identified in the Fisheries Management Plan or the need to protect brook trout from other anthropogenic effects. In fact, Rocky Mountain (greenback cutthroat) and Yellowstone National Parks (Yellowstone cutthroat) both have active restoration programs while allowing the public to fish for these species without any detrimental impacts. The greenback cutthroat trout is Federally threatened while the Yellowstone cutthroat trout is being petitioned for listing. In addition, the greenback cutthroat trout restoration projects in Rocky Mountain National Park has

raised public awareness of the importance of native fish restoration and generated acceptance of the program.

If approved, the public would view the opening of these streams to fishing as one of the greatest fisheries management success stories of our era. Additionally, we believe that, in addition to providing Park visitors an opportunity to experience these fish, the project would generate the following benefits: 1) public support for future restoration projects and protection brook trout; and 2) educating the public about the history and future of brook trout in GRSM. Given the historic and cultural stature of brook trout in the southeastern U.S., brook trout fishing opportunities are a valuable interpretive tool and greatly treasured by anglers. To date, GRSM has successfully met the intent of 1916 Organic Act by protecting and preserving brook trout in segments of their historic range. The implementation of the proposed experimental fishery will fulfill the last part of the act, which provides for use and enjoyment by present and future generations.

This study will provide Park management, biologists, and anglers in the southeast the data necessary to make an informed decision regarding angling impacts to wild trout populations.