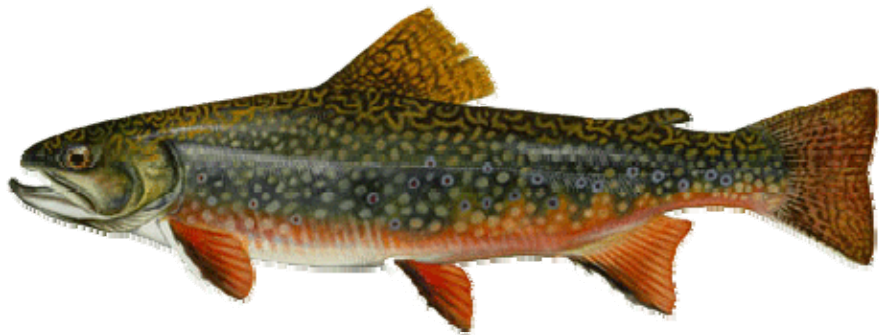


**DRAFT**  
**2014 Review of the**  
**2006 Maryland Brook Trout Fishery Management Plan**

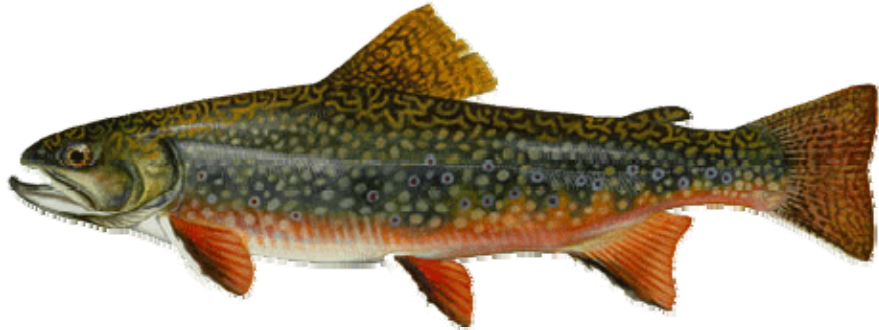


**April 2014**

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**2014 Review of the  
2006 Maryland Brook Trout Fishery Management Plan**



April 2014

**Plan Review Team**

Fishery Management Plans Program Staff  
Inland Fisheries Program Staff  
Fisheries Service Management Team  
Sport Fisheries Advisory Commission  
Maryland Biological Stream Survey Staff

**Approved by:**

Thomas J. O'Connell  
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## List of Acronyms

AL – Appalachian Laboratory  
AMD – Acid Mine Drainage  
BT FMP – Brook Trout Fisheries Management Plan  
BOM – Bureau of Mines  
COMAR – Annotated Code of Maryland  
CREP – Conservation Reserve Enhancement Program  
CVI – Canaan Valley Institute  
DNR – Department of Natural Resources  
EBTJV – Eastern Brook Trout Joint Venture  
FMP – Fishery Management  
FS – Maryland Department of Natural Resources Fisheries Service  
GEP – Genetic Effective Population  
GIS – Geographic Information System  
HAPC – Habitat Area of Particular Concern  
ICPRB – Interstate Commission on the Potomac River Basin  
IWL – Izaak Walton League  
MAC-TU – Mid-Atlantic Council of Trout Unlimited  
MBSS – Maryland Biological Stream Survey  
MDE – Maryland Department of the Environment  
NFWF – National Fish and Wildlife Foundation  
NGO – Non-Governmental Organization  
NRCS – National Resource Conservation Service  
ORV – Off Road Vehicle  
OSM – Office of Surface Mining  
PIT – Passive Integrated Transponder  
PRT- Plan Review Team  
SDAFS – Southern Division of the American Fisheries Society  
SFAC – Sport Fisheries Advisory Commission  
SHA – State Highway Administration  
SRWA – Savage River Watershed Association  
SWG – State Wildlife Grant  
TC – Technical Committee  
TU – Trout Unlimited  
UMCES – University of Maryland Center for Environmental Studies  
USACE – United States Army Corps of Engineers  
USGS – United States Geological Survey  
YRWA – Youghiogheny River Watershed Association

## Summary

The Maryland Department of Natural Resources (DNR) Fisheries Service (FS) Plan Review Team (PRT) evaluated the 2006 Maryland Brook Trout Fishery Management Plan (BT FMP) in 2013/2014 to determine if the management framework is still appropriate, needs to be amended, or should be completely revised. Details of the review process can be found in Addendum 1.

The FS PRT evaluated the goal, objectives, strategies and actions in the plan and progress towards completing five priority actions identified during the 2010 review. The FS PRT concluded that the 2006 BT FMP is an appropriate framework for managing the brook trout resource and does not recommend any changes to the plan.

Significant progress has been made on three of the five priority actions, and research and monitoring efforts have provided additional data for managing brook trout. The FS PRT recommends: 1) continuing progress on the 2010 priorities, focusing on three additional strategies and actions during the 2014-2016 timeframe; 2) developing a population index to better assess changes in stock status; 3) evaluating the utility of a regional approach to assessing and managing brook trout populations; 4) protecting and restoring brook trout habitat, and minimizing impacts when full protection is not possible; 5) incorporating the BT FMP by reference into regulation; and 6) reviewing the plan again in 2016, unless any adaptive management needs become known before that time.

### Status of the Fishery Management Plan

Date of FMP Approval:	2006
Amendments:	None
FMP Review Dates:	2010

Fishery management plans (FMPs) provide a framework for how a fishery resource will be managed based on a species life history, habitat, ecosystem considerations and fishery utilization. Over time, the status of a resource can change and new issues arise. Strategies and actions within a plan need to be periodically reviewed and evaluated to ensure the management framework is still appropriate or amended/revised to address significant changes. For specific details on the process for reviewing plans and developing or amending plans, see Addendum 1.

The Maryland Brook Trout Fisheries Management Plan was developed in 2006 and reviewed in 2010. The Department has authority to regulate brook trout through the Code of Maryland Regulations (COMAR 08.02.11.01). When the BT FMP was developed and adopted, brook trout was not on the list of species delineated in Natural Resource Article §4-215 (b)(1-24) so the plan was never incorporated by reference into regulation. A 2010 legislative bill gave the Department authority to create fishery management plans for new species when warranted. Since the 2006 BT FMP continues to be an appropriate framework for managing the resource, the FS PRT recommends adopting the plan by reference into regulation.

During 2013-2014, a FS PRT was convened to review the plan. The FS PRT was comprised of staff from the FMP program (Marek Topolski, Nancy Butowski) and Inland Fisheries Division

(Alan Heft, Matt Sell). Additional staff members from Fisheries Service and Resource Assessment Service participated in the BT FMP review as well as members of the Sport Fisheries Advisory Commission (SFAC) (*Note: This draft does not yet incorporate input from SFAC as their review is occurring now.*). The goal of the 2006 BT FMP 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.”*

In order to meet the goal, the following FMP objectives were defined:

- 1) *Collect and organize available brook trout data and information from the array of sources where they currently reside.*
- 2) *Gather and utilize the latest genetic information to formulate recommendations that maintain appropriate genetic integrity of distinct stocks.*
- 3) *Evaluate current and future freshwater fishery management policies and practices to assure that they support healthy brook trout populations.*
- 4) *Determine stakeholder preferences for managing wild brook trout.*
- 5) *Determine best methods to maintain, protect and restore populations. The primary emphasis is to maintain and protect existing populations and then move toward restoration of extirpated populations where possible.*
- 6) *Educate state and county agencies, relevant non-governmental organizations (NGO’s), and local government representatives on the importance of preserving the limited number of habitats that support brook trout. Work cooperatively with agency staff to promote an ecosystem-based approach to protecting/restoring brook trout, with particular emphasis on DNR public lands.*
- 7) *Determine habitat requirements and anthropogenic stressors for brook trout. Work with state and county agencies, institutions, community watershed groups, private organizations and landowners to maintain or restore cold water habitat for brook trout through best management practices, restoration of stream buffers, mitigation of stream blockages, land planning, and initiatives to reduce the impact of development in watersheds that contain brook trout populations or have streams with habitat conditions that are suitable for restoring brook trout populations.*
- 8) *Provide information to state and county agencies, institutions, community watershed groups, private organizations and landowners to ensure that brook trout populations are preserved, protected or enhanced by restoration and protection efforts.*
- 9) *Coordinate stream monitoring programs within DNR and develop a comprehensive strategy that will ensure continued tracking of long-term stock status.*

The FS PRT agreed that the goal and objectives continue to be appropriate for managing the brook trout resource.

## **Status of the Stock**

Eastern brook trout (*Salvelinus fontinalis*) populations have been declining throughout their native range (Maine to Georgia) in the eastern United States, and Maryland's populations are no exception. In the most recent status review (EBTJV 2011) brook trout are now extirpated from 62% of historically occupied subwatersheds in Maryland, a 5% increase since the initial assessment (57%) completed in 2005 (Hudy et al. 2005). Additionally the vast majority of Maryland's brook trout populations (84%) are considered to be "greatly reduced" from their historic levels. The only subwatershed in Maryland that is considered to be "intact" (brook trout present in > 90% of historical habitat) is the upper Savage River watershed, located in western Maryland (Garrett County). The upper Savage River is also considered to be the last remaining stronghold for brook trout in Maryland and one of the only unfragmented brook trout resources in the entire mid-Atlantic region. Brook trout populations east of Garrett County are highly fragmented and greatly diminished from their historic range. Of the remaining 47 subwatersheds where brook trout still occur in central and western counties, none are "intact", 10% are "reduced" (only 50 - 90% of historic habitat occupied), and the majority (90%) are "greatly reduced" (only 1 - 50% of historic habitat occupied). Anthropogenic impacts have been identified as the primary reason for the documented declines, with increasing urbanization, deforestation, exotic species, and mining being identified as a few of Maryland's most imminent threats. Likewise the future of Maryland's brook trout remains uncertain in the face of increasing water temperatures in response to climate change, the development of Marcellus shale natural gas resources, and an ever-increasing human population.

Opportunity to reestablish extirpated brook trout populations is very limited, particularly in the eastern and central portion of the state where anthropogenic impacts of human population growth continues; however, strengthening existing populations in these areas through habitat restoration and conservation projects can be a realistic goal for some of these streams. In western Maryland, there are opportunities to reestablish extirpated populations in streams where the water quality has been degraded by relict mining impacts (AMD, acid mine drainage) but the physical habitat is suitable. Since the implementation of the BT FMP two brook trout reintroductions have occurred in streams where mitigation of AMD impacts has sufficiently improved water quality. Both streams are in Garrett County, Aaron Run (Savage River watershed) and Winebrenner Run (Georges Creek watershed). In addition, AMD mitigation work has been done in the Mill Run watershed (completed) and is ongoing in the Casselman River watershed, with the goal of improving water quality and increasing brook trout population density, distribution, and connectivity.

The DNR's Wildlife and Heritage Service lists brook trout on the "Rare, Threatened, and Endangered Animals" list. They are ranked as S3S4. The S3 ranking places some brook trout populations on the "Watch List - defined as rare to uncommon with the number of occurrences typically in the range of 21 to 100. They may have fewer occurrences but with a large number of individuals in some populations, and they may be susceptible to large-scale disturbances. Species with this rank are not actively tracked by the Wildlife and Heritage Service." The S4 ranking places some brook trout populations as "Secure - with typically more than 100 occurrences or may have fewer occurrences if they contain large numbers of individuals. Brook trout in this category are apparently secure under present conditions, although they may be restricted to only a portion of the State." [www.dnr.maryland.gov/wildlife/Plants\\_Wildlife/rte/rteanimals.asp](http://www.dnr.maryland.gov/wildlife/Plants_Wildlife/rte/rteanimals.asp). Brook trout are also listed as a "Greatest Conservation Need" (GCN) species in Maryland's Wildlife Diversity Conservation Plan and as a Regional Species of GCN by the Northeast Regional synthesis for Conservation Need.

## **Status of the Fishery**

The status of recreational brook trout fisheries in Maryland is largely uncertain due to a lack of directed recreational surveys to determine effort, success, and angler preferences. Current information is based on anecdotal information, reports from anglers, research and population survey results, and observations in conjunction with Inland Fisheries staff annual field work. The small average size of brook trout; difficult, small-stream fishing conditions; and lack of public accessibility discourages angling over much of their range in the western and central region counties of Maryland. The opposite is true in Garrett County where there are larger streams and ample public access.

The upper Savage River watershed is considered the most important fishery in the state due to the large number of streams with healthy populations, excellent accessibility, high density populations, and the chance to catch larger trout (12" +). Restrictive angling regulations (COMAR 08.02.11.01; Table 1) were implemented for the upper Savage River brook trout fishery in 2007 in response to declining populations as compared to historic levels. Post-regulation monitoring surveys showed increasing trends in the number of adult fish in the population and in the availability of larger fish. Numerous reports were received from anglers noting improved fishing. Other anglers protested the loss of opportunities to fish with bait and harvest fish. These anglers were less concerned with catching larger trout and did not agree that population decreases warranted the more restrictive regulations. Some have likely dropped out of the fishery altogether. Poor young of year recruitment occurred area wide from 2008 through 2011 which resulted in a reduction in density of trout in the regulation area as elsewhere. Yet during this period anglers continued reporting satisfactory fishing with relatively large fish in their catch. This may have been due to increased survival of adult fish resulting from the catch and release regulations. A very good yearclass in 2012 has improved trout density and is expected to improve the fishery even further.

Many of the largest brook trout are caught by anglers fishing the Put and Take management reach of the upper Savage River in the early spring. Recent telemetry studies show that these larger brook trout migrate into the upper river and tributaries later in the season as waters warm and then return to the mainstem in the fall. In an angler creel survey focused on tracking these fish, it was found that they are subject to harvest and high fishing pressure from late March through May. Anglers sometimes preferentially harvest these brook trout as they are often larger than the stocked trout. Survey work planned for spring of 2014 will further investigate the impact of this harvest on the population of larger brook trout and the overall impact to the entire system. Protecting larger fish, in addition to habitat, is imperative for the overall health and productivity of the upper Savage River brook trout resource on the whole.

Other streams which are known to receive angling pressure directed at brook trout include several Potomac River tributaries in the Potomac-Garrett State Forest (Lostland Run and Laurel Run), Bear Creek, Mill Creek, and the upper South Branch Casselman River in the lower Youghiogheny River watershed, Braddock Run in the Wills Creek watershed, and Little Fishing Creek, Little Hunting Creek, and Big Hunting Creek in the Monocacy River watershed. Monitoring surveys indicate that these localized populations have remained resilient at the current rate of fishing pressure. However, angler use data are needed to better assess the impacts of fishing. Gathering these data is an essential part of the BT FMP and priority actions adopted in the 2010 review.

### **Status of Management Strategies and Actions**



When the BT FMP was reviewed in 2010, the review team recognized that with 49 strategies and actions, a more focused approach was needed for success. Five priority actions were identified for brook trout management during 2010-2013 and this review provides an update on each action.

Action 1.1.1 Identify and pursue additional funding sources to accomplish the needed work: specifically, collecting sufficient brook trout life history and angler exploitation information for management needs.

A five year brook trout life history project was completed for the Savage River watershed. This project was a joint effort between Maryland DNR Inland Fisheries Brook Trout Project staff and researchers from the University of Maryland Center for Environmental Science Appalachian Laboratory (UMCES AL). The field work phase that collected life history data ended in 2013. The research was successful in meeting the initial four main objectives of the project: 1) Determine longevity, recruitment, growth, and mortality rates of brook trout; 2) Determine seasonal/annual movement patterns of varying age classes of brook trout, using PIT (passive integrated transponders) tagging and radio telemetry; 3) Determine the relationships between seasonal water temperatures, flow rates, movement patterns, and population structure and density; and 4) Determine the relationships between seasonal brook trout location and density in relation to physical habitat variables. Models are currently being developed to help direct future fishery management activities. The modeling results and final report are scheduled for completion in 2015. Although the five year study has been completed, brook trout life history characteristics will continue to be collected and the database annually updated. Funding to support this brook trout research project was obtained through a State Wildlife Grant (SWG).

Adult brook trout movement patterns within the upper Savage River have been evaluated with radio telemetry. As part of the life history research project on Big Run, Monroe Run, and Middlefork, Inland Fisheries conducted a large-scale mark-recapture study to monitor >3000 brook trout over a three year period. Data collection has been completed and analyzed. Preliminary results indicate that movement is related to temperature. The upper tributary appears to provide a refugia when water temperatures increase. These results point to the importance of tributary connectivity for effective population management. Growth rates and survival rates can be different from tributary to tributary. Using the field-based estimates of vital rates, Inland Fisheries staff will be running stage-based population models to evaluate additional management strategies under current and alternative conditions (2015-2017).

Inland Fisheries is continuing to monitor the impact of the upper Savage River catch and release, artificial lure only, brook trout fishery on the populations in the watershed. This monitoring will continue through 2016. The FS PRT recommends collecting recreational data by expanding creel surveys on an annual basis and at statewide levels.

Action 3.1.1 Determine at risk populations by statewide fisheries region using current data, and then by using information from a genetically effective population (GEP) index once it becomes available.

The development of a GIS brook trout population layer based on the GEP results and population risk factors is in progress. The last few populations (stream level) to be analyzed will be done by the United States Geological Survey (USGS) in Shepherdstown, West Virginia, during the winter (2014) and will provide an overall picture of the genetic makeup of Maryland's brook trout populations. At-risk brook trout populations are being identified and prioritized and the results will be compiled into a draft status report.

Completion of the GIS population layer is scheduled for 2016 with a final report by early 2017. The genetic information will ultimately be used to formulate recommendations that maintain the genetic integrity of distinct stocks. “Genetic integrity” is defined as the maintenance of a natural gene pool, commonly at the species level, but sometimes at the population (stock) level as well. This information will be used to help direct reintroduction protocols.

Action 13.1.3 Develop a Geographic Information System (GIS) database describing brook trout population boundaries, population information, habitat variable information, and water temperature data, as discussed in Action 4.1.1 of the General Recommendations section.

The GIS database of brook trout population and habitat data was fully functional in 2013. The water temperature database is being completed within Inland Fisheries. Once the database is completed it will be connected to the brook trout population and habitat database. The water temperature database is an exceptionally large data set and there are a number of obstacles, to overcome to make it fully functional including data storage, data format, accessibility, and maintenance. Work will also be needed to make the data more user-friendly.

A land use/land cover and stream buffer GIS layer will be developed and added. A 2% impervious surface threshold is recommended to identify brook trout habitats at risk. There are a number of different methods to estimate impervious surface (hand drawn, satellite, tax data, ortho photo, etc.). It will be necessary to explicitly state the source of data and how the estimates of impervious surface are derived when recommending limits for protecting brook trout habitat.

Action 7.1.1 Adopt and modify the guidelines developed for brook trout restoration by the American Fisheries Society’s Southern Division Trout Committee.

There are several factors that will contribute to modifying the Southern Division of the American Fisheries Society (SDAFS) guidelines including population, genetic and habitat data. Collecting and compiling the information is in progress. Inland Fisheries will initiate a review/update of the SDAFS Trout Committee’s reintroduction policy and conduct a literature review of associated publications to develop a statewide guideline for Maryland (2015 - 2016). The Maryland Inland Fisheries Coldwater Fisheries Management Policy (1988) will also be reevaluated as it relates to stocking of hatchery reared trout in wild brook trout streams.

Action 6.1.1 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. Provide an ecosystem perspective by including a description of how brook trout serve as indicators of overall stream health; and what a healthy brook trout population means to the health of a watershed and the lives of those who reside there.

Inland Fisheries staff has conducted outreach efforts within DNR, Maryland Department of the Environment (MDE), the public, local government, and non-governmental organizations (NGOs). DNR’s new Integrated Policy and Review Unit has access to the comprehensive brook trout database and uses it for project review as well as proactive initiatives such as County Comprehensive Plans. Water quality monitoring is being coordinated with the MBSS staff and community organizations such as the Savage River Watershed Association (SRWA). SRWA is

collecting water quality data and identifying areas in need of protection and conservation. Inland Fisheries staff has been working with other communities to encourage formation of new watershed organizations. Brook trout project staff is continuing to participate professionally with the EBTJV (steering committee, science committee, outreach committee) and the SDAFS Trout Committee (members, past chairs 2011 and 2013). These programs are vital to both the national and state level brook trout restoration and conservation efforts and staff are intimately involved in these efforts. Regionally, Inland Fisheries staff is working with the EBTJV to update the regional objectives with Maryland's conservation and restoration priorities. Research within Maryland and nationally has documented the habitat requirements and anthropogenic stressors for brook trout.

Since significant progress has occurred and will continue to occur on the 2010 priority actions, the FS PRT recommends adding three new focus areas for 2014-2016: Action 11.1.1, and Strategies 9.1 and 12.1.

Action 11.1.1 Develop a monitoring schedule to insure that all brook trout populations statewide are sampled at least once every 3 years.

The Fisheries Service staff re-evaluated this action after realizing it was not possible to sample all historic brook trout populations (151) with the current level of manpower every 3 years. In 2009, staff developed and implemented a five year monitoring plan that created three types of sampling categories based on the expert knowledge of the regional biologists and the brook trout staff. The sampling scheme took into account local population status and immediate risks to populations or habitat. The first category of stations was sampled annually during a five year period. The second category were sampled twice during a five year period and the third category were sampled only once in the same five year period. There were also three levels of survey types: Level 1 was designed to determine presence/absence of brook trout (electrofishing and/or visual observations of adult fish, young-of-year, or fry, without the need for quantitative data); Level 2 included electrofishing for brook trout using random sampling stations with no habitat data collected; and Level 3 required a full 75 meter standard sampling effort, including habitat data, with fixed or random stations depending on historical protocol.

This modified monitoring schedule increased the number of streams that were sampled by 10% over the prior five year effort and was a substantial increase in effort by brook trout staff and regional staff. Approximately 30% of streams sampled in the 2003 - 2009 effort were done as extra sites by the State Wildlife Grant trout crew while collecting data for the GEP size research project. Overall, staff increased effort by 40% from 2009 – 2013 but still not all streams identified for the five year monitoring schedule were sampled. In addition, as the statewide brook trout GIS database was being developed numerous additions and modifications were made to the list of brook trout streams in Maryland. Based on these changes, the monitoring plan has been further modified in order to increase the number of streams sampled over the next five year period (2014 - 2019). The next five year monitoring schedule will incorporate the most complete list of brook trout populations available.

In order to meet the amount of FS staff effort necessary to complete the monitoring schedule, the staff will collaborate with other field personnel when possible. Available staff time will increase now that the Big Run brook trout life history project (2013) has been completed and the upper Savage River brook trout regulation monitoring work will be ending (2016). Also, the addition of a brook trout biologist position (2009) and seasonal summer help (2013-2014) has and will provide an increase in available man-hours dedicated to brook trout monitoring.

A standard operating procedure (SOP) guide for brook trout sampling has been completed and will be implemented starting with the 2014 monitoring season. This will increase efficiency and simplify field crew efforts during the annual monitoring work. With the modified five-year monitoring schedule, seasonal manpower, and the brook trout sampling SOP, it is anticipated that all brook trout populations will be sampled at least once every five years and many populations will be sampled more than once. The monitoring schedule will be annually reviewed and modified as necessary to provide the best data possible on brook trout throughout the state.

Strategy 9.1 Establish pathways to inform the general public about brook trout conservation and protection.

Inland Fisheries staff continues to update the SFAC as new research and monitoring information becomes available. Staff provides outreach information on brook trout upon request. However, limited progress has been made on developing specific outreach materials for brook trout and their habitat in Maryland. The BT FMP and brook trout fishing information are available on the FS web site. A webpage dedicated to brook trout is planned for development in 2015-2016. It will provide management updates, research highlights, habitat needs, and an interactive public comment section. The webpage will also provide an opportunity to solicit angler comments and an avenue for connecting to the regulatory scoping web page.

Information from Maryland brook trout research is now available to fully develop communication and education tools for brook trout and their habitat. Maryland-specific outreach materials such as PowerPoint presentations and information literature/brochures are scheduled for development during 2016 - 2017. Till then, the Eastern Brook Trout Joint Venture (EBTJV) has educational and outreach materials such as videos, webinars, maps, and reports from a national perspective that can be utilized for brook trout outreach in Maryland (<http://easternbrooktrout.org/>)

An increased awareness of brook trout related issues is being raised at all levels of government and within affected and interested citizenry and NGO's. Inland Fisheries will continue to provide information and to communicate with local, state, and federal governmental agencies and others.

Strategy 12.1 Develop a standardized sampling protocol for monitoring brook trout populations that includes: MBSS water quality and habitat data collection components; establishment of permanent sampling stations; number of stations per stream length; and fish collection methodology.

This remains a work in progress and will be reviewed and updated annually. A standard operating procedure (SOP) was developed in 2014 for all Inland Fisheries statewide brook trout sampling activities. Inland Fisheries staff will continue to coordinate and cooperate with the Maryland Biological Stream Survey (MBSS) monitoring efforts, data sharing and analysis, and research efforts. Inland Fisheries staff has developed a modified MBSS sampling protocol for the brook trout monitoring plan and will be implemented in 2014. Climate change impacts will also be considered.

### **Brook Trout Conservation Highlights**

A multi-agency and watershed group cooperative project was completed to remove an instream pond on the upper Savage River. The pond blocked upstream movement of brook trout and created high water temperatures downstream of the blockage which exceeded brook trout

tolerance. Approximately 1000' of new stream channel was created to replace the drained pond, including fish structures to benefit brook trout recolonization. Brook trout have been collected at the downstream section of the restoration area since 2011. Partners included the Brook Trout Project staff, MD DNR, City of Frostburg, MDE, National Fish and Wildlife Foundation (NFWF), SRWA, and the Canaan Valley Institute (CVI).

A three-year Aaron Run stream restoration project included the construction and operation of an instream limestone doser, construction of leach beds to mitigate acid mine drainage (AMD) seeps, construction of wetlands, and streambank restoration work. The project was completed with the reintroduction of brook trout at the site (2013). The project ended an estimated 100+ years of brook trout extirpation from the area. This project was a multi-group collaboration among MD DNR Brook Trout staff, the MDE Bureau of Mines (BOM), Trout Unlimited (TU) and private landowners. The DNR Brook Trout staff was awarded a \$75,000 grant from the EBTJV, combined with \$10,000 from MD DNR and approximately \$150,000 from MDE BOM. A complete list of brook trout research, restoration, and reintroduction projects completed since 2006 can be found in Table 2.

DNR's Land Acquisition and Planning Unit developed a draft Off-Road Vehicle (ORV) Policy that addresses brook trout habitat needs. The policy was developed based, in part, on a study completed on the Poplar Lick Trail, Savage River State Forest (A. Heft, DNR FS). Title 8 (08.01.03.01a) of the Maryland Annotated Code states that ORV trails are not to be constructed in "Wildlife and fishery management areas". Brook trout are sensitive to landscape impacts including those caused by ORVs. Consideration of site characteristics is important during the route siting process to reduce stream sedimentation. Routes should only be located where soils are stable; avoiding those that are highly erodible. Routes should not exceed a slope of 15% nor climb directly up the hillside. ORV routes should not be located within 300 ft of fish-bearing streams and lakes or 150 ft of permanently flowing non-fish-bearing streams, ponds, reservoirs, and wetlands greater than one acre. Routes that have in-stream crossings should be reconfigured, rerouted, or closed and new routes are not to have in-stream crossings. Other ecologically sensitive or significant habitats especially prone to erosion should be avoided. Routes should be closed to ORV use where high levels of erosion raise sedimentation above Total Maximum Daily Loads (TMDL) and/or reduce native fish population potential. Routes should not be constructed where soils have been contaminated by mine tailings until they are recovered, fully stable, and able to sustain safe ORV usage.

Legislation was adopted in 2014 to increase the amount of wildland areas within Maryland from 40,000 to 60,000.. The purpose of this legislation is to ensure the preservation and protection of designated areas in their natural condition for present and future generations to enjoy. Wildland designation will protect fish populations and their habitat from the negative effects that result from landscape alterations. Brook trout are particularly sensitive to the increased water temperature and sedimentation associated with land development.

Fisheries Service established a Fisheries Habitat Workgroup in 2014 which consists of members from all of Fisheries Service's advisory bodies and additional partners. The goal of this workgroup is "to conserve and rehabilitate fish habitat in order to promote sustainable fisheries for today and the future". The goal will be met through implementation of two objectives; 1) inform constituents of conservation priorities by developing outreach and communication strategies; 2) informing constituents of the decision-making process and opportunities to provide public input; and 3) mobilize constituents to become conservation partners and advocates during the planning and decision-making process. Additionally, the Fisheries Habitat Workgroup will

advise Fisheries Service on fish habitat stressors, conservation priorities, and priority habitat threats.

The 1987 Chesapeake Bay Agreement was revised and renewed in 2000. The renewed bay agreement was designed to guide restoration activities throughout the bay watershed through 2010. The Chesapeake Bay partners agreed to restore the health of the bay by implementing more than 100 specific actions. As a result of the 2009 Executive Order and the conclusion of the Chesapeake 2000 Agreement, partners have developed a new draft Watershed Agreement. The draft plan was available for public comment until March 2014. Among the proposed outcomes for sustainable fisheries and habitat, there is one that directly addresses brook trout: “Restore naturally reproducing brook trout populations, representative of healthy headwater streams, with an 8 percent increase in occupied habitat by 2025.” In addition, there are three other habitat outcomes that will also address brook trout habitat. The stream health outcome: “Restore stream health and function by 10% above the 2008 level throughout the watershed by 2025” with the baseline to be re-assessed. The fish passage outcome: “By 2025, restore historical fish migratory routes by opening 1,000 additional stream miles, with restoration success indicated by the presence of alewife, blueback herring, American shad, hickory shad, American eel and/or brook trout” using 2011 as the baseline year. The forest buffer outcome: “Restore 900 miles per year of riparian forest buffer and conserve existing buffers until at least 70% of riparian areas throughout the watershed are forested.” Although the draft Watershed Agreement addresses goals and outcomes by topic areas, the Chesapeake Bay Program partners recognize that the goals and outcomes are interrelated. There is an understanding that water quality and habitat improvements will ultimately lead to improvements in living resources.

To date, the Chesapeake Bay Program acknowledges the following accomplishments:

- Nitrogen has been reduced by over 100 million lbs. annually since 1985;
- 2,500 miles of streams and rivers have been opened to migratory fish species;
- Populations of striped bass and blue crabs have been returned to sustainable levels;
- 20% of the total land area in the watershed has been permanently protected;
- 7,500 miles of forest buffers along streams, rivers and the bay have been planted since 1996;
- Thousands of students in the watershed have been exposed directly to the bay and its rivers as part of their primary and secondary education ([www.chesapeakebay.net](http://www.chesapeakebay.net))

## **Emerging Issues**

Since the BT FMP was developed, research efforts and monitoring results have provided additional data for managing brook trout. A significant improvement to the plan would be the development of a population index to better assess the status of the stocks in Maryland. The FS PRT recommends evaluating the utility of a regional approach to assessing and managing brook trout populations. For example, population status, conservation threats and stressors, needs and social interactions are different in different regions of Maryland. Evaluating the utility of a regional brook trout approach would help focus management actions relevant to each area (i.e. impervious surface in central Maryland, AMD in western Maryland, etc.).

Loss and alteration of habitat is a significant threat to the brook trout resource. Poor land management practices was one of the key findings by the EBTJV. The FS PRT recommends continuing to protect and restore brook trout habitat, and minimize or eliminate habitat impacts from fragmented streams, stormwater, impervious surface, AMD, wastewater, agricultural and forestry practices, pesticides, and stream blockages.

Natural gas drilling into the Marcellus Shale formation is an emerging threat to the conservation

and restoration of native brook trout. The process of hydraulic fracturing was granted exemptions to the Clean Water and the Safe Drinking Water Acts under the Energy Policy Act of 2005. Activities associated with natural gas drilling and environmental changes that directly influence brook trout include changes in hydrology associated with water withdrawals; elevated sediment inputs and loss of connectivity; and water contamination from introduced chemicals or wastewater (Weltman-Fahs & Taylor 2013). DNR is currently conducting some Marcellus Shale baseline monitoring work in western MD. There are 34 conductivity loggers deployed in Garrett and western Allegany County measuring stream conductivity and temperature at 1 hr intervals. In addition we are collecting water chemistry data at these locations. Some stations are sampled monthly while others are sampled quarterly for a long list of water quality parameters (trace metals, stream methane, PAHs, surfactants, gross alpha/beta). Full MBSS sampling protocols (benthic, fish, and habitat) are conducted at twelve stream sites. In addition, there is a volunteer monitoring program set up with local watershed groups (Youghiogheny, Savage, Frostburg U, DNR MCC, Mountain Ridge HS) collecting weekly/bi-weekly measurement of conductivity, TDS, and temperature at ~68 sites. These groups are also collecting spring benthic samples at these locations. A link to the DNR webpage describing more of this project and an interactive map showing many of the sampling sites can be found at <http://www.dnr.state.md.us/streams/marcellus.asp>. (M. Kashiwagi, DNR, pers. comm). Environmentalists need to be aware of these efforts and results in order to recommend appropriate measures to protect brook trout populations and habitat.

Water use practices that alter stream flow, increase water withdrawals or reduce stream flow can affect brook trout populations. This is an on-going issue for brook trout in all areas of their distribution, not just Maryland. FS has been working with the Integrated Policy and Review Unit to make recommendations on water withdrawal permitting requests that protect brook trout populations. However, MDE makes the final determination on all permit applications. The FS PRT recommends that there be continued diligence on reviewing water withdrawal/water quality permit requests and that FS staff continue to facilitate an open dialogue with MDE staff regarding impacts to brook trout.

One threat not included in the Brook Trout FMP is climate change. Climate change models predict an increase in global temperatures. Regional climate change models predict increased stream temperatures, alterations in precipitation and shifts in fish distribution. There is general agreement that water temperature is the single most important factor limiting the geographic distribution of brook trout. One strategy to address climate change impacts is to create more resilient landscapes through riparian restoration. Improving tree cover will provide shade for coldwater stream habitats. Promoting limits on deforestation and urbanization will also add resilience. Additionally, minimizing stressors continue to be important aspects for protecting brook trout populations.

## **Conclusion**

The FS PRT concluded that the 2006 BT FMP is an appropriate framework for managing the brook trout resource in Maryland. The FS PRT has reviewed and updated priority focus areas for 2014-2016. The FS PRT recommends that the BT FMP be incorporated by reference into regulation be reviewed again in 2016, unless any adaptive management needs become known before that time.

## References

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Table 1. Brook trout regulations implemented in the upper Savage River watershed: COMAR 08.02.11.01.

Fishery	Season	Species	Minimum size	Creel	Tackle	Bait
Trophy: Savage River mainstem from the downstream side of the Route 135 bridge upstream for a distance of approximately 2.7 miles to the lower suspension bridge (Allegheny Bridge).	Open	Brook Brown Other	12" 18" None	All trout species in aggregate – daily:2, possession: 2	Artificial lure, including flies, limited to a single hook. Treble hooks prohibited.	No natural or live bait, or any device enhanced with a scent and capable of catching fish
Trophy: Savage River mainstem from the Savage River Reservoir Dam downstream to the lower suspension bridge (Allegheny Bridge).	Open	Brook Brown Other	12" 18" None	All trout species in aggregate – daily:2, possession: 2	Artificial flies	No natural or live bait, or any device enhanced with a scent and capable of catching fish
Zero Creel Limit Areas for Brook Trout: The area subject to the provisions of this section is the Savage River mainstem and tributaries upstream of the Savage River Reservoir dam, excluding impoundments and Put-and-Take Trout Fishing Areas (Savage River Reservoir, Savage River from Savage River Reservoir upstream to Poplar Lick Run, and New Germany Lake).	Open	Brook Other	- None	Zero Other trout species in aggregate – daily:2, possession: 2	Artificial flies and lures	No natural or live bait, or any device enhanced with a scent and capable of catching fish

Table 2. Brook trout research/restoration/re-introduction projects completed since 2006. Funding addresses Action 1.1.1. (See the page x for a list of acronyms)

Project Name	Date	Agency/Group	Funds	Funding Source	Stream Name
Braddock Run Stormwater Remediation	2006	MDE	260K	State, Federal, NGO	Braddock Run
Cash Valley Run Restoration	2006	MD DNR, ICPRB	35K	State, Federal, NGO	Cash Valley Run
Poplar Lick ORV Impact Investigation	2006	MD DNR, UMCES AL, SWG	60K	State, Federal	Poplar Lick
Upper Savage River Mercury Study	2006	MD DNR, UMCES AL, SWG	20K	State, Federal	Little Savage, Blue Lick
Aaron Run Brook Trout Restoration	2006-2010	MD DNR, MD BOM, US OSM, EBTJV	250K	State, Federal, NGO	Aaron Run
Brook Trout GEP Research Statewide	2007	MD DNR, UMCES AL, SWG	90K	State, Federal	Statewide streams
Chub Run AMD Remediation	2007	MD DNR, MDE	35K	State, Federal	Chub Run
Lostland Run AMD Remediation	2007	MD DNR, MDE	10K	State, Federal	Lostland Run
Raven Rock BT Restoration	2007	MD DNR, MDE	50K	State, Federal	Raven Rock
Resurvey of Western Maryland Brook Trout	2007	MD DNR, UMCES AL, SWG	75K	State, Federal	Statewide streams
Braddock Run Headwater AMD Remediation	2008	MDE	120K	State, Federal	Braddock Run
Braddock Run Headwater Bank Stabilization	2009	MDE, NRCS	50K	State, Federal	Braddock Run
Brook Trout Propagation	2009	MD DNR, FSU, SWG	15K	State, Academia, Federal	Aquaculture
Cash Valley Run Fish Passage	2009	MDE, NRCS	120K	State, Federal, NGO	Cash Valley Run
Casselman River AMD Remediation	2009	MDE BOM, MD DNR, EBTJV	100K	State, Federal	Casselman River tributaries
Casselman River Tributary Survey	2009	MD DNR, MDE, CVI, EBTJV	210K	State, Federal, NGO	Casselman River tributaries
Helman Run Streambank Restoration	2009	NRCS, MD SHA, MD DNR	450K	State, Federal	Braddock Run
Frostburg Pond Restoration	2009 - 2011	MD DNR, SRWA, CVI, NFWF	200K	State, Federal, NGO	Savage River

Brook Trout Life History Research project	2009-2013	MD DNR, UMCES AL, SWG	153.8K	MD DNR, Federal	Big Run
Braddock Run Stormwater Restoration	2010	NRCS, LaVale Sanitary Commission	60K	Local, Federal	Braddock Run
Crabtree Creek Streambank Stabilization	2010	MD DNR, MAC- TU, NRCS		State, Federal	Crabtree Creek
Enlow Farm Tree Planting	2010	NRCS, YRWA, CVI, MAC-TU	16K	Federal	Braddock Run
Garlitz Property Restoration (upper Mudlick)	2010-11	MDE, RCS, MD DNR	100K	State, Federal	Mudlick Run
Porter Run Streambank Stabilization	2011	RCS, Allegheny Co.		Federal	Porter Run
Statewide Brook Trout GIS Database Development	2011-2012	MD DNR, SWG	24.1K		Statewide tributaries
Chub Run AMD Remediation	2011-2013	MD DNR, MD BOM	25K	State, Federal	Chub Run
Cove Run Streambank Restoration	2013	DNR, MAC-TU, NRCS	12K	State, Local, Federal, NGO	Cove Run
Big Run Woody Debris Habitat Enhancement	2013 - 2014	MD DNR Fisheries/Forest Service, CVI	30K	State, Federal	Big Run, Monroe Run
Metz Property Restoration (Upper Savage)	2013 - 2014	CVI, MD DNR, Garrett Co., MDE	150K	State, Federal	Upper Savage Rover
Upper Savage River Brook Trout Genetics Analysis	2014	MD DNR	10.4K	MD DNR, Federal	Upper Savage River tributaries
Total funds invested			\$2,731,300		

**2006 Maryland Brook Trout Fishery Management Plan Implementation Table** (updated 4/2014).

Boldface text indicates newly updated information. Light yellow background indicates priority strategies and actions for the upcoming year(s). Light turquoise background indicates strategies and actions that are functionally complete.

<b>Strategy</b>	<b>Action</b>	<b>Date</b>	<b>Comments</b>
<b>Strategy 1.1</b> Investigate the life history characteristics, i.e. mortality, longevity, fecundity, growth rate, of Maryland brook trout populations statewide.	<b>Action 1.1.1</b> Identify and pursue additional funding sources to accomplish the needed work.	2009 - 2013 Continue  <b>Projected completion 2015</b>	Joint research project with UMCES Appalachian Laboratory (AL) and MD DNR Fisheries. Funds included a SWG grant. Initiated study of brook trout life history study in the Savage River. This was the number 1 priority action in 2010.  <b>Field work completed in 2013. Modeling and report completion is planned for 2015. FS will continue to collect life history data as part of the brook trout monitoring schedule.</b>
<b>Strategy 1.2</b> Investigate angler use and exploitation on Maryland brook trout populations statewide through creel surveys, and relate harvest and incidental angling mortality to brook trout length frequency structure and maximum fish size.	<b>Action 1.2.1</b> Identify and pursue additional funding sources to accomplish the needed work.	<b>2012-2013</b>  <b>Pending</b>	<b>Upper Savage River creel survey completed.</b>  <b>Statewide creel survey will be based on Upper Savage River creel survey. Funding necessary to expand survey statewide has not been identified. Earliest a statewide creel survey would be initiated is 2016.</b>
<b>Strategy 2.1</b> Develop a GEP index for brook trout populations in the state of Maryland.	<b>Action 2.1.1</b> Submit a proposal for funding a GEP index research project to the Maryland DNR State Wildlife Grant program for FY07.	2007-2009 <b>Completed</b>	A SWG project report was completed in 2009. Report directs watershed associations and regional managers where to target conservation efforts.
<b>Strategy 2.2</b> Utilize the index to categorize the status of brook trout populations in Maryland and create a priority list of those most at risk, and those for which conservation efforts would have long term potential for long term restoration.		2009 <b>On-going</b>	No action was formulated in the BTFMP.  GEP index and report (Action 2.1.1) will be used to identify populations at risk by watershed and guide conservation efforts. Priority list will be developed during 2015 – 2016.
<b>Strategy 3.1</b> Identify and protect at- risk brook trout populations.	<b>Action 3.1.1</b> Determine at- risk populations by statewide fisheries region using current data, and then by using GEP index information once it becomes available.	<b>In progress</b> <b>Projected</b>	This was a priority action (with Action 13.1.3) in 2010.  <b>Developing a GIS layer to identify and prioritize at-risk populations based on GEP and other risk</b>

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Strategy	Action	Date	Comments
		<b>completion 2016</b>	<b>factors. Additional resources may be needed to refine the project results.</b>
	<b>Action 3.1.2</b> Develop a priority list of populations to be protected, incorporating the GEP index value, land ownership (private versus public), upstream watershed size and land use, public resource access, connectivity to other brook trout populations, and recreational value.	<b>Pending</b>	Requires completion of 3.1.1. <b>The priority list will be generated when the GEP map has been developed.</b>
<b>Strategy 4.1</b> Develop a brook trout management plan for the Savage River watershed upstream of the Savage River dam. This plan will be used as a blueprint for developing plans in other brook trout watersheds.	<b>Action 4.1.1</b> Develop a comprehensive Geographic Information System (GIS) database detailing land ownership and usage within the upper Savage River watershed, incorporating summer water temperatures and brook trout population abundance from the Maryland DNR's Inland Fisheries and MBSS databases.	2007 Continue  On-going	The Izaak Walton League (IWL) and the Savage River Watershed Association (SRWA) has taken the lead on developing a brook trout conservation management plan. MD DNR is providing technical support. The development of a Savage River GIS data layer is underway.
	<b>Action 4.1.2</b> Utilizing the GIS analysis, identify areas within the Savage River watershed that are negatively impacting brook trout populations and water quality and develop a priority list of restoration/conservation activities.	2007 Continue  On-going	The Savage River GIS analysis will be a part of the overall GIS database for life history, genetic data, water temperature and habitat. Priority conservation areas will be delineated through the IWL, SRWA and DNR.
	<b>Action 4.1.3</b> Identify areas within the Savage River that need additional conservation.	2007 Continue	The IWL and SRWA will take the lead on recommending areas within the Savage River watershed. Various units within DNR will review and provide technical support.
<b>Strategy 4.2</b> Present the information and recommendations in the BTFMP to the MD DNR Western Regional Team to solicit input and support.		2007 <b>Discontinued</b>	No action was formulated in the BTFMP.  MD DNR Western Regional team was disbanded in 2007. Strategy is no longer practicable and is not being pursued.

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<p><b>Strategy 4.3</b> Develop a watershed-wide strategy for protecting habitat, Especially buffer protection and restoration in impacted headwater streams.</p>		<p align="center"><b>Pending</b></p>	<p>No action was formulated in the BTFMP.</p> <p><b>Action: Create a stream buffer and land use/land cover map to locate areas of concern. Threshold for negative impacts is 2% impervious surface. The map will incorporate existing state and federal land preservation and buffer strip restoration programs.</b></p> <p><b>Development of a GIS layer is being explored. Anticipated to begin in 2017.</b></p>
<p><b>Strategy 4.4</b> Identify adverse summer water temperature impact areas (impoundments, etc.) and develop strategies to alleviate the impacts.</p>		<p align="center">2007 On-going</p> <p align="center"><b>2014</b></p>	<p>No action was formulated in the BTFMP.</p> <p><b>Action: Create a network of temperature loggers to monitor thermal impacts to streams.</b></p> <p>Instream water temperature is monitored annually in cooperation with MBSS and the Izaak Walton League. Each Inland Fisheries Region annually rotates 6 to several dozen temperature loggers among priority streams. There are three additional long-term monitoring sites. <b>Integrating the water temperature data into the database is in progress.</b></p>
<p><b>Strategy 4.5</b> Designate the upper Savage River watershed a fisheries “Habitat Area of Particular Concern” (HAPC). This designation will allow the development of regulations and monitoring programs to protect the resource on a watershed specific basis. It will also help to develop and foster the public and resource users’ support for the management actions that need to occur; it will focus efforts to accomplish</p>	<p><b>Action 4.5.1</b> Institute angling regulations to provide for maximum protection of brook trout while still ensuring angler use of the resource, i.e. no closed season, no harvest, single hook barbless lures only, no bait.</p>	<p align="center">2007</p> <p align="center">2007 – 2013 <b>On-going</b></p>	<p>State fishery regulation was enacted to protect upper Savage River brook trout: COMAR 08.02.11.01.</p> <p>Annual monitoring of trout population response is ongoing through at least 2013. <b>Restoration of trout population densities has been partially successful. Data indicate that the regulation has been effective in meeting management objectives to increase the maximum size of fish available to anglers, the number of adult fish, and protect the only intact brook trout system in MD (upper Savage River) (Hilderbrand, 2013). Populations in high access areas remain low relative to other</b></p>

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<b>Strategy</b>	<b>Action</b>	<b>Date</b>	<b>Comments</b>
necessary research; and it will demonstrate Maryland's commitment to protecting and conserving this unique resource.		<b>2014</b>	<b>areas. Plans for long term continued monitoring have been developed and will be implemented in summer 2014.</b>
<b>Strategy 4.6</b> Promote and encourage the development of a citizen-based Savage River watershed advocacy organization. MD DNR will provide technical support as needed.		2006 Completed	No action was formulated in the BTFMP.  Savage River Watershed Association (SRWA) formed and has partnered with DNR in protecting and restoring the watershed. SRWA framework is being used as a model for other watershed associations. Watershed associations will assist with FMP action implementation.
<b>Objective (Strategy) 5</b> Encourage riparian buffer habitat preservation and restoration.	<b>Action 5.1.1</b> Develop a list of target watersheds in Maryland that could benefit from the CREP program, rank each system based on brook trout population status (best to worst), headwater agricultural impact, and size and connectedness of the system.	Pending	Implementation requires completion of Strategy 4.3. Implementation will aid with at-risk population targeting.
	<b>Action 5.1.1</b> Using the list generated from Action 5.1.1, actively recruit and enroll farmers from the targeted watersheds into the CREP program.	Pending	Dependent on the completion of Action 5.1.1
	<b>Action 5.1.2</b> Create a list of the Federal, state, and NGO conservation and restoration programs that are available to landowners; inform Regional Fisheries managers and biologists of these programs so they can work with private landowners to improve land use and water quality.	Pending 2014	No progress to date. Will look to utilize the resources of the newly formed Fisheries Habitat Workgroup to address this action.
<b>Strategy 6.1</b> The information that is needed by regulators and developers to appropriately consider and plan activities so they do not adversely impact brook trout	<b>Action 6.1.1</b> 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. Provide an	2011 Completed	This is a priority action.  <b>Eastern Brook Trout Joint Venture (EBTJV) developed educational and outreach materials such as videos, webinars, maps, and reports with</b>

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<p>populations is available. Developing an outreach strategy to convey this information will provide key agencies and developers with the understanding necessary to make appropriate decisions.</p>	<p>ecosystem perspective by including a description of how brook trout serve as indicators of overall stream health; and what a healthy brook trout population means to the health of a watershed and the lives of those who reside there.</p>	<p align="center">2011 <b>On-going</b></p> <p align="center">2014</p>	<p><b>a national perspective. More information is available at <a href="http://easternbrooktrout.org/">http://easternbrooktrout.org/</a></b></p> <p><b>Information from brook trout research and similar efforts is now available to fully develop communication and education tools for protection of brook trout and their habitat in MD. Action 6.1.1 is scheduled for completion in 2016 – 2017.</b></p> <p>FS established a Fisheries Habitat Workgroup to work on habitat issues that promote sustainable fisheries.</p>
	<p><b>Action 6.1.2</b> Meet with county and local government officials/agencies and commercial developers to present the information and to establish a dialog on the issues relating to the conservation and value of Maryland's native brook trout.</p>	<p align="center">Pending</p>	<p>FS staff address these actions on an on-going basis but a more formal approach will require the completion of Action 6.1.1.</p>
	<p><b>Action 6.1.3</b> Make presentations available to the general public through appropriate pathways, i.e. website, libraries, etc.</p>	<p align="center">Pending</p>	<p>FS staff make presentation upon request but a more formal approach would require the completion of Action 6.1.1. A FS webpage specifically for brook trout will be completed in 2015/2016</p>
	<p><b>Action 6.1.4</b> Work cooperatively with other state agencies to insure adherence to state water quality standards.</p>	<p align="center">2007 Continue</p>	<p>Better communication fostered between MDE and DNR. DNR environmental review expanded to include teams that address specific water quality issues. Direct negotiations between Inland Fisheries and MDE focus primarily on stream classification.</p>
<p><b>Strategy 7.1</b> Develop statewide restoration guidelines for restoring extirpated brook trout populations.</p>	<p><b>Action 7.1.1</b> Adopt and modify the guidelines developed for brook trout restoration by the American Fisheries Society's Southern Division Trout Committee.</p>	<p align="center"><b>Pending</b></p>	<p>This is a priority action.</p> <p><b>The field work phase of the life history and genetic research projects (Actions 1.1.1 and 7.1.2) have been completed but the modeling results and final report are scheduled for completion in 2015. This information is needed to review the SDAFS Technical Committee's guidelines for brook trout</b></p>



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Strategy	Action	Date	Comments
			<b>restoration. The review is scheduled for 2015 - 2016.</b>
	<b>Action 7.1.2</b> Incorporate a genetic component into the guidelines to direct brood fish selection location.	2010 - 2013  2014 Continue	UMCES Appalachian Lab has collected and inventoried brook trout genetics in all watersheds.  <b>Laboratory work and analysis scheduled for winter 2014.</b>
<b>Objective (Strategy) 8</b> Complete genetic inventory of discrete brook trout populations.	<b>Action 8.1</b> Secure funding (an estimated \$10,000) to complete the statewide brook trout genetic inventory. The USFWS State Wildlife Grant Program and EBTJV are two possible funding sources for completing this work.	Pending	Funds are being sought to complete the genetic inventory. <b>To date, grant funding has not been secured. Efforts to secure annual funding will continue in order to maintain this research.</b>
<b>Strategy 9.1</b> Establish pathways to inform the general public about brook trout conservation and protection.	<b>Action 9.1.1</b> Utilize the Maryland Sport Fisheries Advisory Commission (SFAC), DNR Regional Teams, and other appropriate state agencies to solicit input on brook trout conservation measures.	On-going	Strategy 9.1 aligns with Strategy 6.1.  Inland Fisheries advised the MD Taskforce on Fisheries Management and regularly updates the SFAC as new research, monitoring, and regulation information becomes available.
	<b>Action 9.1.2</b> Post the BTFMP on the DNR Fisheries Service webpage and request on-line comments on conservation measures as part of the regular review of the BTFMP.	2006 Continue  <b>Pending</b>	Strategy 9.1 aligns with Strategy 6.1.  BTFMP posted on line. Trout fishing information is available on the DNR Fisheries Service web site.  <b>A DNR Brook Trout webpage is being developed to provide program information such as management updates, research highlights, and habitat needs. The webpage will include an interactive public comment interface allowing DNR to solicit public input, opinions, and observations regarding current and proposed conservation and management actions. Webpage</b>

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			<b>deployment is anticipated in 2015-2016.</b>
<b>Strategy 10.1</b> Encourage public participation in fishery management through informational and regulatory meetings and the development of organized watershed advocacy groups. Current federal efforts are directed at assisting the formation of advocacy groups by funding startup and operational costs.	<b>Action 10.1</b> Develop a list of watershed advocacy organizations in Maryland with current contact information. Evaluate the need for additional groups. Create a list of federal agency contacts that can assist with citizen advocacy groups.	2009 <b>Completed</b>	A list of watershed groups and advocacy organizations has been created. These organizations have developed their own lists of federal agency contacts.
<b>Strategy 11.1</b> Develop a consistent, coordinated monitoring program to: 1) assess and track population abundance and viability; 2) monitor and detect environmental changes from anthropogenic (acidification, sedimentation, development/urbanization, AMD, etc.) and natural causes (floods, drought); 3) monitor and detect exotic species encroachment and impacts; and 4) monitor/detect water flow and temperature changes.	<b>Action 11.1.1</b> Develop a monitoring schedule to insure that all brook trout populations statewide are sampled at least once every 3 years.	2008-2009 Completed          <b>2009 On-going</b>          <b>2012-2013</b>	Monitoring plan is a Federal Aid requirement. Comments from the MD Task Force on Fisheries Management and SFAC were incorporated in the plan.       <b>FS staff re-evaluated this action after realizing it was not possible to sample all historic brook trout populations (151) with the current level of manpower every 3 years. A modified schedule based on a 5-year rotation was developed (2009 – 2013). Although more streams were sampled than in the previous 5- year period, not all streams were monitored. The plan is being modified to prioritize streams &amp; to use different levels of sampling effort to increase the number of streams monitored during the next five year period (2014 - 2019).</b>   <b>Brook trout in the upper Savage River were tagged and tracked via radio telemetry. Seasonal distribution was documented. Tributary connectivity will be important for effective</b>

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Strategy	Action	Date	Comments
			<b>population management. A manuscript was drafted and the release of results is pending publication.</b>
	<b>Action 11.1.2</b> Coordinate brook trout sampling efforts between Inland Fisheries and the MBSS to maximize efficiency. Where possible, reduce the number of sites Inland Fisheries needs to monitor. Fisheries should focus on monitoring streams for recreational fisheries, MBSS on sampling headwater, privately owned streams.	Began 2006 Formalized 2010 <b>On-going</b>	Inland Fisheries and MBSS have increased sampling coordination. <b>Action will continue annually.</b>
<b>Strategy 12.1</b> Develop a standardized sampling protocol for monitoring brook trout populations that includes: MBSS water quality and habitat data collection components; establishment of permanent sampling stations; number of stations per stream length; and fish collection methodology.	<b>Action 12.1.1</b> Create a sampling standardization committee with members from Inland Fisheries and MBSS to develop the sampling methodology.	2006  2011  <b>Pending</b>	MBSS sampling protocol informally adopted for portions of the Savage River.  MBSS sampling protocol requires more discussion before being implemented statewide. Integration of a multi-layer sampling protocol is being considered as a modification to the MBSS sampling protocol. <b>Implementation would be in stages. Earliest implementation would be in 2015.</b>
	<b>Action 12.1.2</b> Conduct training with Inland Fisheries staff to implement the standardized methodology.	2011	Completion of Action 12.1.1 is required.  Some informal training has been done to date.
	<b>Action 12.1.3</b> Collect summer water temperatures with in-stream temperature recorders as part of brook trout monitoring.	2007 <b>On-going</b>	Strategy 12.1 aligns with Strategy 4.4.  Includes Inland Fisheries efforts and data from MBSS.
<b>Strategy 13.1</b> Develop a database that incorporates, and where possible, standardizes, the historic and current statewide brook trout information available from the	<b>Action 13.1.1</b> Establish a data management group that includes a representative from each of the major groups (DNR, UM, and MBSS) to standardize the data collection format and create a statewide database of brook trout information.	2009 Completed <b>Continue as needed</b>	Action 13.1.1 is a priority (along with Action 3.1.3).  <b>Informal data management group has been established and convenes as needed.</b>

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Boldface text indicates newly updated information. Light yellow background indicates priority strategies and actions for the upcoming year(s). Light turquoise background indicates strategies and actions that are functionally complete.

<b>Strategy</b>	<b>Action</b>	<b>Date</b>	<b>Comments</b>
Inland Fisheries, the MBSS, and the University of Maryland monitoring programs.	<b>Action 13.1.2</b> Identify other sources of brook trout data, such as MD Bureau of Mines, additional academic institutions, and Federal agencies, and incorporate the data into the statewide format.	<b>Completed</b>	Requires completion of Action 13.1.1.
	<b>Action 13.1.3</b> Develop a GIS database describing brook trout population boundaries, population information, habitat variable information, and water temperature data, as discussed in Action 4.1.1 of the <i>General Recommendations</i> section.	2009  <b>2013 On-going</b>	Action 13.1.3 was the number 2 priority (along with Action 3.1.1) in 2010.  <b>GIS database on life history was completed and will be updated annually.</b>

**Acronyms**

- |   |   |
|---|---|
| AMD – Acid Mine Drainage                        | MD DNR – Maryland Department of Natural Resources               |
| BTFMP – Brook Trout Fisheries Management Plan   | MDE – Maryland Department of the Environment                    |
| CREP – Conservation Reserve Enhancement Program | SDAFS – Southern Division of the American Fisheries Society     |
| COMAR – Annotated Code of Maryland              | SFAC – Sport Fisheries Advisory Commission                      |
| EBTJV – Eastern Brook Trout Joint Venture       | SRWA – Savage River Watershed Association                       |
| GEP – Genetic Effective Population              | SWG – State Wildlife Grant                                      |
| GIS – Geographic Information System             | TC – Technical Committee  |
| MBSS – Maryland Biological Stream Survey        | UMCES – University of Maryland Center for Environmental Studies |