Managing Southern Appalachian Brook Trout: A Position Statement

ABSTRACT

Conservation of native fish stocks is an increasingly important task for fishery managers. Genetic research has shown that brook trout (*Salvelinus fontinalis*) native to the southern Appalachian Mountains differ considerably from stocks originating outside the region. Inventories throughout the southern Appalachians during the past decade identified over 500 km of streams that continue to support native brook trout populations. Genetic information can now be integrated with population dynamics data (e.g., abundance and distribution trends) to shape appropriate management strategies for this important fishery and biological resource given the threats it currently faces. Consequently, the American Fisheries Society's Southern Division Trout Committee developed a position statement to advocate management approaches suitable for conserving native southern Appalachian brook trout. The committee's position emphasizes the significance of these stocks, but also recognizes the value of fisheries provided by wild brook trout populations of mixed genetic heritage. Recommendations are provided for addressing issues including habitat protection and improvement, population restorations, stocking of hatchery brook trout, and angling regulations. The committee believes that these recommendations and guidelines, if implemented, will help ensure the future viability of southern Appalachian brook trout.

Southern Division of the American Fisheries Society Trout Committee

Prepared by Jim Habera and Steve Moore.

The American Fisheries Society's Southern Division Trout Committee is comprised of coldwater fisheries biologists representing 11 state and four federal natural resource management agencies in the southeastern United States, as well as two universities and the private sector. This position statement represents the majority opinion of the committee. Habera can be contacted at jim.habera@state.tn.us.

Issue Definition and Purpose

The southern Appalachian Mountains (Figure 1) contain about 9,600 km of coldwater habitat capable of supporting wild (self-sustaining) trout (Habera and Strange 1993). Brook trout (*Salvelinus fontinalis*), the region's only native salmonid, currently inhabit about one-fourth of this habitat; naturalized populations of rainbow trout (*Oncorhynchus mykiss*) and brown trout (*Salmo trutta*) occupy the remainder (Habera and Strange 1993). Concern about continuing distribution shrinkage and the long-term survival of brook trout in the southern Appalachians arose early in the twentieth century (King 1937) and drove regional management strategies for this species through the 1980s (Lennon 1967; Kelly et al. 1980; Bivens et al. 1985). Encroachment and control of introduced rainbow trout were particularly significant during that period (Larson and Moore 1985; Moore et al. 1986). Loss of allopatric brook trout distribution and total replacement by rainbow trout remain potential problems, but these threats now appear less critical to the continued existence of brook trout (Strange and Habera 1998; Habera et al. 2001).

Early fishery managers speculated that wild brook trout native to southern Appalachian streams, referenced here as southern Appalachian brook trout (SABT), differed, based on morphological characteristics (e.g., size and number of red spots; Lennon 1967), from the hatchery-produced brook trout (from nonnative stocks) being stocked throughout the region. However, because of inadequate early stocking records and the inability to assess hybridization, brook trout heritage could not be reliably determined or factored into later management decisions. Furthermore, SABT viability was unknown, resulting in a growing concern that SABT might be (or might soon become) rare and particularly at risk of extirpation.

Research during the past decade confirmed that SABT are genetically distinct from other brook trout (McCracken et al. 1993; Danzmann et al. 1998; Guffey et al. 1999). Concurrently, fisheries management agencies in Virginia, Tennessee, North Carolina, Georgia, and South Carolina, as well as Great Smoky Mountains National Park (GRSM), initiated efforts to determine the genetic heritage of brook trout populations under their respective jurisdictions. In some cases, these efforts are nearly complete (Tennessee and South Carolina); in others, work remains (Virginia and North Carolina).

Given the development of genetic inventories, better biological and distribution trend data, and a clearer understanding of the threats currently facing SABT, the American Fisheries Society's Southern Division Trout Committee (SDTC) considered it imperative to develop a management position statement for SABT. The purpose of the position statement is to express the importance of SABT and facilitate comprehensive, region-wide management strategies that integrate current information and address the need to provide for both protection and sustainable use of this unique resource. Various management aspects are treated, including habitat protection needs, identification

and prioritization of streams for SABT restoration or enhancement, stocking and translocation practices, and the status of wild brook trout populations not comprised of SABT. Specific management actions and guidelines are recommended based on the majority opinion of the SDTC.

Background

The southern Appalachian Mountains represent the southern limit of the natural range of brook trout in eastern North America (MacCrimmon and Campbell 1969). This area was logged extensively during the early twentieth century (Williams 1989). The logging techniques employed at that time, along with other human activities, degraded brook trout habitat and caused substantial reductions in distribution (King 1937). Habitat began to recover by the late 1930s and fishery managers started stocking streams with large numbers of brook and rainbow trout (and some brown trout) to help meet fishing demand (Chamberlain 1942). Some of the first stocking efforts specifically directed at restoring SABT populations also occurred at this time in GRSM (King 1939, 1942).

Hatchery-produced brook trout derived from northeastern U.S. stocks were used in most stocking efforts because SABT proved too difficult to culture (Lennon 1967). Hatchery fish were released into many streams over the years to provide, improve, or restore fisheries. Many streams receiving hatchery fish contained remnant SABT populations, and some restoration efforts (particularly in the 1980s) involved transfers of brook trout among streams. Consequently, wild brook trout populations in the region currently consist of SABT, descendants of hatchery fish, or their intergrades (McCracken et al. 1993; Kriegler et al. 1995; Galbreath et al. 2001). These intergrade (mixed) populations constitute hybrid swarms as described by Allendorf et al. (2001).

Protein electrophoresis typically is used to identify the genetic origin of brook trout populations in the region. Southern Appalachian brook trout populations are those fixed (i.e., with a frequency of 1.0) for the CK-A2*100 allele, whereas populations descended from hatchery fish are fixed for the CK-A2*78 allele, and mixed populations contain both alleles (McCracken et al. 1993; Kriegler et al. 1995; Guffey 1998). Certain alleles at other loci also can indicate a mixed population with a low level of introgression even if the CK-A2*100 frequency for the sample is 1.0 (Galbreath et al. 2001).

The genetic distinctiveness of SABT populations and the heterogeneity of their mitochondrial and nuclear markers reflect the phylogeographic history of the species (Guffey et al. 1999). Heterozygosity is greater among northern brook trout populations (and hatchery brook trout derived from them) than among SABT populations. Genetic variation also is partitioned differently in these groups. Most (65%) of the total nuclear genetic variation in northern brook trout is shared among populations, but in SABT, only 38% is shared among populations (Guffey 1998). Sequence variation in the rapidly evolving mitochondrial genome also exhibits greater haplotype diversity among southern populations than among northern populations (Hayes et al. 1996). These patterns of nuclear and mitochondrial marker variation are consistent with hypotheses of different biogeographical histories of the two groups.

To account for the observed genetic differences, Guffey et al. (1999) proposed a model with the following components: (1) fixed genetic differences between northern and southern Appalachian populations evolved in populations ancestral to the two groups prior to post-glacial recolonization of the Northeast; (2) a small number of closely related lineages (probably just two) founded current northern populations; and (3) divergence among southern Appalachian populations is a consequence of the isolation and small effective size of headwater populations. Greater heterozygosity in northern populations and lower levels of mitochondrial and nuclear gene heterogeneity among northern populations reflect a recent origin, maintenance of large populations, or the persistence of gene flow among some populations. Conversely, lower heterozygosities within and greater genetic heterogeneity among southern Appalachian populations suggests longer isolation or lower effective sizes of isolated populations.

NATIONAL PARK SERVICE

The Southern Appalachian brook trout, like this one from Great Smoky Mountains National Park, is the only native salmonid in the region.

Despite genetic heterogeneity, brook trout populations in southern Appalachian streams share several biological characteristics. Food is the primary limiting factor in these systems, particularly during summer; thus, production rates are low (Whitworth and Strange 1983; Cada et al. 1987; Ensign et al. 1990). Adult fish are typically small (<229 mm TL), and life spans seldom exceed three

years (Konopacky and Estes 1986; Habera et al. 2001). Brook trout populations in similar habitats in other regions exhibit comparable characteristics (Larscheid and Hubert 1992; Clarke and Scruton 1999).

Over 3,000 km of streams supporting wild brook trout, including areas of sympatry with nonnative salmonids, occur across the region (Table 1). Currently, SABT inhabit 526 km of these streams (Table 1), representing many populations. Southern Appalachian brook trout populations are distributed from the New River drainage in Virginia southward into Tennessee, North Carolina, South Carolina, and Georgia (Figure 1). Most populations are located in the upper Tennessee River (Mississippi River) system, but a few also occur in three Atlantic Slope and two Gulf Slope drainages. Seventy percent or more of the known SABT resource within each state and 88% overall occurs on public lands (Table 1).

Committee Position

The SDTC's position regarding SABT evolved over the past two decades. The National Park Service's (NPS) mandate to protect and preserve native species in GRSM led it to take the first steps toward recognizing SABT as unique or "special" in 1976 (Moore et al. 1983). As the uniqueness of SABT became more clearly defined through genetic research, agencies responsible for managing this resource began to devise, implement, and refine strategies to promote SABT conservation despite the absence of an official position by the SDTC. New issues emerged and the need for concordant strategies became evident with increased knowledge of SABT. As a result, the SDTC realized the need to develop a comprehensive position statement suitable for guiding SABT management across the region.

Southern Appalachian brook trout represent significant components of the region's ecological integrity, biological diversity, and sportfishing legacy. North and South Carolina have officially recognized the importance of SABT by designating it as a state heritage species (Epifanio 2000). Accordingly, the SDTC's position is that wild trout management programs effective within SABT range should emphasize SABT conservation. Other wild brook trout populations (i.e., those not comprised of SABT) and the fisheries that many of them support throughout the southern Appalachians also are valuable resources, although they do not hold the same status as putatively pure SABT populations. The SDTC recognizes that successful SABT conservation, as well as proper management of other brook trout resources, requires management agencies to develop and implement new strategies (or modify existing ones) and believes this position statement will facilitate those efforts.

Factors Limiting SABT and Recommended Management Actions and Guidelines

Given the factors currently limiting SABT, the SDTC identified eight issues, including habitat protection, genetic inventories, taxonomic status, hatchery brook trout stocking, and restorations and translocations (Table 2), as having the most important management and conservation implications. The committee recommends the following actions and guidelines (summarized in Table 2) for addressing these issues and promoting the long-term maintenance of SABT. The SDTC (or an "SABT oversight" subcommittee) should facilitate and annually review progress toward implementing these recommendations, particularly where timelines or interagency cooperation are involved, and update them accordingly as new information becomes available. A memorandum of understanding among the key agencies that officially endorses the recommendations of this group would help ensure that the necessary actions are taken.

Habitat Protection and Improvement

The maintenance of self-sustaining salmonid populations across the United States is obstructed most frequently by habitat impacts (Epifanio 2000). Ensuring the long-term survival of all brook

Table 1. Distribution and estimated abundance of southern Appalachian brook trout (SABT) resources. Parenthetical values are percentages of known brook trout stream length that have been genetically categorized (total) and percentages of genetically categorized stream lengths that have SABT (with SABT). Genetic inventories were not prioritized based on suspected presence of SABT.

Location	Known stream length with wild brook trout (km)	Genetically categorized stream length (km)		% of SABT resource on public land[a]
		Total (%)	with SABT (%)	
VA	1,158[b]	223 (19)	77 (35)	71
TN	237	228 (96)	127 (56)	70
NC	1,081[c]	315 (29)	196 (62)	100
GRSM (TN/NC)	294	178 (61)	85 (57)	100
GA	233	136 (58)	29 (21)	100
SC	90	74 (82)	12 (16)	95
Total	3,093	1,154 (37)	526 (46)	88

[a] State or federally owned and managed lands including state parks and natural areas, national forests (excluding any public inholdings), and Great Smoky Mountains National Park (GRSM).
[b] Includes only those streams in the New River drainage and southward.
[c] Includes only those streams within national forests (few brook trout streams on private lands have been surveyed). The North Carolina Wildlife Resources Commission estimates that these streams represent about 73% of known brook trout resources in the state.

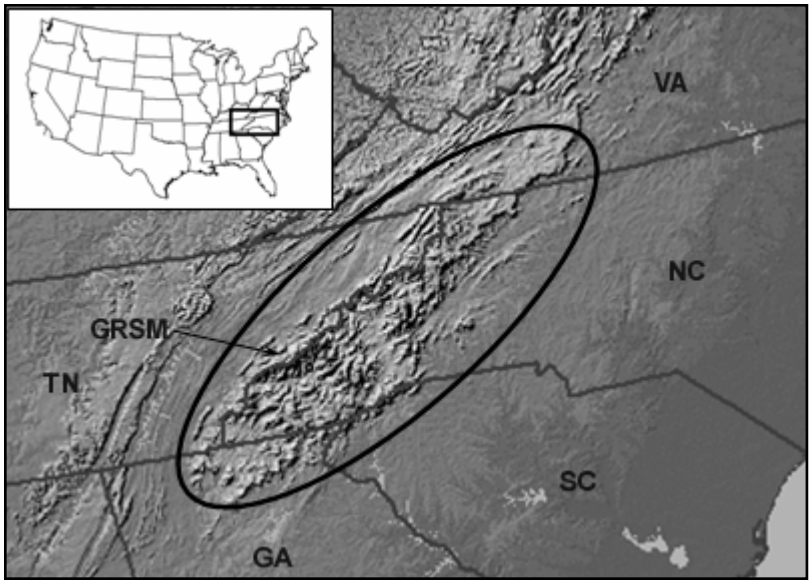


Figure 1. Southern Appalachian brook trout currently inhabit over 500 km of streams from the New River drainage in Virginia southward into northern Georgia (oval). GRSM is Great Smoky Mountains National Park.

ROY HAWK

Population monitoring will be an important part of southern Appalachian brook trout management.

Table 2. The eight most important issues relative to southern Appalachian brook trout conservation identified by the American Fisheries Society's Southern Division Trout Committee and recommended management actions and guidelines for addressing them.

Issue	Recommended actions or guidelines
Habitat protection and improvement	1. Ensure that state water quality standards and usage classifications that are at least protective of wild trout populations apply to all SABT streams; review water quality standards applicable to SABT streams by 2006 and, if insufficient, establish a new classification with appropriate criteria.
	2. Promote BMPs where disturbances (e.g., silviculture, road construction) could potentially affect SABT habitat; seek enforcement of water quality standards where lack of BMP implementation impacts habitat.
	3. Ensure that culverts and road crossings that permit fish passage are used on SABT streams unless encroachment by undesirable species (e.g., rainbow trout) would occur.
	4. Verify compliance with all Section 404 permits where SABT may be affected.
	5. Begin monitoring sensitive SABT habitat for acidification (elevations above 1,067 m) and warming (elevations below 915 m) by 2007.
	6. Promote/use federally funded programs to restore or improve brook trout habitat.
Genetic inventories	1. Complete genetic inventories by 2008 using non-lethal sampling; coordinate efforts if necessary.
	2. Assess SABT viability (sub-basin and region-wide scales) following completion of genetic inventories.
Taxonomic status	1. Resolve the taxonomic status of SABT; coordinate sampling efforts through SDTC if necessary.
Hatchery brook trout stocking	1. Hatchery brook trout (nonnative stocks) must not be stocked where the genetic integrity and health of SABT populations could be compromised.
	2. Use triploid hatchery brook trout (provide training for hatchery personnel if necessary).
	3. Maintain records of sources, types, and stocking locations for hatchery brook trout.
	4. Require permits for all private trout stocking and prohibit private stocking and translocation of any trout where SABT could be impacted.
Population restoration and enhancement	1. Initiate no restoration or enhancement projects or brook trout translocations without genetic information.
	2. Adapt guidelines for reintroducing bull trout (Epifanio et al. 2003) to identify streams for SABT restoration; concentrate restoration efforts on streams that historically supported SABT.
	3. Use river basins and sub-basins as management units for conserving genetic variability; use SABT from donor populations in the same sub-basin (or if necessary, an adjacent one) for restoration projects.
	4. Determine minimum habitat patch sizes needed by SABT to design and prioritize restoration strategies.
	5. Do not introduce SABT into an existing population to reduce presumed inbreeding.
Angling regulations	1. Restrictive angling regulations or stream closures to protect SABT populations are unnecessary except to assist restorations or where other factors (e.g., habitat quality) are impacting survival.
Population monitoring	1. Implement programs to monitor SABT abundance and distribution trends, water and habitat quality, and angler use; coordinate efforts among agencies with shared resources.
Planning	1. Develop, implement, review, and periodically update SABT management plans.

trout in southern Appalachian streams, therefore, will require habitat protection and improvement (where it has been degraded by human activity). Many SABT populations occur on privately-owned lands, and some (e.g., in Tennessee and North Carolina) have been identified only recently. Population growth and land use change, such as conversion of forests to residential use, will potentially increase nonpoint source pollution and habitat degradation in these streams (SAMAB 1996a). At a minimum, it is important to ensure that state water quality standards and usage classifications designed to protect wild trout populations apply. For example, temperature may not exceed 20° C and dissolved oxygen may not be less than 8.0 mg/L in waters designated as supporting naturally reproducing (wild) trout in Tennessee (TDEC 2004). Water quality standards applicable to SABT streams across the region should be reviewed by 2006 and, if deemed insufficient to protect SABT, new (consistent) classifications with appropriate criteria should be developed.

Trout population impacts related to sedimentation are well documented (Waters 1999; Sweka and Hartman 2001, Curry and MacNeill 2004). Accordingly, compliance with Clean Water Act (Section 404) dredge and fill permits should be verified and best management practices (BMPs) encouraged during silvicultural or other soil-disturbing activities where SABT habitat is involved. Although BMP programs are nonregulatory in all states with SABT, silvicultural activities that degrade water quality are subject to enforcement action by designated water pollution control agencies (Prud'homme and Greis 2002). In addition to being a major source of sediment, road construction also typically requires culverts that can obstruct fish passage (Belford and Gould 1989; Gibson et al. 2005) and fragment SABT populations. New or replacement culverts and stream crossings should be designed to permit fish passage unless doing so would allow encroachment by undesirable species (e.g., rainbow trout).

Because stream acidification poses a substantial threat to brook trout (Fiss and Carline 1993; Gagen et al. 1993; Nislow and Lowe 2003), the committee recommends establishment of monitoring programs by 2007 to evaluate acidification of potentially sensitive SABT habitat (i.e., streams above an elevation of 1,067 m). The southern Appalachians experience some of the highest levels of acidic deposition in the United States (SAMAB 1996b), and sulfur and nitrogen loadings are most severe in high-elevation watersheds where streams are least capable of buffering the acidic input (SAMAB 1996b). Currently, only GRSM and Virginia have acidification-monitoring programs within SABT range. Recent GRSM data indicate that continuation of present acidification trends could reduce pH to 5.5 in streams above 1,067 m (Robinson et al. 2001). Additionally, SABT distribution has decreased by about 24 km in the headwaters of 6 GRSM streams (including 2 in which brook trout were eliminated) as a result of chronic and episodic acidification (unpublished NPS data). Short-term mitigation of acidified brook trout streams is possible (Clayton et al. 1998; Hudy et al. 2000), but broad scale control of acidic deposition will require controlling and reducing emissions (e.g., from fossil fuel use) of sulfur dioxide and nitrogen oxides (Driscoll et al. 2001).

A warmer climate is also a threat to brook trout in the southern Appalachians, and the committee recommends monitoring summer temperatures (by 2007) in SABT habitat that would be most sensitive to warming associated with global climate change (i.e., streams below an elevation of 915 m). Summer temperature data would help identify existing margins for warming, thermal trends, and additional habitat protection measures necessary to maintain suitable stream temperatures. Global climate change currently receives limited attention in management plans for U.S. salmonid fisheries, possibly because of uncertainty regarding its effects on these resources (Born and Stairs 2003). However, Meisner (1990) projected the loss of all brook trout habitat in Georgia and South Carolina and substantial reductions in Tennessee with a 3.8° C increase in mean annual air temperature and an associated increase in groundwater temperature. Restriction of remaining brook trout habitat to higher elevations would cause distribution to be further fragmented (SAMAB 1996a).

A number of federally-funded aquatic habitat restoration programs are now in place that can be used to cover or share costs for restoring, maintaining, or improving brook trout habitat in the southern Appalachians (SAMAB 1996a). These include Rise to the Future and Bring Back the Natives (U. S. Forest Service), Partners for Fish and Wildlife and the National Fish Passage Program (U. S. Fish and Wildlife Service), and the Section 319 Nonpoint Source Program (Environmental Protection Agency). The SDTC recommends these programs to help implement brook trout habitat protection across the region.

Genetic Inventories

Because thorough genetic inventories are necessary to accurately determine SABT viability, the SDTC recommends that these efforts be completed by 2008 and followed by viability assessments at sub-basin and region-wide scales. The genetic identity of brook trout is known for approximately 37% of the stream length they inhabit within the region, and 47% of this supports SABT (Table 1). Most of the remaining inventoried populations are descended from mixed stocks, and allele frequencies for most mixed populations

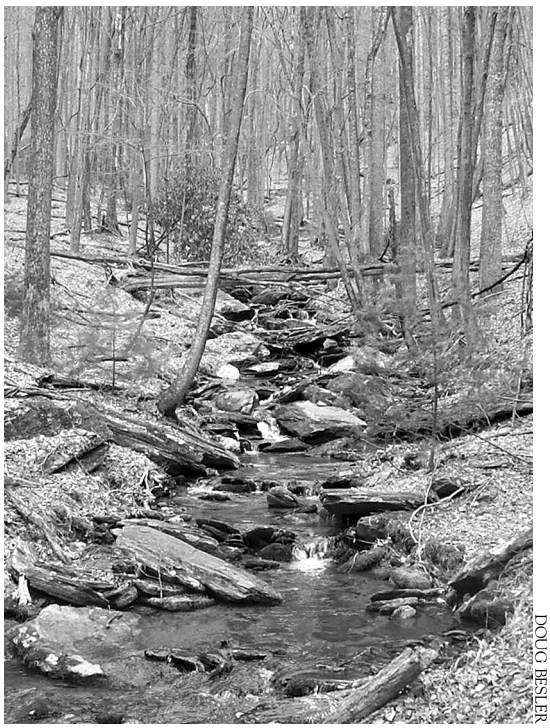
indicate a predominantly southern Appalachian origin (e.g., Kriegler et al. 1995; Galbreath et al. 2001). Only a small proportion of inventoried populations (<15%) is descended entirely from hatchery fish. These data suggest that a substantial portion of brook trout populations across the region is of southern Appalachian origin or predominantly descended from those stocks. Genetic information also will be necessary before any brook trout population can be prioritized for enhancement efforts or considered as a source of fish for translocation (in restoration projects). Additionally, completion of genetic inventories will ensure that appropriate water quality criteria, usage classifications, and habitat protection measures can be applied to all streams supporting SABT. The committee recommends the use of non-lethal sampling techniques (Galbreath et al. 2001) and coordination of sampling efforts among state and federal agencies where this would expedite completion of inventories.

Taxonomic Status

Given the substantial body of evidence indicating that SABT are distinct evolutionary entities (Stoneking et al. 1981; McCracken et al. 1993; Guffey et al. 1999), the taxonomy of *Salvelinus fontinalis* should be further examined. The SDTC recommends that research necessary for resolving the taxonomic status of SABT should be conducted and is willing to support these efforts (e.g., by helping coordinate collection of any necessary samples). Lack of taxonomic distinctness from other brook trout will not affect the status of SABT with respect to regional trout management policy. Conserving native fish stocks is a legitimate goal, regardless of taxonomy. However, if SABT are ultimately recognized as a separate taxon, enhanced public awareness and appreciation could substantially benefit efforts to protect habitat and maintain genetic integrity.

Hatchery Brook Trout Stocking

It is imperative that fishery managers restrict the use of hatchery-produced (nonnative) brook trout to areas where SABT genetic integrity cannot be compromised through interbreeding or altered selective pressures related to ecological interactions (Krueger and Menzel 1979). Limiting the use of hatchery brook trout also will eliminate the potential for disease transmission to SABT populations. Currently, all state natural resource management agencies in the southern Appalachians except Georgia use hatchery-produced brook trout to help provide fisheries in waters that do not support wild trout or that are isolated from SABT. These efforts provide more anglers with the opportunity to catch brook trout (e.g., in South Carolina) and may reduce angling pressure on wild populations (particularly



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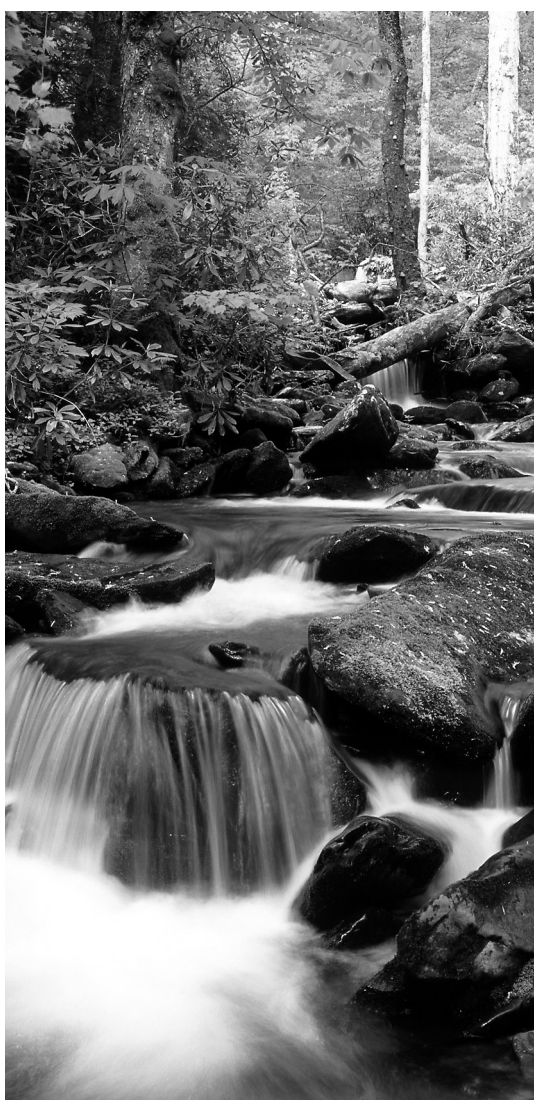

RICHARD BERNABE

First and second order headwater streams are typical southern Appalachian brook trout habitat.

SABT). Although hatchery-produced SABT would be better suited for meeting angling needs than the hatchery stocks now in use, SABT remain too difficult to culture for this purpose. Triploid (sterile) brook trout are recommended for stocking purposes as they present a lower genetic risk to native stocks while providing consumptive angling opportunity (Dillon et al. 2000). Additionally, records detailing the source, type, and location of any brook trout stocked should be maintained.

Because of potential risks to SABT populations presented by private stocking or translocation of brook trout, the SDTC urges that these activities be prohibited. In addition to being genetic threats, salmonids produced at private operations in the region typically do not require disease-free certification before being distributed. All five states in the southern Appalachian region allow trout stocking by private citizens, but only North Carolina does not require a permit or prior approval from its Wildlife Resources Commission. The committee recommends that permits be required for all private trout stocking and that requests for permits to stock any trout where SABT could be impacted be denied.

JIM HABERA

A southern Appalachian brook trout from Tennessee's Watauga River basin.

Population Restoration and Enhancement

Restoring or enhancing SABT populations are legitimate (and possibly necessary) management strategies, but the SDTC strongly recommends that no such project proceed without knowledge of the genetic origin of potential donor populations (restorations) or any population to be enhanced. An excellent set of guidelines for identifying streams suitable for bull trout (*S. confluentus*) reintroduction was developed by Epifanio et al. (2003) and can be adapted to SABT. Using these guidelines, a restoration project would proceed only if SABT are no longer present, the cause of their elimination is known and corrected, natural recolonization cannot occur, and an SABT donor population is available that can safely provide the necessary adults. Because genetic heterogeneity among SABT populations is relatively high (Kriegler et al. 1995; Hayes et al. 1996; Guffey 1998), the committee recommends using river subbasins and watersheds as management units for conserving genetic variability (Perkins et al. 1993; Kriegler et al. 1995; Hall et al. 2002). Accordingly, restoration projects must use SABT from donor populations in the same sub-basin or if necessary, an adjacent one (Kriegler et al. 1995).

Restoration efforts should concentrate on streams known or strongly suspected to have historically supported SABT. Other streams with suitable habitat can be considered if options are limited and the project meets agency recovery goals. Naturally fishless streams should be excluded because of the potential for impacts to other aquatic organisms (Dunham et al. 2004). Enhancing an existing SABT trout population (i.e., increasing its abundance and distribution) should only involve fish from that population. Attempting to increase heterozygosity or mitigate presumed inbreeding by introducing fish from other SABT populations is unnecessary and could cause outbreeding depression (Marsden et al. 1993; Gharrett et al. 1999). Additionally, minimum habitat patch size (e.g., Rieman and McIntyre 1995) should be determined to most effectively design and prioritize SABT restoration strategies.

Converting mixed or hatchery-derived brook trout populations to SABT may be desirable (e.g., where SABT distribution is limited or where SABT genetic integrity could be compromised), but managers should proceed with caution (Kriegler et al. 1995). Although the conservation value of hybridized populations is limited, they may have other values (Allendorf et al. 2001). For example, mixed or hatchery-derived populations can help meet angling demand for wild brook trout while the status of SABT is evaluated and restoration efforts are completed in selected habitats currently occupied by rainbow trout.

Angling Regulations

The SDTC emphasizes that SABT management primarily should focus on maintaining or enhancing existing populations (e.g., through habitat protection/improvement), restoring populations where desirable, and conserving genetic differentiation. Eliminating angling mortality through restrictive regulations or stream closures is unlikely to be necessary to ensure survival of an SABT population (except to assist a restoration effort or where there are impacts caused by other factors such as habitat quality). Angling regulations varying from liberal (e.g., bait permitted and creel limits up to 10 fish) to restrictive (e.g., fly fishing only and no harvest) have been applied to wild brook trout fisheries in the southern Appalachians for decades. SABT populations have been successfully managed across this spectrum, primarily because their biological characteristics (e.g., small size and short life spans) limit the efficacy of restrictive angling regulations (Habera and Strange 1993). Recently, the NPS reopened 8 GRSM brook trout streams to angling (including 6 with SABT) because closure for over 25 years had no perceptible effect on abundance or size structure when compared with exploited SABT

populations (unpublished NPS and Tennessee Wildlife Resource Agency data). Brook trout populations appear resistant to angling exploitation in a range of other habitats because of their ability to mature at small sizes and early ages (Curry et al. 2003; Paul et al. 2003).

Population Monitoring

The SDTC recommends development and implementation of population monitoring programs to ensure effective management of all brook trout resources in the region, especially those comprised of SABT. Monitoring is necessary to assess annual variability in abundance (population stability), and to track changes such as those related to stream acidification, land use impacts, effectiveness of habitat restoration projects, floods (Roghair et al. 2002) and other environmental events. Assessment of distribution trends for SABT and any encroaching salmonids (Strange and Habera 1998), as well as the success of SABT restoration projects, also require monitoring data. Monitoring and evaluation efforts should be coordinated among agencies that share resources (e.g., within a sub-basin) to increase sampling efficiency and obtain data that might otherwise be difficult to acquire.

Planning

The SDTC recommends that all natural resource management agencies in the region develop and implement SABT management plans. Long-term maintenance of coldwater habitats and the fisheries they support requires effective strategic planning and policy-making (Born and Stairs 2003). Among several other important features, effective planning should include input and support from the public and stakeholders (Born and Stairs 2003). Additionally, the emergence of new issues and information will require that management plans and programs be periodically reviewed and updated to ensure that resource needs are being met (Epifanio 2000).

Summary

Coldwater fishery managers across the United States recently ranked conservation of native species second only to wild trout protection and enhancement as a priority concern (Born and Stairs 2003). As the only native salmonid in the southern Appalachians, SABT have both ecological and recreational importance. Because they are a unique component of the region's wild trout resources, maintaining and enhancing SABT populations are primary management concerns. While information-based management of SABT has been strengthened through genetic inventories and distribution surveys, these efforts are incomplete. Additionally, broad-scale threats to SABT populations remain, such as habitat damage and loss caused by development and poor land use practices. We encourage coldwater fishery managers in the region to use the recommendations provided here to develop and implement strategies (or modify existing ones) that address the SABT management issues identified in this position statement.

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