

# Conserving the Eastern Brook Trout: Action Strategies



## Eastern Brook Trout **JOINT VENTURE**

Prepared by:  
Conservation Strategy/Habitat Work Group  
Eastern Brook Trout Joint Venture

January 2011

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## **Executive Summary**

Brook trout *Salvelinus fontinalis* are a recreationally and culturally important species, regional icon, and indicator of high water quality; however, populations are declining across their historic eastern United States range (Maine to Georgia). The Eastern Brook Trout Joint Venture (EBTJV) is a partnership of state and federal agencies, nongovernmental organizations, and academic institutions. This collaborative approach to brook trout management is justified because (1) brook trout are declining across their entire eastern range; (2) causes for these declines are similar; (3) an integrated approach would be cost effective; and, (4) watersheds of concern span state borders and state and federal jurisdictions.

In 2005, the EBTJV completed a range-wide assessment of brook trout populations throughout their native eastern United States range (Hudy et al. 2005). The study area encompassed approximately 25% of the native range of brook trout in North America and 70% of its native United States range. The assessment revealed wild brook trout populations in the eastern United States are impaired. Intact stream populations of brook trout, where wild brook trout occupy >90% of historical habitat, exist in only 5% of the watersheds assessed. Populations of stream-dwelling brook trout are greatly reduced or have been extirpated from nearly half of the watersheds in their native range. The vast majority of historically occupied large rivers no longer support self-reproducing populations of brook trout. Watersheds with intact populations of lake-dwelling brook trout are almost exclusively located in Maine, although some lakes and ponds in New York, New Hampshire, and Vermont still contain self-sustaining brook trout populations.

The EBTJV partners agreed that a broad-scale, range-wide conservation strategy is necessary to stop brook trout declines, improve technology transfer, and effectively prioritize funds and projects to restore this important species. This Conservation Strategy is a goal-oriented, science-based, action plan that explicitly states EBTJV principal goals, presents guidance for decision-making, and provides methods for evaluating success. Findings from the range-wide status and threats assessment serve as the foundation for the development of the vision, goals, objectives, strategies, procedures, and guidelines contained within the EBTJV Conservation Strategy. The EBTJV believes this structure will result in a focused, technically credible, publicly accountable program linking EBTJV projects to specific objectives so funding will be effectively utilized.

The vision of the EBTJV is to ensure “healthy, fishable brook trout populations throughout their historic eastern United States range.” The principal goals of the EBTJV are: (1) conserve, enhance and restore brook trout populations that have been impacted by habitat modification, or other threats and disturbances; (2) encourage partnerships among management agencies and stakeholders to seek solutions to issues such as regional environmental and ecological threats; (3) develop and implement outreach and educational programs to ensure public awareness of the challenges that face brook trout populations; and (4) develop support for implementation of programs that perpetuate and restore brook trout throughout their historic range.

This report summarizes the range-wide, regional, and state-level goals, objectives, and strategies designed to achieve the overall principle goals of the EBTJV. This report also focuses on strategic planning to develop partnerships and secure funding to ensure the continuation of the EBTJV. In addition, individual state conservation strategies are presented, which demonstrate the commitment of all EBTJV partners and focus range-wide goals and objectives down to the state and local levels. Together, the components of this working document represent the framework necessary to begin the conservation of brook trout in the eastern United States.

## **Introduction**

Brook trout *Salvelinus fontinalis* are a recreationally and culturally important species, regional icon, and indicator of high water quality. Biologists have long known that brook trout populations are declining across their historic eastern United States range, which spans from Maine to Georgia. For purposes of this document, a population of brook trout is defined as a group of individuals that are reproductively isolated from other groups. In recognition of this trend of long-term decline and continued vulnerability, representatives from over 50 state and federal fish and wildlife management agencies, nongovernmental organizations, and academic institutions met in June 2004 to discuss the opportunity for a collaborative approach to the conservation of brook trout in the eastern United States. In addition to identifying threats to brook trout across their historic range, it was the group's consensus there was an opportunity to form an Eastern Brook Trout Joint Venture (EBTJV). A collaborative approach to brook trout management is justified because (1) brook trout are declining across their entire eastern range; (2) causes for these declines are similar; (3) an integrated approach would be cost effective; and, (4) watersheds of concern span state borders and state and federal jurisdictions.

At the 2004 meeting, participants agreed a broad-scale, range-wide conservation strategy is necessary to stop brook trout declines, improve technology transfer, and effectively prioritize funds and projects to restore this recreationally and culturally important species. Past conservation efforts and applications of new technologies have occurred in a fragmented fashion without consideration of broader conservation goals, often with only localized effectiveness. For example, techniques for mitigating impacts of acid precipitation are used to great effect in parts of West Virginia, new methodologies for eliminating non-native salmonids have been developed in eastern Tennessee, and locally comprehensive research into the adaptive significance of genetic strains has been applied in New York. However, these valuable developments in management technologies have not been effectively transferred among resource management agencies.

This conservation strategy is a goal-oriented, science-based, action plan that explicitly states Joint Venture partner goals, presents guidance for decision-making, and provides methods for evaluating success. The fundamental framework of the Conservation Strategy is comprised of three distinct components: (1) vision; (2) principal goals and (3) key priorities. Because of the large geographic distribution of brook trout in the eastern United States, this conservation strategy is organized into three primary levels of distinction: range-wide, regional, and state-level.

The EBTJV believes this framework will result in a carefully focused, technically credible, and publicly accountable program linking EBTJV projects to specific strategies so that funding will be utilized most effectively. As such, an important criterion for project funding recommendations will be consistency with the vision, goals, key priorities and strategies of the Conservation Strategy. The Conservation Strategy framework is also intended to provide opportunities for partners to coordinate information gathering, planning, and implementation of recovery actions.

The EBTJV Conservation Strategy is not intended to address all issues relative to brook trout population declines throughout their eastern United States range. Nonetheless, the EBTJV partnership believes the Conservation Strategy will complement other existing brook trout protection and recovery efforts, serve as a model for other species-specific conservation efforts, and foster information sharing.

## **Range-wide Status of Brook Trout Populations**

A comprehensive assessment of the status of brook trout populations throughout their entire eastern United States range (Maine to Georgia) was completed in 2005 by the EBTJV (Hudy et al. 2005). The area of the assessment encompassed approximately 25% of the native range of brook trout in North America and 70% of the native United States range. Data were compiled from more than 1,300 6th level hydrologic unit watersheds within the historic range of brook trout. Watersheds were classified according to seven brook trout status categories: (1) absent (brook trout not present or never present); (2) no data; (3) present but qualitative data only; (4) present and intact (>90% of historical habitat contained wild, reproducing brook trout); (5) present but moderately reduced (<90% but > 50% of historical habitat contained wild, reproducing brook trout); (6) present but greatly reduced (<50% of historical habitat contained wild, reproducing brook trout); and (7) extirpated.

The assessment revealed wild brook trout populations in the eastern United States are impaired. Intact stream populations of brook trout exist in only 5% of the watersheds assessed. Wild stream populations of brook trout have vanished or are greatly reduced in nearly half of the watersheds. The vast majority of historically occupied large rivers no longer support self-reproducing populations of brook trout.

## **Regional and State-level Status of Brook Trout Populations**

Hudy et al. (2005) also completed status assessment of brook trout at the individual state level. Assessment at this level showed distinct trends that were combined into a regional perspective.

In the northeastern United States, Maine possesses almost 150 intact watersheds containing stream-dwelling brook trout populations; however, Maine also has the most watersheds where brook trout are known to be present but only qualitative data were available. New Hampshire followed Maine with respect to the number of watersheds where brook trout were present but only qualitative data were available. Connecticut possessed the highest number of watersheds where brook trout are present, but severely reduced, or extirpated.

New York contained the largest number of intact watersheds with stream-dwelling brook trout populations among the northern states (New York, New Jersey, and Pennsylvania). Pennsylvania had the greatest number of watersheds with brook trout population classified as reduced, severely reduced, extirpated, or unknown.

Intact brook trout populations in lakes are confined exclusively to the northern states of Maine, New Hampshire, New York, and Vermont. In Maine, brook trout lakes in 323 watersheds have severely reduced status, while lakes in 235 watersheds have an unknown population status. New Hampshire contains the highest number watersheds with lakes of unknown status, while Vermont and New York contain the most watersheds where brook trout populations in lakes have been extirpated.

The stronghold for stream-dwelling brook trout populations among the mid-Atlantic states (Virginia, West Virginia, and Maryland) is Virginia, with 36 watersheds classified as intact and 80 watersheds classified as present but reduced. West Virginia contained the highest number of watersheds with brook trout classified as severely reduced as well as a large percentage of watersheds with insufficient data to determine if brook trout were extirpated or never historically existed. Virginia had the largest number of extirpated watersheds in the region.

Only Tennessee had an intact watershed among the southern states (North Carolina, Tennessee, South Carolina, and Georgia). Tennessee and North Carolina combined had only five watersheds where brook trout populations were present but moderately reduced. North Carolina also has the highest number of present but severely reduced watersheds and extirpated watersheds. Brook trout remain in less than 30% of the historical watersheds in Georgia.

## **Assessment of Threats to Brook Trout**

In addition to compiling data on brook trout population status over a 17-state region (Hudy et al. 2005), regional fishery managers were asked them to rank perturbations and threats for all watersheds that historically supported reproducing brook trout populations. Perturbations and threats were separated into three categories of severity: (1) eliminates a brook trout life cycle component; (2) reduces brook trout population abundance; and (3) potentially impacts brook trout populations. Across the entire study area, the top five perturbations for stream-dwelling brook trout populations were high water temperature, agriculture, riparian condition, non-native fish species, and urbanization. Non-native fish species were considered the greatest threats to lake populations, although acid precipitation, low dissolved oxygen, eutrophication, and poor forestry management practices were also significant concerns.

Although brook trout are not threatened as a species across their vast range in the eastern United States, the assessment clearly illustrates that wild brook trout populations have experienced dramatic declines from historic levels. Brook trout continue to persist, however, in isolated strongholds and in a large number of increasingly fragmented populations. Findings from the range-wide status and threats assessment were used to develop a unified vision, as well as goals, key priorities, and strategies for the Joint Venture.

## **Vision**

*The vision of the Eastern Brook Trout Joint Venture is to ensure healthy, fishable brook trout populations throughout their historic eastern United States range.*

## **Principal Goals**

- I. Conserve, enhance or restore brook trout populations that have been impacted by habitat modification or other population level threats.*
- II. Encourage partnerships among management agencies and stakeholders to seek solutions to regional environmental and ecological threats.*
- III. Develop and implement outreach and educational programs to ensure public awareness of the challenges that face brook trout populations.*
- IV. Develop support for program implementation that perpetuate and restore brook trout populations throughout their historic range.*

## **Key Priorities**

The following key priorities were established to meet the principal goals of the EBTJV:

- 1. Protect brook trout populations across the eastern United States.**
- 2. Restore brook trout populations where original habitat conditions exist and where habitats can be restored.**
- 3. Monitor and evaluate brook trout population responses to habitat protection, enhancement and restoration projects.**
- 4. Complete brook trout distribution and quantitative status assessments.**
- 5. Increase recreational fishing opportunities for wild brook trout.**

Key priorities serve as the framework for the development of state-level brook trout conservation action plans. To date, 12 state-level conservation action plans have been created (Appendix I). Each action plan prioritizes the specific strategies needed for brook trout conservation within that state. Most state action plans were developed with input from a variety of federal, state, and nongovernmental partners and reflect a broad approach to brook trout conservation. These plans collectively form the basis for the broader regional and range-wide conservation strategies.

The conservation strategy described below outlines the actions needed to conserve, enhance or restore brook trout populations impacted by habitat modification or other population level threats. This comprehensive strategy consists of three distinct, but interrelated, components: range-wide, regional, and state-level. Range-wide strategies are designed to be flexible general guidelines. Regional and state-level strategies are more geographically specific, are consistent among regions, and follow the best available scientific knowledge. Together the range-wide, regional, and state-level goals and strategies form a well-integrated, well-organized, and comprehensive Conservation Strategy for brook trout.

## **Conservation Strategies**

**Principal Goal I: *Conserve, enhance or restore brook trout populations that have been impacted by habitat modification or other population level threats.***

The EBTJV believes that efforts to improve the status of brook trout should begin by protecting “the best of the best” habitat that supports existing healthy, stable populations. The next step is to improve and reconnect adjacent habitats that have a high likelihood of supporting stable populations. This approach also applies to the restoration of impacted or unstable brook trout populations. Restoration should focus on habitat supporting populations that are doing relatively well, then extend to adjacent habitats.

Regional and state-level actions will vary depending on the current condition and restoration potential of the habitat available for use by brook trout. Actions by Joint Venture partners



should focus on preserving largely intact brook trout habitat focusing on spawning and early life history habitat critical for sustainable natural reproduction. Where habitat for brook trout is absent or severely diminished, actions should center around habitat restoration that can be accomplished through the best available scientific knowledge. Where brook trout populations are self-sustaining, efforts should be directed towards improving habitat to intact condition. If brook trout populations have been eliminated as a result of habitat deterioration, they can be restored by transplanting brook trout of the appropriate genetic origin from adjacent streams or watersheds after restoration of the habitat is completed.

Increasing the abundance of self-sustaining brook trout populations may not, by itself, result in long-term recovery. Restoration efforts must focus on restoring habitats and developing ecosystem conditions and functions that will allow for expanding and maintaining diversity within and among species in order to sustain a system of robust populations in the face of environmental variation.

Preserving the genetic diversity of brook trout populations in the eastern United States is a critical component of the EBTJV. Restoration efforts should be distributed among watersheds that preserve genetic diversity of native populations, or specific strains such as Southern Appalachian brook trout as much as possible. In addition, the EBTJV should strive to preserve unique brook trout life history strategies, such as lacustrine populations, large river populations, and coastal populations.

### **Range-wide Habitat Objectives**

Range-wide habitat objectives are designed to measure the overall success of the EBTJV over the long term. The EBTJV determined that the appropriate time scale to measure long-term success was at 15-year intervals. The term “healthy” is used as a planning component, which combines Intact and Reduced habitat categories. Below are the long-term habitat goals that will be used to measure success. Actions that strengthen populations include, but are not limited to, habitat enhancement, reducing excessive harvest, increasing distribution within a subwatershed, improving water quality, or reducing exotics.

#### **1. Increase number of subwatersheds classified as healthy by 10% by 2025.**

This objective reflects each states’ intention to protect the “best of the best” remaining brook trout populations. Most of the intact watersheds are located in the northern region of the range, so a substantial amount of the total effort will be directed towards protecting those northern watersheds. States in the southern region, where less intact populations exist, will direct regional efforts towards protecting the best remaining habitat, regardless of current brook trout population status.

#### **2. Establish self-sustaining brook trout populations in 10% of known extirpated subwatersheds by 2025.**

Successful re-establishment of brook trout populations within their historic range can restore connectivity between isolated populations and provides sources for future population expansions. Fishery managers will identify suitable watersheds and initiate restoration efforts using a variety of techniques.

**3. Improve 30% of reduced subwatersheds to healthy classification and maintain 70% of reduced subwatersheds in existing or improved condition by 2025.**

Active conservation applied to watersheds with the potential to increase or expand brook trout populations is expected to maintain or improve the classification of a substantial number of watersheds throughout the range. Strengthening reduced populations supports the range-wide vision by decreasing the chances of extirpation and providing a foundation for future population enhancements. Maintaining current condition within watersheds is equally, if not more, important at the vulnerable reduced population level as it is at the intact level. To prevent further population loss, regional strategies support maintaining the status quo in greatly reduced watersheds. Regional fishery managers agree this objective may be the most difficult to accomplish given current resource investment levels. Landscape change of such magnitude will require committed resources to accomplish this objective.

**4. Validate classification of all predicted subwatersheds by 2025.**

Data are lacking to confirm brook trout status for many watersheds in the northern region. The validity of models used to predict the status of brook trout populations where no data exists needs to be ground-truthed for accuracy.

**Regional Habitat Objectives**

Although based on the short-term (2012), the following regional habitat objectives are designed to meet range-wide habitat goals by 2025. Short-term regional habitat objectives are disproportionately allocated among the northern and southern regions based on priorities within each region as well as the likelihood of success.

1. Maintain the status, or no net less, of 617 subwatersheds classified as healthy by 2012.  
Northern Region = 493  
Southern Region = 124
2. Strengthen brook trout populations in 31 subwatersheds classified as healthy by 2012.  
Northern Region = 20  
Southern Region = 11
3. Establish self-sustaining brook trout populations in 8 subwatersheds classified as extirpated by 2012.  
Northern Region = 2  
Southern Region = 6
4. Improve 7 reduced subwatersheds to healthy classification by 2012.  
Northern Region = 2  
Southern Region = 5
5. Strengthen brook trout populations in 63 subwatersheds classified as reduced by 2012.  
Northern Region = 30  
Southern Region = 33

6. Maintain 713 reduced subwatersheds in existing condition by 2012.  
Northern Region = 505  
Southern Region = 208
7. Validate the predictive brook trout status model by assessing 50% of predicted subwatersheds by 2012.  
Northern Region = 700  
Southern Region = 92
8. Maintain the status, or no net loss, of healthy pond and lake watersheds, and assess the status of 100 unknown subwatersheds by 2012.  
Northern Region = 50  
Southern Region = 50

### **State-Level Habitat Strategies**

The Joint Venture is comprised of 17 states within the historical range of brook trout in the eastern United States. Each state was asked to produce a state-level brook trout conservation plan consistent with the vision of the EBTJV framed around the five key priorities. To date, individual state strategies have been produced by Massachusetts, Maine, New Hampshire, New York, Vermont, Maryland, Pennsylvania, West Virginia, Georgia, North Carolina, South Carolina, Virginia, and Tennessee (Appendix I). These state planning efforts serve as the basis for regional and range-wide goals and objectives. The state level is where the vast amount of brook trout conservation efforts will occur. Although each member state developed a unique plan, common goals, objectives, and strategies were evident. Presented below is a summarization of state-level objectives and associated strategies to meet those objectives.

1. Improve protection of brook trout resources.
  - a. Develop structured timelines for input opportunities to state and federal level resource management plans, solicit input from appropriate groups, and provide formal comments.
  - b. Include non-traditional resource “interest” groups, such as watershed enhancement organizations, organized angling groups, and land conservancies in the planning and comment process during the formation of state-level trout management plans or other management plans.
2. Maximize brook trout habitat and water quality protection through state and federal agencies.
  - a. Provide appropriate agency habitat conservation comments on all brook trout related projects that require federal or state permits.
  - b. Establish and enforce buffer requirements on all perennial streams.
3. Pursue direct land purchase or conservation easements to protect brook trout habitat.
  - a. Partner with land trusts or other conservation organizations.

- b. Appropriate percentage of agency operating funds or license revenue towards direct purchases or conservation easements.
  - c. Use mitigation to protect trout habitat.
- 4. Establish land conservation easements that require the use of Best Management Practices and include the development of stewardship plans.
  - a. Develop a standard protocol/design for conservation easements.
  - b. Identify organizational structures to hold easements or property deeds.
  - c. Develop guidelines for “brook trout friendly” developments and establish a formalized certification process through the EBTJV.
  - d. Partner with developers to study watersheds to determine if brook trout protection requirements in “brook trout friendly” developments are effective.
- 5. Assist landowners in utilizing existing land conservation programs.
  - a. Utilize existing USDA Farm Bill programs (LIP, CREP, etc.)
  - b. Develop potential list of state-level, regional, or national land conservation programs that might be available to landowners complete with cost share requirements, deadlines, and reporting guidelines.
  - c. Partner with landowners in key watersheds that have high potential for habitat restoration (e. g., spring creeks in southwest Virginia).
- 6. Minimize fish stocking impacts to wild brook trout populations.
  - a. Develop stocking protocols that reduce potential impacts to wild brook trout populations.
  - b. Use triploid trout (sterile) in stocking programs.
- 7. Mitigate factors that degrade water quality.
  - a. Consider using direct treatment (i.e., adding lime) to improve water quality.
  - b. Establish or increase stream buffers.
  - c. Use direct stream restoration activities, such as Rosgen-type channel modification, to reduce inputs of sediment at critical areas.
  - d. Use indirect stream enhancement activities, such as riparian plantings, to stabilize stream banks and reduce inputs of sediment over a broad area.
  - e. Remediate Acid Mine Drainage (AMD) and acid deposition impacts to brook trout habitat
- 8. Maintain or restore natural hydrologic regimes.
  - a. Utilize active instream management and design.
  - b. Establish and maintain adequate stream buffers.
  - c. Re-establish fish passage and brook trout population re-connectivity through barrier removal (where appropriate).
- 9. Prevent the spread of invasive species into brook trout habitat.
  - a. Develop EBTJV-produced educational pamphlets that highlight state-level, regional, and range-wide threats from invasive species. Update annually.

- b. Develop lists of invasives with state or federal agencies responsible for permitting aquaculture operators or distributors.
  - c. Eradicate invasive species from brook trout habitat where feasible.
- 10. Expand and integrate state, federal, and private programs that support riparian conservation in watersheds that support brook trout populations.
  - a. Utilize CREP, WHIP, Partners for Fish and Wildlife, and state, county, or other conservation programs. This should include efforts to integrate alternative mitigation programs when applicable.
- 11. Utilize state, federal and private programs that support watershed stewardship programs in systems containing brook trout.
  - a. Utilize USDA Healthy Forest Restoration Act through state forestry agencies.
- 12. Partner with organizations on projects that involve nongame species, migratory birds, and brook trout.
  - a. Develop a list of organizations that peripherally could support work with brook trout restoration and protection. Such groups include, but are not limited to, the American Fisheries Society, Natural Heritage program, Audubon Society, and Trout Unlimited's Back the Brookie campaign.

### **Monitoring Strategies**

The effectiveness of EBTJV conservation actions to improve the status of wild brook trout populations and their habitats needs to be assessed. To address this need, the EBTJV supports the development of monitoring programs that reduce redundancy, increase efficiency, and meet the goals of the Conservation Strategy.

1. Monitor brook trout habitat and water quality trends. Focus on remotely-sensed data when possible to minimize manpower needs of EBTJV participants.
2. Monitor long-term brook trout population trends at selected sites throughout its eastern US range. Develop statistically designed site selection procedures and standard protocols for data collection.
3. Summarize monitoring data into summary reports, integrate with current web-based GIS applications, and make information available via EBTJV web site.

### **Data Management Strategies**

It is imperative that the EBTJV establish and implement a centralized, web-based, data management system that permits all agencies with brook trout management responsibilities to contribute, store, and access data. In addition, providing EBTJV partners, outside organizations, and the public with relevant data, maps, and reports is an important function of the EBTJV.

1. Work with management agencies to develop minimum data standards to facilitate data sharing and reporting.
2. Assess current data gaps.
3. Create a centralized, web-based, data access system to query data owned and maintained by the management agency. This would permit biologists to access other organizations' data from a central location while allowing the state and federal data owners to maintain full ownership and control of their data.
4. Develop web-based map server (ArcIMS) application to view brook trout distribution, abundance, and habitat information.
5. Integrate other information as appropriate to assess brook trout status and management needs.
6. Establish web-based system for the efficient dissemination of EBTJV related data, maps, reports, and outreach material.

### **Research Strategies**

The heart of the Conservation Strategy is a set of immediate actions to improve conditions for brook trout. However, another important function of the EBTJV is to facilitate applied research directed to answer questions relative to brook trout conservation actions.

1. Establish statistically-designed research projects to identify cause-and-effect relationships for changes in brook trout populations.
2. Develop research projects designed to determine genetic impacts of brook trout restoration techniques. This research would benefit managers by providing information on the genetic variability needed to establish new brook trout populations, protect existing populations, ways to strengthen populations with low genetic variability, and protect unique strains.
3. Use effectiveness monitoring when cause-and-effect relationships between habitat improvement and brook trout population responses are being established. The design of effectiveness monitoring requires data be collected simultaneously at both treatment and control sites before and after treatment.
4. Establish a research plan that identifies key brook trout conservation needs and establishes priorities for research funding.
  - a. Prioritize at state, regional, and range-wide levels annually.
  - b. Utilize and apply prior research results to assist in prioritization process.
  - c. Develop standardized protocols to assist in research prioritization process, implementation schedule, and reporting deadlines.
  - d. Establish research standing committee.

5. Make information from EBTJV research products readily available.
  - a. Develop coordinated EBTJV press releases and outreach plan.
  - b. Utilize EBTJV web site to archive and distribute reports.

### **Standards for Determining Success**

Implementation of the Conservation Strategy must also include a process to evaluate whether the EBTJV conservation actions are achieving desired goals. Since the ecosystems that support brook trout are inherently variable and highly complex, conservation actions must be taken in an adaptive manner. Adaptive management is a systematic process for continually improving management policies and practices by learning from the outcomes of operational programs.

### **Evaluation Strategies**

1. Create benchmarks for measuring brook trout conservation success.
  - a. Short-term benchmarks should be set and evaluated in 2012 and subsequently at 5-year intervals. Short-term goals, objectives, key priorities, and strategies should be re-evaluated at this time.
  - b. Long-term benchmarks should be set and evaluated in 2025 and subsequently at 15-year intervals. Long-term goals, objectives, key priorities, and strategies should be re-evaluated at this time.
2. The Steering Committee will produce an annual evaluation report that provides an accounting of Conservation Strategy project accomplishments and operational costs.
3. Analyze brook trout conservation actions and communicate the results through the EBTJV web site, reports, and outreach materials.

### **Strategic Planning for Partnerships**

**Principal Goal II:** *Encourage partnerships among management agencies and stakeholders to seek solutions to regional environmental and ecological threats.*

Encouraging partnerships among management agencies and stakeholders to seek solutions to the threats that impact brook trout is essential because a collaborative approach leads to enhanced conservation of brook trout and their habitat. Eastern Brook Trout Joint Venture partners affirm and agree to use their best efforts to implement a Conservation Strategy that will accomplish goals, objectives, and address on-the-ground actions that conserve, enhance, and restore brook trout populations.

Building partnerships can be achieved by promoting informed collaboration through a variety of strategies. Partners can collectively pursue funding initiatives at the state, regional, or range-wide level through grants, mitigation programs, in-kind contributions, or other available avenues that support the Joint Venture. In addition, partners should collectively pursue interagency

agreements, cooperative agreements, and contracts to fund and implement Eastern Brook Trout Joint Venture sponsored projects. Encouraging and supporting additional partners will strengthen the effectiveness of the joint venture.

Measuring partnership success is a needed component of the EBTJV. In order to achieve this goal, a series of both short-term (5-year) and long-term (15-year) target tracking goals have been developed.

## **Strategic Planning for Outreach and Educational Programs**

**Principal Goal III:** *Develop and implement outreach and educational programs to ensure public awareness of the challenges that face brook trout populations.*

### **Outreach and Education Goals and Strategies**

A comprehensive outreach plan is a critical element to engaging, informing, and inspiring the public and policy makers to take action to conserve brook trout in the eastern United States. Equally important is the need to develop a focused educational component designed to provide the public and policy makers with relevant information regarding the status of brook trout, current Joint Venture projects, and opportunities to become involved. Outreach and education goals and strategies include:

1. Raise public awareness about wild brook trout resources
2. Foster public/private collaborative stewardship of brook trout resources.
3. Build strong coalitions that support the conservation of wild brook trout.
4. Produce information on the impacts invasive species have on brook trout and their habitats.
5. Develop an understanding of and support for protecting brook trout habitat among policy makers with an educational and public awareness campaign.

### **Allocating Responsibilities**

The EBTJV needs to develop methods to allocate responsibilities equitably among partners. The allocation of responsibilities for outreach and education program should fall primarily to the outreach and education work group with oversight from the steering committee.

### **Measuring Outreach and Education Success: Targets, Timelines, and Metrics**

The EBTJV also has a need to measure the effectiveness of its outreach and education programs. The allocation of responsibilities for outreach and education program should fall



primarily to the outreach and education work group with oversight from the steering committee. The Outreach and Education work group will develop outreach and education targets, timelines, and metrics for both short-term (2012) and long-term time scales (2025). Progress on education and outreach goals will be reported to the Steering Committee annually.

## **Strategic Plan for Program Support**

**Principal Goal IV: *Develop support for program implementation that perpetuate and restore brook trout populations throughout their historic range.***

The EBTJV needs significant public and political program support at local, state, regional, and range-wide levels in order to be successful over the long-term. In addition to program support, the EBTJV will need to ensure consistent, reliable, funding for both short-term projects and long-term goals. To that end, the Steering Committee will develop:

1. List of political and public support goals for continuation of EBTJV.
  - a. Short-term (2012) and long-term (2025) time scales.
  - b. Local, state, regional, and range-wide geographic scales.
2. List of funding requirements for continuation of EBTJV.
  - a. Short-term (2012) and long-term (2025) time scales.
  - b. Local, state, regional, and range-wide geographic scales.
4. Funding matrix that will allow more accurate estimation of project costs at local, state, regional, and range-wide levels. This will be based on a model that is currently under development by the EBTJV that has been successfully tested and applied to New Hampshire. The test matrix will be applied to all states within the EBTJV and will identify:
  - a. Estimated costs for individual states.
  - b. Funding dispersal matrix table created after state cost estimate matrices are completed.
  - c. Develop funding timetable for both short-term (2012) and long-term (2025) cost estimates.
5. Framework for tracking and reporting fund allocations spent on EBTJV projects.

## **Regional Coordination**

Given that the EBTJV encompasses a 17-state geographic area there is a need for regional-level coordination. Two regional subcommittees: (1) Northern (Maine, New Hampshire, Vermont, New York, Massachusetts, Pennsylvania, Rhode Island, and Connecticut and (2) Southern (Virginia, New Jersey, North Carolina, South Carolina, West Virginia, Maryland, Georgia, and Tennessee) will operate under the umbrella of the EBTJV Steering Committee. The purpose of these subcommittees is to focus efforts on identifying regional threats and coordinating regional conservation actions to address these threats.

## **Expected Results and Benefits**

The EBTJV expects multiple benefits to accrue from the Conservation Strategy:

1. Improved data sharing and coordination will give the management agencies an unprecedented way to monitor population trends and compare brook trout populations geographically across the entire eastern range. A clear understanding of population status, trends, and threats should help the management agencies prioritize restoration efforts.
2. Coordination of restoration efforts, sharing of relevant data, and utilization of previous lessons learned should improve the ability of Joint Venture partners to manage brook trout populations.
3. An assessment and management strategy should help gain attention for restoration needs for brook trout in the east from policy-makers, thereby raising the priority level of resource requests and policy decisions affecting brook trout.
4. A strategic and well-planned outreach component should result in a better informed public. This should produce favorable political decisions regarding funding allocations, land management decisions, and other pertinent conservation measures that support the Joint Venture's vision.

## **Conclusions**

This document presents the framework necessary to begin the conservation of brook trout in the eastern United States. This “working” document will be updated at periodic intervals to reflect changes to priority objectives, add new state conservation strategies, and to incorporate new monitoring and research data. This level of fluidity, we believe, will be necessary to ensure that the EBTJV remains responsive to the needs of the partners that will ultimately ensure the perpetuation of the eastern brook trout.

## **Acknowledgements**

The authors would like to thank members of the EBTJV Conservation Strategy/Habitat, Data Management, and Education and Outreach work groups for their work in developing this action plan. The authors would also like to thank the EBTJV Steering Committee for oversight and editorial review of this document. We would also like to thank the many state and federal agency employees, NGOs, and volunteers that assisted in the development of this action plan.

## **References**

Hudy, M., T. M. Thieling, N. Gillespie and E. P. Smith. 2005. Distribution, Status and Perturbations to Brook Trout within the eastern United States. Final report to the steering committee of Eastern Brook Trout Joint Venture. 77 pp.

## Appendix I

### *Northern Region*

#### **Massachusetts Eastern Brook Trout Conservation Strategies**

January, 2007

Massachusetts is home to more than 700 wild brook trout streams. Western Massachusetts, particularly the Berkshires has long been known for its brook trout habitat. Less known is that brook trout are distributed statewide, from the high elevation Berkshire streams to the sea-level coastal streams of Cape Cod. Although all brook trout streams are at risk in a small state inhabited by more than 6 million people, the streams in the eastern part of the state are particularly imperiled by many of the threats identified by the Eastern Brook Trout Joint Venture. Massachusetts has brook trout populations in all watersheds, at nearly all elevations (sea level to high elevation Berkshire streams) and both resident and sea-run populations.

Coldwater habitat is shared by several other species besides brook trout. Slimy sculpin, longnose sucker, Atlantic salmon, rainbow and brown trout can all be found within some of the same streams as brook trout. In the western part of the state, brook trout typically coexist with slimy sculpin and, on rare occasion, longnose sucker. This species of sucker is listed as a species of special concern under our State Endangered Species Act and occurs in low abundance with brook trout. Brown trout are self-sustaining in many of the same streams as brook trout and gain an advantage particularly in those streams with extensive habitat degradation. Rainbow trout are self-sustaining in only a few of streams within one watershed. Atlantic salmon are found with brook trout only in those streams selected (based on habitat characteristics) which are included in the Atlantic salmon restoration effort. More than 40 streams that are stocked with Atlantic salmon fry annually and monitored each year to track growth and survival of New England's historically extirpated salmon species.

Brook trout are a coldwater species associated with small streams in Massachusetts, partly due to a near total loss of brook trout in larger stream ecosystems. The specific habitats within these small streams are highly varied. Substrates from ledge to silt are all used to some extent by brook trout. They, like all fluvial specialists, require flows that mimic the natural hydrograph to meet their seasonal habitat needs. Brook Trout are also susceptible to degradations in water quality and have been impacted in many streams statewide. Physical habitat alteration, and changes to water quality and quantity continue to reduce and restrict the amount of habitat available to brook trout in Massachusetts. Some streams no longer support the coldwater fishery resources they once supported; other streams have lost the habitat that supports high abundance of coldwater fish. Brook trout are an indicator species of cold, clean water, that the public values.

Small streams experience a wide array of environmental conditions throughout the year. Summer flows are typically the lowest annual flows and can, at times, be near zero. Aquatic organisms that can find refuge during these extreme climate conditions can survive to repopulate. Spring flows are extreme in fluctuation and magnitude (excluding single events such as hurricanes which are not annual). These habitats depend on high flows to redistribute sediments and provide water to floodplain ecosystems. Many species key in on these high flows to initiate the reproductive cycle. Fall and winter flows are typically moderate compared to spring and summer, but the environmental conditions can still be extreme due to New England weather.

Cold winters can cause the formation of anchor ice that can freeze stream channels solid. Fish will find small refugia in which to survive or move downstream to medium and large streams that will likely have more refugia. Small streams are relatively unstable (stochastic) environments with associated flora and fauna that have come to adapt and, in some cases, rely on dramatic environmental perturbations. It is the frequency and duration of these extreme events that will change as small streams are impacted by the threats listed below and it is the conservation actions also outlined below that will help protect these resources.

Many species that inhabit small streams are tolerant of wide fluctuations found naturally, but cannot adapt to further degradations to already extreme fluctuations. Extreme low flows at natural recurrence intervals can cause population level effects in brook trout that take years to recover from. Water withdrawals that increase the low flow occurrence interval from 20 years to 3 years will result in populations that never recover. Likewise, exacerbating the extremity of low flows may result in population extirpations requiring more costly restoration efforts.

Dams on small streams cause several impacts to aquatic habitats. First, they create unsuitable habitat for native fluvial species and preferred by native and non-native pond species. Second, they stop the flow and transfer of energy, sediments, and nutrients. Water retained in small stream impoundments warms with increased exposure to sunlight and nutrients trapped in the impoundments become available for macrophyte or algal growth. All of these impacts translate into altered water quality downstream of the impoundment. Third, dams create barriers to fish passage that result in isolated populations of fluvial fish less able to cope with environmental extremes. Finally, most dams have no provision for minimum flow and, other than leakage, provide no flow downstream in the summer months or other low flow periods. Low or no flow events then increase in frequency and magnitude and reduce the ability of the fish population to recover. All of these impacts will affect surrounding habitats as well.

## **Priority 1: Assessment**

### **Short Term Goals**

#### **1.1 Continue Massachusetts' brook trout distribution assessment.**

**Strategy:** Continue to determine the spatial distribution of brook trout populations by 2010 using sampling protocols developed for attainment of this goal.

#### **1.2 Develop a comprehensive brook trout data GIS layer.**

**Strategy:** Archive and map historic and current brook trout distribution by 2010 and further incorporate fish database into GIS.

### **Long Term Goals**

#### **1.3 Annually monitor Massachusetts' brook trout populations.**

**Strategy:** Develop statewide monitoring protocol that includes index brook trout streams to analyze shifts in species composition and health of brook trout populations.

**Strategy:** Employ a coldwater and/or brook trout-specific Index of Biotic Integrity to address site-specific measures of brook trout population health.

**Strategy:** Monitor temperature regimes in brook trout streams.

## **Priority 2: Habitat Protection**

### **Short Term Goal**

#### **2.1 Protect brook trout habitat.**

**Strategy:** Develop GIS-based tools for regulatory agencies that describe and quantify brook trout habitat. Develop BMP based on EBTJV threats assessment to provide regulatory agencies and local Conservation Commissions the tools to better protect brook trout habitat using the Wetlands Protection Act, the Clean Water Act, Stormwater Management Standards, Water Management Act and other regulatory frameworks.

### **Long Term Goal**

#### **2.2 Improve brook trout habitat.**

**Strategy:** Develop selection criteria for brook trout habitat improvement projects based on need, and distribution information, land ownership, likelihood for success, and angling access.

**Strategy:** Use GIS land use overlays and results of *Eastern Brook Trout: Status and Threats* as well as additional products provided by the EBTJV to develop a predictive model of those watersheds most likely to change status negatively (From “Intact” to “Reduced” to “Greatly Reduced”) due to anthropogenic changes. This model will be used to provide focus and priorities for protective measures. The same model will be used to predict which watersheds have the greatest potential to improve their status (from “Greatly Reduced” to “Reduced” to “Intact”) to focus restoration efforts in a positive direction. These models will be used with the mapping and outreach examples provided in section 2.1.

## **Priority 3: Outreach**

### **Short Term Goal**

#### **3.1 Create/enhance public interest in brook trout.**

**Strategy:** Produce and employ educational materials (e.g., maps, brochures, posters, articles, videos, live fish displays, etc.) highlighting the importance of Massachusetts brook trout and associated management activities. Venues include the agency website and magazine, schools, stakeholder meetings, and fishing shows.

**Strategy:** Promote the Eastern Brook Trout Joint Venture (EBTJV) on the agency web site and other media outlets.

### **Long Term Goals**

#### **3.2 Increase landowner participation in habitat improvement programs.**

**Strategy:** Publicize (via the agency website, magazine, and other outlets) information regarding all current Federal and State grants and programs, such as the Landowner Incentive Program (LIP), available to landowners for protecting and improving water quality and habitat in brook trout streams. Provide technical assistance as needed.

**Strategy:** Publicize the application of BMPs, as well as the benefits of protecting and improving water/habitat quality, by presenting success stories (in local

newspapers, on the agency website, etc.) that show how entire communities benefit, not just fish and anglers.

**3.3 Develop partnerships that foster brook trout conservation.**

**Strategy:** Facilitate achievement of brook trout conservation goals by establishing relationships with NGOs, city and county governments, land trusts, and other organizations.

**Priority 4: Brook Trout Protection and Restoration**

**Strategy:** Develop partnerships with other federal and state agencies, NGOs and other stakeholders to conduct restoration projects.

**Strategy:** Monitor restored or enhanced brook trout populations to evaluate project success.

**Priority 5: Recreational Fishing**

**Long Term Goals**

**5.1 Make brook trout angling opportunities readily available.**

**Strategy:** Provide some brook trout fisheries in waters that are readily accessible (e.g., tailwaters and larger hatchery-streams with road access) so that anglers have the opportunity to catch and develop an appreciation for brook trout.

**5.2 Comprehensively manage brook trout fisheries.**

**Strategy:** Periodically conduct creel surveys on selected brook trout streams to document angler use, exploitation rates, and preferences. Use this information, along with brook trout population monitoring data, to adjust angling regulations if necessary or provide special fishing opportunities.

## Maine Brook Trout Conservation Strategies

### Background

Maine's lentic<sup>1</sup> brook trout resource consists of populations in 1,135 lakes and ponds of which 645 are self-sustaining (wild) populations; 305 of these waters have never been stocked. In addition, brook trout occur in 22,248 miles of stream habitat, the vast majority of which are wild. The value for stream populations is estimated<sup>2</sup>, because many streams have not been surveyed and population status is largely unknown. Maine's wild brook trout populations are concentrated in the interior highlands of the state, much of which is located in privately owned commercial forestlands. Maine's forests have a long history of land use changes associated with commercial wood harvest including extensive modifications to facilitate log driving through streams and rivers. Although log driving was ended statewide over thirty years ago, many aquatic habitats within forested lands retain chronic degraded conditions and channel instabilities. A total of 177 lakes and ponds that have suitable habitat for trout are zoned as Remote Ponds<sup>3</sup> by Maine's Land Use Regulation Commission (LURC), which oversees zoning in Maine's 10.4 million acres of unorganized territory.

Maine's coastal plain maintains fewer Brook trout populations than the interior highlands and lakes are typically supported by stocking programs. The coast also has many wild, but unquantified, populations of anadromous<sup>4</sup> brook trout. Habitat in the southern part of the state and along the coastal plain tends to be more heavily developed, has suffered more habitat degradation, and has more introduced fish species that compete with brook trout (Jones 1986). However, illegal introductions of competing fish species into areas away from the coastal plain has accelerated within the last two decades. Habitat loss and degradation in southern and central Maine is mainly attributed to urbanization and agricultural land uses and is a growing concern for brook trout conservation.

Genetic assessment was conducted on more than 32 populations, representing 32 subwatersheds throughout the state, in the 1990's. Results indicate that Maine's wild brook trout retain high levels of genetic diversity and uniqueness. Restrictive brook trout fishing regulations were imposed as necessary in 1996 to assure that wild populations were protected from harvest until they attained sexual maturity. As a result, the proportion of larger, sexually mature brook trout has increased in monitored waters. Maine's brook trout management efforts have historically been concentrated on lakes and ponds. Since the 1980's, however, a small number of rivers and streams have been surveyed annually to quantify and qualify brook trout habitat. More recently, a modest number of stream restoration projects have been undertaken and are being evaluated.

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1 Lentic waters are standing water habitats with little to no discernable flow, such as lakes, ponds, wetlands and reservoirs.

2 Based on an estimate of 70% of Maine's 31,806 miles of flowing water.

3 This designation is limited to waters that are not accessible within one half mile by two-wheel-drive vehicles; that have no more than one non-commercial remote camp; and that have cold water game fisheries.

4 Brook trout that live part of their life cycle in freshwaters and part in seawater estuaries.

## **PRIORITY 1: Assessment**

### **Short Term Goals**

#### **1.1 Determine the status of wild brook trout in watersheds lacking adequate and contemporary data.**

**Strategy 1.1.1.** Determine wild brook trout status for lotic<sup>5</sup> habitats in 500 HUC subwatersheds (12 digit HUC<sup>6</sup>) by 2010.

**Strategy 1.1.2.** Determine wild brook trout status for lentic habitats in 100 HUC subwatersheds where current status is unknown by 2010.

**Strategy 1.1.3.** Determine the current status of anadromous brook trout in coastal watersheds and compare to historical distribution.

**Strategy 1.1.4.** Describe and characterize the genetic relationships of Maine's anadromous, lentic and lotic wild brook trout with adequate representation from all seven major river drainages.

**Strategy 1.1.5.** Assist with developing and validating a landscape-scale brook trout habitat relationship model (Thieling 2006).

#### **1.2 Develop statewide GIS data layers for wild brook trout management and conservation planning purposes.**

**Strategy 1.2.1.** Continue efforts at digitizing and converting historical information to GIS formats.

**Strategy 1.2.2.** Develop a series of GIS datalayers displaying wild brook trout status, overall habitat quality, geomorphic condition<sup>7</sup> and critical areas for conservation and management. Examples include spawning, nursery, or adult holding habitats.

### **Long Term Goal**

#### **1.3 Maximize the contribution of wild brook trout stocks to the fishery.**

**Strategy 1.3.1.** Protect native and wild brook trout populations<sup>8</sup> by adhering to Department policies including Legislative Act LD 1131<sup>9</sup> and a Report to the Joint Standing Committee on Inland Fisheries and Wildlife: Managing Maine's Wild Brook Trout Fisheries in Lakes and Ponds.

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5 Lotic waters represent flowing waters, such as brooks, streams, and rivers.

6 HUC is an acronym for Hydrologic Unit Code. The HUC system classifies nested watersheds from large river basins (2 digit code) to small subwatersheds (12 digit code).

7 The classification and condition of stream channel types. This contributes to rating stream stability.

8 Native brook trout waters are those that have never been stocked. Wild brook trout waters are defined as those that have not been stocked since 1980. Their populations, though self-sustaining, have some level of stocking in their history.

9 An Act to Recognize and Protect the Native Eastern Brook Trout as one of Maine's Heritage Fish.



**Strategy 1.3.2.** For wild brook trout lakes, evaluate angling regulatory efficacy by comparing the proportion of older-age (age IV and greater) fish sampled from waters with differing regulatory severity.

**Strategy 1.3.3.** Increase effort to collect angler use and harvest rates, as well as brook trout population statistics, for management areas that are under-represented in current assessment programs, such as LURC's Remote Ponds, streams, and coastal habitats.

**Strategy 1.3.4.** Continue annual monitoring of wild brook trout streams for fishery independent estimates of population status, fish condition, and size/age structure.

**Strategy 1.3.5.** Prevent, eradicate or control the detrimental effects caused by the intrusion of non-native aquatic species into brook trout habitats.

## **PRIORITY 2: Habitat Protection**

### **Short Term Goals**

#### **2.1 Identify degraded stream habitats and prioritize sites for restoration efforts**

**Strategy 2.1.1.** Survey and inventory about 1500 stream reaches per year and rank habitat quality and channel stability for brook trout life history stages by stream reach.

**Strategy 2.1.2.** Identify barriers to fish passage and re-establish habitat connectivity where possible.

**Strategy 2.1.3.** Prevent the intrusion of non-native aquatic species into previously uncolonized habitats where natural landform provides strategic opportunities for optimal or selective barrier placement.

#### **2.2 Identify critical areas and habitats for conservation planning and land protection, such as pursuing conservation easements.**

**Strategy 2.2.1.** Survey and inventory about 1500 stream reaches per year and map spawning, nursery and adult holding areas.

**Strategy 2.2.2.** Identify critical spawning, nursery, thermal, and winter refuge<sup>10</sup> habitats for conservation.

### **Long Term Goals**

#### **2.3 Permanently protect critical habitats.**

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<sup>10</sup> Refuges are specific areas where trout congregate to alleviate stressful seasonal conditions.

**Strategy 2.3.1.** Establish collaborative partnerships with State, Federal, Tribal and private entities for the permanent conservation of critical wild brook trout habitats and refuges.

#### **2.4 Restore degraded brook trout habitats.**

**Strategy 2.4.1.** Increase collaborative partnerships with State, Federal, Tribal and private entities to implement stream restoration projects at a rate of at least ten projects annually.

**Strategy 2.4.2.** Monitor efficacy of implemented projects for ecological responses and indicators of success

#### **2.5 Prevent continued degradation of brook trout habitats**

**Strategy 2.5.1.** Work with landowners to continue developing riparian use practices that protect or restore streambank stability, eliminate erosion and sedimentation concerns, maintain shading and thermal regimes, and reduce rapid precipitation runoff.

**Strategy 2.5.2.** Negotiate with stakeholders in developing water use, flow, and groundwater withdrawal agreements.

**Strategy 2.5.3.** Cooperate with other state and federal agencies to document environmental degradation, recommend venues of responsible development, and enforce violations.

**Strategy 2.5.4.** Support legislation intended to minimize or eliminate environmental degradation if necessary.

### **Priority 3: Outreach**

#### **Short Term Goals**

##### **3.1 Raise public awareness of Maine's wild brook trout resources.**

**Strategy 3.1.1.** Advertise Maine's brook trout resource through the Department's Public Information and Education Division and the Maine State Office of Tourism, emphasizing appropriate management and harvest strategies, respect for landowner rights, and the physical beauty of the setting of many of Maine's brook trout waters.

**Strategy 3.1.2.** Encourage volunteer and school group participation in assessment and monitoring programs.

##### **3.2 Foster public/private collaborative stewardship of brook trout resources**

**Strategy 3.2.1.** Inform the public and encourage interest and participation in addressing environmental issues.

**Strategy 3.2.2.** Continue public education efforts highlighting the permanent ecological repercussions associated with illegal fish stockings.

**Strategy 3.2.3.** Contribute toward public policy that includes brook trout population health and sustainability as positive indicators toward improving or enhancing environmental quality.

#### **Priority 4: Recreational Fishing**

##### **Goals**

#### **4.1 Optimize brook trout angling opportunities.**

**Strategy 4.1.1.** Continue to gain appropriate public access rights over private ways by purchase, negotiation and agreement, easement, gift, cooperation with landowners, and by encouragement of private groups and enterprises.

#### **4.2 Monitor Maine's wild brook trout waters to maximize angling opportunities for principal fisheries<sup>11</sup>.**

**Strategy 4.2.1.** Continue to evaluate annually brook trout populations in lakes, increasing sampling frequency to yield age and growth information from 120 waters, abundance estimates for 12 waters, and harvest estimates for 6 waters.

**Strategy 4.2.2.** Determine angler demand and attitudes through use of the statewide angler questionnaire every fifth year.

**Strategy 4.2.3.** Initiate a systematic statewide sampling regime for estimating angler use, harvest, and fishing quality for lotic habitats.

#### ***References***

Jones, J. 1986. The cumulative impacts of development in southern Maine: Important wildlife habitats. Maine State Planning Office, Augusta ME.

Thieling, T. M. 2006. Assessment and predictive model for brook trout (*Salvelinus fontinalis*) population status in the eastern United States. MS Thesis. James Madison University. 65 pp.

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<sup>11</sup> A principal fishery is defined as one for which the species is regularly sought after by anglers and which makes up a significant portion of the catch.

## **New Hampshire Brook Trout Conservation Strategies**

### **Background**

Approximately 7% of New Hampshire's subwatersheds are known to contain a high percentage (>90%) of historic habitat occupied by self-sustaining (wild) brook trout populations, which are primarily concentrated in northern New Hampshire, including the Upper Connecticut and Dead Diamond River systems and the Magalloway River. Wild brook trout are present throughout a majority of the state but there is insufficient data available to quantitatively classify the current distribution and status of these populations in 70% of the subwatersheds.

Like most of New England, New Hampshire endured intensive timber harvest during the period of early European settlement. The resulting deforestation, log drives, and sediment runoff caused the loss of many wild brook trout populations through habitat degradation. While the state has become reforested to a large extent, suburban and urban development, acid deposition from airborne sources, habitat fragmentation resulting from dams and poorly designed road crossings, and sediment from roadways yield high levels of threat to New Hampshire's wild brook trout.

### **Priority 1: Protection**

#### **Short Term Goal**

##### **1.1. Identify native populations of brook trout in New Hampshire.**

**Strategy 1.1.1.** Collect tissue from brook trout in different watersheds throughout the state for genetic analysis.

**Strategy 1.1.2.** Map brook trout families and determine if these are from hatchery or native stocks.

##### **1.2. Develop a comprehensive wild brook trout database.**

**Strategy 1.2.1.** Create GIS data layers that delineate the stream miles occupied by wild brook trout and identify threats to their habitat.

#### **Long Term Goals**

##### **1.3. Implement actions that protect brook trout populations and their habitat.**

**Strategy 1.3.1.** Review New Hampshire's water quality standards and usage classifications to determine if they provide adequate protection to brook trout habitat and develop revisions if necessary.

**Strategy 1.3.2.** Work with bordering states to develop strategies to increase funding and staffing to insure landowner compliance with water quality regulations.

**Strategy 1.3.3.** Verify that dredge and fill activities that can affect brook trout habitat are in compliance with permit conditions and Section 404 of the Clean Water Act.

**Strategy 1.3.4.** Promote the use of Best Management Practices for silvicultural and other soil-disturbing activities in areas that can affect brook trout habitat.

**Strategy 1.3.5.** Evaluate road crossings of streams within subwatersheds containing wild brook trout to determine if they are degrading habitat and/or obstructing fish passage. Develop plans to replace road crossings as needed.

**Strategy 1.3.6.** Conduct environmental reviews of all plans and applications for new highway corridors, bridge and road replacement and maintenance projects, stream diversion and channel changes, dam construction, dam removal, installation of hydroelectric production facilities on existing dams, and disposal of municipal, residual and hazardous wastes located within subwatersheds containing wild brook trout and provide comments and alternatives to state and federal regulatory agencies to prevent damage to brook trout habitat.

**Strategy 1.3.7.** Communicate brook trout habitat protection needs to pertinent policy and decision-making arenas.

**Strategy 1.3.8.** Identify lands and riparian areas where providing critical protection to brook trout habitat requires obtaining fee title or permanent conservation easements and collaborate with other agencies and land conservation organizations to protect these lands.

**Strategy 1.3.9.** Develop and use metrics that describe progress in protecting the status and distribution of wild brook trout in New Hampshire.

**Strategy 1.3.10.** Prevent the spread of exotic species that can negatively affect wild brook trout populations.

**Strategy 1.3.11.** Limit the use of hatchery-reared trout in subwatersheds of streams that contain intact populations of wild brook trout.

#### **1.4. Identify changes in threats to brook trout populations and their habitat.**

**Strategy 1.4.1.** Evaluate acidification in sensitive areas of subwatersheds containing wild brook trout.

**Strategy 1.4.2.** Develop a partnership with New Hampshire Department of Environmental Services personnel and Volunteer Lakes Program (VLAP) members to collect water samples annually.

**Strategy 1.4.3.** Monitor summer stream temperatures in sub-watersheds containing wild brook trout.

**Strategy 1.4.4.** Screen for changes in land and water use practices that impact brook trout.

**Strategy 1.4.5.** Continually update geographically explicit threat data in the wild brook trout database.

## **Priority 2: Assessment**

### **Short Term Goal**

#### **2.1. Prioritize subwatersheds for quantitative data collection.**

**Strategy 2.1.1.** Create a GIS data layer that delineates the stream miles in subwatersheds where qualitative data indicates the presence of wild brook trout.

**Strategy 2.1.2.** Create a map using GIS layers of the various threats and habitat occupied by wild brook trout and rank subwatersheds by priority need for quantitative assessment of wild brook trout status and distribution.

### **Long Term Goal**

#### **2.2. Obtain quantitative data on the status and distribution of wild brook trout.**

**Strategy 2.2.1.** Collect quantitative data on the distribution of wild brook trout populations and use the data to classify its status at the subwatershed level.

**Strategy 2.2.2.** Validate the models Hudy et al. (2005) developed to predict wild brook trout population status by subwatershed.

## **Priority 3: Enhancement and Restoration**

### **Short Term Goal**

#### **3.1. Determine suitability of subwatersheds for enhancement or restoration of wild brook trout.**

**Strategy 3.1.1.** Identify and prioritize subwatersheds that are least likely to change with climate and contain suitable habitat for increased occupancy by wild brook trout.

## **Long Term Goal**

### **3.2. Increase the percentage of historic habitat occupied by wild brook trout.**

**Strategy 3.2.1.** Identify and use effective habitat restoration/enhancement techniques.

**Strategy 3.2.2.** Evaluate brook trout habitat enhancement and restoration actions and monitor the use by wild brook trout.

**Strategy 3.2.3.** Expand the range of wild brook trout into enhanced and restored habitat through the process of natural recolonization. When natural recolonization cannot occur, wild brook trout donor populations within the same subwatershed or if necessary, an adjacent subwatershed will be used.

## **Priority 4: Recreational Fishing**

### **Short Term Goal**

#### **4.1. Identify waters capable of sustaining wild brook trout fisheries.**

**Strategy 4.1.1.** Monitor selected waters to determine if water temperatures are a limiting factor for brook trout.

**Strategy 4.1.2.** Evaluate the quality and quantity of brook trout habitat in selected waters not limited by water temperatures.

**Strategy 4.1.3.** Derive wild brook trout population estimates in suitable waters.

### **Long Term Goal**

#### **4.2. Provide wild brook trout fisheries in suitable waters.**

**Strategy 4.2.1.** Manage for wild brook trout fisheries in waters that support self-sustaining populations at densities  $\geq 13$  lbs/acre.

**Strategy 4.2.2.** Sustain and improve wild brook trout fisheries through the use of appropriate angling regulations and habitat management that maintain or enhance wild population levels and/or fish size.

**Strategy 4.2.3.** Determine angling effort directed towards wild brook trout fisheries and evaluate the affects of angling regulations.

## **Priority 5: Outreach**

### **Long Term Goal**

#### **5.1. Build strong coalitions that support the conservation of wild brook trout.**

**Strategy 5.1.1.** Establish partnerships with federal, state, and public angling, environmental, and watershed organizations that seek to meet the conservation needs of New Hampshire's wild brook trout.

**Strategy 5.1.2.** Build strong grass root support that places conserving wild brook trout high on the public agenda and brings sustained attention to the need for action.

**Strategy 5.1.3.** Develop an understanding of and support for protecting brook trout habitat among policy makers with an educational and public awareness campaign.

**Strategy 5.1.4.** Develop educational programs and material that teach youths the connection between good water quality and wild brook trout and how to preserve both.



## **New York State Brook Trout Conservation Strategies**

### **Background**

New York State's wild brook trout resources include a large number of both stream and pond populations. Thousands of miles of small streams in New York State contain wild brook trout, most prominently in the Adirondack, Tug Hill and Catskill regions. More limited stream populations exist in western New York State, east of the Hudson, and on Long Island. Remnant anadromous "salter" populations may exist on Long Island. The primary threats to stream populations of brook trout are poor land management practices and related issues such as high water temperatures. Non-native fish species such as brown trout are also threat. These species may out-compete brook trout especially in warmer, degraded streams. As a result brook trout populations in many larger, higher order streams been lost and are now mostly relegated to smaller, headwater streams. While most of these brook trout streams contain wild fish their genetic composition is generally uncertain due to brook trout stocking that started with the widespread stocking of fingerling brook trout in the late 1800's.

New York State currently manages over 400 lakes and ponds as brook trout waters, and natural brook trout reproduction is known to occur in at least 100 of these. New York State's active brook trout management program has produced a high quality and popular fishery, with annual reports of four to five pound fish being caught by anglers. However, the current number of wild, self-sustaining brook trout ponds in New York State is very low relative to historic conditions. Gallagher and Baker (1990) reported that less than 5% of the 1,469 Adirondack lakes and ponds sampled contained unstocked, healthy wild brook trout populations. Many of these waters were likely stocked in the past. Keller (1979) listed only eleven known "heritage" brook trout strains (i.e., no stocking history) still extant in their native waters. Genetic work performed by Perkins et. al. (1993) confirmed the unique genetic character of most of these populations. Furthermore, Perkins et. al. (1993) found significant genetic differences among river basins, among drainages within basins, and even among samples within minor drainages, and suggested that individual heritage populations should be the primary ecological units on which management strategies are based.

Primary threats to lake and pond populations of brook trout include diminished water quality resulting from acid precipitation and competition and predation from introduced species. Increasing beaver populations have been identified as a threat to both pond and stream populations of brook trout in many areas. Beaver ponds and dams may increase water temperatures and block access to or eliminate spawning areas.

### **Priority 1: Assessment**

#### **Short Term Goals**

- 1.1. Determine the status brook of trout for parts of New York State for which we have no quantitative data.**

**Strategy 1.1.1.** Conduct fisheries surveys in each of the 106 HUC level 5 watersheds classified as “Qualitative Presence” in the Status and Trends study. Utilize State partnerships with NGO’s such as Trout Unlimited and leverage local knowledge to locate likely brook trout streams.

**1.2. Determine status of brook trout for parts of New York State where their status is unknown.**

**Strategy 1.2.1.** Conduct fisheries surveys in each of the 89 HUC level 5 watersheds classified as “Unknown, No Data” in the Status and Trends study. Utilize State partnerships with NGO’s such as Trout Unlimited and leverage local knowledge to locate likely brook trout streams. Watersheds that should be categorized “Absent/No History” need to be identified and separated from those that are truly lacking data. In some cases it may be best to split large watersheds that contain discrete areas markedly differing in brook trout status.

**1.3. Map existing wild brook trout populations in lakes and ponds.**

**Strategy 1.3.1.** Create a GIS layer containing information on wild brook trout lake and pond populations, including heritage strain information, stocking history, liming and reclamation history, groundwater inputs, and a measure of natural reproduction (e.g., wild two-year old brook trout or older fish caught per net).

**1.4. Use genetic research to determine appropriate management units.**

**Strategy 1.4.1.** Confirm earlier allozyme genetic studies of New York brook trout with newer microsatellite DNA techniques and place the relatedness of New York strains of brook trout within the context of brook trout populations throughout their eastern range. Brook trout will be managed to prevent the loss of populations that contribute to the overall genetic variation in New York brook trout, and the selection of fish for active broodstock, propagation, and restoration efforts will be based upon this work.

**Long Term Goals**

**1.5. Use genetic techniques to identify “heritage” brook trout waters.**

**Strategy 1.5.1.** Use genetic markers/techniques to determine if specific waters contain native “heritage” strain brook trout and how these populations contribute to the overall genetic diversity of brook trout in New York. Management actions would be tailored to preserve this genetic diversity.

**1.6. Determine brook status for watersheds where status may have changed.**

**Strategy 1.6.1.** Conduct fisheries surveys to update brook trout status in HUC level 5 watersheds, especially in areas of rapid development or other changing conditions.

**Strategy 1.6.2.** Survey for new populations in selected HUC level 5 watersheds.

## **1.7. Map existing wild brook trout populations in streams.**

**Strategy 1.7.1.** Create a GIS layer containing information on wild brook trout stream populations. Include recent stocking history if known.

## **Priority 2: Habitat Protection and Improvement**

### **Short Term Goals**

#### **2.1. Expand staff habitat improvement expertise.**

**Strategy 2.1.1.** Provide training to DEC staff to expand on their ability to identify potential habitat projects, work with contractors as needed to design projects, and coordinate and oversee contractors and local volunteers during project implementation.

#### **2.2. Identify and conduct habitat improvement projects.**

**Strategy 2.2.1.** Establish relationships and partner with local non-profit groups and other government agencies to help in identifying and then implementing habitat improvement projects and projects to improve fish passage (e.g., culvert design and replacement).

**Strategy 2.2.2.** Work with permitting staff to develop and improve standards for culverts, stream crossings, storm water runoff management, and riparian buffers, incorporating natural channel principles and design to the extent possible.

**Strategy 2.2.3.** Identify dams and other structures that prevent passage from tidal habitat up into streams with native Long Island brook trout populations. Work with local government and NGO's to secure funding and install fish passage where needed.

### **Long Term Goals**

#### **2.3. Protect brook trout habitat.**

**Strategy 2.3.1.** Coordinate with regional habitat protection biologists to ensure proper permitting and compliance with all federal and state regulations for projects affecting waters supporting brook trout.

**Strategy 2.3.2.** Identify waters where beavers are impacting brook trout populations and encourage actions to limit beaver populations or develop mitigative techniques to improve conditions for brook trout.

**Strategy 2.3.3.** Initiate private landowner incentive programs to protect and manage for brook trout habitat.

## **Priority 3: Brook Trout Protection, Restoration, and Enhancement**

### **Short Term Goals**

#### **3.1. Restore lake and pond populations of naturally reproducing brook trout.**

**Strategy 3.1.1.** Through survey work and large-scale GIS analysis, identify suitable candidate lakes and ponds for restoration.

**Strategy 3.1.2.** Continue chemical reclamation and liming efforts followed by restocking with suitable strains of brook trout.

**Strategy 3.1.3.** Conduct studies to assess the relative reproductive success of various strains of brook trout.

**Strategy 3.1.4.** Work with the Adirondack Park Agency to support work by DEC fisheries personnel to preserve, protect, enhance and restore brook trout in ponded waters including designated wild forest and wilderness areas of the Adirondack and Catskill Parks.

#### **3.2. Protect native brook trout populations from introductions of exotic species.**

**Strategy 3.2.1.** Increase penalties for illegal fish introductions to brook trout waters. Illegal introductions and unpermitted stockings of exotic and native but widely introduced species into brook trout lakes and ponds are a major threat. Current penalties for these introductions need to be substantially increased, possibly coupled with a generous reward program for tips leading to convictions.

**Strategy 3.2.2.** Where needed, maintain and construct barrier dams to prevent the spread of unwanted brook trout competitors.

**Strategy 3.2.3.** Evaluate stocking policies in streams where stocked brown and rainbow trout may be impacting wild brook trout populations. Consider the termination of stocking if feasible given the current fishery and if publicly acceptable.

### **Long Term Goals**

#### **3.3. Preserve the genetic diversity of brook trout in New York State.**

**Strategy 3.3.1.** Tailor stocking, restoration, and habitat protection programs to preserve known heritage populations as distinct entities, thereby maximizing the overall genetic diversity of brook trout in New York.

**Strategy 3.3.2.** Based on genetic characteristics, continue propagation of selected, representative strains of heritage brook trout. This will entail developing adequate broodstock waters and coordinating with the state, county and private hatcheries. Pursue

the development of broodstock waters, particularly on new state land acquisitions and private lands. Cooperation with NGO's that manage private waters will be essential.

**Strategy 3.3.3.** Pursue land-acquisition projects that will help to preserve overall genetic diversity of brook trout.

#### **3.4. Restore Stream populations of naturally reproducing brook trout.**

**Strategy 3.4.1.** Through survey work, large-scale GIS analysis, and constituent interest, identify suitable candidate streams for restoration.

**Strategy 3.4.2.** Where biologically feasible and publicly acceptable, remove competing fish species.

**Strategy 3.4.3.** Restock as needed with suitable strains of brook trout.

#### **3.5. Conduct research into the control of black bass and other competitors in large lakes.**

**Strategy 3.5.1.** Explore biological and other methods for controlling black bass and other competitors in large lakes. Most of the large lakes that were formally excellent brook trout waters have been severely impacted by the introduction of these competitors, and are too large for chemical reclamation.

#### **3.6. Research the feasibility of "salter" brook trout restoration to Long Island tidewaters.**

**Strategy 3.6.1.** Determine habitat requirements of tidal trout in waters where they are established, such as Cape Cod, and determine if Long Island tidewaters provide suitable habitat.

**Strategy 3.6.2.** Once barriers have been removed, increase protection of brook trout in tidal waters by extending the Long Island brook trout catch and release only regulation to the tidal waters.

**Strategy 3.6.3.** If/when returning tidal brook trout are identified, seed other suitable locations by transporting returning trout to suitable habitat in other streams.

**Strategy 3.6.4.** If no tidal trout are identified, consider establishing populations by stocking using genetically appropriate local or sea run strains.

## **Priority 4: Outreach**

### **Short Term Goal**

#### **4.1. Enhance angler and public awareness of wild brook trout.**

**Strategy 4.1.1.** Produce printed material and web content that fosters awareness and respect for wild brook trout and angling opportunities.

**Strategy 4.1.2.** Expand existing trout in the classroom programs. NGO's are likely to take the lead on this strategy.

**Strategy 4.1.3.** Produce information on the impacts of baitfish and other introduced species, land use practices, and examples of habitat improvement projects.

**Strategy 4.1.4.** Cooperate with the communication efforts conducted by NGO's such as Trout Unlimited.

## **Priority 5: Recreational Fishing**

### **Short Term Goal**

#### **5.1. Manage selected stream sections as experimental "special brook trout management areas".**

**Strategy 5.1.1.** Establish an experimental management regime on selected streams that exhibit good brook trout survival and growth (greater than ten inches) and that are sizable enough to support a fishery. Restrictive brook trout harvest regulations would be established in these areas and all stocking (state and private) would be eliminated. Harvest of brown and rainbow trout would be encouraged in these areas. Collect information on other state's experiences with similar efforts – criteria for selecting streams, regulations enacted, and success.

#### **5.2. Establish trophy brook trout lakes or management areas.**

**Strategy 5.2.1.** Select lakes and ponds with good trout survival and growth potential (greater than 16 inches) and manage these waters as trophy brook trout waters through reduced stocking and/or special regulations, and other management actions. Consider establishing trophy brook trout zones within selected state land units. An assessment of similar regulations/management actions and their results in New York and other states (Maine) will be considered.

## **Pennsylvania's Brook Trout Conservation Strategies**

### **Background**

Brook trout are the only native stream dwelling salmonid to Pennsylvania waters and are the official state fish. They are important to Pennsylvania not only from the many hours of recreational angling opportunities they provide but also as a symbol of our state's rich outdoor heritage. Despite numerous changes that have occurred in Pennsylvania's landscape since the pre-colonial era, brook trout continue to be distributed over a broad range of the state. Based on stream examination information collected by the Pennsylvania Fish & Boat Commission since 1976, wild brook trout populations have been documented in 1,524 stream sections covering a total of 5,044 miles of streams. This figure provides a conservative estimate of the miles of stream inhabited by wild brook trout in Pennsylvania, as it includes only those waters where wild brook trout populations have been confirmed via stream survey information. There are numerous miles of first and second order streams in Pennsylvania that have not been inventoried to date.

Over time, industrialization and urbanization have altered the distribution and abundance of brook trout across the Commonwealth. Pennsylvania was once dominated by vast stands of hemlock trees; these were essentially eliminated during the lumbering era during the late 1800's and early 1900's. The result of widespread lumbering led to increased erosion and elevated water temperatures, which undoubtedly caused many streams to become unsuitable for brook trout. Pennsylvania has also been a leading producer of coal which, following extraction, often resulted in chronic pollution from acid mine drainage. Currently, approximately 2,500 miles of flowing water are affected by acid mine drainage in Pennsylvania. Many of the streams affected by acid mine drainage historically supported wild brook trout.

The primary strongholds for wild brook trout populations occur within the Northern Tier and Center regions of Pennsylvania. For example, 1,875 miles of wild brook trout streams exist within the West Branch Susquehanna River basin, followed by 942 miles of stream within the upper Allegheny River basin, and 936 miles of stream within the North Branch Susquehanna River basin. Collectively, these three major drainage basins support 74.4% of the documented miles of wild brook trout streams in the state.

Overall, wild brook trout are the only species of salmonid that inhabit 607 sections of stream covering 1,730 miles of water. Currently, 247 stream sections and 679 miles of Pennsylvania streams have been designated as Class A wild brook trout waters. Class A wild brook trout waters are defined as those stream sections that support a minimum of 30 kg/ha of wild brook trout with a minimum of 0.1/kg/ha of wild brook trout less than 15 cm, and where brook trout biomass must comprise a minimum of 75% of the wild trout biomass within the stream section.

In Pennsylvania streams, wild brook trout often occur in combination with wild brown trout (596 sections, 1,984 miles) and to a much lesser degree in combination with wild rainbow trout populations (22 sections, 61.61 miles). Of the 5,044.3 miles of stream that support some level of brook trout reproduction, a total of 299 sections and 1,268.65 miles are also stocked with hatchery trout.

Although Pennsylvania supports a considerable wild brook trout resource, much of this resource is fragmented and primarily exists in first and second order headwater streams. Major threats to wild brook trout populations in Pennsylvania include poor land use practices stemming from agriculture and urbanization, sedimentation from road construction and dirt and gravel roads, water temperature elevations stemming from storm water runoff and the loss of riparian vegetation along the stream corridor, and the presence of non-native species such as, brown trout. Other threats include acid precipitation and acid mine drainage that continue to have a negative impact on water quality on a regional basis across the state.

The strategies outlined in this report are designed to focus on improving conditions for wild brook trout populations on a statewide basis. These should include preserving conditions for existing populations and enhancing conditions to allow wild brook trout to expand beyond their current range of waters.

## **Priority 1: Habitat Protection**

### **Short Term Goal**

#### **1.1. Protect brook trout habitat.**

**Strategy 1.1.1.** Coordinate with state and federal regulatory agencies to provide maximum protection of brook trout habitat within current regulatory standards.

**Strategy 1.1.2.** Incorporate recommendations and establish goals within local and regional watershed planning documents (river conservation plans, Chesapeake Bay Program, Delaware Estuary Program, etc.) to increase awareness and advance wild brook trout habitat protection.

### **Long Term Goal**

#### **1.2. Improve brook trout habitat.**

**Strategy 1.2.1.** Pursue conservation easements on private property to provide protection to high value wild brook trout habitat.

**Strategy 1.2.2.** Coordinate with owners to implement conservation practices to protect wild brook trout habitat on private lands.

**Strategy 1.2.3.** Coordinate with appropriate state and federal agencies and local governments to implement conservation practices to protect wild brook trout habitat on public lands.



## **Priority 2: Assessment**

### **Short Term Goals**

#### **2.1. Inventory unassessed waters to confirm presence of brook trout.**

**Strategy 2.1.1.** Collect baseline data and document the status of brook trout populations in waters that have not been inventoried to date but are expected to support wild brook trout. Priority should be given to identify brook trout populations in those streams where current Water Quality Standards are below the Pennsylvania Department of Environmental Protection's High Quality-Cold Water Fishes designation.

#### **2.2. Monitor status of existing brook trout populations.**

**Strategy 2.2.1.** Develop sampling protocols to periodically monitor a random set of representative brook trout streams. Build on existing data sets to monitor trends in brook trout populations.

#### **2.3. Develop a comprehensive GIS brook trout data layer.**

**Strategy 2.3.1.** Map current statewide brook trout distribution by 2010.

### **Long Term Goal**

#### **2.4. Develop brook trout genetic assessment.**

**Strategy 2.4.1.** Partner with University researchers to characterize the genetic identity of Pennsylvania's wild brook trout resource. Efforts should focus on identifying genetic composition with sampling conducted within each major drainage basin in Pennsylvania by 2015.

## **Priority 3: Brook Trout Protection, Restoration, and Enhancement**

### **Short Term Goal**

#### **3.1. Protect existing brook trout populations from future degradation.**

**Strategy 3.1.1.** Provide maximum water quality protection for streams identified as supporting brook trout populations by seeking the highest applicable Pennsylvania Department of Environmental Protection Chapter 93 Water Quality Standards for these streams.

**Strategy 3.1.2.** Partner with other public agencies such as, the Pennsylvania Department of Conservation and Natural Resources, the United States Forest Service, the Pennsylvania Game Commission, the National Park Service, and stakeholder groups such

as, Trout Unlimited, local watershed associations and sportsmen's groups to develop riparian habitat protection and stewardship practices as a model for private landowners.

### **Long Term Goal**

#### **3.2. Restore and Enhance Brook Trout Populations.**

**Strategy 3.2.1.** Through database review, develop a prioritized list of streams for brook trout protection, restoration, and enhancement projects. Consider streams or brook trout populations based on criteria, which may include, population status, potential gain in angling opportunity, and the likelihood for success. Partner with groups such as, Trout Unlimited, local watershed associations and sportsmen's groups to define limiting factors and develop sound restoration and enhancement plans to address identified limiting factors.

**Strategy 3.2.2.** Produce a prioritized listing of five waters where brook trout populations have been extirpated and implement wild brook trout restoration efforts by 2015. Periodically monitor these waters to examine progress of restoration efforts.

**Strategy 3.2.3.** Add additional qualifying watersheds to the Wilderness Trout Streams program.

**Strategy 3.2.4.** Develop partnerships with groups such as, Trout Unlimited under the Coldwater Heritage Partnership, to advance the implementation of brook trout habitat protection, restoration, and enhancement projects. Seek project funding through federal, state and private grants, mitigation settlements, and other sources.

#### **Priority 4: Outreach**

### **Short Term Goal**

#### **4.1. Enhance public interest and knowledge about brook trout and the importance of protecting, enhancing and restoring wild brook trout populations.**

**Strategy 4.1.1.** Develop, present and distribute a multi-media program describing the history of brook trout in Pennsylvania.

**Strategy 4.1.2.** Partner with the Pennsylvania Outdoor Writers Association, and numerous other organizations that publish a newsletter (or other media access), to communicate the imperative to protect brook trout and their habitats.

**Strategy 4.1.3.** Publicize and promote the results of protecting, enhancing and restoring water quality and aquatic habitat that demonstrate how all citizens benefit not just the fish and sporting interests.

**Strategy 4.1.4.** Use internet-media sources such as the Pennsylvania Fish and Boat Commission, Pennsylvania Council of Trout Unlimited and National Trout Unlimited websites to post information on the Eastern Brook Trout Joint Venture and the National Fish Habitat Initiative.

**Strategy 4.1.5.** Take the EBTJV and NFHI informational materials to sportsmen shows and meetings with watershed associations and sportsmen's groups for distribution.

**Strategy 4.1.6.** Provide copies of EBTJV and NFHI informational materials and the Pennsylvania Trout newsletter to all school and public libraries in Pennsylvania.

### **Long Term Goal**

#### **4.2. Develop relationships that foster brook trout enhancement, protection and restoration.**

**Strategy 4.2.1.** Work with municipal officials and policy decision makers to promote and improve water quality. For example, The Center for Dirt and Gravel Roads to reach out to municipalities and counties and tie in water quality and habitat enhancement with their work.

**Strategy 4.2.2.** Engage public officials at all levels.

**Strategy 4.2.3.** Encourage natural resource agencies (Pennsylvania Fish and Boat Commission, Pennsylvania Game Commission, Pennsylvania Department of Conservation and Natural Resources Bureau of Forestry, and United States Forest Service) to conduct workshops and demonstrations for private landowners to promote protection, enhancement and restoration of wild brook trout habitat and populations.

### **Priority 5: Recreational Fishing**

#### **Short Term Goal**

##### **5.1. Increase angler awareness of brook trout angling opportunities**

**Strategy 5.1.1.** Focus on existing angling opportunities through the various Pennsylvania Fish and Boat Commission information and media outlets. Include an emphasis on the special nature of brook trout and why they are important. Encourage conservation angling practices when fishing for wild brook trout.

#### **Long Term Goal**

##### **5.2. Comprehensively manage brook trout fisheries.**

**Strategy 5.2.1.** Conduct creel surveys on randomly selected brook trout populations to collect angler use and harvest data on these waters. Combine these data with biological data to make adjustments in regulations, if necessary.

## Vermont Brook Trout Conservation Strategies

### Background

Brook trout are Vermont's only native stream-dwelling trout and are the most widely distributed trout species throughout the state. Brook trout are also a favorite of Vermont anglers. Statewide angler surveys conducted in 1991 and 2000 revealed it was the fish species most targeted by resident anglers and was their most preferred species for open-water fishing in Vermont.

Vermont's brook trout resource has had a remarkable history of abundance, devastation and recovery. Historical clearing of Vermont's forests, mill development and associated pollution were implicated in the statewide decline of brook trout by the late 1800s:

*"...the depletion of our forests is connected with the disappearance of our brook trout"*

*"While the forests are being converted to lumber the streams are filled with sawdust and refuse destructive to fish life"*

*"After the forests are depleted the streams alternate between "violent and destructive torrents and dry beds of sand and boulders.""*

*"That the depletion of trout in Vermont is largely caused by the impurities thrown into the water, is also conceded"*

(Twelfth Biennial Report of the Commissioners of Fish and Game of the State of Vermont, 1894)

By the 1950s, a statewide stream survey indicated Vermont's brook trout resource had substantially recovered as "*significant numbers of brook trout were taken from all watersheds,*" and "*a striking amount of natural reproduction*" was observed (MacMartin 1960). While physical habitat conditions were improving from the onset of reforestation, pollution from dairies, canneries, tanneries, paper mills, sawmills, granite sheds and slaughterhouses were still noted as significant threats. Although self-sustaining wild brown trout and rainbow trout populations were well established, it was primarily temperature that was believed to limit the distribution of brook trout at this time.

Today, brook trout are widely distributed throughout the state and found in every major watershed. Wild, self-sustaining populations are primarily relegated to small to mid-sized coldwater streams, and a few larger rivers, such as the Castleton River and Batten Kill, which have significant groundwater influence. It is the fish species most likely to be encountered in small upland streams, particularly at elevations exceeding 1000 feet, where it is often the only fish species inhabiting these waters. The Vermont Management Plan for Brook, Brown and Rainbow Trout (VDFW 1993) gives special recognition to these wild trout resources: "*Although environmental factors coupled with relatively short life cycles associated with these populations preclude most wild fish from attaining a large size, these streams are often sustaining populations near their maximum potential. These populations may represent Vermont's only native trout resource which has not been significantly altered by past management practices.*" In a recent study, brook trout populations sampled in 62 sites representing 53 streams and 12

watersheds were characterized by abundant natural reproduction and multiple age-classes (Kirn 2001). On the contrary, wild populations of brook trout in standing waters are very limited in Vermont. High water temperatures and the widespread introduction of competing fish species, such as black bass and yellow perch, largely preclude management for wild brook trout in lakes and ponds.

Although the advent of environmental regulations since the 1970s has greatly improved water quality and physical habitats, there are still significant threats to the long-term survival of wild brook trout populations in Vermont. As water temperature is still the most critical factor in determining the distribution of brook trout populations, land-use practices that help maintain cool water temperatures are of the utmost importance. The preservation and restoration of streamside vegetation has been long recognized as extremely important for controlling temperatures by shading stream channels. Undisturbed, naturally vegetated buffer strips also promote stable streambanks, filter pollutants, provide food and shelter for fish and other aquatic organisms, and are sources of woody debris which creates aquatic habitat diversity and complexity in streams and ponds. These benefits are realized not only within the protected stream reach, but also in its downstream receiving waters. Other activities that promote wider stream channels (e.g. channelization, gravel removal, pond construction) or reduced streamflows may also contribute to increased water temperatures.

In addition to thermal impacts, sedimentation and instream habitat alterations are among the most serious threats facing Vermont's wild brook trout stream populations. Artificial barriers to fish movement, such as culverts and dams, may also be of greater significance to these populations than previously believed. Although many early studies of brook trout in high elevation streams have indicated limited movements, recent work has illustrated potential biases in previous studies and documented significant migrations of this species.

Fisheries management practices may also have significant effects on wild brook trout resources, both positive and negative. Stocking artificially reared trout may be effective in maintaining recreational fisheries where adequate wild populations cannot be sustained due to physical or environmental habitat limitations. While the stocking of hatchery reared trout is an important fisheries management tool, this practice poses several risks to wild trout populations including direct competition, displacement, genetic alteration and the introduction of diseases.

Wild brook trout populations are particularly at risk from genetic interactions with stocked fish, as hatchery-reared trout need only survive a few months after stocking to spawn with wild stocks. Although cases of reproductive isolation have been observed in conjunction with long term stocking programs, introgression and hybridization between wild and hatchery stocks have been well documented for many salmonid species, including brook trout. Wide-spread stocking of brook trout since the late 1800s has raised questions regarding the origin of current-day brook trout populations, i.e. "do native populations still exist?" Genetic testing of five brook trout populations from geographically distinct Vermont watersheds was conducted in 2006. Preliminary results indicate that these populations are genetically diverse, highly differentiated and show no evidence of influence from past stocking practices (T. King, USGS, personal communication). The existence of genetically distinct wild brook trout populations reinforces the need for a prudent approach to trout stocking.

The role of infectious diseases in fish populations is often poorly understood or underestimated, despite documentation of their contribution to significant mortalities in both cultured and wild populations. The potential consequences of disease introductions on fish populations include direct mortality, reduced performance (e.g. growth, survival, stamina), increased sensitivity to stressors and the creation of a reservoir of infection. The recent appearance of whirling disease to Vermont's waters and Viral Hemorrhagic Septicemia (VHS) in nearby states raises serious concerns for wild brook trout resources.

The achievement of the following goals and strategies will be essential to sustain and enhance the long-term viability of Vermont's wild brook trout populations and the recreational fisheries they support.

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**Prepared by:** Rich Kirn, Fisheries Biologist

([rich.kirn@state.vt.us](mailto:rich.kirn@state.vt.us))

Vermont Department of Fish and Wildlife

January 31, 2007

**Partners (Contact):**

USFWS (Dave Tilton; [Dave\\_Tilton@fws.gov](mailto:Dave_Tilton@fws.gov))

USFS (Steve Roy; [sroy@fs.fed.us](mailto:sroy@fs.fed.us) )

USGS (Donna Parrish; [Donna.Parrish@uvm.edu](mailto:Donna.Parrish@uvm.edu))

TU (Dana Baker; [dana\\_j\\_baker@comcast.net](mailto:dana_j_baker@comcast.net))

# Vermont Brook Trout Conservation Strategies

## *1 Priority 1: Habitat Protection*

### **Short Term Goals**

#### **1.1 Protect brook trout habitats**

- 1.1.1** Aggressively participate in state and federal environmental regulatory processes to protect brook trout habitats.
- 1.1.2** Develop and implement stream crossing guidelines that provide for unrestricted passage of brook trout and other aquatic organisms where appropriate.
- 1.1.3** Protect wild brook trout populations from the introduction of exotic and non-indigenous fishes, aquatic species and diseases that may adversely impact brook trout populations or their habitat.

### **Long Term Goals**

#### **1.2 Expand non-regulatory brook trout habitat protection efforts.**

- 1.2.1** Work with state and federal departments and agencies to develop policies and practices that protect brook trout habitats.
- 1.2.2** Work with local governments to encourage sound land-use practices near waters of the state.
- 1.2.3** Encourage the development of instate expertise in the design and construction of stream crossings that provide for unrestricted brook trout passage when appropriate.
- 1.2.4** Encourage the development of incentives for private landowners to maintain “healthy riparian zones.”
- 1.2.5** Identify and protect important riparian habitats along waters supporting wild brook trout, via purchase, easement, or formal agreements.

## *2 Priority 2: Brook trout protection, restoration and enhancement*

### **Short Term Goals**

#### **2.1 Restore or enhance brook trout populations**

- 2.1.1** Use biological and habitat evaluations to identify and pursue opportunities for brook trout habitat enhancement projects.
- 2.1.2** Identify and resolve factors that limit the effective use of existing funding sources to implement brook trout habitat enhancement projects
- 2.1.3** Identify ponds with the potential for wild brook trout management and develop implementation strategies.



## **2.2 Minimize potential impacts of cultured trout on wild populations through prudent management of cultured trout strains, diseases, stocking densities and species introductions.**

- 2.2.1 Manage small upland streams supporting naturally reproducing populations of brook trout as wild trout waters (i.e. no stocking), unless *specific* evaluations indicate the stocking of cultured trout is justified. These waters will often support moderate to dense populations of wild brook trout and are unlikely to attract high enough fishing pressure to warrant stocking.
- 2.2.2 Minimize potential impacts of serious fish diseases upon cultured and wild trout stocks through continued management of a statewide fish health program.
- 2.2.3 Evaluate the use of sterile triploid and all-female triploid brook trout to minimize genetic risks to nearby wild populations, where the use of cultured fish is justified to meet recreational needs.
- 2.2.4 Evaluate the use of sterile triploid and all-female triploid rainbow trout and brown trout to minimize the risk of establishing competing populations, where the use of cultured fish is justified to meet recreational needs.
- 2.2.5 Investigate the need for regulations or statutes to restrict private stocking of waters designated for wild trout management.

### **Long Term Goals**

## **2.3 Encourage the prioritization of enhancement projects by need (from brook trout population and habitat assessments), the magnitude of impact (amount of habitat improved or access gained), and the likelihood of success.**

- 2.3.1 Use biological and stream crossing inventories to develop a process for identifying fish passage enhancement priorities.
- 2.3.2 Use quantitative fish habitat and channel geomorphic surveys to monitor and evaluate long-term trends of brook trout habitat.

## **3 Priority 3: Recreational Fishing**

### **Short Term Goals**

## **3.1 Identify, promote and maintain recreational fishing opportunities for wild brook trout.**

- 3.1.1 Provide information on the status and location of wild brook trout resources.
- 3.1.2 Maintain and enhance access to recreational fishing opportunities to waters supporting wild brook trout, via purchase, easement, or formal agreements.

### **Long Term Goals**

## **3.2 Manage wild brook trout populations for long-term sustainability**

- 3.2.1 Evaluate and apply appropriate angler harvest regulations to conserve/enhance trout population levels and/or size structure.

## ***4 Priority 4: Outreach***

### **Short Term Goals**

#### **4.1 Promote the public’s understanding of the status of wild brook trout in Vermont, their habitat needs and current threats to their populations.**

- 4.1.1** Complete a “Vermont wild brook trout poster” for general distribution.
- 4.1.2** Disseminate information to the general public via various media outlets (web, news releases, brochures, etc.) stressing the importance of habitat to the conservation of wild brook trout populations in Vermont, the public’s responsibility and role toward protecting and enhancing this important resource and the potential threats of exotic species and disease introductions and expansions within Vermont.

### **Long Term Goals**

#### **4.2 Improve access to wild brook trout distribution information.**

- 4.2.1** Create a GIS layer on the distribution and status of wild brook trout resources.
- 4.2.2** Develop age-appropriate support materials for teachers on brook trout life history, distribution, habitat needs and threats.

## ***5 Priority 5: Assessment***

### **Short Term Goals**

#### **5.1 Monitor current brook trout populations**

- 5.1.1** Continue long-term monitoring of specific brook trout streams to better understand population dynamics in response to environmental and land-use factors.
- 5.1.2** Identify information gaps and conduct quantitative fisheries assessments to identify the distribution and status of wild brook trout populations.

### **Long Term Goals**

#### **5.2 Evaluate long-term population trends and identify influences of past management practices on wild brook trout populations.**

- 5.2.1** Repeat the statewide assessment of wild brook trout populations comparing population levels from the 1950s and 1990s.
- 5.2.2** Evaluate the need for additional genetic assessments for Vermont wild brook trout waters. Identify specific goals and objectives for genetic assessment.

## *Southern Region*

### **Georgia Brook Trout Conservation Strategies**

#### **Background**

The brook trout, found in the mountainous region of northern Georgia is Georgia's only native salmonid (trout) species. Current data indicate that there are about 150 miles of brook trout streams in Georgia, with most streams located at high elevations above barrier falls that prevent the movement of other fishes into brook trout water. Most brook trout streams are quite short, often less than one mile in length. Brook trout in Georgia have a short life span, with few individuals exceeding age three or growing larger than six to eight inches.

The original distribution of brook trout in Georgia is unknown, due to widespread losses of brook trout range prior to the time when accurate scientific records were kept. The present range of brook trout in Georgia has been significantly reduced from historical levels due to a variety of factors associated with human activities. In the early 19th century, European immigrants began to settle the southern mountains as other, more desirable land was already occupied by that time. Small subsistence farms were created, mostly located along stream corridors, where the only tillable land was generally located. By the early 20th century, large corporate interests had purchased much of the remaining wooded landscape in the southern Appalachians due to the value of the virgin timber growing there. Widespread logging of high elevation watersheds occurred in the early decades of that century, and the primitive logging techniques used at the time resulted in significant losses of brook trout range. The subsequent introduction of non-native rainbow and brown trout prevented brook trout from becoming reestablished in many streams where they formerly existed.

Recent genetic surveys of Georgia brook trout populations indicated that there are at least 12 populations that appear to be descended from the original native southern Appalachian stocks, 4 populations descended from hatchery (northern) stocks, and 33 populations that are hybrids between the two (Dunham et al. 2001, Seehorn 2004, GAWRD, unpublished data). The vast majority of brook trout streams in Georgia are located at high elevations on USFS lands, which protects them from most disturbances. As a result, most of the remaining brook trout populations in Georgia appear to be relatively stable since most remaining populations are located in relatively remote, undisturbed areas, and the indiscriminate stocking of streams with competitive species has long since stopped. Similar trends have been observed in Tennessee and elsewhere.

#### **The Brook Trout Management Plan**

The overall objective of brook trout management in Georgia is:

“The protection and enhancement of Georgia brook trout populations, recognizing their importance as our only native salmonid species.”

The major strategies that will be implemented to achieve this objective include: Assessment of the current populations of brook trout in Georgia, habitat enhancement and protection, restoration of brook trout populations, public education and the enhancement of fishing opportunities. In this document, the overall goals of the plan will be presented for each of these components. From this information, an annual work plan will be developed with the cooperation of the Georgia Wildlife Resources Division (GAWRD), Fisheries Section and the US Forest Service (USFS). Input from such citizen conservation groups as may be interested in the project will also be solicited.

Because brook trout are a renewable natural resource, the focus of this plan will be to conserve this species so that it will remain a viable and important component of the sport fishing resource in Georgia. Biological, social and economic issues will all be considered when making management decisions, but the biological health of the species will be the most important consideration.

## **Priority 1: Assessment**

### **Short Term Goals**

#### **1.1 Documenting the current distribution of brook trout in Georgia**

**Strategy 1.1.1.** Determine the distribution of brook trout in Georgia. Complete the survey of brook trout streams by 2010.

#### **1.2 Determine the genetic makeup of Georgia's brook trout populations**

**Strategy 1.2.1.** Complete field collections of brook trout tissue samples for genetic analysis by 2010.

#### **1.3 Develop a brook trout GIS layer for Georgia**

**Strategy 1.3.1.** Map both current and historic brook trout genetic and distribution information by 2015.

### **Long Term Goals**

#### **1.4 Develop an expanded brook trout monitoring program**

**Strategy 1.4.1.** Expand the current stream sampling program to include more brook trout streams, particularly those with significant management interest.

## **Priority 2: Habitat Protection and Enhancement**

### **Short Term Goals**

#### **2.1 Develop a prioritized list of habitat improvement projects**

**Strategy 2.1.1.** Work with the U.S. Forest Service (USFS), Trout Unlimited (TU) and other stakeholders to develop a prioritized list of habitat improvement projects by 2007.

## **2.2 Develop a cooperative water quality sampling program**

**Strategy 2.2.1.** Work with the USFS, TU and North Georgia Technical College (NGTC) to establish a sampling program to monitor pH, ANC and temperature for a subset of Georgia brook trout streams by 2007.

### **Long Term Goal**

## **2.3 Evaluate all brook trout watersheds for sources of anthropomorphic sediment**

**Strategy:** Work with the USFS to locate possible sources of sediment. Corrective measures should be proposed and implemented where possible.

## **Priority 3: Restoration of Brook Trout Populations**

### **Long Term Goal**

## **3.1 Conserve Georgia's brook trout populations**

**Strategy 3.1.1.** Develop a list of candidate streams for restoration of brook trout in consultation with stakeholders and partners by 2008. Factors such as genetic type, the presence of barriers and the quality of the existing trout fishery should be considered.

**Strategy 3.1.2.** Follow the management guidelines suggested by the American Fishery Society's Southern Division Trout Committee in its position statement on managing southern Appalachian brook trout (SDAFSTC 2005).

**Strategy 3.1.3.** Working with partners and stakeholders, develop plans for five brook trout restoration projects and begin implementing them by 2010. Priority should be given to streams that are suitable for the southern Appalachian genotype.

## **Priority 4: Education**

### **Short Term Goals**

## **4.1 Public education**

**Strategy 4.1.1.** Develop a Powerpoint presentation on brook trout issues for presentation to sportsman's clubs and other citizen groups by 2007.

**Strategy 4.1.2.** Develop a fold out fact sheet on brook trout for distribution to the public by 2007. Copies should be made available to the public at WRD facilities, USFS offices and state parks.

## **4.2 Inter and intra agency education**

**Strategy 4.2.1.** Agency personnel (WRD and USFS) not directly involved in fisheries management need to be adequately informed concerning brook trout management issues so that their program management activities are as consistent as possible with brook trout conservation. An in-service training program on brook trout issues should be developed and implemented by 2008.

## **Priority 5: Fishing Opportunities**

### **Long Term Goal**

#### **5.1 Provide a variety of angling experiences for brook trout anglers**

**Strategy 5.1.1** Maintain the existing special regulations (16" minimum size) on brook trout streams in the Noontootla Creek watershed. Evaluate the need for any additional regulations to provide a sufficient variety of brook trout fishing experiences.

#### **References:**

- Dunham, R.A., H. Kucuktas, Z. Liu, L. Keefer, and M. Spencer. 2001. Biochemical genetics of brook trout in Georgia: Management Implications. Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 55: 63-80
- Seehorn, T. 2004. Brook trout in the Chattooga drainage: A stream suitability index. PhD. Dissertation, Clemson Univ. Clemson SC, 56pp.
- Southern Division American Fisheries Society Trout Committee (SDAFSTC). 2005. Managing southern Appalachian brook trout: a position statement. Fisheries 30(7):10-20.

## Maryland Brook Trout Conservation Strategies

### Background

Brook trout are Maryland's only native freshwater trout species and have been a popular recreational angling resource since European colonization of North America. Brook trout require relatively pristine conditions for survival and typically cannot survive when water temperatures exceed 68<sup>0</sup>F. Anthropogenic alterations to Maryland's environment over the last several centuries including clear cutting of forests, establishing large agricultural areas, and urbanization have resulted in the extirpation of brook trout from 62% of their historic habitat in Maryland. Of the remaining 151 streams where brook trout populations are found, over half are in westernmost Garrett County, the least developed area of Maryland. The vast majority (82%) of the remaining populations are classified as "greatly reduced", meaning that within the subwatersheds where they occur they occupy only 1% to 10% of the area that was historically inhabited.

A major difficulty in managing the brook trout resource is that only 11% of all brook trout streams and stream miles are fully within state lands; the vast majority of habitat is on private land and a mix of private/public lands. Of the more immediate threats to brook trout populations in Maryland, urbanization is the most serious. In watersheds where human land use exceeds 18% brook trout populations cannot survive. If impervious surface area is greater than 0.5% in a watershed brook trout will typically be extirpated. There are also long-term threats to brook trout populations such as global warming. Current predictions indicate that warming water temperatures over the next 100 years could eliminate brook trout populations statewide except for western Maryland (Garrett County) by approximately 2100.

There is increasing local and national recognition of the uniqueness and quality of fishing for native brook trout and the Maryland Department of Natural Resources (MD DNR) has listed brook trout as a "Species of Greatest Conservation Need" in its Wildlife Action Plan. Concern for the status of the brook trout resource prompted the MD DNR Inland Fisheries Management Division, which is responsible for management of statewide freshwater sport fish species, to develop a brook trout fishery management plan (BTFMP). The goal of Maryland's BTFMP is to *"restore and maintain healthy brook trout populations in Maryland's freshwater streams and provide long-term social and economic benefits from a recreational fishery."* Partners in this effort include researchers from the University of Maryland Center for Environmental Studies Appalachian Laboratory and the Maryland Biological Stream Survey.

### Priority 1: Assessment

#### Short Term Goals

#### 1.1 Complete the Maryland DNR's Statewide Brook Trout Fisheries Management Plan (BTFMP).

**Strategy 1.1.1.** Complete the BTFMP by August 2006 (*in progress*).

#### 1.2 Develop a statewide database on historical and current brook trout population information from all state and university agencies, including a GIS layer that

**incorporates distribution, genetics, co-occurring trout species, population density, and habitat variables.**

**Strategy 1.2.1.** Complete the development of this database by the end of 2008.

**1.3 Complete the genetics assessment of Maryland brook trout populations.**

**Strategy 1.3.1.** Genetic analysis has been completed for approximately 75% of Maryland brook trout populations; complete the analysis for the remaining 25% by 2010.

**1.4 Complete the GEP (genetically effective population-size) investigation for Maryland brook trout populations.**

**Strategy 1.4.1.** Develop a statewide GEP index for all brook trout populations by 2008 (*in progress*).

**1.5 Re-survey brook trout distribution and population densities for brook trout populations in Garrett county, and develop summer upper and lower population boundary limits.**

**Strategy 1.5.1.** Re-survey the brook trout streams investigated during 1988-1990 in Garrett County, MD (58% of all brook trout stream miles in state) and determine upper and lower brook trout population limits during peak summer water temperature period, by 2008.

**Long Term Goals**

**1.6 Continue and refine annual brook trout population monitoring surveys.**

**Strategy 1.6.1.** Survey the remaining 42% of brook trout streams in MD not covered in Objective 1.5 by 2010.

**Strategy 1.6.2.** Refine annual monitoring schedule of statewide brook trout populations to insure that each population is surveyed at least once every three years.

**1.7 Conduct research to determine brook trout population life history characteristics.**

**Strategy 1.7.1.** Develop cooperative projects with University researchers in order to address data gaps and develop a complete life history description for Maryland brook trout by 2010.

**1.8 Investigate angler use and exploitation of Maryland brook trout populations.**

**Strategy 1.8.1.** Develop cooperative projects with University researchers to investigate angler use and exploitation information for Maryland brook trout by 2010.



## Priority 2: Habitat Protection

### Short Term Goals

- 2.1 Protect brook trout habitat on state owned land through cooperation with DNR Regional Team (multi-agency teams), and by implementing the Brook Trout Fisheries Management Plan recommendations.**

**Strategy 2.1.1.** Work closely with state managers from other resource and related agencies to insure that strategies for land use and management decisions that affect water quality and habitat will not have negative impacts, by 2007 (*in progress*).

- 2.2. Protect brook trout habitat on privately owned land by participating on and assisting citizen alliances and watershed organizations in promoting land conservation and watershed conservation programs.**

**Strategy 2.2.1.** Participate on and provide assistance to the Maryland Brook Trout Alliance organization (MBTA) and statewide citizen watershed advocacy and alliance groups (Youghiogheny River, Savage River, Gunpowder River, Monacacy and Antietam, etc.) to educate, encourage and assist private landowners with habitat conservation and restoration through Federal agency programs (CREP, WHIP, LIP, etc.), by 2007 (*in progress*).

### Long Term Goals

- 2.3. Protect brook trout habitat by developing a list of priority habitat protection projects for populations at risk of imminent extirpation and for the only intact Maryland population.**

**Strategy 2.3.1.** Develop a list of habitat protection needs for the most at risk and the only intact Maryland brook trout populations, and work with the appropriate state agencies or citizens groups to direct efforts towards protection.

## Priority 3: Enhancement and Restoration

### Short Term Goals

- 3.1. Develop a priority list of brook trout populations at-risk-of-imminent extirpation, ranked on GEP value, land ownership, angler access, connectivity to other brook trout populations, and recreational value.**

**Strategy 3.1.1.** Develop the priority list by statewide regions and use it to direct private and public restoration efforts, by 2008.

**3.2. Develop a list of acid impacted streams (acid deposition and/or acid mine drainage) where brook trout have been extirpated, and that are only limited by water quality issues, that could support brook trout populations again if water quality improved.**

**Strategy 3.2.1.** Since populations lost to urbanization and agriculture face myriad habitat and political issues that in most cases are insurmountable, acid remediation (dosers, fines, leach beds, etc.) is the largest single opportunity for brook trout restoration in Maryland. Develop a list of acid impacted streams where water quality is the only major issue and physical habitat remains good or will recover naturally, by 2007.

**3.3. Develop statewide guidelines for restoring extirpated populations.**

**Strategy 3.3.1.** Develop guidelines to direct how restoration will be done, including GEP evaluation, genetics of brood, etc., by 2008.

**3.4. Identify and develop a list of thermal pollution sources (ponds, beaver pools, stormwater, etc.) to existing brook trout populations.**

**Strategy 3.4.1.** Work with county and state agencies to identify, review, and develop mitigation plans for thermal pollution sources on identified, impacted brook trout populations, by 2008.

### **Long Term Goals**

**3.5. Develop a list of brook trout streams where exotic trout co-occur (or are encroaching) and develop and evaluate a management strategy to address the situation, by individual stream.**

**Strategy 3.5.1.** Through population survey work and GEP evaluations determine the impact of co-occurring (or encroaching) exotic trout on brook trout populations and develop individual plans to mitigate the impacts.

**3.6. Determine the impact of catch and release, no bait angling regulations on heavily pressured brook trout streams to enhance the size structure and density of individual populations .**

**Strategy 3.6.1.** Data indicate a severe truncation of larger brook trout and lower numbers of both adults and YOY trout in the Savage River watershed in concurrence with heavy angling pressure and distance from road crossings. The Savage River watershed is Maryland's only intact watershed and consists of over 125 miles of interconnected brook trout streams, and will be regulated as of 1/1/07 under catch and release, no bait regulations. Monitor population density and size structure through 2012.

## **Priority 4: Outreach**

### **Short Term Goals**

**4.1. Foster interaction with anglers, conservation/environmental NGO's, and the public in regards to brook trout.**

**Strategy 4.1.1.** Prepare and present informational presentations on the status, history, management, value, future (BTFMP) of brook trout in Maryland, by 2007.

**4.2. Convey impacts of human activities on brook trout populations to local and state government agencies and the general public.**

**Strategy 4.2.1.** Develop a series of Powerpoint presentations that illustrate the life history needs of brook trout, and the adverse impacts that can occur from anthropogenic activities, by 2007.

**Strategy 4.2.2.** Meet with county and local government agencies and planners to present the information and establish a dialog on the issues relating to brook trout conservation, by 2007.

**4.3. Complete, disseminate, and implement the comprehensive Maryland DNR Brook Trout Fisheries Management Plan (BTFMP).**

**Strategy 4.3.1.** Complete the Maryland BTFMP by August 2006 and begin implementing the recommendations, by fall 2006.

**Long Term Goals**

**4.4. Increase landowner participation in habitat improvement programs.**

**Strategy 4.4.1.** Publicize (via the agency website, magazine, and other outlets) information regarding all current State and Federal grants and programs available to landowners for protecting and improving water quality and habitat in brook trout streams. Provide technical assistance as needed.

**4.5. Develop relationships that foster brook trout conservation.**

**Strategy 4.5.1.** Facilitate achievement of brook trout conservation by establishing relationships with NGO's, municipal and county governments, land trusts, watershed alliances and other organizations.

**Priority 5: Recreational Fishing**

**Short Term Goals**

**5.1. Provide and enhance brook trout recreational angling opportunities.**

**Strategy 5.1.1.** Maintain, publicize, and delineate brook trout angling areas on public lands.

**Strategy 5.1.2.** Pursue public angler access to brook trout streams on private property through cooperative agreements, easements, etc.

**5.2. Utilize angling regulations to provide the maximal angling opportunity while ensuring the long term viability of the resource.**

**Strategy 5.2.1.** Conduct angler creel surveys and brook trout population sampling to monitor angler pressure and harvest and impacts to the overall population, and to select appropriate regulations based on this information.

**Long Term Goals**

**5.3. Determine angler preferences and opinions on brook trout management.**

**Strategy 5.3.1.** Solicit angler input for brook trout management and regulatory decisions. This information is necessary to balance the interests of anglers and Maryland's brook trout populations.

# North Carolina Brook Trout Conservation Strategies

## Background

North Carolina boasts the largest number of brook trout populations in the southeastern United States. To date, more than 500 populations of brook trout have been documented in 32 counties of western North Carolina. Brook trout in North Carolina have been severely impacted by alterations to the landscape, however and are now found in less than 80% of their historic range. The majority of brook trout populations are currently found in the Pisgah and Nantahala National Forests and the Great Smoky Mountains National Park. The distribution and status of brook trout on private lands in North Carolina remains to a large extent unknown. Although brook trout are the only trout species native to North Carolina, wild populations of rainbow trout and brown trout currently occupy most of the brook trout's former range. Recent genetic assessments of North Carolina's brook trout populations indicate that 39% are the native Southern Appalachian strain, 9% are direct descendents of northern stocks, and 52% are a mixture.

Brook trout populations located on publicly owned lands are relatively stable, as a result of their location in protected forested watersheds, but face threats from acid rain, global climate change, and competition from rainbow and brown trout. Brook trout on private lands in North Carolina, however face the additional threats of unrestricted commercial silviculture, agriculture, road construction, and extensive residential development.

Management agencies including the North Carolina Wildlife Resources Commission, United States Forest Service, Blue Ridge Parkway, and the Great Smoky Mountains National Park in conjunction with the conservation organizations Trout Unlimited and the Federation of Fly Fishers have jointly developed this brook trout conservation strategy for North Carolina. This conservation strategy lists short term and long term goals as well as strategies to meet the goals deemed necessary to protect, enhance, and restore populations of brook trout in North Carolina. Although the broad goal categories in this report are listed in priority order, those distinctions are slight and used to denote likely order of completion. It is the consensus among the cooperators that all components are integral to meeting the goals listed in this document and to meet the broader goals of the Eastern Brook Trout Joint Venture.

## Priority 1: Assessment

### Short Term Goals

#### 1.1. Complete North Carolina brook trout assessment.

**Strategy 1.1.1.** Complete electrofishing surveys designed to locate all populations of wild brook trout in North Carolina.

#### 1.2. Complete North Carolina brook trout genetics assessment.

**Strategy 1.2.1.** Genetically test all brook trout populations in North Carolina to strain (Southern Appalachian, northern, or mixed).

### **1.3. Develop a comprehensive brook trout distribution GIS data layer.**

**Strategy 1.3.1.** Create electronic storage platform to archive historic and current brook trout distribution and genetic information.

### **Long Term Goals**

### **1.4. Produce or revise comprehensive trout management plans.**

**Strategy 1.4.1.** Develop and update agency trout management plans to include expanded sections focused on brook trout.

### **1.5. Conduct research on causative factors for brook trout population loss.**

**Strategy 1.5.1.** Conduct GIS based land use study to determine how land use patterns relate to brook trout population status.

### **1.6. Develop a long term brook trout monitoring program.**

**Strategy 1.6.1.** Develop and implement long-term brook trout monitoring program designed to collect quantitative information on brook trout population characteristics (range, age and growth, density, and biomass) across western North Carolina.

**Strategy 1.6.2.** Develop concurrent long-term water quality (chemical and biological) monitoring studies on brook trout waters included in long term monitoring program.

## **Priority 2: Habitat Protection**

### **Short Term Goals**

### **2.1. Initiate a compliance program for USACE Section 404 permits issued for waters containing brook trout populations.**

**Strategy 2.1.1.** Follow up on permits issued by USACE that affect brook trout waters to document degree of compliance with permit requirements. Report on compliance and make appropriate recommendations to USACE.

### **2.2. Obtain the highest State water quality classification for brook trout waters.**

**Strategy 2.2.1.** Petition State for highest water quality rating obtainable on all waters that contain brook trout populations.

### **2.3. Investigate effects of stream acidification on brook trout populations in North Carolina.**

**Strategy 2.3.1.** Develop a research project to determine current acidification status of streams in North Carolina; identify trends and determine actions necessary to protect brook trout populations from acid precipitation.

**2.4. Avoid impoundment of brook trout streams.**

**Strategy 2.4.1.** Develop criteria for State and Federal agencies that issue permits for impoundment construction to avoid and minimize impacts to brook trout waters.

**Long Term Goals**

**2.5. Incorporate brook trout streams and watersheds on private lands in North Carolina into the public trust.**

**Strategy 2.5.1.** Develop program that prioritizes brook trout streams and watersheds for fee-simple purchase or conservation easement based on potential benefits for brook trout protection, public access, and recreational fisheries.

**Strategy 2.5.2.** Develop comprehensive assessment GIS based data layer which would include information from the Eastern Brook Trout Joint Venture habitat assessment, state aquatic surveys, water quality information, land ownership, and other variables needed to make prioritization decisions.

**Strategy 2.5.3.** Actively pursue internal and external funding mechanisms for acquisition of prioritized streams and watersheds.

**2.6. Establish vegetated buffers on all North Carolina waters.**

**Strategy 2.6.1.** Support North Carolina Environmental Management Commission's (EMC) attempts to require functional vegetated buffers on all waters in North Carolina, particularly waters supporting brook trout. Provide technical assistance to EMC as needed.

**Priority 3: Habitat and Population Restoration**

**Short Term Goals**

**3.1. Identify candidate streams for brook trout population restoration.**

**Strategy 3.1.1.** Use historic brook trout distribution data and genetic information to develop prioritized list of streams suitable for restoration.

**Strategy 3.1.2.** Develop guidelines and procedures for restoration of brook trout populations.

**Strategy 3.1.3.** Utilize relocation, supplementation, and chemical removals where appropriate for brook trout restorations.

### **3.2. Identify brook trout habitat improvement projects.**

**Strategy 3.2.1.** Develop criteria for habitat improvement projects based on brook trout genetics information, trout distribution data, land ownership, likelihood for success, and angling access.

### **3.3. Initiate brook trout habitat improvement projects.**

**Strategy 3.3.1.** Utilize prioritized list to seek funding for habitat improvement projects. Seek existing funding mechanisms such as highway mitigation work, mitigation banks, State and Federal agricultural incentive programs, or other established funding sources. Utilize a variety of stream restoration techniques including livestock exclusion, site re-vegetation, and in-stream channel modification.

## **Long Term Goals**

### **3.4. Pursue opportunities for brook trout restoration.**

**Strategy 3.4.1.** Select streams based on likelihood for success, location relative to other brook trout populations, and presence of other trout species.

**Strategy 3.4.2.** Conduct long term monitoring on restored brook trout populations to assess viability of program.

## **Priority 4: Protect and Maintain Biological Diversity**

### **Short Term Goals**

#### **4.1. Conserve North Carolina's native, southern Appalachian brook trout.**

**Strategy 4.1.1.** Implement the management actions and guidelines recommended by the American Fisheries Society's Southern Division Trout Committee in its position statement on managing southern Appalachian brook trout (SDAFSTC 2005). This document provides guidance regarding issues such as protecting biodiversity, genetic integrity and conducting restoration and enhancement projects.

#### **4.2. Protect the genetic integrity of brook trout populations.**

**Strategy 4.2.1.** Prohibit introduction of hatchery-reared trout into waters containing self-sustaining populations of brook trout.

**Strategy 4.2.2.** Require stocking permit for fish introductions in all public or private waters in North Carolina.

#### **4.3. Stop loss of fragmented brook trout populations.**



**Strategy 4.3.1.** Identify brook trout populations that have critically low population levels or are at risk of extirpation.

**Strategy 4.3.2.** Seek funding solutions to protect vulnerable or at-risk brook trout populations through conservation easements or fee-simple purchase.

**Strategy 4.3.3.** Relocate imminently threatened brook trout populations in accordance with restoration guidelines.

### **Long Term Goals**

#### **4.4. Develop and implement guidelines to protect the genetic integrity of North Carolina brook trout populations.**

**Strategy 4.4.1.** Initiate research to test efficacy of producing triploid catchable trout for recreational stocking.

**Strategy 4.4.2.** Initiate research on producing viable line of tetraploid trout.

**Strategy 4.4.3.** Prohibit stocking reproductively viable trout in North Carolina waters.

**Strategy 4.4.4.** Require use of sterile trout for all stocking permits issued by the North Carolina Wildlife Resources Commission for public and private waters.

#### **4.5. Maintain brook trout genetic diversity.**

**Strategy 4.5.1.** Develop program that seeks protection of all brook trout populations located on private lands in North Carolina. Options would include conservation easements, fee-simple purchase, buffer restrictions, or other incentive programs.

**Strategy 4.5.2.** Seek highest water quality and land management standards from State and Federal regulatory agencies in watersheds with brook trout populations.

### **Priority 5: Outreach**

#### **Short Term Goals**

##### **5.1. Create public interest and knowledge about brook trout program.**

**Strategy 5.1.1.** Seek funding to develop public outreach programs specific to brook trout in North Carolina.

**Strategy 5.1.2.** Develop specific outreach programs for targeted audiences.

**Strategy 5.1.3.** Incorporate and enhance existing educational programs currently administered by Cooperators.

**Strategy 5.1.4.** Incorporate and promote the Eastern Brook Trout Joint Venture on Cooperator's web sites and through earned media campaigns.

**Strategy 5.1.5.** Utilize comprehensive media approach (TV, print, web) to emphasize plight of brook trout in North Carolina.

### **Long Term Goals**

#### **5.2. Disseminate agency trout management plans to the public.**

**Strategy 5.2.1.** Disseminate agency management plans to the public using a variety of media outlets and Cooperator's outreach programs.

#### **5.3. Establish relationships that foster protection of brook trout populations.**

**Strategy 5.3.1.** Establish contacts and relationships with NGOs, city and county governments, land trusts, and grass roots organizations to foster brook trout protection goals.

#### **5.4. Increase interest in current environmental improvement programs by landowners.**

**Strategy 5.4.1.** Increase landowner interest in ongoing Federal and State programs that improve wetland function, establish stream buffers, exclude livestock, and provide incentives for best management practices by fostering relationships with those agencies, maintaining an active technical role, and providing educational materials.

### **Priority 6: Recreational Fishing**

#### **Short Term Goals**

#### **6.1. Provide and enhance brook trout recreational fishing opportunities.**

**Strategy 6.1.1.** Maintain current level of public access on all public and private lands in North Carolina.

**Strategy 6.1.2.** Pursue additional access to brook trout streams on private lands through fee-simple purchase, access easements, conservation easements, or other long-term agreements with landowners.

## **Long Term Goals**

### **6.2. Maximize recreational fishing opportunities for brook trout.**

**Strategy 6.2.1.** Use appropriate size and creel regulations to protect brook trout populations from over-harvest and provide fishing opportunities.

**Strategy 6.2.2.** Develop incentive program for private landowners that encourages protection of brook trout habitats and allows public access for angling. This could be accomplished through the use of recognition programs, special signage, tax breaks or credits, or other financial incentives.

**Strategy 6.2.3.** Explore opportunities to legislate legal access to all public waters in North Carolina.

# South Carolina Brook Trout Conservation Strategy

## Background

South Carolina's brook trout resource currently consists of self-sustaining (wild) populations inhabiting about 95 km in 16 streams in the northwestern portion of the state. Brook trout inhabit northern portions of Oconee, Pickens and Greenville Counties along the Blue Ridge Escarpment and Chattooga Ridge. Wild brook trout habitat is found exclusively in the Crystalline Blue Ridge Eco-Region in first and second order (headwater) streams at elevations as low as 1,700 feet, but generally above 2,000 ft. Over 50% of SC brook trout streams by number occur on the Andrew Pickens District of the Sumter National Forest. However, brook trout streams, primarily along the Chattooga Ridge, on the National Forest tend to be represented by smaller and shorter stream segments. Brook trout streams draining the Blue Ridge Escarpment in the Mountain Bridge section of Greenville County tend to be less numerous, but longer and larger. Brook trout are considered to be South Carolina's only native salmonid, although there is much debate over pre-European distribution in the Atlantic slope streams in SC. Brook currently represent only about 11% of the state's wild trout resources. Generally speaking, rainbow trout occupy most of the coldwater habitat that once supported brook trout along the eastern flank of brook trout habitat in SC. Brown trout have generally displaced brook trout in lower gradient high elevation streams along the Chattooga Ridge in the eastern portion of SC brook trout range. These introduced species have displaced brook trout up to barriers to upstream fish movement. In a few cases only, brook trout co-exist with these species. Genetic assessment of SC's brook trout populations is nearly complete. Only 2 out of the twelve populations tested (17%) are descended from native, southern Appalachian stocks. Two additional populations show "little introgression of northern alleles." Since that time two additional brook trout populations have been reclaimed through stock relocation. At this point, 4 of 16 (25%) of SC brook trout are known to harbor pure southern, with two additional populations exhibiting such low levels of northern alleles that they should be protected as pure southern populations, but perhaps not used as stock for restoration efforts. Seven SC populations (44%) were intergrades between northern and southern strains, indicating stocking of northern fish over southern populations and/or stocking of intergrades from the hatchery system. South Carolina's brook trout continue to be limited by competition from introduced species, as well as residential development and poor land uses practices. Acidic deposition and stream warming associated with climate change are also potential threats.

## Priority 1: Assessment

### Short Term Goals

#### 1.1 Develop a comprehensive brook trout data GIS layer.

**Strategy 1.1.1.** Archive and map historic and current brook trout distribution/habitat and genetic information by 2010.

#### 1.2 Develop a baseline habitat inventory for all brook trout streams.

**Strategy 1.2.1.** Conduct baseline habitat inventory of all brook trout streams using the Basin-wide Habitat Inventory Technique (BVET) by 2010. Comparisons with reference streams (ex. Indian Camp, Slicking Creek, Joyce Kilmer streams) will be used to identify habitat deficiencies and prioritize habitat restoration projects. Habitat surveys should also be conducted on non-brook trout streams being considered for brook trout restoration.

### **1.3 Develop baseline water quality data for brook trout streams.**

**Strategy 1.3.1.** Collect baseline water quality parameters such as: temperature (summer thermographs), pH, ANC, Alkalinity, Conductivity, Nutrients, Turbidity, metals etc. ANC will be particularly important to document the threat posed by acid deposition.

### **1.4 Complete South Carolina's brook trout genetics assessment.**

**Strategy 1.4.1.** Determine the genetic identities (Southern Appalachian, northern, or mixed) of one recently-documented brook trout population by 2010.

## **Long Term Goals**

### **1.5 Develop a long-term brook trout population monitoring program.**

**Strategy 1.5.1.** Obtain quantitative population data for all SC brook trout populations (emphasis on allopatric populations) following sampling procedures outlined by the Southern Division Trout Committee. Once baseline quantitative data is available for all streams conduct rotational monitoring where each stream is quantitatively sampled every 3-5 years (ideally).

### **1.6 Long-term water quality monitoring of SC's brook trout populations.**

**Strategy 1.6.1.** Water quality samples are collected per 1.4 above for SC brook trout streams every 3-5 years. Intended to monitor long-term changes in water quality.

### **1.7 Long-term habitat monitoring of SC brook trout streams.**

**Strategy 1.7.1.** BVET habitat surveys will be conducted periodically on an as needed basis.

### **1.8 Refine current knowledge of brook trout distribution.**

**Strategy 1.8.1.** Refine knowledge on the distributional limits of brook trout in streams. This particularly deals with sympatric populations as allopatric population distribution is largely defined.

## **Priority 2: Habitat Protection and Enhancement**

## Short Term Goal

### 2.1 Protect brook trout habitat.

**Strategy 2.1.1.** Coordinate with the SCNDR’s environmental permitting review section to verify compliance with all Clean Water Act (Section 404) and SCDHEC Permits issued for projects affecting waters supporting brook trout. Make appropriate recommendations to the US Army Corps of Engineers and the South Carolina Department of Health and Environmental Control to ensure that permit requirements adequately protect brook trout habitat.

**Strategy 2.1.2.** Coordinate with the South Carolina Forestry Commission (SCFC) to assure that forestry operations along SC brook trout streams comply with SC Best Management Practices for forestry operations. Make SCFC BMP Foresters aware of the location of SC brook trout streams for use in aerial surveys of forestry operations. These flights can be used to locate recent forestry activity and unauthorized pond/lake construction.

**Strategy 2.1.3.** Recommend to SCDHEC that all SC brook trout streams and stream segments harboring potential allopatric brook trout habitat (where restoration is eminent) are given the highest protective classification as “Outstanding Resource Waters” (Class ORW).

**Strategy:** Develop a database of critical property owners along SC brook trout streams. Educate property owners through outreach programs (examples: mailing of Eastern Brook Trout Joint Venture “Status and Threats” publication to all land owners, hosting day meeting(s) designed to educate landowners of conservation and protection needs – opportunities for easements, conservation bank purchases, etc.).

## Long Term Goal

### 2.2 Improve brook trout habitat.

**Strategy 2.2.1.** Develop selection criteria for brook trout habitat improvement projects based on need (i.e. BVET surveys), genetics and distribution information, land ownership, likelihood for success, and angling access (public versus private).

**Strategy 2.2.2.** Continue the “Partners-for-Trout” partnership. Partners-for-Trout is partnership comprised of federal and state resource agencies (USFWS, USFS, NRCS, SCDNR, Clemson University), non-governmental organizations (Foothills RCD, SCWF, TU). Employ various stream restoration techniques as necessary (e.g., tree-felling, in-stream channel modification, riparian, etc.). Continue to seek project funding through established sources such as: Sportfish Restoration, USFS fishery programs, USFWS-Partners for Fish and Wildlife, Trout Unlimited-EAS and local chapter donations, Farm Bill programs (Wildlife Habitat Incentives Program-WHIP), mitigation banks, and various grants from non-profit groups.

## **Priority 3: Outreach**

### **Short Term Goal**

#### **3.1 Create and enhance public interest in brook trout.**

**Strategy 3.1.1.** Produce and employ educational materials (e.g. brochures, posters, articles, videos, live fish displays, etc.) highlighting the importance of conservation of South Carolina's brook trout and associated management activities. Venues include the agency website and magazine, SC Wildlife TV Show, schools, stakeholder meetings, and fishing shows.

**Strategy 3.1.2.** Promote the Eastern Brook Trout Joint Venture (EBTJV) on the agency web site and other media outlets.

### **Long Term Goals**

#### **3.2 Increase landowner participation in habitat improvement programs.**

**Strategy 3.2.1.** Publicize (via the agency website, magazine, meeting(s) catered to key landowners, and other outlets) information regarding all current Federal and State grants and programs available to landowners for protecting and improving water quality and habitat in brook trout streams. Provide technical assistance as needed.

**Strategy 3.2.2.** Publicize the application of BMPs, as well as the benefits of protecting and improving water/habitat quality, by presenting success stories (in local newspapers, on the agency website, etc.) that show how entire communities benefit, not just fish and anglers.

#### **3.3 Develop relationships that foster brook trout conservation.**

**Strategy 3.3.1.** Facilitate achievement of brook trout conservation goals by establishing relationships with federal and state agencies, NGOs, city and county governments, land trusts, key private landowners and other organizations.

## **Priority 4: Brook Trout Protection, Restoration, and Enhancement**

### **Short Term Goals**

#### **4.1 Ongoing Brook Trout Restoration in SC.**

**Strategy 4.1.1.** Monitor the success of the 2005 brook trout restoration project on 3-miles of stream on Sumter National Forest. Monitoring includes: monitoring the spawning success of recently reintroduced southern Appalachian brook trout, continued monitoring of the impacts of antimycin on non-target aquatics, and monitoring the

success of tree felling to mobilize sediment, enhance pool habitat and overhead cover for brook trout.

**Strategy 4.1.2.** Complete the ongoing brook trout restoration projects on the remaining USFS streams identified in the approved EA by 2010.

**Strategy 4.1.3.** Assist other agencies with technical assistance on brook trout restoration techniques as requested. Publish or present restoration results to assist other agencies with brook trout restoration planning. Provide training opportunities, through ongoing projects, for biologists from other states/agencies to receive on-the-ground technical training in brook trout restoration techniques as requested (antimycin application, BVET, habitat enhancement, etc.).

**Strategy 4.1.4.** Establish relationships/agreements with neighboring states to provide brook trout needed for restocking renovated streams. This assistance is necessary for SC restoration projects to utilize pure southern Appalachian brook trout in ongoing restoration/renovation efforts.

#### **4.2 Future Brook Trout Restoration in SC.**

**Strategy 4.2.1.** Produce a prioritized list of potential southern Appalachian brook trout restoration or enhancement projects emphasizing streams on Jocassee Gorges (DNR property) and for streams along the Blue Ridge Escarpment in the Mountain Bridge Wilderness by 2010. This list will seek to include restorations in river systems (sub-watersheds) where brook trout have been extirpated or where brook trout distribution is very limited. Factors such as elevation, available habitat, species composition, physical barriers (waterfalls), water quality, ownership, accessibility and public support will be considered.

### **Long Term Goals**

#### **4.3 Conserve SC's southern Appalachian brook trout.**

**Strategy 4.3.1.** Implement the management actions and guidelines recommended by the American Fisheries Society's Southern Division Trout Committee in its position statement on managing southern Appalachian brook trout (SDAFS Trout Committee 2005). This document provides guidance regarding issues such as protecting genetic integrity and conducting restoration and enhancement projects.

#### **4.4 Re-establish stable populations of southern Appalachian brook trout in SC.**

**Strategy 4.4.1.** Restore southern Appalachian brook trout populations in SC to a self-sufficient level, defined by having an adequate number of populations in each sub-watershed with sufficient densities to maintain genetic integrity and to support future restoration efforts if needed.



## **Priority 5: Recreational Fishing**

### **Short Term Goal**

#### **5.1 Make brook trout angling opportunities more readily available.**

**Strategy 5.1.1.** Provide some brook trout fisheries in waters that are readily accessible (e.g., larger hatchery supported streams with good access, delayed harvest, Jones Gap C&R, etc.) so that a majority of anglers have the opportunity to catch and develop an appreciation for brook trout.

**Strategy 5.1.2.** Conduct seasonal stocking of brook trout in at least six remote, hatchery supported streams to provide better back-country angling opportunities for brook trout in larger streams (e.g. Thompson River, Devils Fork Creek, lower Howard Creek, Brasstown Creek, Whetstone Creek, South Pacolet River). Continue to stock larger brook trout in Delayed Harvest waters. This has proven highly successful as the brook trout are in spawning colors in fall-winter programs. Seek to maintain a ratio of 10% brook trout in the spring put-take stocking program in mountain streams.

### **Long Term Goal**

#### **5.2 Comprehensively manage wild brook trout fisheries.**

**Strategy 5.2.1.** Periodically conduct surveys on selected brook trout streams to document angler use, total mortality, exploitation rates, and preferences on an as needed basis. Use this information along with brook trout population monitoring data to adjust angling regulations if necessary or provide quality fishing opportunities.

## Tennessee Brook Trout Conservation Strategy

### Background

Tennessee's brook trout resource currently consists of self-sustaining (wild) populations inhabiting about 150 miles in 107 streams in the mountains along the eastern margin of the state and one hatchery-supported tailwater fishery. Wild brook trout habitat is characterized by first and second order (headwater) streams at elevations above 2,400 ft. About 70% of this habitat occurs within the Cherokee National Forest. Another 70 miles of wild brook trout water is located in the Tennessee portion of Great Smoky Mountains National Park (GRSM). While brook trout are Tennessee's only native salmonid, they currently represent only about 25% of the state's wild trout resources. Rainbow trout and, less frequently, brown trout occupy most of the coldwater habitat that once supported brook trout. Additionally, these introduced species occur along with brook trout in over half of the existing brook trout streams. Genetic assessment of Tennessee's brook trout populations is nearly complete and has revealed that approximately 58% are native, southern Appalachian stocks. Brook trout populations in over 30 streams have been restored or enhanced by removing rainbow and brown trout during the past 25 years. This includes 11 streams (27.5 km) in GRSM. However, many of the early projects occurred prior to the genetic assessment and did not involve native populations. Native populations are now the primary focus of brook trout management efforts. Tennessee's brook trout continue to be limited or threatened by competition from introduced species, as well as urbanization and poor land use practices. Acidic deposition and stream warming associated with climate change are also threats.

The Tennessee Wildlife Resources Agency, National Park Service (GRSM), and United States Forest Service are primarily responsible for managing brook trout and their habitat in Tennessee. The Tennessee Valley Authority also provides assistance with restoration projects and helps protect brook trout habitat through its watershed restoration and reservoir release improvement programs. These agencies, in conjunction with the conservation organization Trout Unlimited, have jointly developed this brook trout conservation strategy for Tennessee. It provides goals and strategies intended to help protect, enhance, and restore populations of Tennessee's brook trout and to attain the broader goals of the Eastern Brook Trout Joint Venture. The general goal categories are prioritized, but distinctions are slight and primarily denote the likely order of completion.

### Priority 1: Assessment

#### Short Term Goals

#### 1.1. Complete Tennessee's brook trout genetics assessment.

**Strategy 1.1.1.** Determine the genetic identities (southern Appalachian, northern, or mixed) of all un-typed populations (about 25) by 2010.

#### 1.2. Develop a comprehensive brook trout data GIS layer.

**Strategy 1.2.1.** Archive and map historic and current brook trout distribution and genetic information by 2010.

## Long Term Goals

### 1.3. Annually monitor Tennessee's brook trout populations.

**Strategy 1.3.1.** Continue (and refine as necessary) the existing monitoring programs designed to assess annual variability in brook trout abundance in allopatric and sympatric populations.

**Strategy 1.3.2.** Continue or develop cooperative long-term water quality monitoring programs that focus on key parameters (i.e., pH, anions, cations, sulfate, nitrate, temperature etc.) along elevational gradients. Relate the results of this monitoring to population monitoring results and identify areas where protection is needed.

### 1.4. Resurvey brook trout distribution.

**Strategy 1.4.1.** Locate and obtain GPS coordinates for the upper and lower distributional limits of each brook trout population by 2015. Map new distributions and assess changes/trends since completion of the previous surveys from the 1990s.

## Priority 2: Habitat Protection

### Short Term Goal

#### 2.1. Protect brook trout habitat.

**Strategy 2.1.1.** Coordinate with the regional habitat protection biologist to verify compliance with all Clean Water Act (Section 404) and Aquatic Resource Alteration Permits issued for projects affecting waters supporting brook trout. Make appropriate recommendations to the US Army Corps of Engineers and the Tennessee Department of Environment and Conservation to ensure that permit requirements adequately protect brook trout habitat.

### Long Term Goal

#### 2.2. Improve brook trout habitat.

**Strategy 2.2.1.** Develop selection criteria for brook trout habitat improvement projects based on need, genetics and distribution information, land ownership, likelihood for success, and angling access.

**Strategy 2.2.2.** Develop a prioritized list of brook trout habitat improvement projects employing various stream restoration techniques as necessary (e.g., livestock exclusion, site re-vegetation, and in-stream channel modification). Seek project funding through established sources such as stream mitigation programs and State and Federal agricultural incentive programs.

## **Priority 3: Outreach**

### **Short Term Goal**

#### **3.1. Create/enhance public interest in brook trout.**

**Strategy 3.1.1.** Produce and employ educational materials (e.g., maps, brochures, posters, articles, videos, live fish displays, etc.) highlighting the importance of Tennessee's brook trout and associated management activities (particularly those directed at native, southern Appalachian brook trout). Venues include agency websites, magazines, newsletters, school programs, stakeholder meetings, and fishing shows.

**Strategy 3.1.2.** Promote the Eastern Brook Trout Joint Venture (EBTJV) on websites and through other media outlets.

### **Long Term Goals**

#### **3.2. Increase landowner participation in habitat improvement programs.**

**Strategy 3.2.1.** Publicize information regarding all current Federal and State grants and programs available to private landowners for protecting and improving water quality and habitat in brook trout streams. Provide technical assistance as needed.

**Strategy 3.2.2.** Publicize the application of BMPs, as well as the benefits of protecting and improving water/habitat quality, by presenting success stories (in local newspapers, on websites, magazines, newsletters etc.) that show how entire communities benefit, not just fish and anglers.

#### **3.3. Develop relationships that foster brook trout conservation.**

**Strategy 3.3.1.** Facilitate achievement of brook trout conservation goals by establishing relationships with non-governmental organizations (NGOs), city and county governments, land trusts, and other organizations.

## **Priority 4: Brook Trout Protection, Restoration, and Enhancement**

### **Long Term Goals**

#### **4.1. Conserve Tennessee's native, southern Appalachian brook trout.**

**Strategy 4.1.1.** Implement the management actions and guidelines recommended by the American Fisheries Society's Southern Division Trout Committee in its position statement on managing southern Appalachian brook trout (SDAFSTC 2005). This document provides guidance regarding issues such as protecting biodiversity, genetic integrity and conducting restoration and enhancement projects.

**Strategy 4.1.2.** Identify candidate streams for southern Appalachian brook trout restoration or enhancement. Consider streams or brook trout populations for such projects based on criteria including need (population status, relative abundance of other native brook trout populations in the area, etc.), the presence of fish barriers, the quality/popularity of existing trout fisheries, and the likelihood for success.

**Strategy 4.1.3.** Produce a prioritized list of five to ten streams for native, southern Appalachian brook trout restoration or enhancement projects and begin implementation of these projects by 2010. If possible, this list will include restorations in at least two of the 16 subwatersheds where brook trout have been extirpated (EBTJV assessment) and two third-order (or larger) stream segments, such as lower Sycamore Creek on the Cherokee National Forest in Monroe County and Lynn Camp Prong in GRSM.

**Strategy 4.1.4.** Monitor restored or enhanced brook trout populations to evaluate project success.

#### **4.2. Maintain Tennessee's other brook trout fisheries**

**Strategy 4.2.1.** Periodically monitor the status of other brook trout populations (hatchery or hybrid origin) that provide significant fisheries, particularly where there is (or could be) encroachment by introduced rainbow or brown trout.

**Strategy 4.2.2.** Conduct restoration/enhancement projects or other management actions as necessary to protect these resources.

### **Priority 5: Recreational Fishing**

#### **Long Term Goals**

##### **5.1. Provide or Enhance Recreational Fishing Opportunities for Brook Trout**

**Strategy 5.1.1.** Provide and maintain recreational fishing opportunities for native Southern Appalachian brook trout.

**Strategy 5.1.2.** Provide some brook trout fisheries in waters that are readily accessible (e.g., tailwaters and larger hatchery-supported streams with road access) so that most anglers, including those with handicaps, have the opportunity to catch and develop an appreciation for brook trout.

##### **5.2. Comprehensively manage brook trout fisheries.**

**Strategy 5.2.1.** Periodically conduct creel surveys on selected brook trout streams to document angler use, exploitation rates, and preferences. Use this information, along with brook trout population monitoring data, to adjust angling regulations if necessary or provide special fishing opportunities.

## References

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- Perkins, D. L., C. C. Krueger, and B. May. 1993. Heritage Brook Trout in Northeastern USA: Genetic Variability within and among Populations. Transactions of the American Fisheries Society 122:515-532.
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# Virginia Brook Trout Conservation Strategies

## Background

Virginia has one of the strongest native brook trout resources in the Southeast. Of the 2,350 miles of wild trout resource identified, approximately 80% remains brook trout. Wild brook trout populations are generally limited to higher elevations in the western mountains of the state. However, brook trout were once found throughout the limestone spring creeks in the Great Valley region located between the Blue Ridge and Allegheny mountain ranges and along some of the smaller tributaries of the Potomac at least as far east as Fairfax County. Most of the valley limestone stream populations were likely extirpated a century or more ago with the agricultural development of the valley but some persisted as late as the mid-1960s. The populations within Potomac River tributaries were known to be strong through the 1950s and still persisted as late as the early 1980s. These populations were eliminated with residential development of the region. It is estimated that at least 38% of the original brook trout populations have been extirpated.

Most of the remaining populations are well protected from landuse changes due to public ownership. Land management agencies include the George Washington and Jefferson National Forest, the Shenandoah National Park and scattered holdings of the Virginia Department of Game and Inland Fisheries. One significant area of private watershed ownership of high quality wild brook trout streams occurs in the Blue Ridge Plateau area of Floyd, Carroll and Patrick Counties.

Virginia has had a complete inventory of trout waters since 1980. This inventory is continually updated providing a 30 year historical record. The dividing line between the natural ranges of the northern and southern strain of brook trout occurs within Virginia. Southern Appalachian brook trout were originally found from the New River drainage south while the northern strain was found from the James drainage north. Historically, it is thought that the Atlantic slope drainages from the Roanoke River in Virginia, south, did not contain brook trout although wild populations are now found in many headwater areas within these drainages. Virginia is currently in the process of genetically typing brook trout populations from the New River south. This analysis is scheduled for completion by December, 2007.

## Priority 1: Assessment

### Short Term Goals

#### 1.1 Complete Virginia's brook trout genetics assessment.

**Strategy:** Complete genetic analysis of population samples through contract with Virginia Tech by December, 2007.

### **Long Term Goals**

- 1.2 Annually monitoring of Virginia’s brook trout populations.**  
**Strategy:** Continue annual monitoring program for brook trout streams that updates data for individual streams at least once every 7 years.
- 1.3 Monitor the impact of acid deposition on brook trout populations.**  
**Strategy:** Continue biennial sampling of established sampling stations that vary in sensitive to acidification.  
**Strategy:** Continue to assist as appropriate with collection of water samples for the UVA Virginia Stream Sensitive Study.

## **Priority 2: Habitat Protection**

### **Short Term Goals**

- 2.1 Protect brook trout habitat through permit review.**  
**Strategy:** Work closely with state and federal permitting agencies (DEQ, COE & VMRC) to avoid or minimize potential impact to brook trout habitat or water quality.  
**Strategy:** Work with private landowners to protect, enhance or re-establish good riparian corridors on all brook trout waters.

### **Long Term Goals**

- 2.2 Protect critical brook trout habitat on private land.**  
**Strategy:** Work with private landowners to establish conservation easements on brook trout waters.  
**Strategy:** Work with local jurisdictions to identify quality brook trout habitat within their jurisdiction and establish protection through local ordinance and proffers prior to development.  
**Strategy:** Identify a prioritized list of quality brook trout waters and establish a funding source for acquisition.

## **Priority 3: Habitat and Population Restoration**

- 3.1 Conserve Virginia’s native, southern Appalachian brook trout.**  
**Strategy:** Complete genetic typing of trout populations within the historic range of southern Appalachian brook trout  
**Strategy:** Develop a comprehensive management plan to protect the genetic integrity of remaining southern Appalachian brook trout populations and restore populations where appropriate.
- 3.2 Identify potential brook trout improvement projects.**  
**Strategy:** Develop a list of potential projects based on brook trout distribution data, land ownership, likelihood for success and angler access.



**Strategy:** Use the state’s restoration biologists to develop natural stream designs for habitat restoration projects.

**3.3 Identify candidate streams for brook trout population restoration.**

**Strategy:** Use historic brook trout distribution information, current landuse data, water quality data and location of spring sources to develop a list of streams that could be restored with a high potential likelihood for success.

**Strategy:** Use existing stream water quality databases and supplemental water quality analysis to identify acidified streams that could be restored through liming.

**Long Term Goals**

**3.4 Restore brook trout populations in extirpated watersheds.**

**Strategy:** Work with private landowners to restore the biological integrity of extirpated brook trout watersheds through restoration of riparian habitat, stream channel restoration and re-introduction of native fish species.

**Strategy:** Secure conservation easements or purchase stream segments where possible to protect restored stream reaches.

**Priority 4: Outreach**

**Short Term Goals**

**4.1 Create/enhance public interest in brook trout.**

**Strategy:** Produce and employ educational materials (e.g., maps, brochures, posters, articles, videos, live fish displays, etc.) highlighting the importance of Virginia’s brook trout and associated management activities. Venues include the agency website and magazine, schools, stakeholder meetings, and fishing shows.

**Strategy:** Promote the Eastern Brook Trout Joint Venture (EBTJV) on the agency web site and other media outlets.

**Long Term Goals**

**4.2 Increase landowner participation in habitat improvement programs.**

**Strategy:** Publicize (via the agency website, magazine, and other outlets) information regarding all current Federal and State grants and programs available to landowners for protecting and improving water quality and habitat in brook trout streams. Provide technical assistance as needed.

**4.3 Develop relationships that foster brook trout conservation.**

**Strategy:** Facilitate achievement of brook trout conservation goals by establishing relationships with NGOs, city and county governments, land trusts, and other organizations.

## Priority 5: Recreational Fishing

### Short Term Goals

- 5.1 Provide recreational fishing access to brook trout waters.**  
**Strategy:** Maintain current public access to brook trout waters on both public and private lands  
**Strategy:** Pursue public fishing access to quality private brook trout waters through cooperative agreements, public easement, access fee or fee-simple ownership
- 5.2 Maximize fishing opportunity through regulation.**  
**Strategy:** Monitor populations to determine if angling pressure is adversely impacting brook trout populations  
**Strategy:** Insure optimum populations of brook trout are available for anglers through the appropriate use of size, creel and gear restrictions.  
**Strategy:** Conduct periodic creel surveys on selected brook trout waters to determine angler use, harvest, and preferences.

### Long Term Goals

- 5.3 Encourage landowners to open brook trout waters to public fishing.**  
**Strategy:** Develop an incentive program that encourages landowners to allow public fishing. This could include recognition programs, tax incentives, conservation easements or other financial incentives.
- 5.4 Resolve stream ownership issues.**  
**Strategy:** Seek clarification through legal or legislative means to the question of whether Virginia stream bottoms are privately or publicly held.

## West Virginia Brook Trout Conservation Strategy

Brook trout (*Salvelinus fontinalis*) are the only salmonid (trout, char, or salmon) native to West Virginia. Consequently, the brook trout fishery is an extremely valuable recreational resource and an important part of WV's natural heritage. Nearly 60% of WV trout anglers say that they fish for brook trout, and brook trout are the predominant wild trout fishery in WV. This fact makes WV unique compared to neighboring states (e.g., VA, MD, TN and NC) where wild trout fisheries are dominated by exotic brown and rainbow trout. Brook trout are recognized as a key indicator of stream quality and a quintessential component of WV mountain streams.

Since the early 1900s brook trout populations have undergone a dramatic reduction in size and geographic range. Brook trout have been extirpated from nearly 25% of their historic range in WV and exist as greatly reduced, highly fragmented populations in 85% of their current range<sup>12</sup>. Causes of these losses can be attributed to a range of factors, including: acid precipitation, mining, urbanization, water use, loss of riparian vegetation, loss of instream habitat complexity, overfishing, competition with introduced species (e.g., rainbow and brown trout), dispersal barriers (e.g., culverts), and regional climate changes. Regardless of the causes, a century of declining brook trout populations has resulted in highly altered stream ecosystems and lost economic revenues and recreational fishing opportunities statewide.

Unless immediate action is taken to reverse these trends, we would expect continued extirpations and reductions of brook trout populations to occur in 25-50% of their remaining range. In fact, state biologists agree that within 20 years brook trout could exist as a relict fishery with little or no economic value and are at risk of becoming regionally threatened within 30-40 years. However, biologists also agree that thoughtful conservation actions could not only slow the rate of population losses, but could be used to successfully restore and grow an economically valuable brook trout fishery. Implementation of science based, watershed scale conservation strategies could be used to protect existing populations, reestablish fishable populations, and expand population size and range throughout the state. Doing so would not only restore the brook trout fishery, but it would produce significant downstream benefits, including benefits to other recreational fisheries (e.g., stocked trout streams and smallmouth bass rivers) and other aquatic species (e.g., endangered mussels). A restored brook trout fishery could serve as the basis of a vibrant, natural asset based economy in WV.

To address these issues, a group of individuals representing West Virginia University, US Geologic Survey, WV Division of Natural Resources, Trout Unlimited, the Freshwater Institute, US Fish and Wildlife Service, and the US Forest Service met on three occasions from February – June 2006. The group is referred to as the “WV Brook Trout Conservation Group.” The following document is a summary of the group's progress towards implementing a conservation strategy for brook trout populations in West Virginia streams and watersheds.

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12 Hudy, M., T.M. Thieling, N. Gillespie, and E.P. Smith. 2005. Distribution, status and perturbations to brook trout within the eastern United States. Final Report: Eastern Brook Trout Joint Venture, USFWS, Washington, DC. 76 Pages.

## CONSERVATION GOAL

Given the importance of brook trout to the state of West Virginia and the entire Appalachian region, the overall goal is to:

*Implement statewide strategies that protect, restore, and enhance healthy brook trout populations in West Virginia.*

A healthy population is one that maintains itself through local reproduction (*wild*), possesses a genetic composition that is appropriate to the region (*native*); is comprised of a large enough number of individuals across a range of sizes to support angler harvest (*fishable*); is well connected to other populations in the region through dispersal corridors (*connected*); is part of a balanced ecosystem and does not threaten the status of other species of concern (*balanced*); and does not pose a health threat to people if eaten (*consumable*).

## CONSERVATION PRIORITIES

The conservation goal will be reached by addressing the following priorities:

*Priority 1: Habitat and Population Protection*

*Priority 2: Habitat and Population Restoration and Enhancement*

*Priority 3: Assessment, Monitoring, and Research*

*Priority 4: Outreach, Partnerships, and Capacity Building*

*Priority 5: Enhanced Socio-Economic Value to the State*

## CONSERVATION STRATEGIES

The WV Brook Trout Conservation Strategy will be implemented by following a two-tiered approach. Tier 1 represents a series of statewide goals and objectives (presented here). Tier 2 represents a series of goals and objectives directed at specific targeted watersheds. A targeted watershed is any 4<sup>th</sup> – 5<sup>th</sup> level watershed (i.e., 8 – 10 digit HUC) that has been identified as a high conservation priority. Targeted watersheds will be identified across three regions of the state that follow major river basin divides (Figure 1).

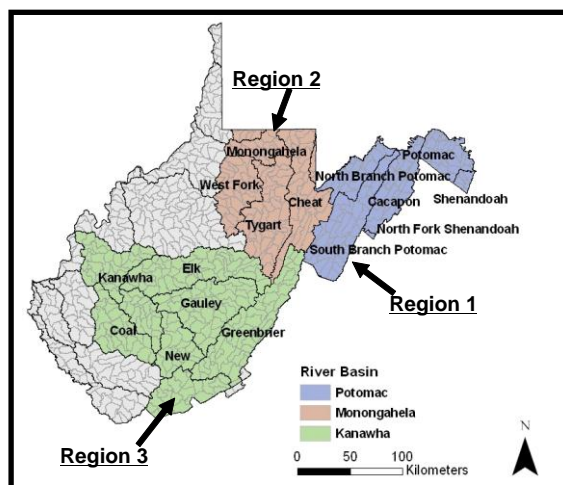


Figure 1. Region 1 is the Eastern Panhandle region (shown in blue), which is comprised of the upper Potomac River watershed (headwaters of the North Branch and South Branch of the Potomac downstream to the Shenandoah River). Region 2 is the Northern Allegheny Mountains region (shown in pink), which is comprised of tributaries of the Monongahela River basin (headwaters and mainstem tributaries of the Cheat and Tygart Valley Rivers). Region 3 is the Southern Allegheny Mountains region (shown in green),

which is comprised of tributaries of the Kanawha River basin including the Greenbrier New, Gauley, and Elk River watersheds.

## **Priority 1: Habitat and Population Protection**

### **Goals**

#### **1.1 Eliminate threats and secure long-term protection of intact brook trout habitats.**

**Strategy 1.1.1.** The state conservation group will develop a prioritized list of threats and needs for long term habitat protection specific to 100% of the intact watersheds within the state. Intact watersheds include Big Run (Potomac Basin), Seneca Creek (Potomac Basin), Gandy Creek (Monongahela Basin), and Mill Creek (Monongahela Basin). Prioritization and implementation of actions will begin by December 2007. Key strategic actions needed to protect brook trout habitat statewide include:

- Classification of intact brook trout streams and ensuring that these streams are protected under relevant state and federal laws.
- Elimination of acidification threats through “at-source” reductions of acid loads.
- Implementation of habitat protection measures during times of crisis (e.g., post-flood).
- Implementation of brook trout specific BMPs for activities that produce non-point source pollutants (e.g., sediments and nutrients) on state, federal, and private lands.
- Expansion and integration of state, federal and private programs that support riparian zone conservation along brook trout streams (e.g., CREP, WHIP, Partners for Fish and Wildlife, and state, county, and private conservation programs). This should include efforts to integrate alternative mitigation programs.

#### **1.2 Eliminate threats and secure long-term protection of intact brook trout populations.**

**Strategy 1.2.1.** The state conservation group will develop a prioritized list of threats and needs for long term brook trout population protection specific to 100% of the intact watersheds within the state. In most cases, population protection will require habitat protection measures as described in Goal 1.1. Additional direct population protection measures include:

- Changes to fishing regulations to reduce fishing related mortality and allow expansion of intact brook trout populations.
- Reducing atmospheric mercury deposition to avoid fish consumption advisories.
- Eliminating exotic fish stocking in intact brook trout streams.

The group will develop a prioritized list of population protection measures by December 2006 and begin implementing these measures by December 2007.

#### **1.3 Minimize and mitigate threats to prevent further habitat degradation of reduced, greatly reduced, and extirpated populations.**

**Strategy 1.3.1.** The state conservation group will identify critical habitats within reduced, greatly reduced, and extirpated watersheds and implement strategies needed to

ensure long-term habitat protection as outlined in Goals 1.1 and 1.2. Implementation of these measures will begin by December 2007.

## **Priority 2: Habitat and Population Restoration and Enhancement**

### **Goals**

#### **2.1 Increase population productivity through habitat improvement within intact watersheds (i.e., expand on core populations).**

**Strategy 2.1.1.** The state conservation group will identify limiting factors in intact watersheds and initiate actions needed to expand intact brook trout populations and connect them to surrounding watersheds. Specific actions may include: culvert replacement, riparian improvement, and sediment and nutrient reductions. The group will initiate population enhancement activities in intact watersheds by December 2008.

#### **2.2 Restore habitat conditions needed to improve population productivity and expand brook trout range in reduced and greatly reduced watersheds.**

**Strategy 2.2.1.** Perhaps the most important goal in the statewide conservation strategy is to improve population productivity in reduced watersheds and expand brook trout population range within West Virginia. Our overall goal is to improve brook trout populations, such that 10% of the greatly reduced watersheds can be reclassified as reduced and 10% of the reduced watersheds can be reclassified as intact by the year 2020 (i.e., 20% improvement by 2020). To meet this goal, the state conservation group will follow a targeted watershed approach. Under this approach the group will identify key watersheds and develop highly specified targeted watershed strategies. Table 1 lists the watersheds for which the group will develop initial strategies and the time frame for development. The group will continue to develop and implement targeted watershed strategies until we have met our overall goals.

#### **2.3 Re-establish self-sustaining brook trout populations in currently “extirpated” watersheds.**

**Strategy 2.3.1.** The group’s strategy for re-establishing brook trout populations in extirpated watersheds is similar to that of Goal 2.2. The state conservation group will follow a targeted watershed approach and our overall goal will be to recover populations in 10% of the currently extirpated watersheds by the year 2020. Key elements of this strategy include: 1) identifying those watersheds where temperature and habitat conditions are such that reintroduction of brook trout is feasible; 2) identifying genetically appropriate source populations; and 3) working with landowners and local communities to provide for long term protection of brook trout habitats and populations in re-established watersheds. Table 1 lists two watersheds that the group will target for developing brook trout reintroduction plans by December 2007.

**TABLE 1.** Summary of watersheds targeted for habitat and population protection, restoration, and enhancement by the state conservation group. Included are proposed dates for completing targeted watershed conservation strategies.

<b>River Basin</b>	<b>Targeted Watershed</b>	<b>Current Status</b>	<b>Goal</b>	<b>Strategy Deadline</b>
Potomac	Abrams Creek (North Branch Potomac)	Greatly Reduced	Reduced	12/1/2006
Potomac	Thorn Creek (South Branch Potomac)	Reduced	Intact	8/1/2007
Potomac	Rockymarsh Run (Potomac mainstem)	Extirpated	Reduced	12/1/2007
Potomac	Bullskin Run (Shenandoah)	Extirpated	Reduced	12/1/2007
Monongahela	Shavers Fork (Cheat)	Reduced	Intact	12/1/2006
Monongahela	Big Sandy Creek (Cheat)	Greatly Reduced	Reduced	8/1/2007
Kanawha (Reg. 3)	West Fork Greenbrier (Greenbrier)	Reduced	Intact	12/1/2007
Kanawha (Reg. 3)	MF Williams River (Gauley)	Greatly Reduced	Reduced	8/1/2007

**Priority 3: Assessment, Monitoring and Research**

**Goals**

**3.1 Assess current population and habitat conditions.**

**Strategy 3.1.1.** The state conservation group will conduct region-specific field assessments of brook trout populations and their habitats. Assessments will follow statistically valid sampling designs, and data from the assessments will be used to construct models capable of predicting brook trout distributions continuously throughout the state. Information from field assessments will then be used to validate and refine, if necessary, maps of current brook trout population status at the 6<sup>th</sup> level subwatershed scale (Hudy et al. 2005). Data collection, archiving, and predictive modeling will be

spatially explicit and GIS compatible. The group will complete this goal for all three regions of the state by December 2009.

### **3.2 Quantify genetic variability and identify genetically unique brook trout populations.**

**Strategy 3.2.1.** The state conservation group will conduct surveys of microsatellite genetics of brook trout populations throughout the state. The genetic surveys will address three objectives: 1) to quantify intra and inter-basin variation in genetic structure; 2) to identify the presence and extent of a “southern Appalachian” brook trout strain in Region 3 of WV; and 3) determine if extant brook trout populations are genetically appropriate for their region or if there is evidence of inter-basin transfers (e.g., transfers from the upper Monongahela River to the Kanawha River and / or the Potomac River). This goal will be completed for all three regions of the state by December 2009.

### **3.3 Establish sampling protocols and facilitate access to data.**

**Strategy 3.3.1.** The state conservation group will establish a common set of sampling and data management protocols designed to ensure data validity, utility, and accessibility. Such protocols will include a list of biological, physical, and chemical variables that should be collected during field assessments in order to be included in the database. The group will establish guidelines on data collection, common unit expressions, quality control and assurance, and data transfer to a designated repository. The designated repository will develop a spatially explicit, web-based, data management framework that is available to EBTJV partners. The group will complete this goal by December 2007.

### **3.4 Identify threats and factors limiting brook trout populations.**

**Strategy 3.4.1.** The state conservation group will conduct region-specific field research designed to identify factors limiting brook trout populations throughout their current and native range. Research will also be conducted to improve our understanding of how to protect, restore, and enhance brook trout populations and their habitats. Research projects will focus on how local and regional factors interact to determine brook trout population dynamics in each of the three regions of the state. The group will identify and initiate at least three critical research projects by December 2008. Research will be continued on an “as needed” basis.

### **3.5 Establish long-term monitoring to assess program effectiveness.**

**Strategy 3.5.1.** Following completion of the statewide population and habitat assessment (Goal 1.1), the state conservation group will develop and implement an annual brook trout population and habitat monitoring program. The monitoring program will provide information that can be used to constantly update brook trout population status statewide. It will also provide information needed to identify restoration and protection priorities. Finally, a monitoring program is necessary to assess the effectiveness of brook trout and habitat conservation actions and to guide an adaptive management framework. The



framework for a long-term monitoring program will be developed and initiated by December 2008.

#### **Priority 4: Outreach, Partnerships, and Capacity Building**

##### **Goals**

#### **4.1 Create ongoing communications plan to reach targeted audiences to increase awareness of brook trout and the conditions they represent.**

**Strategy 4.1.1.** The state conservation group will create an ongoing communications plan that will enable consistent messaging to the public through press releases, schools, special interest groups, community organizations, professional conferences, workshops, and other venues as opportunities arise. Target audiences include any persons or organizations that have an interest or “stake” in WV brook trout policy and conservation projects. The tools to perform this outreach function include: workshops, newsletters, presentations, fact sheets, brochures, press releases and word of mouth. Using props such as the WV Brook Trout brochure, and the recent EBT: Status and Threats document will enhance and reinforce the message. A communications plan for increasing brook trout conservation awareness will be completed by December 2006 and regularly updated every 3 years.

#### **4.2 Identify entities with complementary goals or mutual benefits with whom to establish partnerships.**

**Strategy 4.2.1.** The success of the state brook trout conservation strategy will depend on the strength of partnerships and relationships established among stakeholders. The state conservation group will work to build a comprehensive consortium of partners by December 2006. Establishing partnerships with industry organizations is a priority of this group. Partners in this process will likely include, but are not limited to:

- WV Division of Natural Resources<sup>13</sup>
- WV Department of Environmental Protection
- WV Division of Forestry
- Eastern Brook Trout Joint Venture
- USFWS<sup>2</sup> – national office, West Virginia field office, refuges, and hatcheries
- USFS<sup>2</sup> – Monongahela Forest, regional office, national office
- TU<sup>2</sup> – state council, Back the Brookie program, state chapters
- WVU<sup>2</sup> – Division of Forestry and Natural Resources
- Shepherd’s College, Davis and Elkins College
- USGS<sup>2</sup> – national office, regional science centers, COOP units
- Office of Surface Mining
- The Nature Conservancy
- The Trust for Public Land
- The Conservation Fund<sup>2</sup> – national office, the Freshwater Institute

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<sup>13</sup> Current member of the State Brook Trout Conservation Working Group.

- WV Rivers Coalition and other Conservation Groups
- Coal Association and other Industry Organizations
- WV Farm Bureau and WV Forestry Association
- WV State Development Office

#### **4.3 Identify and attract resources and the ability to distribute resources to projects.**

**Strategy 4.3.1.** Using the information gathered in Priorities 1-3, the state conservation group will determine the type of resources needed to implement the conservation plan. Lead agencies and organizations will have the responsibility to arrange for and distribute resources in an efficient and accountable manner. Clear, concise proposals and fact sheets will be provided to interested partners. A plan for attracting resources will be completed by May 2007.

### **Priority 5: Enhanced Socio-Economic Value to the State**

#### **Goals**

##### **5.1 Increase recreational fishing**

**Strategy 5.1.1.** The goal to increase recreational fishing for brook trout will be met through: 1) increased access to high-quality/high-value fishing opportunities; 2) providing a diverse array of fishing opportunities, e.g., roadside, walk-in, remote, fly-fishing only, catch and release; and 3) promoting and publicizing West Virginia as a destination location for high-quality, wild brook trout fishing. A detailed plan for increasing recreational fishing in West Virginia will be completed by May 2007.

##### **5.2 Increase the quantity and quality of recreational tourism infrastructure**

**Strategy 5.2.1.** The state conservation group will coordinate with the state development office to increase the availability of state loans and grants for tourism businesses. The group also will work with the development office to assist private sector tourism businesses with advertising and promotion and with businesses training. A relationship with the development office and a strategic plan for growing the recreational fishing infrastructure will be in place by May 2007.

##### **5.3 Increase local residents' quality of life**

**Strategy 5.3.1.** The state conservation group believes that a fully restored brook trout fishery can have a significant, positive impact on the quality of life of West Virginia residents. To meet this goal, the group will seek to increase public access to recreational fishing opportunities, coordinate with local land use planning efforts to increase riparian green-space, coordinate with local watershed groups on stream cleanups, etc., and conduct public opinion/attitude surveys to quantify progress towards this goal. Initial efforts to partner with local planning commissions and watershed groups will begin by May 2007.

#### **5.4 Increase local property values and property tax revenues**

**Strategy 5.4.1.** The state conservation group will coordinate with local land use planning efforts and private developers to retain and/or restore green-space, fishing access and other land attributes that enhance local property values and tax revenues. The group will seek support from USFWS Partners for Fish and Wildlife Program to enhance the value of project properties. Finally, the group will work with the state development office to provide information to real estate agents/marketers regarding value-enhancing attributes in the local area (e.g., recreational fishing, green-space, high quality streams). Initial efforts to work with the development office and private developers will begin by May 2007.