

2015 Maryland FMP Report (October 2016)
Section 23. Brook Trout (*Salvelinus fontinalis*)

Introduction

Brook trout are highly valuable in Maryland for their recreational, economic, cultural and biological values. Typically referred to as “brookies” by those who fish for them, the brook trout is Maryland’s only native trout species. Like the lake and bull trout, brook trout belong to the group of fish known as charr - the English name given to all members of this genus. Trout fishing in Maryland is a popular recreational activity with a variety of options available to anglers. Besides brook trout, the trout fishery is supported by the stocking of rainbow and brown trout: introduced trout species that have been successfully domesticated for hatchery production

Brook trout are typically found in Maryland’s more pristine and remote areas because of their life history requirements for clean, cold water and relatively undisturbed habitat. Since they are unable to survive in poor water quality or degraded habitat, brook trout are an iconic symbol of clean water and healthy aquatic systems. The disappearance of brook trout from a coldwater stream or watershed serves as a warning about the health of Maryland waters: an indicator species acting as an aquatic “canary in the coal mine.” The decline of brook trout populations in Maryland since colonial settlement has been significant. An initial review of the status of brook trout completed by the Eastern Brook Trout Joint Venture (EBTJV) in 2006 found that brook trout had been eliminated from 62 % of their historic habitat (HUC 8 level) in Maryland. A 2015 update of this initial assessment conducted at a much finer geographic scale (HUC 12 level) shows an even greater loss with 72% of brook trout populations extirpated in Maryland, 27% persist at a Reduced level (brook trout present in $\leq 50\%$ of the streams), and only 1% are considered Intact (brook trout present in $>50\%$ of habitat in watershed) (Mark Hudy, personal communication). With Maryland’s human population expected to continue to grow over the next several decades, the future of brook trout in Maryland has reached a critical juncture. A major difficulty in

managing the brook trout resource is that only 11% of all brook trout streams are fully within state lands. The majority of habitat is on private land and a mix of private/public lands. Currently, most brook trout populations are relegated to headwater streams, where human disturbance is minimal and forest cover is still prevalent.

A Maryland Brook Trout Fisheries Management Plan (BTFMP) was developed in 2006 to help direct conservation and management activities (Heft et al. 2006). Since then the plan has been annually updated and was formally reviewed in 2010 and 2013/2014.

Stock Status

Eastern brook trout 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 Chesapeake Bay watershed, there are only 103 Intact subwatersheds and 43 Reduced subwatersheds that are assigned high priority scores (≥ 0.79) for potential restoration. Only one of those high priority restoration subwatersheds is in Maryland.

The finer scale assessment of brook trout populations in the Chesapeake Bay watershed completed by the EBTJV (2015) provides natural resource managers with better tools for detecting population changes and for setting conservation priorities. The assessment determined wild brook trout occupancy at the catchment scale (basically a single stream scale) and was used to identify brook trout patches (Whiteley et al. 2013). A “patch” is defined as a group of contiguous catchments occupied by wild brook trout; patches are not connected physically (i.e., they can be separated by a dam, unoccupied warm water habitat, downstream invasive species, etc.) and are generally assumed to be genetically isolated. The assessment found that there were 3,608 “Wild Brook Trout Only” patches in the Chesapeake Bay watershed and only 166 patches in Maryland (4.5%). Maryland’s only “Intact” watershed is the Upper Savage River system and is considered to be one of the best brook trout systems in the mid-Atlantic region.

A restrictive angling regulation was implemented in the Upper Savage River watershed in 2007 to reduce angling-related harvest and mortality within the system and to strengthen the conservation value of the resource. All brook trout captured must be released immediately and bait fishing is not allowed. Annual population monitoring throughout the watershed has continued and in 2015 the populations were at an all-time high since the regulation was enacted. Of particular note was that the population levels at the high access areas, which historically had the lowest numbers, continued an upward trend approaching that of the medium and low access areas. This is a strong indicator that the regulation has been successful in achieving the desired management goals (Hilderbrand 2015).

In general, anthropogenic impacts have been identified as the primary reason for the documented declines in brook trout. Increasing urbanization, deforestation, exotic species, and mining have been identified as Maryland's most imminent threats. Likewise the future of Maryland's brook trout populations remain uncertain in the face of increasing water temperatures in response to climate change, the possible development of Marcellus shale natural gas resources, and an ever-increasing human population.

Status of the Fishery

The statewide angling regulations for brook trout are currently no closed season, 2 fish per person per day, a possession limit of 4 fish, and no minimum size. There is no commercial harvest of brook trout. There are several areas in the state with special regulations that are more restrictive than the general statewide regulations and provide improved angling catch rates and the opportunity to catch larger brook trout. These special areas are described in the annual Maryland Fishing Guide. Maryland's premier brook trout fishery occurs in Garrett County, in the Upper Savage River mainstem and tributaries upstream of the Savage reservoir dam. This system supports the highest population densities and the largest brook trout in the state. The streams are managed under catch and release rules with angling

restricted to artificial lures only. Intensive monitoring of this fishery by DNR's Freshwater Fisheries has been conducted annually since 2006 and has shown progress towards meeting management objectives. Figure 1 shows the watersheds where brook trout historically occurred in Maryland and Figure 2 shows the current distribution as of 2015.

Brook Trout FMP Work Effort Status

A focus area from the 2013/2014 BTFMP review was the development and implementation of a comprehensive statewide sampling schedule, as described in Action 11.1.1 of the FMP (*Develop a monitoring schedule to insure that all brook trout populations statewide are sampled at least once every 3 years*). The initial sampling effort revealed that a 3-year rotation was not feasible, so a new 5-year rotation was developed and initiated in 2014 and continued in 2015. Regional and Brook Trout Program staff were successful in meeting the revised sampling schedule. Staff anticipate that the 5-year sampling schedule is the best approach for meeting the FMP action. In 2015, staff sampled all of the 161 streams scheduled (100%). Table 1 lists the number of streams sampled by river basin.

A second recommended focus area from the FMP review was the development of a standardized sampling protocol for brook trout population sampling (*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*). The Maryland Brook Trout Program Field Sampling Manual (Sell and Heft 2014) was completed prior to the 2014 sampling season and was used in 2015 by all Freshwater Fisheries staff involved with brook trout sampling efforts and by all Resource Assessment Service (RAS) staff that also conduct some brook trout sampling efforts for Freshwater Fisheries.

The third recommended focus area from the 2013 review was to create better ways to provide information to the general public about brook

trout conservation and recreational opportunities. A Brook Trout Program webpage (<http://dnr2.maryland.gov/fisheries/Pages/brook-trout/index.aspx>) was created and is available online as part of the Fisheries website. The page provides information on statewide brook trout work and research. It links to numerous other state and national organizations involved with brook trout work. The webpage is updated annually (last update was 2015).

Focus areas for 2016-2019 (see BTFMP Implementation Table) will include: 1) **Strategy 1.2.** 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; 2) **Strategy 7.1.** Develop statewide restoration guidelines for restoring extirpated brook trout populations; 3) **Action 9.1.1.** Utilize the Maryland Sport Fisheries Advisory Commission (SFAC), DNR Regional Teams, and other appropriate state agencies to solicit input on brook trout conservation measures; 4) **Strategy 4.4.** Identify adverse summer water temperature impact areas (impoundments, etc.) and develop strategies to alleviate the impacts; and 5) **Strategy 11.1.** 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.

Current Management and Restoration Efforts

As part of the 2014 Chesapeake Watershed Agreement, brook trout restoration was included as a specific outcome for the Vital Habitats goal. The outcome is to *Restore and sustain naturally reproducing Brook Trout populations in Chesapeake headwater streams with an eight percent increase in occupied habitat by 2025.* Brook Trout Program staff worked with the Bay Program's Habitat GIT to facilitate and develop a 2-year work plan to address the outcome. Go to http://www.chesapeakebay.net/documents/22040/brook_trout_workpla

[n_4.11.2016.pdf](#) for specific details. The work plan includes specific research designed to develop a metric that will measure progress and is compatible with Maryland's BTFMP. Partners in this effort include: Maryland Department of Natural Resources, New York State Department of Environmental Conservation, Pennsylvania Fish and Boat Commission, Virginia Department of Game and Inland Fisheries, West Virginia Department of Natural Resources, United States Fish and Wildlife Service, United States Geological Survey, Trout Unlimited and Eastern Brook Trout Joint Venture.

Brook Trout Program staff continued to work with Trout Unlimited representatives, MD DNR Freshwater Fisheries staff, Carroll and Baltimore County Natural Resources staff, and the National Aquarium staff to develop and implement restoration efforts for brook trout in the upper Gunpowder River (UGR) watershed (upstream of the Prettyboy reservoir). This watershed has been identified as having a high likelihood of success for brook trout habitat restoration and reintroduction, and will be at a larger scale than has been attempted before in Maryland. It will be a long-term effort with the potential to provide a significant increase in the amount of habitat occupied by brook trout by 2025. Work completed in 2015 included the development of the Upper Gunpowder River Brook Trout Partnership Restoration brochure. It describes the restoration goals and projects that will help reach the outcome. Projects include placing water temperature logging devices in tributaries and a radio telemetry project for adult brook trout to assess and determine seasonal movements (beginning in 2016).

Brook Trout Program staff continued working with the Maryland Department of the Environment's Abandoned Mine Lands Division on a watershed-scale restoration effort within the Casselman River. Acid mine drainage mitigation sites have been installed on tributaries within the watershed and trees have been planted to restore and protect stream habitat. Additional plantings of stream buffers and construction of cattle enclosure fences were completed in 2015. Water quality and brook trout monitoring was also completed at these sites and will continue annually.

A large scale streambank restoration and brook trout habitat enhancement project was completed in the Upper Savage River (USR) mainstem. The project was spearheaded by the Canaan Valley Institute with additional partners: Maryland DNR Freshwater Fisheries, the Savage River Watershed Association, and Trout Unlimited. Funding was provided by the National Fish and Wildlife Foundation (NFWF), the Chesapeake Bay Trust (CBT), and the Exelon Corporation. In-kind matching funds were provided by the Canaan Valley Institute and the Maryland DNR's Freshwater Fisheries Division. Approximately 1,000 feet of streambank was restored and protected and fish habitat structures were created in-stream to benefit the brook trout population. Work was completed in fall of 2015 and brook trout were observed using the newly created habitat within weeks of completion. Fish and invertebrate population monitoring will be done annually to measure the success of the restoration.

Issues of Concern

Initial statewide brook trout population sampling completed in 2014 and continuing work in 2015 revealed a substantial loss of historically occupied brook trout habitat in the Central region of Maryland. While not unexpected, this trend will likely continue as the five-year sampling rotation is completed. Two major factors are likely responsible for the trend, increasing human development in this portion of the state and competition with invasive brown trout. Additional work in the Gunpowder River system is planned for restoration work (upper Gunpowder River mainstem) and research related to brook trout movement within the watershed.

The recent discovery of gill lice *Salmincola edwardsii* in North Carolina brook trout populations is a potential concern for Maryland brook trout populations. This copepod is endemic to brook trout populations in the northern portion of their native range but has not been seen south of New England and Great Lakes states. Typically infestations were not considered significant at a population level but recent increases in parasite loads in Wisconsin and Minnesota are

being suggested as contributing to drastic population declines (Mitro et al. 2014). Brook Trout Program staff applied for grant funding through the State Wildlife Grant (SWG) program in 2014 and received funding in 2015 to investigate if gill lice are present in Maryland brook trout populations. Sampling will be done in 2016 and 2017, if lice are found they will be genetically tested to determine their source of origin.

Additional issues of concern for Maryland brook trout conservation include determining angling effort and harvest, climate change impacts, continued human development pressure in brook trout watersheds, runoff of road salt into streams, and energy extraction and development issues (gas and wind). Angler and citizen input and volunteer effort will be vital for brook trout conservation as land use and development issues are the determining factors if habitat will continue to support brook trout survival. Participating in citizen watershed associations and angler advocacy groups can provide valuable and needed input to assist municipalities and counties with brook trout conservation. The Maryland Brook Trout webpage lists sites and names of state and national groups that are working for brook trout conservation (<http://dnr2.maryland.gov/fisheries/Pages/brook-trout/index.aspx>).

References

- Heft, A. A. (ed.), N. Butowski, D. Cosden, S. Early, C. Gougeon, T. Heerd, A. Heft, Johnson, A. Klotz, K. Knotts, H. Lunsford, J. Mullican, K. Pavol, S. Rivers, M. Staley, M. Toms, P. Kazyak, R. Klauda, S. Stranko, R. Morgan, M. Kline and R. Hilderbrand. 2006. Maryland Brook Trout Fisheries Management Plan, Maryland Department of Natural Resources, Fisheries Service, Inland Fisheries Management Division, Annapolis, MD.
- Hilderbrand, Robert. 2015. Long-Term Monitoring of Savage River Brook Trout Populations, Sampling year 2015. Annual Report to the Maryland Department of Natural Resources, Annapolis, Md.
- Hudy, M, Teresa M. Thieling, Nathaniel Gillespie, and Eric P. Smith. 2008. Distribution, Status, and Land Use Characteristics of

Subwatersheds within the Native Range of Brook Trout in the Eastern United States. *North American Journal of Fisheries Management* 28 (4):1069 - 1085.

Mitro, Matthew G., Sue Marcquenski, Kari Soltau, and Paul Kanehl. 2014. Gill Lice as a Proximate Cause of Brook Trout Loss Under Changing Climatic Conditions. *Proceedings of the Wild Trout Symposium XI, West Yellowstone, MT*, pages 200-209.

Sell, Matthew and Alan A. Heft. 2014. *Brook Trout Program Field Sampling Manual*. Maryland Department of Natural Resources, Fisheries Service, Inland Fisheries Division, Annapolis, MD.

Whiteley, A. R., Jason A. Coombs, Mark Hudy, Zachary Robinson, Amanda R. Colton, Keith H. Nislow, and Benjamin H. Letcher. 2013. Fragmentation and patch size shape genetic structure of brook trout populations. *Canadian Journal of Fisheries and Aquatic Sciences* 70(5): 678-688.

Table 1. 2014 and 2015 Statewide Brook Trout Sampling Effort by River Basin, as per the Maryland Department of Natural Resources Brook Trout Fisheries Management Plan.

River Basin	# Streams Sampled 2014
GU	3
PA	11
MP	8
UNB	25
UP	3
WC	2
YG	19

GU = Gunpowder River; PA = Patapsco River; MP = Middle Potomac River; UNB = Upper North Branch Potomac River; UP = Upper Potomac River; WC = West Chesapeake Bay; YG = Youghiogheny River

Figure 1. Historic Distribution of Brook Trout in Maryland, by Subwatersheds (green is historically occupied).

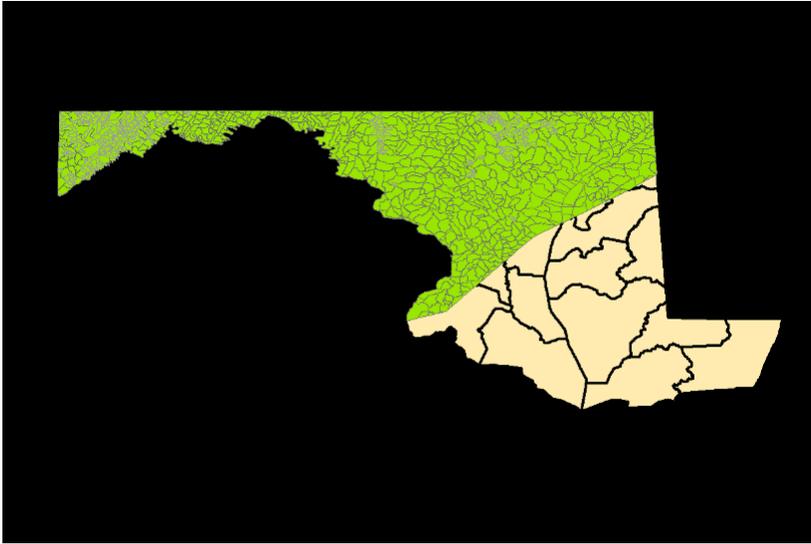
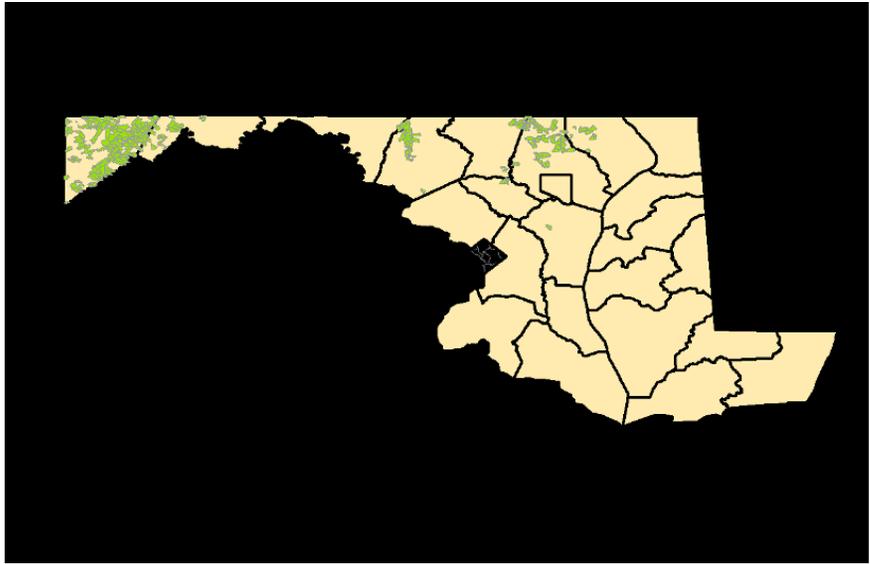


Figure 2. Current (2015) Distribution of Brook Trout in Maryland, by Subwatersheds (green is currently occupied).



2006 Maryland Brook Trout Fishery Management Plan Implementation Table. (updated 10/2016)

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.

Strategy	Action	Date	Comments
Strategy 1.1 Investigate the life history characteristics, i.e. mortality, longevity, fecundity, growth rate, of Maryland brook trout populations statewide.	Action 1.1.1 Identify and pursue additional funding sources to accomplish the needed work.	2009 - 2013 Continue Projected completion 2015	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. Field work completed in 2013. Modeling and report completed in 2015.
Strategy 1.2 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.	Action 1.2.1 Identify and pursue additional funding sources to accomplish the needed work.	2012-2013 Statewide Pending, possible initiation in 2017-2018	This is the number 1 priority for 2016-2019. Upper Savage River creel survey completed. 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 2018.
Strategy 2.1 Develop a GEP index for brook trout populations in the state of Maryland.	Action 2.1.1 Submit a proposal for funding a GEP index research project to the Maryland DNR State Wildlife Grant program for FY07.	2007-2009 Completed	A SWG project report was completed in 2009. Report directs watershed associations and regional managers where to target conservation efforts.
Strategy 2.2 Utilize the index to categorize the status of brook trout populations in		2009	No action was formulated in the BTFMP. GEP index and report (Action 2.1.1) will be

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.		On-going	used to identify populations at risk by watershed and guide conservation efforts. Priority list will be developed during 2018 – 2019.
Strategy 3.1 Identify and protect at- risk brook trout populations.	Action 3.1.1 Determine at- risk populations by statewide fisheries region using current data, and then by using GEP index information once it becomes available.	In progress Projected completion 2019	This was the number 2 priority action (along with Action 13.1.3) in 2010. Developing a GIS layer to identify and prioritize at-risk populations based on GEP and other risk factors. Additional resources are needed to continue project.
	Action 3.1.2 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.	Pending	Requires completion of 3.1.1. The priority list will be generated when the GEP map has been developed.
Strategy 4.1 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.	Action 4.1.1 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	GIS project underway as a joint effort of MD DNR, Savage River Watershed Association, and the Izaak Walton League. Final report is being drafted. GIS database has been completed, water budget work will be initiated in 2017.

	Action 4.1.2 Utilizing the GIS analysis, identify areas within the USR watershed that are impacting brook trout populations and water quality and develop a priority list of restoration/conservation activities.	2007 Continue	Requires completion of 4.1.1. Final report will include prioritized list of impacted brook trout populations.
	Action 4.1.3 Identify areas within the Savage River that need additional conservation.	2007 Continue	Requires completion of 4.1.1. Final report will identify focal conservation areas for watershed associations.
Strategy 4.2 Present the information and recommendations in the BTFMP to the MD DNR Western Regional Team to solicit input and support.		2007 Discontinued	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.
Strategy 4.3 Develop a watershed-wide strategy for protecting habitat, Especially buffer protection and restoration in impacted headwater streams.		Pending	No action was formulated in the BTFMP. 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. Development of a GIS layer is being explored. Anticipated to begin in 2017.
Strategy 4.4 Identify adverse summer water temperature impact areas (impoundments, etc.) and develop strategies to alleviate the impacts.		2007 On-going	No action was formulated in the BTFMP. This is the number 4 priority action for 2016-2019. Action: Create a network of temperature

			<p>loggers to monitor thermal impacts to streams.</p> <p>Obtain existing water temperature data and develop a GIS layer within the BT database.</p>
<p>Strategy 4.5 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 necessary research; and it will demonstrate Maryland’s commitment to protecting and conserving this unique resource.</p>	<p>Action 4.5.1 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>2007</p> <p>2007 – 2013 On-going</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.</p> <p>Results indicate that the regulation has been effective in meeting management objectives to increase the number of fish >200 mm, reduce angler related mortality, and protect the only intact brook trout system in MD (upper Savage River) while optimizing angling use. Restoration of trout population densities has been partially successful. Plans for long term continued monitoring were developed in winter 2014 and implemented in summer 2015.</p>
<p>Strategy 4.6 Promote and encourage the development of a citizen-based Savage River watershed advocacy organization. MD DNR will provide technical support as needed.</p>		<p>2006 Completed</p>	<p>No action was formulated in the BTFMP.</p> <p>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</p>

			will assist with FMP action implementation.
Objective (Strategy) 5 Encourage riparian buffer habitat preservation and restoration.	Action 5.1.1 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.
	Action 5.1.1 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
	Action 5.1.2 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	No progress to date.
Strategy 6.1 The information that is needed by regulators and developers to appropriately consider and plan activities so they do not adversely impact brook trout populations is available. Developing an outreach	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;	2011 Completed	This was the number 4 priority action in 2010. Eastern Brook Trout Joint Venture (EBTJV) developed educational and outreach materials such as videos, webinars, maps, and reports with a national perspective. More information is available at http://easternbrooktrout.org/

<p>strategy to convey this information will provide key agencies and developers with the understanding necessary to make appropriate decisions.</p>	<p>and what a healthy brook trout population means to the health of a watershed and the lives of those who reside there.</p>	<p>2011 On-going</p>	<p>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.</p>
<p>Strategy 7.1 Develop statewide restoration guidelines for restoring extirpated brook trout populations.</p>	<p>Action 6.1.2 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>Pending</p>	<p>Requires completion of 6.1.1.</p>
	<p>Action 6.1.3 Make presentations available to the general public through appropriate pathways, i.e. website, libraries, etc.</p>	<p>Pending</p>	<p>Requires completion of 6.1.1.</p>
	<p>Action 6.1.4 Work cooperatively with other state agencies to insure adherence to state water quality standards.</p>	<p>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 focused primarily on stream classification.</p>
<p>Strategy 7.1 Develop statewide restoration guidelines for restoring extirpated brook trout populations.</p>	<p>Action 7.1.1 Adopt and modify the guidelines developed for brook trout restoration by the American Fisheries Society’s Southern Division Trout Committee.</p>	<p>Pending</p>	<p>This is the number 2 priority action for 2016-2019.</p> <p>Implementation is pending information from the life history and genetic research projects (Actions 1.1.1 and 7.1.2) and review of the Southern Division of the American Fisheries Society Technical Committee’s (SDAFS TC) guidelines for brook trout restoration. Work was originally scheduled for 2015 – 2016 but has</p>

			been rescheduled for 2017-2018
	Action 7.1.2 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. Laboratory work and analysis was scheduled for winter 2014.
Objective (Strategy) 8 Complete genetic inventory of discrete brook trout populations.	Action 8.1 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. Partially completed for the USR in 2014, if funding secured will be completed in 2016.
Strategy 9.1 Establish pathways to inform the general public about brook trout conservation and protection.	Action 9.1.1 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	This is the number 3 priority for 2016-2019. 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.
	Action 9.1.2 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 Completed	Strategy 9.1 aligns with Strategy 6.1. BTFMP posted on line. Trout fishing information is available on the DNR Fisheries Service web site. A DNR Brook Trout webpage has been completed, and provides program information

			such as management updates, research highlights, and habitat needs. The webpage includes an interactive public comment interface allowing DNR to solicit public input, opinions, and observations regarding current and proposed conservation and management actions.
Strategy 10.1 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.	Action 10.1 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 Completed	A list of watershed groups and advocacy organizations has been created. These organizations have developed their own lists of federal agency contacts.
Strategy 11.1 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	Action 11.1.1 Develop a monitoring schedule to insure that all brook trout populations statewide are sampled at least once every 3 years.	2008-2009 Completed 2009 On-going	Monitoring plan is a Federal Aid requirement. Comments from the MD Task Force on Fisheries Management and SFAC were incorporated in the plan. This is the number 5 priority for 2016-2019. Streams will be monitored on a five year rotation from 2014- 2018. Brook trout in the upper Savage River were tagged and tracked via radio telemetry. Seasonal distribution was documented and tributary connectivity will be important for effective population management. A

flow and temperature changes.		2012-2013	manuscript was drafted and study results are not yet available pending publication.
	Action 11.1.2 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 On-going	Inland Fisheries and MBSS have increased sampling coordination. Action will continue annually.
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.	Action 12.1.1 Create a sampling standardization committee with members from Inland Fisheries and MBSS to develop the sampling methodology.	2006 2011 Pending	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.
	Action 12.1.2 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.
	Action 12.1.3 Collect summer water temperatures with in-stream temperature.	2007 On-going	Strategy 12.1 aligns with Strategy 4.4. Includes Inland Fisheries efforts and data from MBSS.
Strategy 13.1 Develop a database that incorporates, and where possible, standardizes, the historic and	Action 13.1.1 Establish a data management group that includes a representative from each of the major groups (DNR, UM, and MBSS) to	2009	Action 13.1.1 is the number 2 priority (along with Action 3.1.3). Informal data management group has been

current statewide brook trout information available from the Inland Fisheries, the MBSS, and the University of Maryland monitoring programs.	standardize the data collection format and create a statewide database of brook trout information.	Completed Continue as needed	established and convenes as needed.
	Action 13.1.2 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.	Completed	Requires completion of Action 13.1.1.
	Action 13.1.3 Develop a GIS database describing BT population boundaries, population information, habitat variable information, and water temperature data.	2009 On-going	Action 13.1.3 was the number 2 priority (along with Action 3.1.1) in 2010. GIS database was completed and functional in 2013. It will be updated annually.

Acronyms

AMD – Acid Mine Drainage
 BTFMP – Brook Trout Fisheries Management Plan
 CREP – Conservation Reserve Enhancement Program
 COMAR – Annotated Code of Maryland
 EBTJV – Eastern Brook Trout Joint Venture
 GEP – Genetic Effective Population
 GIS – Geographic Information System
 HUC – Hydrologic Unit Code
 MBSS – Maryland Biological Stream Survey

MD DNR – Maryland Department of Natural Resources
 MDE – Maryland Department of the Environment
 SDAFS – Southern Division of the American Fisheries Society
 SFAC – Sport Fisheries Advisory Commission
 SRWA – Savage River Watershed Association
 SWG – State Wildlife Grant
 TC – Technical Committee