

# **2015 Fishery Management Plans**

## **Report to the Legislative Committees**

**Prepared by**

**Maryland Department of Natural Resources**

**Fishing and Boating Services**

**Fishery Management Plan Program**

**December 2016**



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## **2015 Fishery Management Plan (FMP) Legislative Report (December 2016)**

This document addresses the requirement to regularly report on the status of each managed stock in the Chesapeake Bay and Coastal Bays of Maryland as required under Natural Resources Article Section 4-215. The report consists of a species-specific narrative and a fishery management plan (FMP) implementation table. The narrative contains information on the FMP background, stock status, management measures, the fisheries and issues/concerns. The implementation table is a synopsis of all the management strategies and actions found in the species FMP, implementation dates, and current status of the management actions. The boldface type highlights the most recent comments.

### **Background**

Under the 1987 Chesapeake Bay Agreement and the 1992 Amendments, the Bay jurisdictions developed a series of FMPs for commercial, recreational, and selected ecologically valuable species. The Chesapeake Bay FMPs provide a framework for the Bay jurisdictions to generate compatible, coordinated management measures to conserve and utilize a fishery resource. As ecosystem-based considerations are included in management plans, interactions among species, habitat, land use, and socioeconomic factors become part of the decision-making process thus balancing sustainable fishery yields with conservation goals. Since a large fraction of the managed fish species in the Chesapeake Bay spends a portion of their life history outside the Bay boundaries, fishery management measures must be coordinated on a regional and coastal basis. For coastal migratory species, the federal Mid-

Atlantic Fishery Management Council (MAFMC) develops management measures for species mainly found in the Exclusive Economic Zone (EEZ or 3-200 miles offshore). For species utilizing the inshore coastal area (0-3 miles offshore), the Atlantic States Marine Fisheries Commission (ASMFC) defines compliance requirements. The ASMFC requires the states to prepare annual compliance reports for the following species: American eel, Atlantic croaker, Atlantic menhaden, Atlantic striped bass, Atlantic sturgeon, black drum, black sea bass, bluefish, horseshoe crabs, Spanish mackerel, red drum, shad and herring, scup, spot, spotted seatrout, summer flounder, tautog, and weakfish. Additional information on stock status and fishery management measures for these migratory fish species can be found at [www.asmfc.org](http://www.asmfc.org) and [www.mafmc.org](http://www.mafmc.org). Coastal fishery requirements are mandated along the Atlantic coast. The Chesapeake Bay FMPs outline how Bay jurisdictions will implement coastal compliance requirements and identify any additional issues specific to the Bay region. The Maryland Coastal Bays FMPs outline how species are managed in the Coastal Bays. Maryland's Coastal Bays FMPs are part of a larger plan, the Comprehensive Coastal Management Plan (CCMP). The Maryland FMPs (yellow perch, white perch, Coastal Bays blue crab, Coastal Bays clams, largemouth bass and brook trout) provide a framework for managing species in Maryland waters, some inland and tidal areas.

In addition to the Chesapeake Bay Program process, Natural Resource Article §4-215 (b)(1-24), Annotated Code of Maryland states that the Department of Natural Resources shall prepare fishery management plans for a list of species. Once a plan has been developed and signed off, it is incorporated by reference into COMAR.

A 2010 legislative bill gave the Department authority to create fishery management plans without the need to annually amend §4-215 to add new species to the list of managed species. The bill requires the Department to address overfishing when data shows that it is an issue. The Department also consults with the Tidal and Sport Fisheries Advisory Commissions (TFAC and SFAC, respectively) for their input when developing management strategies and actions.

## **Introduction**

Fifteen (15) Chesapeake Bay Fishery Management Plans (FMPs) encompassing 21 species and over 260 commitments have been adopted by the Chesapeake Bay Program's Executive Council. In addition, Maryland has developed 5 state-specific FMPs: Yellow Perch, Coastal Bays Blue Crab, Coastal Bays Hard Clam, Brook Trout, Largemouth Bass, and a technical report for catfish. Amendments to the Maryland Tidewater Yellow Perch FMP and the Chesapeake Bay American Eel Fishery Management Plan have been developed. The eel amendment is expected to be adopted in 2016 and the yellow perch amendment in 2017.

Fishery management plans are updated on a regular basis and periodically reviewed to evaluate progress towards meeting goals and objectives. An FMP update consists of Fisheries Service (FS) staff compiling the most recent information on the status of management strategies and actions for each FMP species. An FMP review consists of a more intensive evaluation of a species FMP goal, objectives, management strategies and actions, the current stock status, and any outstanding species issues. The review is conducted by the

species-specific biologists and FMP staff. In order to maintain effective management strategies that reflect the changing needs of fishery resources, the review team: 1) examines the monitoring data for status and trends of the species being reviewed; 2) updates the recreational and commercial fishery statistics; 3) implements coastal recommendations (ASMFC and/or MAFMC); 4) integrates habitat and trophic considerations; 5) tracks the progress/implementation of management actions; 6) addresses any new issues; and , 7) makes recommendations for adaptive management, i.e., whether to continue with the current management framework, amend the plan or revise the plan. The plan review team's recommendations are presented to the Sport Fisheries Advisory Commission and the Tidal Fisheries Advisory Commission as part of the review process. The commissions provide additional input (Figure 1). If an amendment or revision is recommended by the review team, the process for developing FMPs begins (Figure 2). Beginning in 2013, the review process also included the 2012 Fisheries Service Allocation Policy.

During 2015, the Fisheries Service Plan Review Teams (FS PRT) did not complete any FMP reviews. Instead, the reviews will be totally replaced by the annual updates for the FMP report until further notice. The Fisheries staff will rely on requests from the TFAC and SFAC members regarding what species will be reviewed, if any.

## **Fish Habitat and Land Conservation**

Maryland Fisheries Service (FS) has identified land development as one of the major threats to fish habitat. However, fisheries managers have no authority to regulate land use. To address this challenge, FS is developing strategies to

work with constituents to communicate fisheries' concerns. An ad hoc fish habitat workgroup has been convened and developed a vision, objectives and work plan. The message is "land conservation = fish conservation." Studies have been conducted to assess the impacts of impervious surface on fish and fish habitat. A DNR study on the Choptank River (1980-1990) examined the survival rate of striped bass larvae and agricultural best management practices (BMPs). Larval survival increased with the increased adoption of BMPs especially those that conserved soil, reduced run-off and reduced the use of pesticides and fertilizers. Two agricultural methods were notable, conservation tillage and cover crops.

Another DNR Fisheries study examined how the amount of impervious surface (due to the amount of development) affects water quality and then impacts fish spawning. The DNR Fish Habitat Program examined the number of herring eggs or larvae present in a stream. They found that the number of herring decreases with increasing development. As rural watersheds (impervious surface less than 10%) transitioned to suburban watersheds (greater than 10% impervious surface), the number of streams with eggs or larvae decreased. A study on larval yellow perch feeding success also found negative effects due to increasing impervious surface in a watershed. For more details about these studies go to [http://www.dnr.maryland.gov/fisheries/fhep/pdf/CBC\\_Land\\_Conservation\\_Fish\\_Conservation\\_Fact\\_Sheet.pdf](http://www.dnr.maryland.gov/fisheries/fhep/pdf/CBC_Land_Conservation_Fish_Conservation_Fact_Sheet.pdf)

These studies illustrate how important land use decisions are to fish management. Land use policies and conservation strategies need to be better aligned with fishery management strategies.

As a conservative recommendation, impervious surface should be kept below 8% to minimize the effects on the aquatic habitat and fish. As impervious surface increases above 10%, fishery resources are less able to cope with the stress of poor quality habitat. DNR's Fisheries Service has developed a map to help guide conservation and land management. First, they identified high quality anadromous fish habitat. Then they added stressors that limit fish production. Areas were ranked into three categories (good, fair, and poor) based on the potential to support anadromous fish spawning under the existing levels of development. For more detailed information on the Habitat and Ecosystem Program go to

<http://www.dnr.maryland.gov/fisheries/fhep/index.asp?p=pub>

Another approach to sustainable fisheries and habitat is through partnership with the Chesapeake Bay Program. A Chesapeake Watershed Agreement was completed in 2014 and defined goals and outcomes to restore and protect the Chesapeake Bay. The goals address sustainable fisheries, vital habitats, water quality, toxic contaminants, healthy watersheds, stewardship, land conservation, public access, environmental literacy and climate resiliency. These goal categories led to the development of specific outcomes and the development of management strategies to outline what steps to take to achieve the outcomes. Of particular importance to fisheries are the blue crab abundance and management outcomes, the oyster outcome, the forage fish outcome, the fish habitat outcome, the brook trout outcome, the stream health and wetlands outcomes, and the fish passage outcome. During 2015, the partners of the Chesapeake Bay Program developed 2-year work plans for 2016/2017 that contain specific actions for each outcome. For

the most recent information on the work plans, go to:  
[http://www.chesapeakebay.net/blog/post/bay\\_program\\_releases\\_final\\_two\\_year\\_work\\_plans](http://www.chesapeakebay.net/blog/post/bay_program_releases_final_two_year_work_plans)

### **Marine Recreational Information Program (MRIP)**

Recreational fishery statistics are an important part of any stock assessment. Scientists need to know how many fish are taken, how much effort was used to catch the fish, and where the fish were caught. The National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS) is responsible for collecting statistics on marine recreational fishing and calculating harvest estimates. The NMFS recreational fishing statistics program formally known as the Marine Recreational Fisheries Statistics Survey or MRFSS has transitioned to a new process.

The NMFS began a new process in 2008 to improve the estimation of recreational harvest. The program was implemented in three concurrent phases: evaluation of current methods; identification and testing of new methods; and implementation of improved methodologies (MRIP 2011). MRIP has accomplished the following: utilized the National Saltwater Angler Registry; tested alternative effort survey approaches; created a new catch estimation methodology; improved the collection of catch data; and improved data timeliness. Improvements to the methodology include better angler dockside surveys, improved statistical precision, and more frequent reporting. The MRIP estimates replace the previous MRFSS recreational estimates. The MRIP recreational catch estimates improve the accuracy of the

estimates by removing statistical bias. Since historic estimates are particularly important data for stock assessments, the recreational catch estimates have been recalculated. Prior to 2004, the dockside survey design was different and not compatible with the new methodology.

During 2012, MRIP developed a revised method to recalculate catch estimates going back in time as far as possible. The recalculation of recreational harvest estimates resulted in species-specific changes. Some catch estimates went up, some went down and some stayed about the same. There was no overall trend in catch estimates from the previous MRFSS estimates. On a coastwide basis, approximately 20% of the species harvest estimates differed by more than or less than 15% of the previous estimates. Species harvest estimates that were considerably different from past estimates include mid-Atlantic scup and species from other areas (Maine- Atlantic cod and haddock; Gulf of Mexico – mutton snapper and black grouper; South Atlantic – black and red grouper; and Atlantic yellowfin tuna). The MRIP recreational harvest estimates did not directly change any of the species' stock status.

Improvements to recreational harvest estimates have continued under MRIP. Since 2012, MRIP has evaluated a number of pilot projects including: an electronic logbook reporting system for charter boats; enhanced angler dockside survey; additional ways to report estimates in a timelier manner; improved protocols for the access point angler intercept survey; the development of an online, interactive Site Register of every recreational fishing access point; and expanded regional surveys. Priorities for 2014 included cataloging and testing

survey designs, monitoring and adjusting new field methodologies for effort estimates, using license and registration information, increasing reporting efficiency for the charter boat fleet; and utilizing new and emerging technologies to understand fishery health.

Recently, a new survey design, Access Point Angler Intercept Survey (APAIS), has been utilized to estimate the number of fish caught, kept and discarded. Part of the improvements in the survey include sampling at all times of the day (no longer assuming that day and night catch rates are the same), using probability sampling protocols, implementing an on-line registry of public fishing sites, utilizing electronic logbooks for headboats and using multiple methods for estimating effort. More information about recent improvements and a summary of 2015 MRIP-funded pilot studies can be found on their website:

<http://www.st.nmfs.noaa.gov/Assets/recreational/pdf/FINAL-updated-implementation-plan-3.22.16.pdf>



**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 ≤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 (Figure 1). 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 2 shows the watersheds where brook trout historically occurred in Maryland and Figure 3 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. (Figure 4). 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](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 (Figures 5 & 6). 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>).

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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.

<b>River Basin</b>	<b># Streams Sampled 2014</b>	<b># Streams Sampled 2015</b>
GU	3	26
PA	11	9
MP	8	8
UNB	25	48
UP	3	2
WC	2	2
YG	19	66

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. Large Brook Trout Collected from the Upper Savage River Zero Creel Limit Special Management Area, Garrett County, Maryland.



Figure 2. Historic Distribution of Brook Trout in Maryland, by Subwatersheds (green is historically occupied).

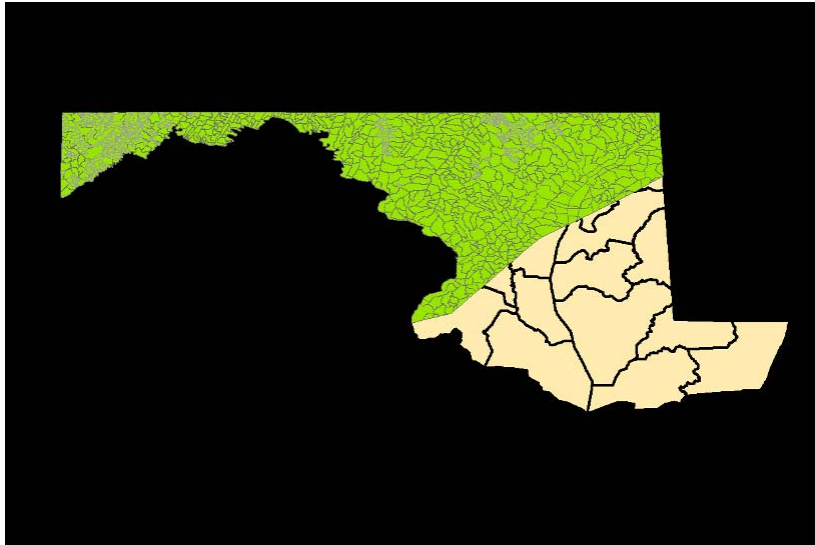


Figure 3. Current (2015) Distribution of Brook Trout in Maryland, by Subwatersheds (green is currently occupied).

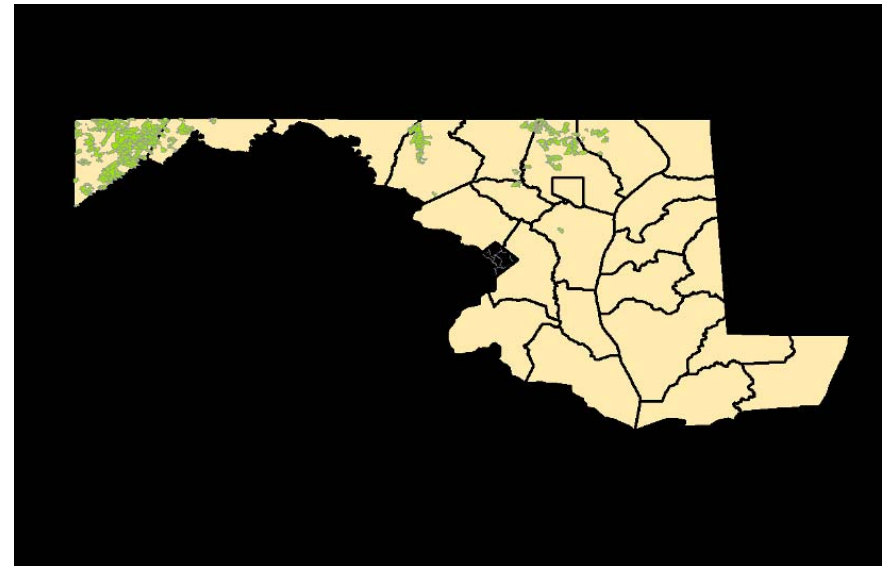


Figure 4. Maryland Department of Natural Resources Inland Fisheries Brook Trout Program Webpage.

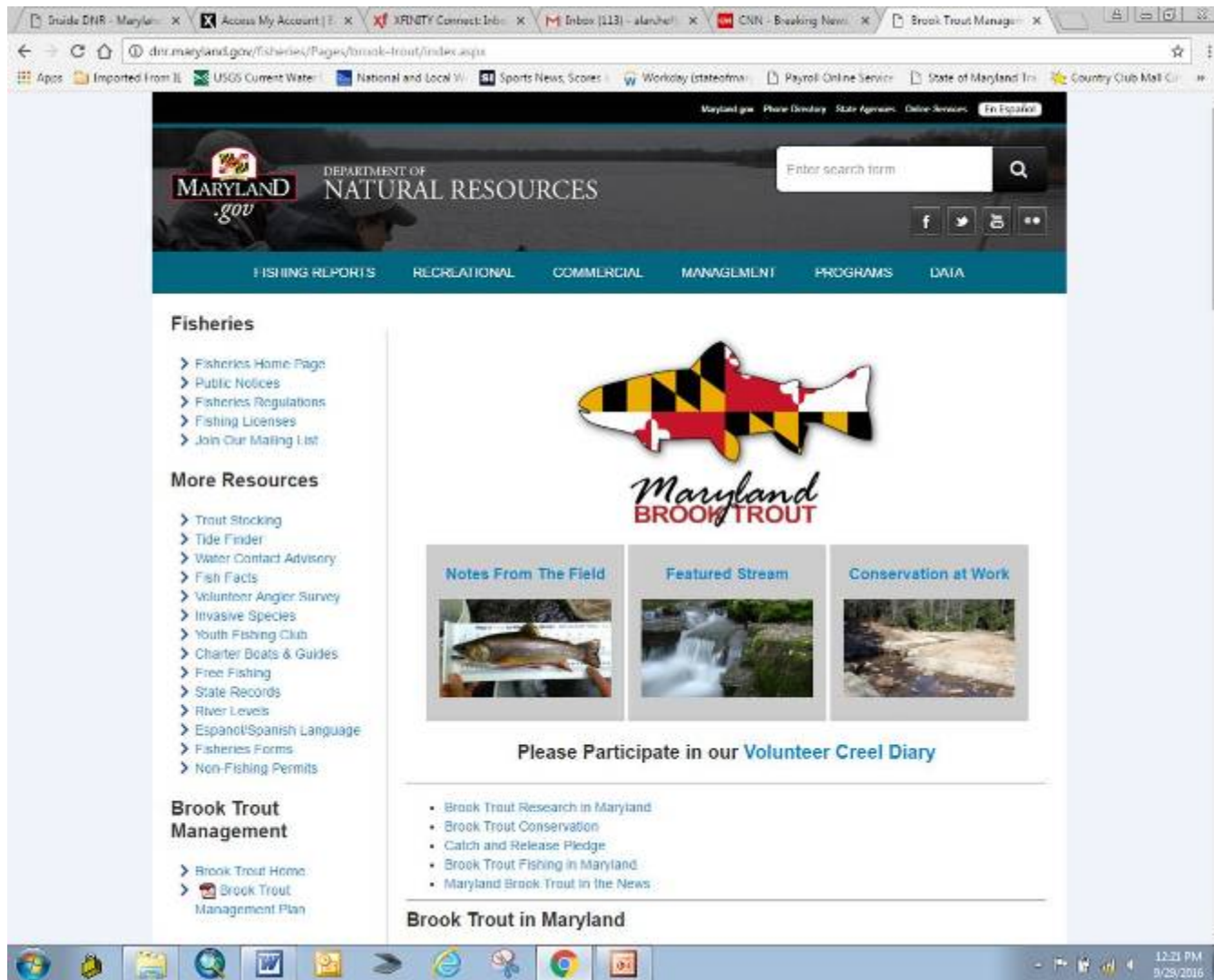




Figure 5. Upper Gunpowder River Brook Trout Partnership Restoration Brochure (page 1).

### Land Issues Impacting Your Watershed

Increase in the amount of impervious surface (pavement) usually associated with development increases runoff that leads to increased stream sedimentation, increased water temperatures, and pollutants which compromise in-stream habitat.

Lack of forest cover or tree canopy increases stream temperatures, reducing viable fish habitat.

Poor agricultural, forest, and land use practices degrade water quality throughout the Chesapeake Bay watershed e.g. sedimentation, erosion, etc.

**Four Easy Ways To Help**

- Plant a tree near a stream
- Place lands in conservation easements
- Reduce development footprints
- Decrease areas of lawn

### Conservation Partners

- Maryland Chapter Trout Unlimited
- Maryland Department of Natural Resources
- Island Fisheries Management Division
- Prettyboy Watershed Alliance
- Eastern Brook Trout Joint Venture
- U.S. Fish and Wildlife Service
- Chesapeake Bay Workgroup
- Baltimore and Carroll Counties

### Get Involved!

Aside from protecting public drinking water and improving the water quality in your watershed, Prettyboy reservoir, and the Chesapeake Bay, you will also be helping to protect brook trout!

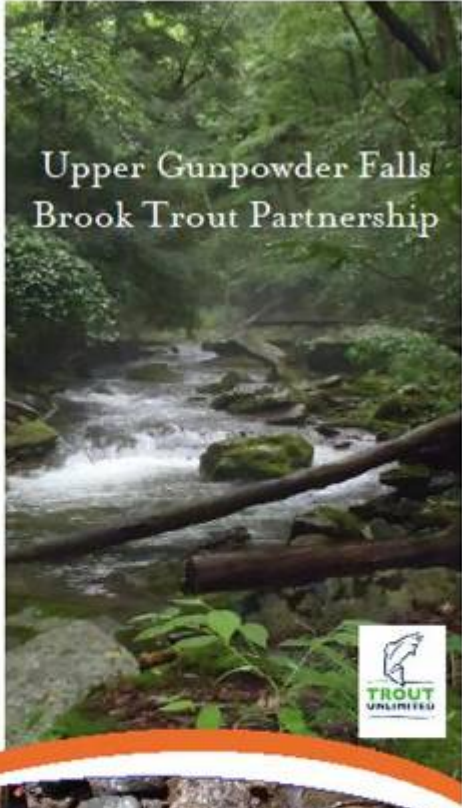
**Plant riparian buffers**  
Planting native trees and shrubs, particularly adjacent to streams, cools stream temperatures, and roots filter and capture sediment and pollutants that degrade water quality.

**Protect existing habitat**  
Protect high quality habitat by keeping your land, particularly stream corridors, vegetated. Maintain new plantings as they grow and replace those that don't succeed.


**Construct and maintain stormwater management facilities**  
Stormwater basins help slow, cool, and filter runoff. Retrofit old stormwater basins, create rain gardens, and remove invasive plants so native plants can flourish. Make sure they are inspected regularly.

**Get involved in land use decisions**  
Local jurisdictions and most public land management agencies ask for public input. Be there and ask the question "How does this decision affect our water?" Consider placing a conservation easement on your property to prevent its future disturbance or explore other long term preservation options with watershed partners.

**Be the eyes and ears of local land management**  
Be observant of changes to water quality and quantity. Sometimes these changes can be subtle, like changes in water color. Sometimes they can be overt like channelization, damming, and poor land management. Contact your state wildlife agency when you see something that doesn't look right.



## Upper Gunpowder Falls Brook Trout Partnership










Figure 6. Upper Gunpowder River Brook Trout Partnership Restoration Brochure (page 2).

### About the Partnership

**Mission:**  
A coalition of volunteers, community organizations, and governmental agencies, the Partnership works collaboratively to improve water quality and stream habitat, helping to conserve and restore brook trout populations in the Upper Gunpowder Falls watershed.

**Purpose:**

- Ensure the protection of Maryland's remaining high quality habitat that supports brook trout populations.
- Return marginal stream habitat to a condition which will once again support brook trout populations.
- Educate and engage landowners, emphasizing the importance and value of preserving the limited number of habitats in Maryland that support brook trout populations.
- Help land owners realize the full economic benefit of their property through best practices in conservation, forestry, and land management.
- Collaborate with land owners to implement scientifically proven storm water management techniques that improve water quality in the Chesapeake Bay watershed.
- Connect private land owners with grant opportunities to improve land management practices.
- Promote land use and conservation strategies that respect land use rights while ensuring the protection of our water resources, habitat, and native flora and fauna.


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Contact: Maryland Chapter Trout Unlimited  
insert contact/facebook page

### Brook Trout in Upper Gunpowder

**About Brook Trout**


- Brook Trout "Char" are Maryland's only native freshwater trout species.
- Maryland Department of Natural Resources has listed brook trout as a "Species of Greatest Conservation Need" in its federally mandated Wildlife Diversity Conservation Plan.
- The vast majority (84%) of Maryland brook trout populations are classified as "greatly reduced", meaning that within the subwatersheds where they occur they occupy only 1% to 10% of the area that was historically inhabited.
- Brook trout are an indicator species; their presence in an area is directly linked to the overall health of the stream system. Their persistence in local watersheds is indicative of healthy ecological systems whose protection should be prioritized.
- Human impacts such as deforestation, agricultural land use, and urbanization have resulted in the extirpation of brook trout from 62% of their historic habitat in Maryland.
- The Gunpowder basin supports the second-highest number of brook trout in the state, holding 25.2% of the total Maryland population (MD DNR 2006).




Maryland

A watershed is an area of land where rainwater all flows into the same river system.

The Upper Gunpowder Falls watershed is 38 square miles and contains 60 miles of streams.



Upper Gunpowder Falls Watershed



**An iconic symbol of persistence and adaptability**

The Eastern brook trout (*Salvelinus fontinalis*) represents the pristine wilderness that once covered North America prior to European settlement. Today it is estimated that within their historic range in the Eastern U.S. only 5% of the subwatersheds support "intact" brook trout populations.

**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.

<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  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.
<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.	2012-2013  <b>Statewide Pending, possible initiation in 2017-2018</b>	<b>This is the number 1 priority for 2016-2019.</b>  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. <b>Earliest a statewide creel survey would be initiated is 2018.</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 Completed	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.  <b>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 2018 – 2019.</b>

<p><b>Strategy 3.1</b> Identify and protect at-risk brook trout populations.</p>	<p><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.</p>	<p><b>In progress Projected completion 2019</b></p>	<p>This was the number 2 priority action (along with Action 13.1.3) in 2010.</p> <p><b>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.</b></p>
	<p><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.</p>	<p>Pending</p>	<p>Requires completion of 3.1.1.</p> <p>The priority list will be generated when the GEP map has been developed.</p>
<p><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.</p>	<p><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.</p>	<p>2007 Continue</p>	<p>GIS project underway as a joint effort of MD DNR, Savage River Watershed Association, and the Izaak Walton League. <b>Final report is being drafted. GIS database has been completed, water budget work will be initiated in 2017.</b></p>
	<p><b>Action 4.1.2</b> 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.</p>	<p>2007 Continue</p>	<p>Requires completion of 4.1.1.</p> <p>Final report will include prioritized list of impacted brook trout populations.</p>
	<p><b>Action 4.1.3</b> Identify areas within the Savage River that need additional conservation.</p>	<p>2007 Continue</p>	<p>Requires completion of 4.1.1.</p> <p>Final report will identify focal conservation areas for watershed associations.</p>
<p><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.</p>		<p>2007 Discontinued</p>	<p>No action was formulated in the BTFMP.</p> <p>MD DNR Western Regional team was disbanded in 2007. Strategy is no longer practicable and is not being pursued.</p>

<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>Pending</p>	<p>No action was formulated in the BTFMP.</p> <p>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.</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>2007 <b>On-going</b></p>	<p>No action was formulated in the BTFMP. This is the number 4 priority action for 2016-2019.</p> <p><b>Action: Create a network of temperature loggers to monitor thermal impacts to streams.</b></p> <p><b>Obtain existing water temperature data and develop a GIS layer within the BT database.</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 necessary research; and it will demonstrate Maryland’s commitment to protecting and conserving this unique resource.</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>2007</p> <p>2007 – 2013</p> <p>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 &gt;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><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.</p>		<p>2006</p> <p>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 will assist with FMP action implementation.</p>
<p><b>Objective (Strategy) 5</b> Encourage riparian buffer habitat preservation and restoration.</p>	<p><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.</p> <p><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.</p>	<p>Pending</p> <p>Pending</p>	<p>Implementation requires completion of Strategy 4.3. Implementation will aid with at-risk population targeting.</p> <p>Dependent on the completion of Action 5.1.1</p>

	<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	No progress to date.
<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 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.	<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 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.	2011 Completed  2011 On-going	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 <a href="http://easternbrooktrout.org/">http://easternbrooktrout.org/</a>  <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>
	<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.	Pending	Requires completion of 6.1.1.
	<b>Action 6.1.3</b> Make presentations available to the general public through appropriate pathways, i.e. website, libraries, etc.	Pending	Requires completion of 6.1.1.
	<b>Action 6.1.4</b> Work cooperatively with other state agencies to insure adherence to state water quality standards.	2007 Continue	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><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><b>Pending</b></p>	<p><b>This is the number 2 priority action for 2016-2019.</b></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 been <b>rescheduled for 2017-2018</b></p>
	<p><b>Action 7.1.2</b> Incorporate a genetic component into the guidelines to direct brood fish selection location.</p>	<p>2010 - 2013</p> <p>2014 Continue</p>	<p>UMCES Appalachian Lab has collected and inventoried brook trout genetics in all watersheds.</p> <p>Laboratory work and analysis was scheduled for winter 2014.</p>
<p><b>Objective (Strategy) 8</b> Complete genetic inventory of discrete brook trout populations.</p>	<p><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.</p>	<p>Pending</p>	<p>Funds are being sought to complete the genetic inventory. <b>Partially completed for the USR in 2014, if funding secured will be completed in 2016.</b></p>
<p><b>Strategy 9.1</b> Establish pathways to inform the general public about brook trout conservation and protection.</p>	<p><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.</p>	<p>On-going</p>	<p><b>This is the number 3 priority for 2016-2019.</b></p> <p>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.</p>



	<p><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.</p>	<p>2006 Continue</p> <p>Completed</p>	<p>Strategy 9.1 aligns with Strategy 6.1.</p> <p>BTFMP posted on line. Trout fishing information is available on the DNR Fisheries Service web site.</p> <p>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.</p>
<p><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.</p>	<p><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.</p>	<p>2009 Completed</p>	<p>A list of watershed groups and advocacy organizations has been created. These organizations have developed their own lists of federal agency contacts.</p>
<p><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;</p>	<p><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.</p>	<p>2008-2009 Completed</p> <p>2009 On-going</p>	<p>Monitoring plan is a Federal Aid requirement. Comments from the MD Task Force on Fisheries Management and SFAC were incorporated in the plan.</p> <p><b>This is the number 5 priority for 2016-2019.</b></p> <p><b>Streams will be monitored on a five year rotation from 2014- 2018.</b></p> <p>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</p>

and 4) monitor/detect water flow and temperature changes.		2012-2013	effective population management. A manuscript was drafted and study results are not yet available pending publication.
	<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 On-going	Inland Fisheries and MBSS have increased sampling coordination. Action will continue annually.

<p><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.</p>	<p><b>Action 12.1.1</b> Create a sampling standardization committee with members from Inland Fisheries and MBSS to develop the sampling methodology.</p>	<p>2006</p> <p>2011</p> <p><b>Pending</b></p>	<p>MBSS sampling protocol informally adopted for portions of the Savage River.</p> <p>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.</p>
	<p><b>Action 12.1.2</b> Conduct training with Inland Fisheries staff to implement the standardized methodology.</p>	<p>2011</p>	<p>Completion of Action 12.1.1 is required.</p> <p>Some informal training has been done to date.</p>
	<p><b>Action 12.1.3</b> Collect summer water temperatures with in-stream temperature.</p>	<p>2007</p> <p><b>On-going</b></p>	<p>Strategy 12.1 aligns with Strategy 4.4. Includes Inland Fisheries efforts and data from MBSS.</p>
<p><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 Inland Fisheries, the MBSS, and the University of Maryland monitoring programs.</p>	<p><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.</p>	<p>2009</p> <p>Completed</p> <p><b>Continue as needed</b></p>	<p>Action 13.1.1 is the number 2 priority (along with Action 3.1.3).</p> <p>Informal data management group has been established and convenes as needed.</p>
	<p><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.</p>	<p>Completed</p>	<p>Requires completion of Action 13.1.1.</p>
	<p><b>Action 13.1.3</b> Develop a GIS database describing BT population boundaries, population information, habitat variable information, and water temperature data.</p>	<p>2009</p> <p><b>On-going</b></p>	<p>Action 13.1.3 was the number 2 priority (along with Action 3.1.1) in 2010.</p> <p><b>GIS database was completed and functional in 2013. It will be updated annually.</b></p>

**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

## 2015 Maryland FMP Report (June 2016)

### Section 1. American Eel (*Anguilla rostrata*)

In 2015, a yellow eel catch cap of 907,671 pounds was implemented for the Atlantic coastal states. Preliminary Atlantic coast landings of 843,587 pounds were below the cap so state specific allocations for the yellow eel fishery were not initiated. Since the American eel stock was designated as depleted after the results of the 2012 coastal stock assessment, management strategies have been developed to reduce mortality. In addition to the coastal yellow eel quota, a coastal commercial glass eel quota was established, the minimum size limit was increased from 6" to 9", and gear restrictions were enacted for the fall fishery to limit silver eel harvest.

The life history strategy of the American eel is unique. Eels spawn in the Sargasso Sea (east of the Bahamas and south of Bermuda) and their larvae (called leptocephali) are carried by currents for approximately one year along the entire Atlantic coast from South America to Greenland. As the larvae approach the continental shelf, they change into glass eels, which actively swim to coastal areas. After approximately 2 months, the glass eels become pigmented and are referred to as elvers. The elvers either remain in estuaries or continue their migration to rivers and streams. They continue to grow into larger, immature yellow eels and spend most of their life in this stage. Their final life stage occurs when yellow eels become sexually mature and are considered silver eels. Mature silver eels then migrate back to the Sargasso Sea to spawn and die. Silver eels can range in age from 3 to 15 years in Maryland and can live up to 30 years in the northern-most latitudes. American eels comprise one panmictic population, i.e., they are a single-breeding population with random mating. They occur in a broader array of habitats than any other fish species. Their complex life history make American eel difficult to assess and challenging to manage.

#### Fishery Management

A Chesapeake Bay American Eel Fishery Management Plan (CBAE FMP) was adopted in 1991. The CBAE FMP goal is to manage the American eel population in the Chesapeake Bay and its tributaries so that harvest does not exceed the natural capacity of the population to maintain its size from year to year. The CBAE FMP was reviewed in 2014. The Plan Review Team concluded that the CBAE FMP management framework is still appropriate for managing the population in the Chesapeake and Coastal Bays but recommended the development of an amendment. A draft amendment was developed during 2015 and includes a provision for the adoption of current and future management requirements established by the ASMFC, updates the status of the eel resource, and provides a framework for managing and monitoring the eel fishery in Maryland waters. Amendment 1 is expected to be adopted by reference into MD regulations in the fall 2016.

The ASMFC adopted a coast wide FMP for American Eel in 1999. The goal is to conserve and protect the American eel resource to ensure its continued role in the

ecosystem while providing the opportunity for its commercial, recreational, scientific, and educational use. The ASMFC developed the FMP to address data needs and other information which indicated the decline of some segments of the American eel population. Jurisdictions were required to implement fishery-independent young-of-the-year (YOY) monitoring surveys and complete an annual compliance report. Since the coastal FMP was developed, four addenda have been adopted.

Addendum I (2006) to ASMFC's FMP required implementation of a commercial licensing and reporting system for American eel fisheries in order to collect catch and effort data. Addendum II (2008) recommended stronger regulatory language by state and federal agencies to improve upstream and downstream passage at dams, particularly for emigrating silver eels. Addendum III (2013) and Addendum IV (2014) were adopted with the goal of reducing mortality of glass (Maine and South Carolina only), yellow, and silver eels. Addendum III management measures include commercial minimum size, gear restrictions, seasonal closure, and recreational size and creel limits. Addendum IV established a coast wide commercial catch cap for the yellow eel fishery, triggers for the implementation of state-by-state commercial quotas, and a quota for the glass eel fishery.<sup>1</sup>

#### Stock Status

The 2012 ASMFC benchmark American eel stock assessment concluded that the American eel stock was depleted.<sup>2</sup> Stock depletion is "likely due to a combination of fishing pressure, habitat loss due to river/stream blockages, mortality from passing through hydroelectric turbines, pollution, disease, and unexplained factors at sea."<sup>2</sup> Although the American eel stock was declared depleted, biomass and fishing mortality reference points could not be determined with confidence.<sup>2</sup> A stock assessment update is scheduled for 2017. To date, climate change considerations have not been included in stock assessments. However, updated information suggests that North Atlantic Ocean currents and habitats are changing. Physical oceanographic processes have been linked to the abundance and recruitment of juvenile American eels making them vulnerable to climate change.<sup>3</sup>

Chesapeake Bay biological reference points for American eel have not been established, therefore stock status in the Bay remains unknown. However, based on fishery dependent and independent surveys completed under the Maryland Eel Population Study, all three indices of abundance have indicated positive trends and increases in abundance since the late 1990's. Significant increases in landings since 2010 without notable changes to fishing mortality further supports the increased abundance trends in Maryland's portion of the Chesapeake Bay.<sup>4,5</sup>

#### Current Management Measures

Glass eel and elver fisheries are prohibited in Maryland. In 2014, the commercial and recreational minimum size limit was increased from 6" to 9." There is no harvest limit for the commercial fishery but beginning January 1, 2014, there is a seasonal closure from September 1st to December 31<sup>st</sup> for all gears except spears and baited eel pots. The recreational creel is 25 eels per person per day. Eel pots must have a minimum mesh size of ½" x ½" by January 1, 2017. Till then, eel pots may have smaller mesh sizes provided they have escape panels.

Starting in 2015, a yellow eel catch cap of 907,671 pounds was implemented for the Atlantic coastal states as part of ASMFC Addendum IV. The coastwide catch cap has two management triggers that would result in the implementation of a state-by-state commercial yellow eel quota: if the catch cap is exceeded by more than 10% in a given year (998,438 pounds) or if the catch cap is exceeded for two consecutive years, regardless of the percent. If either of these two management triggers are met then Maryland will need to implement a commercial quota. State-specific allocations are based on average landings from 2011-2013 and Maryland's quota would be 465,968 pounds. Based on preliminary 2015 coastal landings, no management action was required.

Maryland conducts both fishery dependent and independent annual surveys. Landings from the commercial eel pot fishery are monitored and subsampled for biological data. Fishery independent monitoring includes a yellow eel pot survey in the Sassafras River, a silver eel trap survey from Gravel Run (Corsica River), and young-of-the-year survey in the Coastal Bays.<sup>4</sup> Yellow and silver eels are subsampled for sex and age determination and the prevalence of the swim bladder parasite, *Anquillicolla crassus*. Average prevalence rate among Chesapeake Bay eels was 52% from 2004-2014.<sup>4</sup> The effect of the parasite on yellow and silver eel stages is unknown.

The Maryland Department of Natural Resource Fish Passage Program added eels to its list of targeted species many years ago. Blockage removal projects consider whether or not eels would benefit from implementing a proposed project. The ASMFC published the Proceedings of a Workshop on American Eel Passage Technologies (July 2013). The workshop participants agreed that traditional fish passage structures (fishways and fish lifts) are ineffective at passing juvenile eels and that specialized eel passage structures are necessary. A specialized eel ladder was built at Daniels Dam (Patapsco River) in 2014 and is passing eels upstream in small quantities. Once the down river Bloede Dam is removed (tentatively in 2017-2018), more eels are expected to use the eel ladder at Daniels Dam.

### **The Fishery**

Ninety-nine percent of commercially harvested American eel were caught using eel pots.<sup>6</sup> Maryland's commercial fishery landed 475,743 pounds of American eel during 2015. From 1989-2009 eel harvest averaged approximately 300,000 pounds with little variability. From 2010-2015, annual harvest has nearly doubled to 577,000 pounds and has comprised 57% of the total coastwide harvest (Figure 1).<sup>7,8</sup>

Commercial crabbers are allowed to harvest American eel for use as trotline bait. The 2015 reported trotline bait harvest was 3,329 pounds. The 22- year average eel harvest from commercial crabbers is 23,550 pounds. Eel landings reported on crab harvester forms are not included in National Marine Fisheries Service commercial landings data.<sup>6</sup>

Recreational harvest data for American eel is not available from the Marine Recreational Information Program because of lack of data.<sup>7</sup> Consequently, the recreational harvest of eel is considered to be negligible.

### **Issues/Concerns**

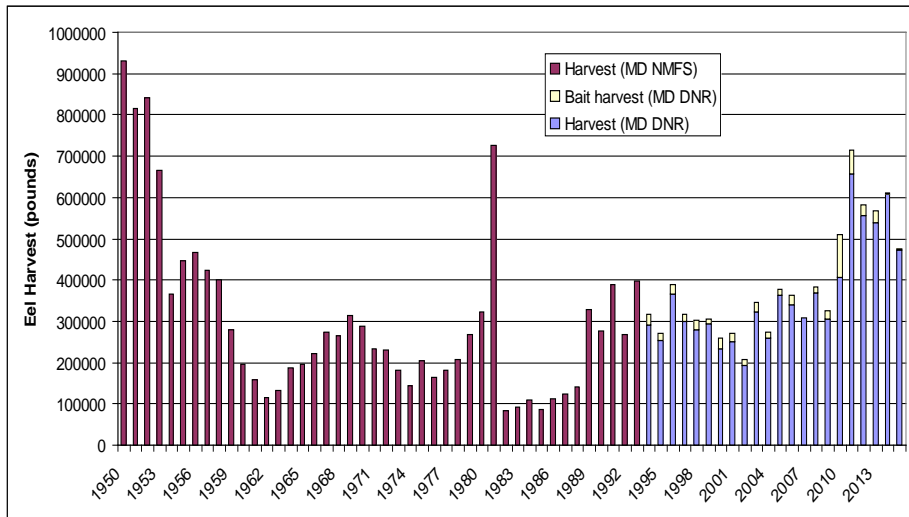
In 2010, the U.S. Fish and Wildlife Service (USFWS) received a petition to list the eel as a threatened species under the Endangered Species Act (ESA) and was followed by a lawsuit in 2012. Since then, the USFWS has conducted an in-depth status review of eels and published a 12-month finding (October 2015). The finding concludes that the American eel resource is stable and does not need protection under the ESA.<sup>9</sup>

The only legal glass eel fisheries along the Atlantic Coast are in the states of Maine and South Carolina.<sup>2</sup> Glass eels are primarily exported to Asian markets. In 2012, the estimated value of the coastal glass eel fishery was \$40 million when the price per pound exceeded \$2000. Despite prices dropping to \$400 - \$650 per pound in 2014, prices again reached \$2000 per pound in 2015. High economic value for glass eels make them a prime target for poaching and illegal activities.<sup>1</sup> In 2016, ASMFC granted North Carolina an aquaculture harvester permit that would allow the harvest of 200lbs of glass eels. Under Addendum IV, other states may submit proposals to harvest glass eels for aquaculture purposes.

Stream and river blockages continue to reduce American eel access to significant amounts of historic habitat. Downstream movement of yellow and silver eels is particularly problematic at hydropower structures where mortality can be as high as 100%. The USFWS monitors eel abundance at the Conowingo Dam, the first major obstruction to eel passage on the Susquehanna River. Beginning in 2008, a seasonal elver ladder is operated at the dam in order to capture and transport eels upstream. In 2015, over 50,000 elvers were stocked.<sup>10</sup> In addition, federal agencies recently developed a technical memorandum on design guidelines for nature-like fishways.<sup>11</sup> Continued attention to removing blockages and providing passage is necessary.

American eel provide a unique ecosystem service as they are a primary host for freshwater mussel larvae and are the primary means of mussel dispersal within a river/stream.<sup>12</sup> Mussels provide important ecological services as water filters in freshwater. Providing fish passage so American eels have the opportunity to move into freshwater habitat will facilitate the rebuilding of freshwater mussel populations.

**Figure 1. American eel commercial landings in Maryland, 1950-2015.**  
 Data for the years 1950-1993 obtained from the National Marine Fisheries Service.<sup>7</sup> Data for years 1994-2015 was provided by Maryland Department of Natural Resources<sup>8</sup>



## References

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- <sup>6</sup> Whiteford, K. 2015. State of Maryland American eel (*Anguilla rostrata*) compliance report to the Atlantic States Marine Fisheries Commission calendar year 2012. Maryland Department of Natural Resources, Annapolis, MD.
- <sup>7</sup> Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division. Retrieved from <http://www.st.nmfs.noaa.gov/index>
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- <sup>9</sup> Federal Register /Vol. 80, No.195 /Thursday, October 8, 2015 /Endangered and threatened wildlife and plants; 12-month findings on petitions to list 19 species as threatened or endangered. Pp 60834- 60850.
- <sup>10</sup> Malavasi, J. and S. Minkinen. 2015. American eel: collection and relocation Conowingo Dam, Susquehanna River, Maryland.
- <sup>11</sup> Turek, J., A. Haro, and B.Towler. 2016. Federal interagency nature-lie fishway passage design guidelines for Atlantic Coast diadromous fishes. Interagency Technical Memorandum. 47pp.
- <sup>12</sup> Lellis, W.A., B, S. White, J.C Cole, C.S. Johnson, J.L. Devers, E.V.S. Gray, H.S. Galbraith. 2013. Newly documented host fishes for the Eastern Elliptio mussel *Elliptio complanata*. Journal of Fish & Wildlife Management: June 2013, Vol. 4, No. 1, pp.75-85

**1991 Chesapeake Bay American Eel Management Plan Implementation Table** (updated 6/16)

<b>Strategy</b>	<b>Action</b>	<b>Date</b>	<b>Comments</b>
<p>1.1 The jurisdictions will adopt a conservative management approach until stock assessment analyses have been completed for American eels in the Bay.</p>	<p>1.1A) Maryland and the Potomac River Fisheries Commission will adopt a minimum size limit of 6 inches for American eels in the Bay.</p> <p>B) Virginia will continue its prohibition on the taking of elvers and will adjust its definition to correspond to a 6” minimum size limit.</p>	<p>1992 1993</p> <p>2005/2006</p> <p>2012</p> <p>2013</p> <p>2014</p> <p>2015-2016</p> <p>TBD</p>	<p>Glass eel and elver fisheries are prohibited in the Chesapeake Bay. No commercial harvest limit. Commercial season open all year for pots and traps. VA restricts other gear to January 1 to August 31. MD, PRFC, VA recreational limit is 25 eels/person/day. Limit for charter/head boat captain or crew is 50 eels/day. There are no harvest regulations in District of Columbia and PA.</p> <p>A coastal stock assessment was conducted in 2005 but the peer review panel determined that the terms of reference were either partially or insufficiently met.</p> <p>A benchmark coastal stock assessment was completed in 2012 and concluded that eels are depleted along the coast.</p> <p>Addendum III to the Interstate Eel FMP required an increase in minimum size from 6” to 9” for all fisheries. Starting in 2014, harvest of eels are prohibited from 9/1-12/31 by any gear other than a baited eel pot or spear. i.e. no harvest of eels with fyke or pound nets.</p> <p>Addendum IV was released for public comment during summer 2014 and adopted in October 2014. The addendum establishes a coastwide commercial catch cap for the yellow eel fishery, the implementation of state-by-state commercial quotas if management triggers are met and a quota for the glass eel fishery.</p> <p><b>Maryland initiated an amendment to the CBAE FMP to adopt current &amp; future ASMFC management requirements, update the status of the eel resource, and provide a framework for managing and monitoring the fishery. Amendment 1 is expected to be adopted by reference into MD regulations in the fall 2016. A quota system will be implemented if one of the management triggers are met: (1) exceeding coastwide quota by more than 10% in a given year, or (2) exceeding the coastwide quota for two consecutive years regardless of the percent overage. If a quota is necessary, Maryland would be allocated 465,968 pounds.</b></p> <p><b>If state by state quotas are implemented, an eel harvester permit will be required for all commercial eel harvesters, including crab license holders intending to harvest eels for bait. All eel permit holders will be subject to daily reporting requirements. In addition, the Department will be able to modify, open or close the season or adjust catch limits by public notice.</b></p>



**1991 Chesapeake Bay American Eel Management Plan Implementation Table** (updated 6/16)

Strategy	Action	Date	Comments
	<p>1.2A) Maryland will implement a ½ x ½” minimum mesh size for eel pots.</p> <p>B) Virginia and the Potomac River Fisheries Commission will continue to enforce a ½ x ½” minimum mesh size for eel pots. Virginia will continue to enforce the escape panel requirements in ½ x ½” mesh pots.</p>	<p>1993 Continue</p> <p>2013 <b>2017</b></p>	<p><b>A coastwide stock assessment update is scheduled for 2017.</b></p> <p>MD, VA and PRFC currently enforce the ½” x ½” minimum mesh size for eel pots. Eel pots in MD with undersize mesh require a 16 in<sup>2</sup> escape panel of ½” x ½” mesh. In MD, pots with mesh size &lt;½” require escape panels. Virginia requires a ½” x 1” escape panels in ½” x ½” mesh pots.</p> <p>Addendum III to the Interstate Eel FMP requires that by January 1, 2017 the entire pot must be ½” x ½” mesh. Escape panels will no longer be allowed in small mesh pots (&lt; ½” mesh).</p>
	<p>1.3 Upon restoration of American eels to the Susquehanna River basin, the Pennsylvania Fish Commission (PFC) will adopt regulations to prevent the overharvest of small eels.</p>	<p>On-going</p> <p>2010 2013</p>	<p>CBP fish passage goal of 2,807 miles opened by 2014.</p> <p>The 2010 SRAFRFC restoration plan did not have specific restoration goals for eel. Addendum III (2013) to the plan specifies eel restoration goals <a href="http://www.srbc.net/pubinfo/docs/SRAFRFC_American_Eel_Restoration_Plan_20140527_220124v1.pdf">http://www.srbc.net/pubinfo/docs/SRAFRFC_American_Eel_Restoration_Plan_20140527_220124v1.pdf</a></p> <p>There are no harvest regulations in PA.</p>
<p>2.1 Catch and effort statistics for the American eel crab bait fishery will be obtained.</p>	<p>2.1 Maryland will require the reporting of American eels used for the crab bait fishery on their finfish reporting forms.</p>	<p>1993</p> <p>2007 Continue</p>	<p>Watermen with crab licenses report the amount of eels caught for bait on their crab reporting forms. Information gathered from the Crab Reporting Forms indicate that previous bait estimates were probably too high.</p> <p>ASMFC requires coastal states/jurisdictions to collect eel catch and effort data from all eel fisheries. MD commercial crabbers are required to report their harvest and effort of eels used for bait. These forms were changed in 2010 and may have increased reporting. Commercial crabbers can use up to 50 eel pots with no catch limit.</p>
<p>3.1 The jurisdictions will increase their understanding of the American eel resource in the Chesapeake Bay. Important research topics include but are not limited to the following: fishery independent estimates of abundance; mortality rates; the effects of fishing exploitation on growth; the factors that influence recruitment in the Bay; and how</p>	<p>3.1A) Maryland and Virginia will continue to collect catch and effort data from the live-eel fishery and begin monitoring the bait eel fishery.</p> <p>B) PRFC will continue to collect catch and effort data from their commercial fishery.</p>	<p>1997 2000 2006 Continue</p>	<p>MD conducts an annual population study. ASMFC implemented mandatory commercial reporting by life stage. ASMFC adopted Addendum I to the Coastal Eel FMP to improve data collection and subsequent stock assessments.</p>
	<p>3.2 Maryland, the Potomac River Fisheries Commission, and Virginia will encourage research to collect basic biological and socioeconomic information.</p>	<p>Continue 2000</p> <p>2006</p>	<p>The ASMFC coastal eel FMP required states/jurisdictions to conduct an annual young of year survey.</p> <p>MD initiated an annual fishery independent eel pot survey and silver eel survey. Eels are also sampled for disease (swimbladder parasite <i>Anquillicolla crassus</i>) prevalence. CB long term average (2004-2015)</p>

**1991 Chesapeake Bay American Eel Management Plan Implementation Table** (updated 6/16)

Strategy	Action	Date	Comments
economic aspects affect the eel fishery.		2007 2010 2015	was 52%.  USFWS determined there was no need to list eels as endangered or threatened. USFWS was petitioned a second time in 2010 for an eel status review. <b>The published status review of the second petition was published in October, 2015 and determined that the eel population is stable and does not warrant protection under the ESA.</b> USFWS completed an American eel biological species report that reviews the best available information on eels in support of the status review.
4.1 The District of Columbia, Environmental Protection Agency, Maryland, Pennsylvania, the Potomac River Fisheries Commission, and Virginia will continue to promote the commitments of the 1987 Chesapeake Bay Agreement. The achievement of the Bay commitments will lead to improved water quality and enhanced biological production. In addition, the jurisdictions have committed to providing upstream passage for migratory fishes.	4.1 The jurisdictions will continue to provide for fish passage at dams, and to remove stream blockages wherever necessary.	2005 2009 2014  2008  2010  2012  2015	The CBP fish passage goal was updated to include opening an additional 1,000 miles of tributary from 2005 to 2014 or 2,807 miles by 2014. The 2014 CB Watershed Agreement (prompted by Executive Order 13508) included an outcome for opening 1,000 miles of migratory fish passage by 2025 (baseline mileage 2,041). American eel was identified as one of the focal species.  ASMFC approved Addendum II to the Coastal eel FMP which placed an emphasis on improving upstream and downstream passage.  USFWS conducted a study to determine the timing & cues for out-migrating eels in the Shenandoah River. Results of the study indicate that outmigration is variable and sometimes protracted.*  Study of the Embry Dam removal on the Rappahannock River indicated that the restoration resulted in increased numbers of eels as far as 100 miles upstream.**  <b>Through 2015, MD DNR's Fish Passage Program has completed 79 projects and reopened 457 miles of upstream habitat in Maryland.</b>
	4.2 The jurisdictions will continue to set specific objectives for water quality goals and review management programs established under the 1987 Chesapeake Bay Agreement. The Agreement and documents developed pursuant to the Agreement call for:  A) Developing habitat requirements and water quality goals for various finfish species.	Continue  2014	Chesapeake Bay Program develops, revises, and monitors goals and strategies for restoration.  The 2014 CBP Watershed Agreement revised the goals and outcomes for natural resources, water quality and stewardship. For more information: <a href="http://www.chesapeakebay.net/chesapeakebaywatershedagreement/page">http://www.chesapeakebay.net/chesapeakebaywatershedagreement/page</a>  <b>Results of the 2012-2014 assessment period indicate that 34% of the</b>

<b>1991 Chesapeake Bay American Eel Management Plan Implementation Table</b> (updated 6/16)			
<b>Strategy</b>	<b>Action</b>	<b>Date</b>	<b>Comments</b>
	<p>B) Developing and adopting basinwide nutrient reduction strategies.</p> <p>C) Developing and adopting basinwide plans for the reduction and control of toxic substances.</p> <p>D) Developing and adopting basinwide management measures for conventional pollutants entering the Bay from point and nonpoint sources.</p> <p>E) Quantifying the impacts and identifying the sources of atmospheric inputs on the Bay system.</p> <p>F) Developing management strategies to protect and restore wetlands and submerged aquatic vegetation.</p> <p>G) Managing population growth to minimize adverse impacts to the Bay environment.</p>		<p><b>water quality standards for dissolved oxygen, water clarity/underwater grasses and chlorophyll a for the Chesapeake Bay were met during this time.</b></p> <p><b>In 2014, 59% of the Chesapeake Bay met the bottom habitat goal, scoring at least three on the one-to-five Benthic index of Biotic Integrity scale.</b></p> <p><b>In 2015, there were an estimated 91,621 acres of underwater grasses in the Chesapeake Bay, achieving 49% of the 185,000-acre goal.</b></p>

ASMFC – Atlantic States Marine Fisheries Commission

CB – Chesapeake Bay

CBP – Chesapeake Bay Program

ESA – Endangered Species Act

FMP – Fishery Management Plan

PFC – Pennsylvania Fish Commission

PRFC – Potomac River Fisheries Commission

SRAFRFC – Susquehanna River Anadromous Fish Restoration Cooperative

USFWS – United States Fish & Wildlife Service

\* Welsh, S. A., D. R. Smith, S. Eyler, and M. T. Mandt. 2010. Migration of silver-phase and yellow-phase American eels in relation to hydroelectric dams on the Shenandoah River. Progress report for Allegheny Energy Supply. <http://www.fws.gov/northeast/fisheries/pdf/EeelShenandoah.pdf>

\*\* Hitt, N. P., S. Eyler, and J. E. B. Wofford. 2012. Dam removal increases American eel abundance in distant headwater streams. Transactions of the American Fisheries Society. 141: 1171-1179.

## 2015 Maryland FMP Report (June 2016)

### Section 10. Maryland Coastal Bays Blue Crab (*Callinectes sapidus*)

Maryland's Coastal Bays and Chesapeake blue crab fisheries are managed separately under two different fishery management plans (FMPs). The Coastal Bays Blue Crab Fishery Management Plan (Coastal BCFMP) recognizes that Maryland's Atlantic Coastal Bays comprise a separate, unique ecosystem from the Chesapeake Bay. The plan identifies management measures to conserve the coastal blue crab stock while protecting its ecological and socio-economic value. The Coastal BCFMP was developed in 2001 and was determined to be an appropriate framework for managing the resource during the last plan review in 2010.

The development of the 2001 Coastal BCFMP was triggered by the Comprehensive and Conservation Management Plan (CCMP) adopted for Maryland's Coastal Bays in 1999. The CCMP recommended that the Maryland Department of Natural Resources address fishery issues specific to Maryland's Coastal Bays. To view the entire CCMP, please visit the Maryland Coastal Bays National Estuary Program website at <http://www.mdcoastalbays.org>. The CCMP is reviewed and updated on a regular basis. A comprehensive review of the CCMP was completed during 2013 and resulted in updated goals, objectives and actions. The plan was revised as the 2015-2025 Maryland Coastal Bays Comprehensive Conservation and Management Plan. The revised plan addresses water quality and environmental health of the estuaries around Ocean City and Assateague Island. The CCMP includes 4 additional plans, 15 goals, 33 challenges and 222 actions.

#### Stock Status

There is no area specific stock assessment for blue crabs in the Coastal Bays. The Coastal Bays Fisheries Investigation (CBFI) program samples blue crabs as part of their trawl and seine surveys. Catch-per-unit-effort (CPUE) calculated from both the seine and trawl surveys indicate that the relative abundance of blue crabs has varied over time without any trends (Figures 1 & 2). Additional fishery independent data collected by the CBFI trawl survey indicate that the mean size of blue crabs in the Coastal Bays has slightly increased. The fishery independent indices, the relative stability of the commercial harvest, and a slight increase in mean size indicate a stable population.

Recruitment of juveniles into the Coastal Bays is largely driven by environmental and hydrologic elements of the Atlantic Ocean waters. Although there is evidence that some internal recruitment is occurring, it is hypothesized that the majority of juveniles that take up residence in Maryland's Coastal Bays are transported by ocean currents from the mouth of the Chesapeake and Delaware Bays. Recent climate change analysis indicates that oceanic currents are influenced by the total amount of carbon dioxide in the atmosphere (greenhouse effect) and the rate of carbon dioxide

increase. The complex factors that drive circulation patterns are non-linear. As a result, circulation patterns could change much faster than previously indicated. Consequently, changes in climate patterns could effect blue crab larval recruitment into the Coastal Bays.

#### Fishery Statistics

Maryland's Coastal Bays support both a commercial and recreational blue crab fishery. The 2015 commercial harvest of hard, soft and peeler crabs from the Coastal Bays was 1.7 million pounds, an increase from 2014 (Figure 1). Annual commercial harvest of blue crabs from the Coastal Bays has ranged from 0.54 to 2.4 million pounds with an average harvest of 1.3 million pounds. Crab pots accounted for 99.8% of the total commercial harvest in 2015. The recreational fishery is primarily a small boat fishery due to limited public shoreline/pier/bulkhead access. Recreational harvest of blue crabs in the Coastal Bays is undocumented. Estimates of recreational harvest from the Chesapeake Bay are believed to be between 8 and 11% of the commercial harvest. Whether or not this estimate is applicable to the Coastal Bays is unknown.

Maryland DNR began implementing an electronic method of reporting blue crab harvest in the Chesapeake Bay in 2012. Providing timely and verifiable harvest data on a daily basis is the first step towards improving the blue crab management system. Watermen from the Coastal Bays have also been participating in the voluntary program.

#### Management Measures

DNR manages the Coastal Bays commercial blue crab fishery through daily catch limits (25 bushels/boat/day), seasons (closed between Nov 1 & Mar 31), gear restrictions (no scrapes or dredges), size limits [minimum 5" for hard crabs, 3 1/2" for soft crabs and time period size differences for peeler crabs (3/4" prior to July 15<sup>th</sup> and 3/2" after July 15<sup>th</sup>)], limited entry, and other management strategies as necessary to control fishing effort. DNR manages the recreational blue crab fishery in the Coastal Bays through daily catch limits (1 bushel/person/day and no more than 2 bushels/boat/day), gear restrictions (no more than 600 ft of trotline/person or two 600 ft. trotlines/boat; 10 collapsible traps or crab net rings/person or 25 traps or rings/boat), and minimum size limits. The taking of sponge crabs is prohibited and there is no minimum size limit on mature female crabs. No license is required. Waterfront property owners can use two crab pots off their dock/pier. The pots must be marked with the owner's name and address or DNR identification number and must have 2 cull rings with required dimensions located in the exterior side panel or on the top panel of the pot. Landowners that use crab pots off their docks must also have a turtle excluder device attached to each entrance or funnel in the lower

chamber constructed of wire or plastic, rectangular in shape and not larger than 1 ¾ inch high by 4 ¾ inch long. The excluder device is required to keep terrapins from drowning in pots. Special regulations are in place for crabbing in Worcester County and may change annually (see COMAR for a complete list of restrictions).

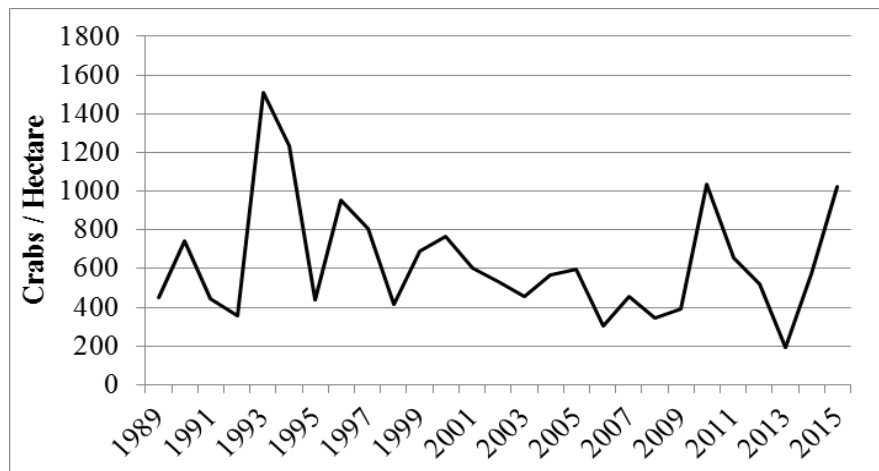
**Concerns/Issues**

A parasitic dinoflagellate, *Hematodinium* sp., can cause mortality in blue crabs from the Coastal Bays. Studies conducted in 2005 and 2006 indicated that the number of infected crabs followed a seasonal pattern increasing from late summer through December. Results indicated that salinity and water temperature are vital components for the proliferation of the parasite and associated mortality. There is still much that is unknown about *Hematodinium* sp. and its effects on the blue crab population in the Coastal Bays. The Virginia Institute of Marine Science (VIMS) and University of Maryland Eastern Shore (UMES) are currently studying the effects of *Hematodinium* on blue crabs.

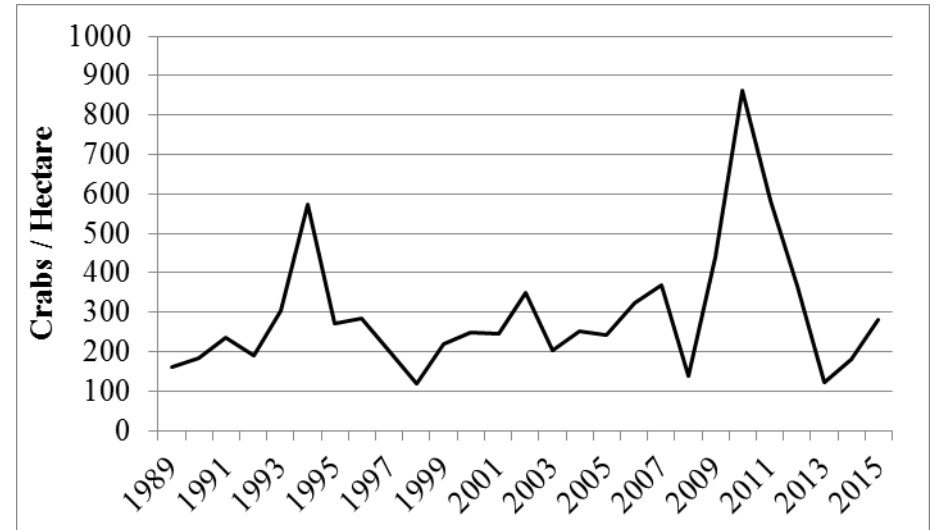
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Viruses of all types have been documented in blue crabs and it is likely that diseases can impact population dynamics. Recent advances in molecular and biotechnological tools have been utilized to assess the prevalence and intensity of diseases. More research is needed to quantify diseases effects on abundance of crabs in the Chesapeake Bay and Coastal Bays.

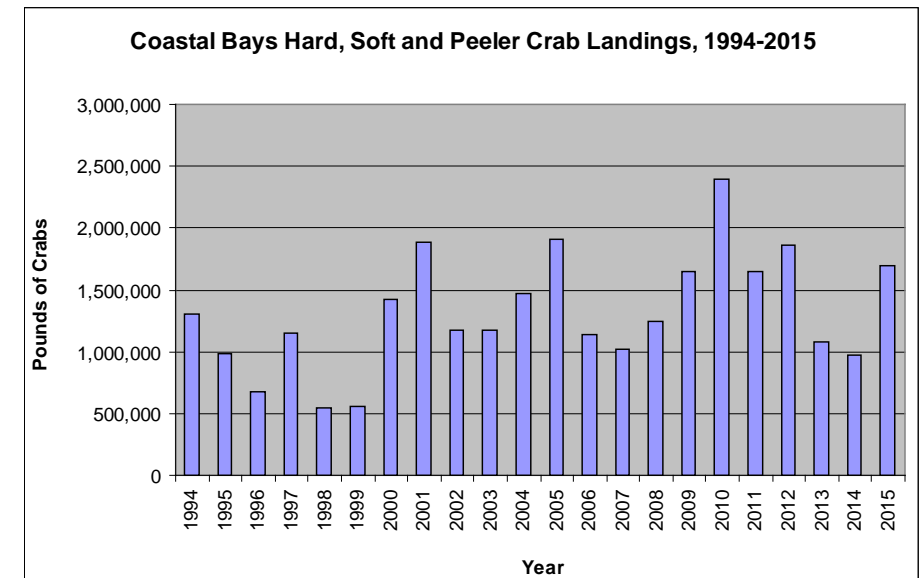
**Figure 1. Maryland blue crab seine CPUE from the Coastal Bays Bay Fisheries Investigations, 1989-2015.**



**Figure 2. Maryland blue crab trawl CPUE from the Coastal Bays Fisheries Investigation, 1989-2015.**



**Figure 1. Total Maryland Coastal Bays Blue Crab commercial harvest in pounds, 1994-2015 (MD DNR data).**



<b>2001 Coastal Bays Blue Crab Fishery Management Plan Implementation</b> (updated 6/16)		
<b>Objective/Problem</b>	<b>Action</b>	<b>Implementation</b>
Obj. 1. Improve our understanding of how <i>Hematodinium</i> contributes to the mortality and population abundance of blue crabs. Prob. 1.1: Research and Monitoring.	<b>1.4.1</b> DNR and MCBP will identify potential funding sources to support the following research and monitoring activities: a) Assess the impact of <i>Hematodinium</i> in the coastal bays blue crab population (i.e. identify what intensity of <i>Hematodinium</i> infection causes mortality, and identify other factors, environmental and/or biological, that may influence blue crab mortality from <i>Hematodinium</i> ). b) Identify factors which influence <i>Hematodinium</i> proliferation, elucidating different life stages, determining the full life cycle of the parasite, and eventual production of a more specific diagnostic tool either by immunoassay or molecular assay techniques. c) Examine how crabs become infected with <i>Hematodinium</i> .	Research includes monitoring prevalence in MD coastal bays. Research is ongoing with the NOAA Oxford Cooperative. University of MD Eastern Shore, and VIMS. A 2010/2011 University of MD project found the presence of <i>Hematodinium</i> sp. in 9% of the water & sediment samples. Viruses of all types have been documented in blue crabs & likely impact population dynamics. VIMS is currently conducting a disease study on crabs from the Eastern Shore of Virginia.
	<b>1.4.2</b> DNR will define the criteria under which a Marine Protected Area can be effective in assessing the impacts of <i>Hematodinium</i> on blue crabs	The Coastal Bays Fisheries Advisory Committee discussed MPAs in the past, without any specific outcome. This committee was disbanded and fishery issues are now discussed through the Maryland Coastal Bays Program <a href="http://www.mdcoastalbays.org/">http://www.mdcoastalbays.org/</a>
Obj. 2. Improve our understanding of blue crab biology and stocks. Prob. 2.1: Stock Status	<b>Action 2.1.1:</b> Adopt an overfishing threshold consistent with Chesapeake Bay that preserves a minimum of 10 percent of the blue crab's spawning potential (F <sub>10</sub> percent), and a fishing target that preserves 20 percent of an unfished stock. (F <sub>20</sub> percent).	No targets and thresholds have been determined for Coastal Bays blue crabs. <b>Reported landings of hard, soft and peeler crabs from the Coastal Bays was 1.7 million lbs. (2015). Average landings have been approximately 1.3 million lbs.</b>
	<b>2.1.2:</b> DNR will work towards implementing the necessary research and monitoring programs to determine the appropriate fishing mortality rates that will achieve the established fishing target of F <sub>20</sub> percent. (Chesapeake Bay mortality rates (fishing and natural) are not necessarily transferable to Maryland's coastal bays.)	There is no direct blue crab monitoring in the Coastal Bays but data is collected through the Coastal Bays fishery independent trawl and seine survey. Research

<b>2001 Coastal Bays Blue Crab Fishery Management Plan Implementation</b> (updated 6/16)		
<b>Objective/Problem</b>	<b>Action</b>	<b>Implementation</b>
		needs have not been defined.
	<b>2.1.3:</b> DNR will work towards allocating funds specific to the Department's coastal bays blue crab monitoring program and data analysis.	No specific funds are designated for blue crab monitoring in the Coastal Bays but data is collected through an ongoing fisheries monitoring program.
	<b>2.1.4:</b> DNR and MCBP will encourage research that examines the stock - recruitment relationship of blue crabs in the coastal bays, level of localized reproduction and entrapment of larvae, and effects of environmental parameters which influence fluctuations in crab abundance (i.e. including this action in the FMP will identify these research needs as a high priority which will better enable DNR, MCBP, Universities and others to obtain support for funding these research projects).	No research completed.
	<b>2.1.5:</b> DNR will examine the utility of developing a public outreach indicator(s) of blue crab abundance that can be used to inform the community on the annual status of blue crab stocks in the coastal bays.	Dependent on all the actions specified in Objective 2.
Prob 2.2: Commercial Catch and Effort Data.	<b>2.2.1:</b> DNR will establish, implement and evaluate a commercial reporting monitoring program to obtain accurate catch and effort data from anyone crabbing commercially in Worcester County consistent with recommendations of the Atlantic Coast Cooperative Statistics Program. a) Evaluate the effectiveness of the A pilot@ daily logbook reporting system implemented in 2000 for commercial crab harvesters and dealers in Worcester Co b) Consider using the Chesapeake Bay's commercial crab reporting system, but make it specific to the coastal bays, including more detailed information on location of harvest and effort data.	As a result of the pilot project, blue crab reporting went from a monthly summary to a daily logbook. The daily logbook program was expanded to the entire state in 2001. A pilot study was conducted in the Chesapeake Bay during 2012 to evaluate the use of an electronic reporting system to improve the timely reporting of catch statistics. <b>A few crab harvesters from the Coastal Bays participated in the study during 2015.</b>
	<b>2.2.2:</b> DNR will improve the enforcement of mandatory monthly reporting	New penalties are now in effect which create a more effective system for commercial fishing licensees who are late or don't turn in their fishing reports. The new penalty system should improve reporting.

<b>2001 Coastal Bays Blue Crab Fishery Management Plan Implementation</b> (updated 6/16)		
<b>Objective/Problem</b>	<b>Action</b>	<b>Implementation</b>
Prob. 2.3: Recreational Catch and Effort Data.	<b>2.3.1:</b> DNR will design and implement a recreational crabbing survey in the coastal bays consistent with the pilot recreational crabbing survey in Chesapeake Bay.	A project to determine the design of a survey was completed. Implementation has been limited due to lack of funding. A Maryland Volunteer Angler Survey started in 2008 and was expanded in 2009. It includes blue crabs but there has been limited response.
	<b>2.3.2:</b> DNR will identify potential funding mechanisms to fund and complement monitoring efforts outlined in Strategies 2.3.1 and 2.1.1.	No funding has been identified.
Prob. 2.4: Invasive, Non-indigenous Species	<b>2.4.1:</b> DNR will continue to monitor the abundance and impact of green crabs and other invasive, non-indigenous crab species.	Ongoing but limited due to lack of funding. In eastern North America, green crabs have been shown to significantly reduce populations of shellfish including soft shell clams, scallops and hard clams.
	<b>2.4.2:</b> DNR will evaluate the following management strategies related to green crabs: a) DNR will prohibit the possession and sale of imported green crabs, and promote the harvest and sale of locally harvested green crabs. b) DNR will prohibit the importation and sale of green crabs.	Green crabs have not been prohibited as bait. They are prohibited from being transported (COMAR 08.02.19.04)
	<b>2.4.3:</b> DNR will continue to work with Maryland's Non-Indigenous Species Task Force to examine invasive species issues, and develop an Aquatic Nuisance Species Plan to become eligible for Federal funding	An Aquatic Nuisance Species Task Force developed a management plan for green crabs for the entire U.S. in 2002. <b>A draft Maryland Aquatic Nuisance Species Management Plan was released for public review in December 2015. The European green crab was identified as a high priority species.</b>
	<b>2.4.4:</b> MCBP will develop an outreach program (i.e. brochures) to educate the coastal bays community on the impacts of exotic species.	Impacts of exotic or non-native species were included in <i>Shifting Sands</i> (2009), a book about the Coastal Bays.
Prob. 2.5: Functional	<b>2.5.1:</b> DNR will examine methods/studies to better understand the natural ecological	No studies have been conducted on



<b>2001 Coastal Bays Blue Crab Fishery Management Plan Implementation</b> (updated 6/16)		
<b>Objective/Problem</b>	<b>Action</b>	<b>Implementation</b>
Role of Blue Crabs in the Natural Ecological Community.	functions of blue crabs in the coastal bays, including the establishment of a Marine Protected Area in the coastal bays.	marine protected areas.
Obj.3. Maintain an economically stable and sustainable commercial blue crab fishery.	<b>3.1.1:</b> DNR will improve the accuracy of effort data in the coastal bays' commercial blue crab fishery by implementing actions related to Problem 2.2 - Commercial Reporting.	See comments Action 2.2.1 and Action 2.2.2.
	<b>3.1.2:</b> DNR will continue to manage the coastal bays commercial blue crab fishery through the use of time limits, seasons, gear restrictions, catch limits, size limits, limited entry, and other management strategies as necessary, to prevent further increases in fishing effort. a) <b>Gear Restrictions</b> - Prohibit the taking of blue crabs in the coastal bays by scrape and dredge to prevent these fisheries from developing, and lessen the gear impacts on blue crab habitat; b) <b>Time Restrictions</b> - Establish similar time restrictions to those in the Chesapeake Bay to prevent a shift in crabbing effort from the Chesapeake Bay to the coastal bays during years when crab abundance is low in the Chesapeake Bay. 1) For 2001 - Prohibit the taking of crabs for commercial purposes between 2:00 p.m. and 5:30 a.m.	Completed.  Prohibition of scrapes & dredges has been enacted. (COMAR.08.02.03.06E) Time restrictions have been enacted. (COMAR.08.02.03.06D2) Closed season enacted: November 1 to April 1. (COMAR 08.02.03.06C)
Prob. 3.2: Harvest of Female Crabs,	<b>3.2.1:</b> DNR will continue to prohibit the harvest of sponge crabs, and limit the taking of female crabs in the coastal bays through the use of time limits, seasons, area closures, gear restrictions, catch limits, and size limits, as necessary. a) <b>Area Closures</b> - DNR will delineate areas where female blue crabs are concentrated (Action 5.2.1(a)), and determine the appropriate time periods for which commercial crabbing and hydraulic clam dredging should be allowed within these areas. The following areas have been identified as potential closure areas but need to be delineated further: 1) The Convention Hall site, bayside of Ocean City roughly between 36 <sup>th</sup> and 50 <sup>th</sup> Street; and 2) The Therefore site, in southern Isle of Wight Bay; 3) The Bridge site, just north of the Verrazano Bridge on the barrier island side. b) <b>Catch and Size Limits</b> - Determine if the current catch and size limits for female crabs are appropriate.	Ongoing.
	<b>3.2.2:</b> DNR will investigate the economic impact of prohibiting the possession and sale of sponge crabs within the state.	Completed. (Lipton and Sullivan 2002).
Prob. 3.3: Wasteful Harvest Practices.	<b>3.3.1</b> DNR will require unobstructed cull rings in crab pots from June 1 through April 30, and will adjust cull ring requirements based upon further research (peeler pot cull ring study being planned on Chesapeake Bay).	Ongoing

<b>2001 Coastal Bays Blue Crab Fishery Management Plan Implementation</b> (updated 6/16)		
<b>Objective/Problem</b>	<b>Action</b>	<b>Implementation</b>
	<b>3.3.2:</b> DNR will determine if measures are necessary to reduce the bycatch mortality of crabs in the hydraulic clam dredge fishery (i.e. Action 3.2.1(a) - prohibition of hydraulic clam dredging in areas where female crabs are concentrated).	Hydraulic Clam Dredging is currently prohibited in Maryland's Coastal Bays, 2007. Natural Resource Article § 4-1002
	<b>3.3.3:</b> DNR will continue to require terrapin excluders in crab pots set for noncommercial purposes, encourage watermen to install terrapin excluders in commercial crab pots, and investigate the feasibility (i.e. effects on catch; economic impact) of requiring terrapin excluders in all crab pots set in the coastal bays.	Ongoing. (Lukacovic et al. 2005)
	<b>3.3.4:</b> MCBP will coordinate an annual/seasonal volunteer effort to locate and remove derelict pots.	Ongoing.
Obj. 4. Improve the recreational crabbing experience. Prob. 4.1: Satisfaction of Recreational Crabbers.	<b>4.1.1:</b> DNR and MCBP will obtain information on satisfaction levels of recreational crabbers in the coastal bays to evaluate the effectiveness of management measures.	No recreational crabbing surveys have been completed.
	<b>4.1.2:</b> DNR will examine the effects of habitat quality on the success rates of recreational crabbing in the coastal bays.	No studies have been conducted.
	<b>4.1.3:</b> DNR and MCBP will develop and distribute the following information pertaining to the recreational crab fishery in the coastal bays: a) Recreational crabbing brochure summarizing crabbing restrictions; b) Recreational crabbing sign for access points (i.e. boat ramps and fishing/crabbing piers); c) Maps of land-based public access and boat based crabbing locations, list of boat ramps and marinas with rental boats, and recreational crabbing tips.	Ongoing.
	<b>4.1.4:</b> DNR, MCBP, Town of Ocean City and Worcester County will work towards increasing the number of land-accessible areas for recreational crabbing.	Ongoing.
Obj. 5. Protect, maintain and enhance blue crab habitat. Prob. 5.1: Submerged Aquatic Vegetation (SAV).	<b>5.1.1:</b> DNR will alleviate the impact of hydraulic clam dredging and prop scarring to SAV in the coastal bays by: a) Prohibit hydraulic clam dredging in SAV; b) Annually documenting the areas and extent of impact; c) Researching seagrass recovery time; d) Investigating the use of buoys to mark beds, SAV setbacks, depth restrictions, GPS equipment to identify boundaries, and education as tools to protect beds from damage; and e) Implementing and enforcing necessary regulations to protect SAV from hydraulic clam dredging.	Hydraulic Clam Dredging is currently prohibited in Maryland's Coastal Bays, 2007. Natural Resource Article § 4-1002
	<b>5.1.2:</b> By implementing Action 3.1.2, DNR will prohibit the taking of blue crabs in the	Completed.

<b>2001 Coastal Bays Blue Crab Fishery Management Plan Implementation</b> (updated 6/16)		
<b>Objective/Problem</b>	<b>Action</b>	<b>Implementation</b>
	coastal bays by scrape and dredge to prevent these fisheries from developing and impacting SAV.	
	<b>5.1.3:</b> DNR and MCBP will continue to identify SAV species needing protection and activities needing restrictions.	Ongoing.
	<b>5.1.4:</b> MCBP will expand surveys/citizens monitoring to ground truth SAV species composition and determine accuracy of photo interpretive maps.	Most recent survey results indicate that SAVs continued to decrease in all areas of the Coastal Bays during 2014. At the time of this update, maps from VIMS surveys were not available for 2015. SAV beds in Maryland's Coastal Bays appear to be an important area of primary habitat for fish.
	<b>5.1.5:</b> DNR and Natural Resources Conservation Service (NRCS) will develop habitat requirements for the growth of seagrasses in the coastal bays by: a) DNR will develop water quality requirements for seagrasses; b) DNR will identify areas that meet water quality requirements for restoration purposes; c) NRCS will compile data relating coastal bay soil types to bottom communities and identify other variables having effects on seagrass establishment and maintenance; and d) NRCS will complete soil mapping effort for entire coastal bays	a) Completed (Maryland Department of Natural Resources 2004). b) Ongoing. c) Completed by MGS & DNR. d) Not yet initiated.
Prob. 5.2: Overwintering Habitat.	<b>5.2.1:</b> DNR will identify and protect blue crab overwintering areas in the coastal bays by: a) Delineating and mapping overwintering areas; and b) Prohibiting hydraulic clam dredging in important overwintering areas year-round, unless data indicates that these areas can be opened on a seasonal basis (see Action 3.2.1(a)). c) DNR will define the criteria under which a Marine Protected Area can be effective in protecting blue crab overwintering areas.	No mapping has occurred for blue crabs. Hydraulic clam dredging is prohibited (2007). No steps have been taken to define marine protected areas.
Prob. 5.3: Shallow Water and Shoreline Habitats.	<b>5.3.1:</b> DNR will support actions in the CCMP, specifically "Challenge 1.9 of the Fish and Wildlife Section" to protect and enhance shallow water and shoreline habitats important to blue crabs. DNR and Worcester County are the lead agencies for the majority of these actions. Refer to the CCMP for more specific information on these actions.	Ongoing. <b>The CCMP was revised in 2015.</b>
Prob. 5.4: Dissolved Oxygen.	<b>5.4.1:</b> DNR will support actions in the CCMP, specifically in the "Water Quality" section and "Fish and Wildlife" section to minimize the impacts of unsuitable dissolved oxygen levels to blue crabs in the coastal bays. Maryland's Coastal Bays Program, Town of Ocean City, and Worcester County are the lead agencies for the majority of these actions. Refer to the CCMP for more specific information on these actions.	Ongoing. (Maryland Department of Natural Resources 2004).The CCMP went through a thorough review and strategies and actions were updated during 2013. <b>It resulted in an updated CCMP</b>

<b>2001 Coastal Bays Blue Crab Fishery Management Plan Implementation</b> (updated 6/16)		
<b>Objective/Problem</b>	<b>Action</b>	<b>Implementation</b>
		<b>(2015).</b>
	<b>5.4.2:</b> DNR will identify areas which have unsuitable levels of dissolved oxygen (i.e. < 3 mg/L) for blue crabs.	Ongoing. (Maryland Department of Natural Resources 2004).
Prob. 5.5: Nutrient, Sediment and Chemical Inputs.	<b>5.5.1:</b> DNR will support actions in the “Water Quality” section of the CCMP to control nutrient, sediment and chemical inputs which will protect and enhance blue crab habitats. Worcester County and Maryland’s Coastal Bays Program are the lead agencies for the majority of these actions. Refer to the CCMP for more specific information on these actions.	Ongoing. (Maryland Department of Natural Resources 2004).
Obj. 6. Improve enforcement of crabbing restrictions. Prob. 6.1: Enforcement of Conservation Measures.	<b>6.1.1:</b> DNR will consider increasing the number of enforcement personnel in the coastal bays, specifically during the crabbing season.	NRP hires seasonal staff to increase patrols during summer months. Penalties for violating regulations and enforcement procedures have been enhanced over the past several years.
	<b>6.1.2:</b> DNR will consider expanding the Natural Resource Police reserve officer program.	The reserve officer program is composed of volunteers committed to performing non-law enforcement duties that would otherwise be performed by commissioned police officers.

**Acronyms:**

COMAR = Code of Maryland Regulations  
DNR = Department of Natural Resources  
MCBP = Maryland Coastal Bays Program  
MPAs = Marine Protected Areas  
NOAA = National Oceanographic and Atmospheric Administration  
NRP = Natural Resources Police  
SAV = Submerged Aquatic Vegetation  
VIMS = Virginia Institute of Marine Science

## 2015 Maryland FMP Report (August 2016)

### Section 11. Maryland Coastal Bays Hard Clam (*Mercenaria mercenaria*)

Hard clam stocks throughout the Coastal Bays either increased or were stable, but with the exception of the St. Martin River, remained below historic baseline levels. It will probably take several more years for these populations to reach benchmark densities. As a result of the relatively low population levels and the ban on mechanical harvesting, there has been little or no commercial activity for hard clams reported; the recreational harvest is unknown. A bill to reinstate mechanical harvesting except for hydraulic escalator dredging in the southern portion of the Coastal Bays was introduced during the 2016 legislative session but did not pass.

#### Coastal Bays FMP

Recognizing Maryland's Coastal Bays as a separate, unique ecosystem from the Chesapeake Bay, a Comprehensive Conservation Management Plan (CCMP) was adopted for Maryland's Coastal Bays in 1999. The plan recommended that the Maryland Department of Natural Resources (MDNR) address fishery issues specific to Maryland's Coastal Bays, including those related to hard clams, the primary molluscan shellfish resource in the region. In accordance with this plan, a Coastal Bays Hard Clam Fishery Management Plan (FMP) was adopted in 2002 to conserve the coastal stock, protect its ecological and socio-economic values, and optimize the long-term utilization of the resource. During 2010, the Coastal Bays Hard Clam Plan was reviewed by the Plan Review Team (PRT). The PRT recommended a revision of the plan because the majority of actions are no longer valid due to the ban on mechanical harvesting. A time line for revising the plan has not been developed yet.

#### Stock Status

Since 1993, the MDNR Shellfish Division has conducted fishery-independent hard clam surveys in the Maryland Coastal Bays. During the six years since the enactment of the dredging ban, trends in the survey findings have varied depending on geographic region. In 2015, hard clam densities in all five bays were either stable or have increased. The St. Martin River, which historically had very low hard clam densities, continued to improve and now exceeds the 1953 baseline (the first of the coastal components to do so). Recruitment has also been variable by region but overall appears to have increased slightly.

During the first two years following the elimination of hydraulic escalator dredging, the southern bays (Chincoteague and Newport) continued to experience declining hard clam densities. Hard clam densities in Chincoteague Bay fell to record low levels, a full order of magnitude below the 1952 benchmark. Since 2010 this trend has reversed, with Chincoteague Bay densities doubling to 1993 levels, where they

have remained for the past four years at 20% of historic densities (Figure 1). Likewise, the hard clam population has more than doubled in Sinepuxent Bay since 2012, and is now at about 72% of its 1953 level. Equally encouraging results have been seen in the northern bays (Assawoman and Isle of Wight), which have had relatively substantial increases since dredging was eliminated. Note that this population expansion actually began before the dredging ban went into effect with sizable recruitment to the population evidenced in 2008 that subsequently went unharvested. Particularly in Isle of Wight, which generally experiences good hard clam recruitment, the post-dredging ban average hard clam density has nearly tripled the pre-ban average (Figure 2). However, over the past five years Isle of Wight clam densities have leveled off below their historic highs, and recruitment has sharply dropped. The population in Assawoman Bay has increased seven-fold from critically low densities in 2006, with a 33% increase in the last year alone, but is still about 48% of the historic benchmark.

Despite the great improvement in Isle of Wight Bay, hard clam densities remain well below historic benchmarks in the remaining regions of the Coastal Bays. The causes of these generally poor densities have not been determined. Low population densities could result from recruitment failures due to unfavorable water quality conditions for hard clam survival<sup>1</sup> (such as brown tide blooms) and possible increased predation by blue crabs<sup>2</sup> and other predators such as cownose rays.

#### Current Management Measures

Hard clam minimum size limit is 1" in the transverse dimension and only hand-held harvesting devices are allowed in the Coastal Bays. In 2007, the Maryland state legislature passed a law prohibiting the harvesting of clams and oysters in the Coastal Bays by hydraulic escalator dredge, power dredging, or other mechanical means. This statute went into effect in September, 2008 and essentially eliminated the commercial fishery. The fishery may resume at some point in the future if stocks build to densities high enough to support manual means of harvesting. The minimum size for the recreational fishery is 1" (transverse measurement) with a 250/person/day limit; a license is not required.

#### The Historical Fishery

Commercial effort and harvest has varied over the years. Harvests in the mid-1990's were below 25,000 pounds per year. Successful recruitment during this period was followed by an increase in landings, which exceeded 100,000 pounds in 1999 and peaked at 163,000 pounds in 2002. Since the prohibition of hydraulic dredging in 2008, commercial fishery landings have been non-existent or negligible. The statewide harvest was reported to be only 368 pounds in 2010,<sup>3</sup> the last year for which landings are available. Information from the recreational fishery is largely unknown.

Aquaculture activities have been slowly expanding in recent years. In 2015, there were 19 active leases covering 181 acres. Both hard clams and oysters were being raised on these leases. Production figures were not available.

### Issues and/or Concerns

Most of the strategies and actions in the 2002 Coastal Bays Hard Clam Fishery Management Plan were developed to address hydraulic dredging. Since the use of hydraulic dredges is prohibited, these strategies and actions are now obsolete. A revised plan is scheduled for development.

A bill introduced during the 2016 Maryland legislative session would have allowed mechanical harvesting in the southern Coastal Bays (below the Verrazano Bridge) but did not pass into law. This legislation would have substantially increased fishing mortality on a still depleted hard clam population. The clams in this region remain well below historic baseline densities and the population needs more time to recover.

User conflicts and stakeholder opposition, especially from shoreline property owners, continue to hinder the expansion of hard clam aquaculture in the Maryland Coastal Bays. One lease application initiated in 2009 was finally approved in 2016.

Non-native green crabs (*Carcinus maenas*) have been introduced, most likely as bait bucket introductions. This species has been recognized by the federal Aquatic Nuisance Species Task Force as an aquatic nuisance species. Green crabs are known clam predators and their impact on the hard clam population is uncertain. Although small pockets of green crabs may be established in the Coastal Bays, they are neither abundant nor widely distributed. The green crab is listed as a “species prohibited from transport” in MD (COMAR 08.02.19.04) and they may not be collected and used as bait in areas where they are not established.

Compliance with the National Shellfish Sanitation Program (NSSP) model ordinance is currently in place and affects the handling of hard clams intended for human consumption. Handlers are required to cool clams and deliver them to Department of Health and Mental Hygiene (DHMH) certified shellfish dealers within 12 hours after harvest (or cooled to specific temperatures within 12 hours).

Figure 1. Chincoteague Bay hard clam densities before and after the dredging ban and the historic benchmark density (red bar) (MDNR data)

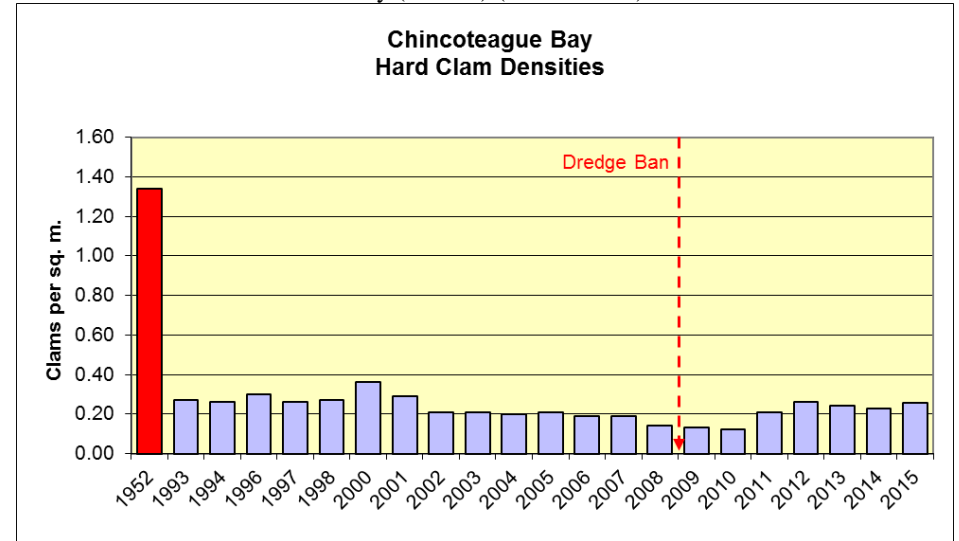
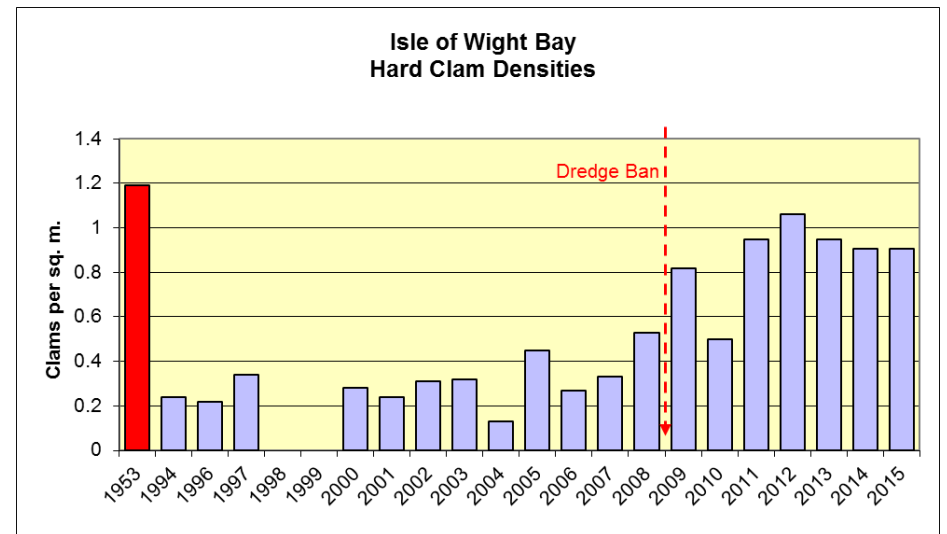


Figure 2. Isle of Wight Bay hard clam densities before and after the dredging ban and the historic benchmark density (red bar) (MDNR data).



## References

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2. Tarnowski, M. 2007. Hard-Shell Clam *Mercenaria mercenaria*. [http://www.dnr.state.md.us/fisheries/fishfacts/hardshell\\_clam.asp](http://www.dnr.state.md.us/fisheries/fishfacts/hardshell_clam.asp)
3. Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division, Silver Spring, MD.
4. Waterway Improvement Capital Program Benefits, Needs, and Opportunities. 2011. Legislative report prepared in response to the 2011 Joint Chairman's Report, Sept. 2011. 23p.

<b>2002 Coastal Bays Hard Clam Fishery Management Plan (updated 09/16)</b>		
<b>Objective/Problem</b>	<b>Action</b>	<b>Implementation</b>
Obj.1. Enhance and perpetuate hard clam stocks. Prob 1.1: Mortality of Small Clams	<b>1.1.1</b> Investigate the importance of habitat closures (MDE restricted areas, SAV closures, and shoreline setback areas) to recognize their benefits as hard clam broodstock protection areas.	Ongoing. Results to date have not shown significant improvement in clam densities within SAV beds. With the prohibition on mechanical harvesting there has been no commercial activity for the past 6 seasons. Limited recreation-only harvest areas and sanctuaries are preferred alternatives to closures and moratoriums.
	<b>1.1.2</b> Develop an action plan for improving hard bottom habitat (i.e., shell or other suitable substrate) to reduce predation on small clams. The action plan will include the identification of: a) Planting materials and sources; b) Enhancement areas; and c) Funding sources (i.e. improved reporting of commercial hard clam harvest will increase funding generated through the shellfish tax which could be used towards bottom enhancement activities).	Pilot studies on habitat improvement indicate that clam survivorship is enhanced but not sufficiently high enough to justify the expense and logistical difficulties associated with such activities. The absence of commercial harvesting resulted in no tax revenue for the past 6 years.
Obj.2. Manage for a viable commercial hard clam harvest to maintain an economically stable fishery. Prob. 2.1: Potential Economic Hardship to Commercial Clammers Caused by the “Boom and Bust” Nature of the Fishery	<b>2.1.1</b> DNR will limit the number of individuals into the commercial hard clam fishery by permit only based upon those individuals who have landed at least 100 bags of hard clams (as documented by DNR dealer reports) in Maryland’s coastal bays in at least 2 years between the 1990/91 and 2000/01 seasons. Using these criteria, a total of 22 individuals would qualify for this permit. This permit should be transferable with a license, or to an individual who purchases a clam rig from an individual who meets the criteria stated above, and relinquishes their permit to the new clam rig owner. DNR will evaluate this action within 3 years to determine if the desired outcomes are being achieved. This action is consistent with actions 5.1.2 and 6.1.3.	Completed. However, lawyers determined that this was legally inadvisable. This objective and action needs further investigation and discussion given the absence of commercial harvest. Limited entry and IFQs continue to be discussed.
	<b>2.1.2</b> DNR will develop a plan (i.e. reporting requirement from commercial clammers) to improve the collection of catch, effort and economic data from the commercial hard clam fishery to assist managers in evaluating the impacts of future management decisions.	There are gaps in the hard clam harvest data but harvest can be estimated from buy tickets (if the hard copies are still available). There has been no commercial harvesting during the past 6 seasons. Commercial clam harvesters are required to report their daily catch of all clam species starting September 2011.
Obj. 3. Evaluate the feasibility of hard clam aquaculture opportunities. Prob 3.1: Establishing Hard Clam Aquaculture	<b>3.1.1</b> Evaluate the legal, institutional and economic incentives and barriers to private aquaculture at the local, state, and federal level in Maryland.	This was done as part of the Maryland Legislative Task Force on Seafood and Aquaculture. DNR will be lead agency as of July 1, 2011 in permit processing. An aquaculture training conference was hosted by UMD, in cooperation with MD DNR, NOAA CBO and the Oyster Recovery



<b>2002 Coastal Bays Hard Clam Fishery Management Plan (updated 09/16)</b>		
<b>Objective/Problem</b>	<b>Action</b>	<b>Implementation</b>
		<p>Partnership. Three aquaculture open houses were held in 2010.</p> <p>An aquaculture financing loan program was announced by Gov. O'Malley. Representatives from the Maryland Oyster Aquaculture Financing Program discussed the loan program at the open houses and began the business planning and application processes.</p> <p>MD DNR and DHMH launched a commercial shellfish tagging program beginning in October, 2011 to meet the requirements of the National Shellfish Sanitation Program (NSSP). Hard clam tagging was implemented in the 2012-2013 license year. Other changes (such as taking and landing times, cooling, shading) needed to comply with NSSP changes have been implemented through regulation.</p>
	<b>3.1.2</b> Identify problems with the permitting process, and make recommendations to specific agencies to solve those problems.	This was done through the above task force, reinforced with information from a range of states at the Maryland Aquaculture Development Conference held in Annapolis in August 2003. Permitting process has improved and will continue to address the myriad laws and regulations of the past 100 years which preserved wild harvest at the expense of aquaculture.
	<b>3.1.3</b> Simplify the application process, and designate a single point contact at DNR to assist potential applicants with aquaculture permits, questions related to the regulatory requirement, guidance through the permitting process and fulfilling of regulatory obligations, tracking permit applications, and coordinating state agency permitting activities to aquaculture permits.	<p>The leasing laws were entirely revised in 2009, including the provision for pre-approved lease areas in the coastal bays to streamline the process. Two areas have since been pre-approved: South Point Shoal and Whale Gizzard Shoal. Because these areas have been pre-screened for leasing conflicts, the application process is shorter.</p> <p>MD DNR has been designated as the lead agency for coordinating all aquaculture permitting as of 7-01-11 (SB 847 &amp; HB 1053). DNR will issue water column leases</p>

<b>2002 Coastal Bays Hard Clam Fishery Management Plan (updated 09/16)</b>		
<b>Objective/Problem</b>	<b>Action</b>	<b>Implementation</b>
		<p>and staff the Aquaculture Coordinating Council and Aquaculture Review Board.</p> <p>The lease application was simplified in 2010. It is now a single joint application with the US Army Corps of Engineers, Baltimore Office and the MD DNR.</p> <p>One lease for hard clam aquaculture was approved in 2010. One additional applicant pursued a submerged land lease application in 2012.</p> <p>One older lease hard clam aquaculture operation began reporting harvest under new reporting requirements in effect since June, 2012.</p>
	<p><b>3.1.4</b> DNR will evaluate the feasibility of hard clam aquaculture in Maryland's coastal bays by:</p> <ul style="list-style-type: none"> <li>a) Identifying potential areas and size of area for hard clam aquaculture;</li> <li>b) Initiating and providing funding for pilot hard clam aquaculture studies;</li> <li>c) Investigating the economic impact of hard clam aquaculture; and</li> <li>d) Assessing the ecological impacts associated with hard clam aquaculture</li> </ul>	<ul style="list-style-type: none"> <li>a) This was not meant to designate where shellfish farmers would be compelled to site their operations (already taken care of in MD law with regard to leasing). It should be used as a point of reference for the types of bottom most beneficial for the production of hard clams and oysters. Pre-approved leasing areas have been evaluated and proposed.</li> <li>b) This has been done through the development of a shellfish nursery at Gordon's Shellfish (supported by the MIPS program) and trials with several types of production methods. Information on what works best according to the bottom types and circulation patterns in the area, and the management objectives of the operator have been considered.</li> <li>c) Ongoing - but hard clam aquaculture has revolutionized the Florida fishing industry and kept many former fishermen in business when they had few other options. It is a multi-million dollar industry in VA where the production of high quality shellfish runs ahead of MD.</li> <li>d) A study of the incidence of the clam</li> </ul>

<b>2002 Coastal Bays Hard Clam Fishery Management Plan (updated 09/16)</b>		
<b>Objective/Problem</b>	<b>Action</b>	<b>Implementation</b>
		disease QPX (MDNR/VIMS) was completed. Continue to monitor mortality in farmed clams for disease (none reported). MDNR conducted a study of hard clam growth in the presence of brown tide. Proposals were submitted to fund a two-year study on commercial hard clam aquaculture and SAVs but because of budget problems, neither has been funded. A literature review was presented to the Coastal Bays STAC.
Obj 4. Enhance and promote the recreational hard clam fishery. Prob. 4.1: Limited Access and Knowledge of Recreational Clamming Opportunities in Maryland's Coastal Bays	<b>4.1.1</b> DNR will develop and distribute a public outreach brochure illustrating recreational clamming areas, access points, methods and harvest restrictions.	This is a low priority and has not been initiated. Increased education on recreational harvest should include the responsibility and mechanism to report harvest. This may be an opportunity for Coastal Baykeeper input.
	<b>4.1.2</b> DNR will work with the Town of Ocean City and Worcester County to improve access to recreational clamming areas	Boat ramps and associated facilities continue to be constructed and renovated with funding provided in full or in part by the DNR Waterway Improvement Fund, funded by boat taxes. Most recently, the West Ocean City Harbor ramp, built in 1988, was renovated over four months and re-opened, June, 2011. Due to decreased revenues (50% since FY2006), DNR was able to fund only 19% of the state and local boating access and dredging projects <sup>4</sup> .
	<b>4.1.3</b> DNR will investigate the feasibility of planting seed to establish and/or enhance areas for recreational clamming, and if feasible, develop a seeding strategy.	Low priority and most likely will not be implemented.
	<b>4.2.1</b> DNR will reduce the recreational catch limit for hard clams from 1 bushel to 250 hard clams per person per day.	Effected in 2002.
Obj.5. Minimize conflicts between coastal bay user groups and commercial hard clam fishermen.	<b>5.1.1</b> DNR will prohibit commercial clamming in the area between the Ocean City Airport at Marker 13 northward to the Rt. 90 Bridge on Saturdays (Sundays currently closed) between September 15 through October 15, and April 15 through May 31.	Effected in 2002. Action item to be moved to history/background in new FMP which will be totally revised to include aquaculture.

<b>2002 Coastal Bays Hard Clam Fishery Management Plan (updated 09/16)</b>		
<b>Objective/Problem</b>	<b>Action</b>	<b>Implementation</b>
Prob. 5.1: Conflict Between Recreational Fishermen and Commercial Clammers.		
	<b>5.1.2</b> DNR will limit the number of individuals into the commercial hard clam fishery by permit only based upon those individuals who have landed at least 100 bags of hard clams (as documented by DNR dealer reports) in Maryland's coastal bays in at least 2 years between the 1990/91 and 2000/01 seasons. Using these criteria, a total of 22 individuals would qualify for this permit. This permit should be transferable with a license, or to an individual who purchases a clam rig from an individual who meets the criteria stated above, and relinquishes their permit to the new clam rig owner. DNR will evaluate this action within 3 years to determine if the desired outcomes are being achieved. This action is consistent with actions 2.1.2 and 6.1.3	Legally inadvisable (see Sec. 2.1.1). Action item to be addressed in 2.1.1.
	<b>5.1.3</b> DNR will reduce the bycatch allowance of hard clams for recreational purposes in the hydraulic dredge fishery from 1 bushel to 250 hard clams per person per day.	Effectuated in 2002. Action item is no longer needed.
Prob. 5.2: Conflict Between Shoreline Property Owners and Commercial Clammers.	<b>5.2.1</b> DNR will establish a maximum noise level limit for commercial vessels consistent with the recreational limit	Regulation clarified to reference existing reg. (COMAR 08.18.03.03) establishing maximum noise levels all for vessels in Maryland. This action item may be addressed in aquaculture permitting.
<b>Obsolete – Mechanical harvesting now prohibited.</b>	<b>5.2.2</b> DNR will increase the shoreline setback distance for which a person may not catch hard clams with a hydraulic dredge in front of federal or state-owned property from 150 to 300 feet	Effectuated in 2002.
	<b>5.2.3</b> DNR's Natural Resource Police will monitor the causes of reported noise complaints to facilitate future management decisions related to this issue.	Study conducted by NRP of 5 clam boats found that all were in compliance with muffler and noise level regulations.
	<b>5.2.4</b> DNR will investigate the impacts of prohibiting or restricting the written permission provision that allows an individual to catch hard shell clams with a hydraulic dredge within the shoreline setback of 300 feet.	Written permission provision eliminated in 2002.
Obj. 6. Minimize ecological impacts associated with the commercial and recreational hard clam fisheries. Prob. 6.1: Community Concern on the Ecological Effects of Commercial Hydraulic Clam Dredging.	<b>6.1.1</b> DNR and Maryland's Coastal Bays Program will educate the public on the ecological effects of hydraulic clam dredging and the importance of the commercial hard clam fishery to the coastal bays community.	A literature review was compiled documenting the impact of hydraulic escalator dredging and other harvesting and natural disturbances on marine ecosystems. A new FMP will discuss ecosystem based recommendations and habitat improvement.
<b>Obsolete – hydraulic escalator dredges now prohibited.</b>	<b>6.1.2</b> DNR will encourage studies to evaluate the ecological impacts of hydraulic clam dredging in Maryland coastal bays.	Action is obsolete.

<b>2002 Coastal Bays Hard Clam Fishery Management Plan (updated 09/16)</b>		
<b>Objective/Problem</b>	<b>Action</b>	<b>Implementation</b>
	<b>6.1.3</b> DNR will limit the number of individuals into the commercial hard clam fishery by permit only based upon those individuals who have landed at least 100 bags of hard clams (as documented by DNR dealer reports) in Maryland's coastal bays in at least 2 years between the 1990/91 and 2000/01 seasons. Using these criteria, a total of 22 individuals would qualify for this permit. This permit should be transferable with a license, or to an individual who purchases a clam rig from an individual who meets the criteria stated above, and relinquishes their permit to the new clam rig owner. DNR will evaluate this action within 3 years to determine if the desired outcomes are being achieved. This action is consistent with actions 2.1.2 and 5.1.2.	Legally inadvisable (see Sec. 2.1.1). Action is addressed in 2.1.1.
Prob. 6.2: Direct Impact to Submerged Aquatic Vegetation (SAV) by Commercial Hydraulic Clam Dredging	<b>6.2.1</b> DNR will continue to prohibit the use of hydraulic clam dredges in SAV beds, and delineate existing SAV beds as necessary to maintain this protection over time.	Obsolete – hydraulic escalator dredges now prohibited.
<b>Obsolete – hydraulic escalator dredges now prohibited.</b>	<b>6.2.1a</b> The Maryland Coastal Bays Fishery Advisory Committee shall become the local group to develop and provide recommendations to DNR regarding the delineation of SAV closure areas to harvest from hydraulic clam dredging.	Obsolete – hydraulic escalator dredges now prohibited.
	<b>6.2.1b</b> DNR will continue to foster the support among legislators to make recommended changes in the SAV law which would benefit all stakeholder groups by making the delineation and enforcement process more manageable, and the closure areas consistent over a longer period of time	Ongoing.
	<b>6.2.2</b> DNR and the National Park Service will investigate the feasibility and funding options for using Global Positioning System (GPS) units to improve the ability for clambers to comply with SAV closure areas and offset the maintenance cost associated with using buoys to identify SAV closure areas.	There has been no commercial activity for the past 4 years. No action to date.
Prob. 6.3: Potential Impact to Overwintering Blue Crabs by Commercial Hydraulic Clam Dredging. <b>Obsolete – hydraulic escalator dredges prohibited.</b>	<b>6.3.1</b> DNR will evaluate the need to restrict hydraulic dredging in important female blue crab overwintering areas by: a) Delineating female blue crab overwintering areas; b) <i>Determining the significance or contribution of these overwintering crabs to the coastal bays blue crab population;</i> c) Determining the magnitude of overwintering blue crab bycatch in the hydraulic clam dredge fishery; and d) Assessing the impact of dredging activity on overwintering female blue crabs.	Preliminary study was conducted by the MDNR Coastal Fisheries Program. Obsolete – hydraulic escalator dredges now prohibited.
Obj. 7. Protect, maintain and enhance important hard clam habitats. Prob. 7.1: Water Quality	<b>7.1.1</b> Develop strategies to restore water quality in areas closed to harvesting hard clams because of pollution	Ongoing.
Prob. 7.2: Hard Bottom Habitat	<b>7.2.1</b> Develop an action plan for improving hard bottom habitat (i.e. shell or other suitable substrate) to reduce predation on small clams. The action plan will include the identification of:	Studies on habitat improvement indicate that clam survivorship is enhanced but not sufficiently high enough to justify the

<b>2002 Coastal Bays Hard Clam Fishery Management Plan (updated 09/16)</b>		
<b>Objective/Problem</b>	<b>Action</b>	<b>Implementation</b>
	a) Planting materials and sources; b) Enhancement areas; and c) Funding sources.	expense and logistical difficulties associated with such activities.
Prob. 7.3: Navigational Channel Dredging and Dredge Disposal.	<b>7.3.1</b> The MD Coastal Bays Navigation and Dredging Advisory Group (NADAG) will seek comments from DNR's Shellfish Program on the potential impacts of proposed dredging activities on hard clams.	MDNR is routinely consulted during the permitting process on projects that may impact hard clams.
Prob. 7.4: Growth of Noxious Algal Blooms.	<b>7.4.1</b> DNR and MCBP will identify potential funding sources to support the following research and monitoring activities: 1) Assess the potential impact that noxious algal blooms have on hard clam populations; and 2) Identify factors which might contribute to noxious algal blooms.	MDNR conducted a study on the impact of brown tide on clams in culture. Sampling for harmful algal blooms and analyses of causes is ongoing at MDNR.
Obj. 8: Minimize the impacts of non-indigenous invasive species. Prob. 8.1: Green Crabs.	<b>8.1.1</b> DNR with the advice of Maryland's Coastal Bays Fishery Advisory Committee will implement measures to minimize the impact of green crabs and Japanese shore crab on the hard clam population in Maryland's coastal bays, and coordinate this effort with Delaware and Virginia.	Not yet initiated
	<b>8.1.2</b> DNR will continue to work with Maryland's Non-indigenous Species Task Force to examine invasive species issues, and develop an Aquatic Nuisance Species plan to become eligible for Federal funding	A draft Maryland Aquatic Nuisance Species Management Plan is under review.
Obj. 9. Implement fisheries dependent and independent monitoring programs to obtain sufficient and accurate data for managing hard clams Prob. 9.1: Stock Assessment	<b>9.1.1</b> DNR will continue to survey the hard clam resource on annual basis in Maryland's coastal bays to facilitate management decisions.	Ongoing. This action will be included in stock assessment discussion in a revised FMP.
Prob. 9.2: Assessment of Bottom Enhancement Activities.	<b>9.2.1</b> Design and implement a program to monitor the efficacy of bottom enhancement activities.	The results of pilot studies suggest that such a program would not be cost-effective. See action 7.2.1
Prob. 9.3. Commercial Catch, Effort and Economic Data.	<b>9.3.1</b> DNR will establish, implement and evaluate a commercial reporting program to obtain accurate catch, effort and economic data from anyone harvesting hard clams in Maryland's coastal bays. This action is consistent with action 2.1.2.	Not yet initiated. There has been no commercial harvesting during the past 6 seasons.
Prob. 9.4: Recreational Catch, Effort and Economic Data.	<b>9.4.1</b> DNR will facilitate the design and implementation of a recreational clamming survey in Maryland's coastal bays.	Questions on recreational clamming were included as part of a broader 2006 angler survey by UMES.

**Acronyms:**

DHMH = Department of Health and Mental Hygiene

FMP = Fishery Management Plan

IFQs = Individual Fishing Quotas

MDNR = Maryland Department of Natural Resources

MIPS = Maryland Industrial Partnerships

NOAA CBO = National Oceanographic and Atmospheric Administration, Chesapeake Bay Office

NRP = Natural Resource Police

SAV = Submerged Aquatic Vegetation

STAC = Scientific & Technical Advisory Committee

UMD = University of Maryland

UMES = University of Maryland Eastern Shore

VIMS = Virginia Institute of Marine Science

## 2015 Maryland FMP Report (August 2016)

### Section 12. Horseshoe Crab (*Limulus polyphemus*)

The Adaptive Resource Management (ARM) Framework for horseshoe crabs was developed to address the relationship between horseshoe crabs and migrating shorebirds. Implementation of the management framework began in 2013 and continued through 2015. The framework underwent a technical review at the beginning of 2016 in response to a decline in harvest in 2015. Since harvest was restricted to male crabs only, the demand for local-caught Maryland horseshoe crabs was reduced and there were some seasonal harvest factors that led to a decrease in the Maryland harvest during 2015. Maryland Fisheries Service is presently evaluating options to modify the fishing season for horseshoe crabs.

Horseshoe crabs are an important species to a number of different stakeholders. Not only do they support several important commercial fisheries and a major biomedical process, they also are a critical food source for many migratory shorebirds. As a result, the management of horseshoe crabs has a broad ecosystem management approach and is closely intertwined with the conservation efforts of migratory birds.

Horseshoe crabs and migratory shorebirds, particularly the red knot (*Calidris canutus rufa*), have a unique ecological relationship. Red knot rely on horseshoe crab eggs as food during their spring migration from South America to their Arctic breeding grounds. In September, 2013, the U.S. Fish and Wildlife Service (USFWS) published a proposed rule in the Federal Register to list the red knot as a threatened species.<sup>1</sup> The final rule listing the red knot as threatened was published on December 12, 2014. The USFWS identified climate change induced effects such as habitat impairment and loss, asynchronous timing with food resources, and predation as principal threats. The USFWS expressed confidence that the Atlantic States Marine Fisheries Commission's (ASMFC) ARM framework was a reasonable approach to ensure sufficient egg abundance to meet the needs of both red knots and horseshoe crabs.<sup>1</sup>

#### Fishery Management Plans (FMPs)

##### Chesapeake Bay

The Chesapeake Bay and Atlantic Coast Horseshoe Crab Fishery Management Plan (CBHSC FMP) was adopted in 1994. The CBHSC FMP prohibited the harvest of horseshoe crabs during the spawning season as a conservation measure for protecting their eggs and providing an important food resource for shorebirds. The plan established a spawning stock census of horseshoe crabs, stricter harvest reporting standards, and a program to delineate important spawning areas. The CBHSC FMP was reviewed in 2011. The plan review team recommended amending the plan to address two issues: 1) adopt the ASMFC's ARM framework and 2) address the lack of genetic and spawning data for horseshoe crabs within Chesapeake Bay.

##### ASMFC

In 1998, the ASMFC adopted the Interstate Fishery Management Plan for Horseshoe Crabs. Since then, there have been a number of changes. Addendum I (2000) to the Interstate Fishery Management Plan for Horseshoe Crab established state-by-state quotas on horseshoe crab landings that were 25% below reference period landings. Addendum II (2001) allowed quota transfer between states. Addendum III (2004) further reduced commercial harvest and added seasonal closures in New Jersey, Delaware, and Maryland. These additional restrictions were implemented to further increase horseshoe crab egg abundance, especially in regards to providing for migratory shorebirds including the red knot.

Addendum IV (2006) instituted seasonal and spatial harvest restrictions in Maryland and Virginia. Harvest restrictions apply only to the bait fishery. In addition, no more than 40% of Virginia's quota can be harvested east of the COLREGS line (determined by the International Regulations for Preventing Collisions at Sea and the "rules of the road" followed by vessels at sea). They must also have a minimum male to female ratio of 2:1 if landed in Virginia. Addenda V (2008) and VI (2010) continued the Addendum IV restrictions for Maryland and Virginia. Addendum VII (2012) implemented the ARM framework in 2013 to optimize horseshoe crab harvest while conserving both shorebird and horseshoe crab abundance. In 2014, the Virginia Polytechnic Institute trawl survey, critical for determining the harvest level of horseshoe crabs under the ARM model, was discontinued. In its place, the ASMFC board used a composite index from Delaware and New Jersey, and decided to hold the harvest at status quo.<sup>2</sup> Funding for the Virginia trawl survey has been secured for 2016. The horseshoe crab technical committee began a review of the ARM framework in 2016. Based on the review, the ASMFC approved the development of a new addendum to incorporate the mortality associated with the biomedical use of horseshoe crabs and to explore the possibility of allowing a limited harvest of female horseshoe crabs. A draft is expected by October 2016. There will be an open public comment period after the draft is approved by ASMFC.

#### Stock Status

A coast wide horseshoe crab stock assessment update was completed in 2013 but limited data made it difficult to assess the status of the stock. Consequently, a trend analysis was done in lieu of a complete stock assessment. To date, no overfishing, overfished, or depleted definitions and reference points have been developed.<sup>2</sup> Abundance trends vary regionally. Abundance has increased in the southeast, has been stable in the mid-Atlantic and has decreased in the northeast. There is no detectable abundance trend for adult females. Increased stock biomass has been attributed to harvest closures and decreased fishing mortality.<sup>3</sup>

Horseshoe crabs caught in Maryland waters include individuals from three separate spawning stocks: Maryland, Virginia, and Delaware Bay. Mean catch of horseshoe



crabs from the Maryland Coastal Bays trawl survey indicates a variable but increasing trend in catch since 2002 (Figure 1).

Egg density on Delaware Bay and New Jersey beaches has been highly variable seasonally, annually and spatially over the years. Peak egg density generally coincides with peak shorebird migration. Beginning in 2014, the Delaware and New Jersey egg survey is no longer a mandatory monitoring requirement by ASMFC.

Reported biomedical mortality from harvest to release was 1.3% in 2012. However, a 15% rate for bleeding and release mortality was assumed and used in the stock assessment.<sup>4</sup> In 2011, a mortality range of 5-30% was included in the ARM assessment. Estimated annual mortality has averaged 75,346 crabs from 2008 – 2014.<sup>2</sup> Coastwide biomedical harvest has increased and has been above the 57,500 crab cap since 2007. The estimated biomedical use was 524,103 crabs in 2014 a slight decline from the average of 554,737 (2008-2014).<sup>2</sup>

### **Current Management Measures**

Maryland's commercial fishery has operated under a quota system since 1998. Beginning in 2013, the harvest of female horseshoe crabs was prohibited and the quota was set for male horseshoe crabs only. Any overages are deducted from the following year's quota. Horseshoe crab harvest was prohibited from December 1 to June 8. Harvest was restricted to waters beyond 1 mile of Maryland's Atlantic coast from June 9 to July 15 and limited to 100 crabs per person per day for harvesters possessing a horseshoe crab permit. Permitted harvesters were allowed to catch their daily limit (indicated on their permit) from July 15 to December 1. Horseshoe crab harvest was allowed in all tidal waters of Maryland from July 15 to December 1. Harvesters without a horseshoe crab permit are limited to 25 crabs per person per day. All horseshoe crab harvest is limited to Monday through Friday. Permitted harvesters report landings weekly; non-permitted harvesters report landings monthly.

There are four companies along the Atlantic Coast that process horseshoe crab blood. The scientific permits for biomedical use allow horseshoe crab collection during seasonal closures. Limulus Amebocyte Lysate (LAL), extracted from horseshoe crab blood, is used to screen injectable drugs, biologics, medical devices, and raw materials for presence of endotoxins and gram-negative bacteria. All crabs harvested for bleeding must be returned to the waters where they were caught within 48 hours. Crabs purchased from bait harvesters must be returned to the bait harvester after being bled. A chain of custody form must accompany all batches of horseshoe crabs.

The ARM framework identified two circumstances that affect red knot demography and annual survival: 1) horseshoe crab abundance and red knot body mass at departure from Delaware Bay and 2) arctic snow conditions upon arrival at the breeding grounds. As a result, the ARM workgroup developed five horseshoe crab management alternatives:<sup>7</sup> 1) a full harvest moratorium on both sexes; 2) a harvest

limit of 250,000 males and 0 females; 3) a harvest limit of 500,000 males and 0 females; 4) a harvest limit of 280,000 males and 140,000 females; and 5) a harvest limit of 420,000 males and 210,000 females. Alternative #3 is currently in place. The ARM framework underwent a review in 2016.

The U.S. Fish and Wildlife Service coordinates a coast-wide tagging program. Biomedical, conservation outreach, and research entities tag horseshoe crabs annually. Since 1999, over 254,000 crabs have been tagged and released with a recapture rate of 12%.<sup>2</sup> The ASMFC Horseshoe Crab Technical Committee developed tagging program guidelines to make data collected more applicable to management issues.

### **The Fisheries**

Maryland's commercial horseshoe crab harvest is caught primarily by trawl nets in the Atlantic Ocean. The harvest quota increased to 255,980 for 2013 and will continue at that level through 2015 and 2016. With the increase in quota, the harvest was restricted to male horseshoe crabs only. Previously the quota had been 170,000 male or female horseshoe crabs (2004-2012). Landings in 2013 were 240,688 horseshoe crabs or 94% of the Maryland quota (Figure 2). Landings in 2014 were 148,269 horseshoe crabs or 58% of the quota. Landings in 2015 were 27,494 animals.<sup>6</sup> The implementation of the male only harvest in Maryland has reduced demand for locally caught horseshoe crabs.

The number of crabs landed coastwide for biomedical bleeding (not bait) has increased since the mid-2000s. Horseshoe crab mortality in the biomedical sector has exceeded the 57,500 crab threshold each year since 2007 (Figure 3). In 2014, the total estimated mortality on biomedical crabs was 78,798 crabs.<sup>2</sup> Due to consistent, overages of the mortality threshold, the ASMFC Plan Review Team recommended that the ASMFC Management Board consider actions to evaluate biomedical use and mortality of horseshoe crabs during the ARM review.<sup>3</sup>

### **Issues/Concerns**

USFWS published a rule to list the red knot as a threatened species in December 2014. The primary threats to red knot in the mid-Atlantic region are climate change induced effects such as habitat impairment and loss, and asynchronous timing with food resources. Availability of horseshoe crab eggs, horseshoe crab harvest, and bleeding mortality are of concern. The USFWS recognized the validity of the ARM framework to control horseshoe crab harvest and prevent harvest from being a threat to red knot. A concurrent factor is the presence of peregrine falcons, which prey on red knot. The presence of peregrine falcons can inhibit red knot foraging regardless of horseshoe crab egg abundance.<sup>1</sup> In addition, genetic variability in red knot body mass thresholds may be an important factor for their annual survival. The 2014 Delaware Bay red knot surveys indicated a modest increase in red knot abundance.

The Virginia Tech benthic trawl horseshoe crab survey has provided important data for the ARM framework and stock assessments. These analyses are necessary to ensure that horseshoe crab spawning stock and egg production are sufficient to support migratory shorebird feeding. The biomedical industry was able to provide partial funding for the 2012 trawl survey but Congressional funding was discontinued in 2014.<sup>2</sup> and. The trawl survey is relatively inexpensive (\$200,000)<sup>3</sup> and the ASMFC horseshoe crab ARM committee has been actively working to find an alternative to the trawl survey. A composite index based alternative was used in 2015.

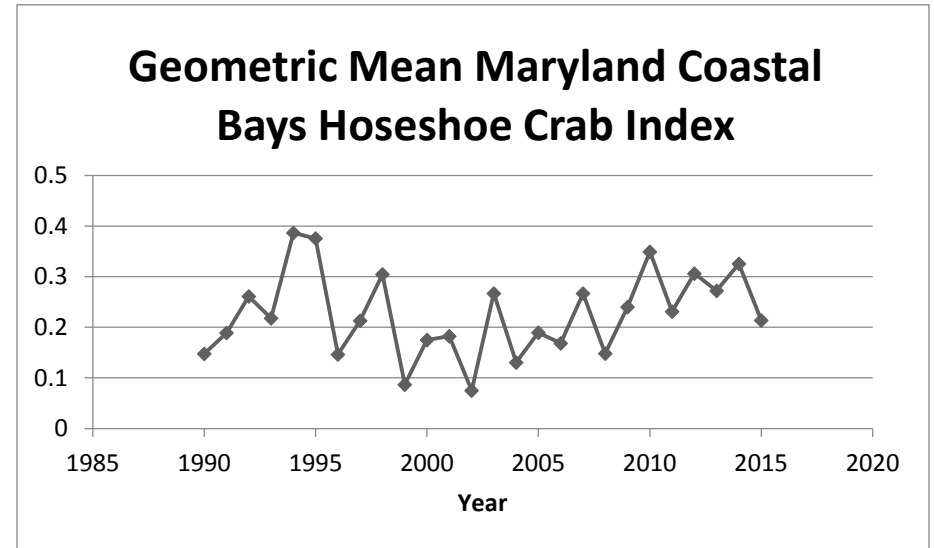
Reductions in Mid-Atlantic harvest quotas, particularly in Delaware Bay, have redirected harvest to the New York and New England fisheries. Localized overharvest within these regions is possible meaning current harvest levels may not be sustainable.<sup>2</sup>

Regional differences in the level of biomedical harvest and mortality are evident.<sup>3</sup> Research in Massachusetts indicates that biomedical related mortality may be double the 15% level used for management.<sup>7</sup> An increase in estimated biomedical mortality would significantly increase the extent of mortality overages, which have occurred annually since 2007. Demand for LAL has increased during this same time period. The ASMFC Plan Review Team recommended that the Management Board consider implementation of additional restrictions on the biomedical industry.<sup>3</sup> A draft addendum to address biomedical mortality is under development.

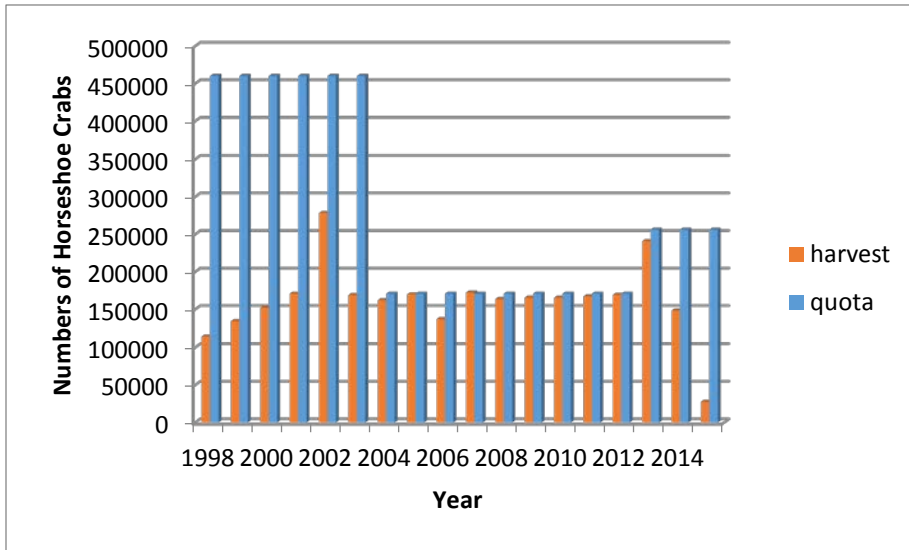
The bait industry has been importing three Asian horseshoe crab species to supply the bait market and take advantage of increased bait prices. Two concerns associated with importation of this non-native species are the introduction of non-native parasites and pathogens; and possible human health risks from the neurotoxin tetrodotoxin found in one of the Asian species.<sup>3</sup> ASMFC approved Resolution 13-01 to ban the import and use of the Asian horseshoe crab as bait (<http://www.asmfc.org/species/horseshoe-crab>) and has encouraged member states to ban importation of Asian horseshoe crabs. Maryland banned the import of Asian horseshoe crabs in 2013.<sup>8</sup>

A substantial number of horseshoe crabs were impinged annually at the water intakes for Calvert Cliffs Nuclear Power Plant.<sup>6</sup> Prior to the 2012 spawn, a horseshoe crab barrier was installed at the water intakes. Impingement was reduced from 1,755 horseshoe crabs in 2011 down to 430 in 2012. Impingement results for 2013 were similar to those for 2012. In 2014 total horseshoe crabs mortality due to impingement was 117 animals. The 2015 data is not yet available.

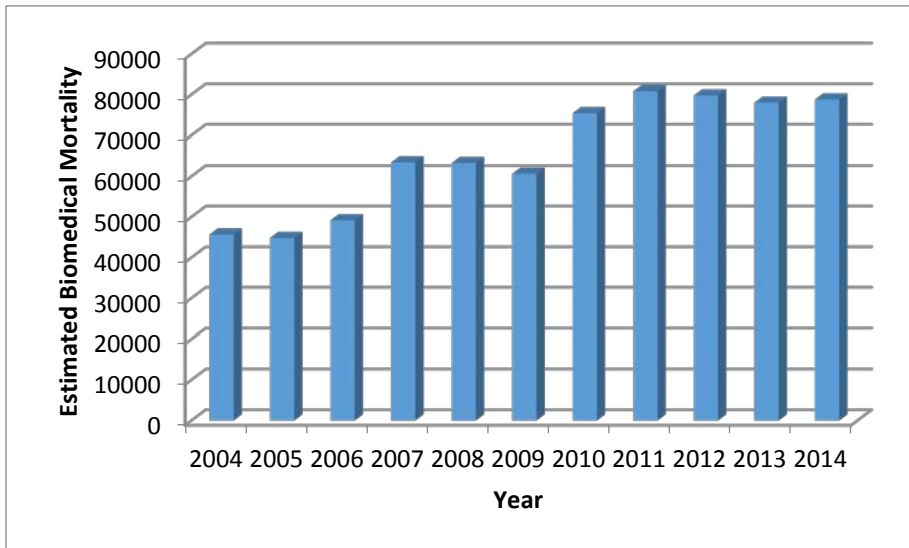
**Figure 1. Geometric mean catch of horseshoe crabs per trawl from the Maryland Coastal Bays Trawl Survey: 1990 – 2015.<sup>6</sup>**



**Figure 2. Maryland’s commercial horseshoe crab landings and quota: 1998-2015.**<sup>6</sup> The 2013-2015 quota was restricted to male horseshoe crabs.



**Figure 3. Estimated mortalities of horseshoe crabs bled for the biomedical industry: 2004-2014.**<sup>3</sup> The 2015 mortality estimate was not available at the time of this report. Mortality does not include crabs returned to the bait industry. Threshold is 57,500.



## References

- <sup>1</sup> Federal Register /Vol. 78, No. 189 /Monday, September 30, 2013 / Proposed Rules. Endangered and Threatened Wildlife and Plants; Proposed Threatened Status for the Rufa Red Knot (*Calidris canutus rufa*). Pp 60024-60098. <http://www.regulations.gov/#!documentDetail;D=FWS-R5-ES-2013-0097-0001>
- <sup>2</sup> ASMFC. 2015. 2015 review of the Atlantic States Marine Fisheries Commission fishery management plan for horseshoe crab (*Limulus polyphemus*): 2014 fishing year. Atlantic States Marine Fisheries Commission, Alexandria, VA.
- <sup>3</sup> ASMFC. 2013. Horseshoe crab stock assessment update. Atlantic States Marine Fisheries Commission, Washington, DC. August 2013.
- <sup>4</sup> ASMFC. 2009. Horseshoe crab stock assessment for peer review. Stock Assessment Report No. 09-02 (Supplement A). Atlantic States Marine Fisheries Commission, Washington, DC.
- <sup>4</sup> ASMFC. 2010. 2010 review of the fishery management plan in 2009 for horseshoe crab (*Limulus polyphemus*). Atlantic States Marine Fisheries Commission, Alexandria, VA.
- <sup>5</sup> ASMFC. 2011. 2011 review of the fishery management plan in 2010 for horseshoe crab (*Limulus polyphemus*). Atlantic States Marine Fisheries Commission, Alexandria, VA.
- <sup>6</sup> Doctor, S. 2016. Maryland’s 2015 horseshoe crab (*Limulus polyphemus*) compliance report to the Atlantic States Marine Fisheries Commission. Maryland Department of Natural Resources Fisheries Service, Annapolis, MD.
- <sup>7</sup> Eyler, S., S. Michels, and D. Brzezinski. 2011. 2011 review of the fishery management plan in 2010 for horseshoe crab (*Limulus polyphemus*). Atlantic States Marine Fisheries Commission, Washington, DC.
- <sup>8</sup> Classification of Nonnative Aquatic Organisms. Annotated Code of Maryland § 08.02.19.04 (2013).

**1994 Chesapeake Bay and Atlantic Coast Horseshoe Crab Management Plan Implementation Table** (updated 8/2016)

<b>Problem Area</b>	<b>Action</b>	<b>Date</b>	<b>Comments</b>		
Strategy 1.1 Maryland and Virginia will protect the ecological role of horseshoe crabs by protecting horseshoe crab spawning areas and monitoring harvest.	1.1 Maryland and Virginia will prohibit the hand collection of horseshoe crabs from beaches during the peak time of shorebird migration, May 1-June 7.	1995	MD prohibited hand collection of HSCs between May 1 and June 7.		
		1996	Based on spawning data, MD modified the restriction on hand collection of HSC to between April 1 and June 30 on Monday and Thursday only.		
		1998	Since the CBP Horseshoe Crab FMP was adopted in 1994, coastal ASMFC requirements were adopted in 1998. Jurisdictions comply with all ASMFC HSC harvest restrictions.		
		2001	NMFS established a HSC reserve in federal waters having a 30 mile radius from the mouth of Delaware Bay.		
		2009 Continue	MD COMAR 08.02.10.01.01 states that all persons are prohibited from catching or landing HSCs in state waters from December 1 to June 7, and catching or landing HSCs from the Chesapeake Bay and its tidal tributaries, or within 1 mile of the Atlantic coast or its coastal bays shoreline from June 8 to July 12. Persons can collect crabs Monday thru Friday from July 13 to November 30. There are no recreational catch limits but a person must abide by the seasonal closures and the 25 crab/person/day if he/she doesn't have a permit.		
		Continue	VA Chapter 4 VAC 20-900- restricts hand collection unless a person has a hand harvester license. 5 HSCs/person/day may be harvested for personal use without a license.		
		2006	VA prohibits HSC harvest within 1,000 ft. of mean low water May 1 through June 7.		
		2011	VA implemented a license and permit moratorium. Only commercial fishermen who held a HSC harvest permit prior to May 1, 2011 are eligible to purchase a permit after May 1, 2011.		
		1.2a Maryland will prohibit the scraping, trawling or dredging of horseshoe crabs between May 1 and June 7 within the Chesapeake Bay, coastal bay areas, and 1 mile of the Atlantic Coast.		1995	The time period recommended to prohibit the scraping, trawling, and dredging of HSCs within the Chesapeake Bay, Coastal Bays, and within 1 mile of the Atlantic coast was changed from May 1 and June 7 to April 1 and June 30 based upon MD spawning survey data
				2004	Crabs harvested from the bait industry can be bled by the biomedical industry. These crabs must be returned to the bait harvester after being bled.
2009 Continue	April catch or harvest restriction was added to the spring fishery. MD COMAR 08.02.10.01.01 states that HSCs cannot be caught or landed in MD state waters from December 1 to June 7. This restriction includes a May 1 to June 7 closure. Scientific collection permits (including biomedical bleeding) allow HSC				

**1994 Chesapeake Bay and Atlantic Coast Horseshoe Crab Management Plan Implementation Table** (updated 8/2016)

Problem Area	Action	Date	Comments
		On-going	collection during the fishery closure so long as crabs are released alive within 48 hours to waters where they were caught. HSCs are collected and reared as part of the education outreach program and is a tri-state endeavor.  June 8 to July 10 harvest is allowed 1 mile off Maryland’s Atlantic coast. Harvest is allowed in all tidal waters from July 13 to November 30. Harvest is Monday through Friday and female harvest is prohibited.
	1.2b Virginia will continue its ban on trawling within state waters.	1995	Virginia prohibits the use of trawls in Virginia’s portion of the Territorial Sea.
	1.3 Virginia will prohibit a directed horseshoe crab fishery between May 1 and June 7, continue mandatory reporting in the conch dredge fishery and monitor bycatch of horseshoe crabs.	1995	An ASMFC HSC FMP was adopted in 1998. Since then, additional harvest restrictions have been implemented as needed.
Strategy 2.1 Maryland and Virginia will coordinate with Delaware and begin to develop a spawning stock census of horseshoe crabs that will serve as the basis for determining management recommendations as appropriate.	2.1 Maryland and Virginia will coordinate and implement a horseshoe crab spawning stock census in Chesapeake Bay, coastal bays, and along the Atlantic coast.	1995  2002 Continue  2007 Continue  2008 Continue	An annual spawning stock survey was initiated from 1994 to 2000 in MD. The Delaware spawning survey provides data on assessing the status of the spawning population. MD’s spawning survey is only in the Coastal Bays (not the Chesapeake Bay). The MD Coastal Bays HSC trawl survey has been conducted since 1990.  Maryland Coastal Bays program began a volunteer spawning survey. Public reports of HSC spawning in Chesapeake Bay are kept on file.  Adaptive Resource Management Modeling (ARM) is being used to determine the ecological interaction between HSCs and shorebirds, and the economic and biological value of HSCs to the commercial fishery and the biomedical industry. This approach was formally adopted by ASMFC Addendum VII in 2012. <b>The process will undergo an in-depth review in 2016 and has resulted in the development of an ASMFC addendum.</b>  Biomedical industry is collaborating with USFWS Coast wide Tagging Program for HSC. Annual total coastwide harvest by the biomedical industry is reported and estimated mortality is calculated. The total estimated mortality on biomedical crabs was approximately 78,798 crabs in 2014. <sup>2</sup>
	2.2 Maryland and Virginia will promote and encourage research on horseshoe crab estimates of population abundance, age and size composition, mortality estimates and migration.	Open	Continue to participate in the annual HSC meeting of regional biologists and managers. A University of Maryland Eastern Shore project to determine if a spawning stock survey could be used to provide a statistically significant index of abundance was partially funded. CPUE data is collected from MD’s offshore and coastal bay trawl survey, and blue crab summer trawl survey within the Chesapeake Bay. Sex data is collected from MD’s spawning beach survey. A tagging program was initiated in 1995 to determine migratory patterns, identify stocks, and increase our understanding of the HSCs spawning behavior. USFWS currently directs the effort.

**1994 Chesapeake Bay and Atlantic Coast Horseshoe Crab Management Plan Implementation Table** (updated 8/2016)

Problem Area	Action	Date	Comments
		On-going	ASMFC coastal management actions include a mandatory monitoring program, tagging studies, spawning surveys, and egg surveys.
3.1 Maryland and Virginia will monitor the commercial and medical harvest of horseshoe crabs to improve the quality of data obtained from the commercial fishery.	3.1a Maryland will require horseshoe crab harvesters to provide monthly reports on the size of harvest, area of collection, gear usage, and any other information the Department of Natural Resources deems necessary.	1995 Continue  2000  2004 On-going 2005   2006   2004 Continue  2008  2009 Continue  2010 On-going  2011	Reporting was implemented on January 29 <sup>th</sup> , 1996. Permit system currently required and used to monitor commercial harvest.  ASMFC instituted a 25% reduction in horseshoe crab bait landings using 1995-1997 as the reference period.  MD has implemented additional restrictions based on ASMFC Addendum III. MD landings limited to 170,653 lbs. annually based on 2001 landings. MD began implementing a 1:1 male:female harvest ratio issued by public notice. Saturday and Sunday harvest closure. Limit of 100/person/day with permit 1 mile off Atlantic Coast from Jun 8 to Jul 10. From Jul 13 thru Nov 30 in all waters, harvest is quota on permit or 25/person/day without permit. Permittee's catch limit based on ratio of reported 1996 landings applied to total annual allowable landings for the present year.  ASMFC Addendum IV changed start of harvest closure from May 1 to January 1. This provision was to expire in 2008 but was continued through 2009. All HSC supplied to the bait fishery is included in that states allowable harvest. Biomedical industry will make available all HSC that die prior to live release to the bait fishery.  HSC annual bait fishery quota has been 170,653 HSCs since 2004. Harvest closure was Dec 1 – March 31 and May 1 - June 7. Harvest is allowed >1 mile offshore during April 1 – 30 & June 8 - 30. Harvest is allowed from July 1 – Nov 30 in all MD tidal waters.  MD changed the HSC harvest ratio to 2:1 male:female ratio (issued by public notice).  Biomedical industry is allowed to land male HSCs for bleeding during the May 1 to June 7 harvest closure so long as the crabs are released within 48 hours. Spring harvest closure was extended to include April 30. A “chain of custody” must be documented for every batch of HSCs received.  Harvesters are required to submit monthly catch logs. Commercial harvest reports must be submitted to MDNR Fisheries Service within 10 days after the end of the month being reported after which the report is late.  Harvesters began importing Asian horseshoe crabs for bait market.

1994 Chesapeake Bay and Atlantic Coast Horseshoe Crab Management Plan Implementation Table (updated 8/2016)			
Problem Area	Action	Date	Comments
		2013	Maryland banned the importation of Asian horseshoe crabs.
	3.1b Maryland will determine if a special permit to harvest horseshoe crabs is necessary after evaluating the new federal reporting system and the results of the monthly reports	1995	MD requires a special HSC permit to land HSCs.
		2001 On-going	ASMFC allows state-to-state transfer of quotas.
	3.2 Virginia will continue their mandatory reporting procedures implemented in January 1993.	1993 Continue	Reporting was implemented in January of 1993. VA has a commercial quota based on coastal reference period.
		2000	ASMFC instituted a 25% reduction in horseshoe crab bait landings using 1995 to 1997 as the reference period.
2006		ASMFC Addendum IV changed the start of harvest closure from May 1 to January 1 through 2008. It required that Virginia trawl harvest not exceed a certain percentage from a specified area and must maintain at least a 2:1 male:female harvest ratio to protect the Delaware stock. Commercial quota is 152,495 HSCs. Quota can be transferred from other jurisdictions with a combined cap.	
		<b>2016</b>	<b>Virginia HSC harvest east of the COLREGS line is 81,331 male crabs.</b>
	3.3 Maryland and Virginia will survey American eel harvesters and their use of horseshoe crabs by sex for bait.	1995	No longer an issue. Both eels and horseshoe crabs are managed through ASMFC coastal FMPs.
		2000	
4.1.1 The jurisdictions will define and protect horseshoe crab spawning areas that are used by migrating shorebirds.	4.1 Maryland and Virginia will initiate a study to delineate the geographic distribution of horseshoe crab spawning habitat in the Chesapeake Bay and coastal bays if funding is available.	Open	A HSC hotline and spawning beach survey was developed in 1994 to delineate spawning habitat in Maryland. The survey is available through the MDNR website. VA has also established a hotline.
		Continue	MD DNR Coastal Bays Program and Worcester County staff have cooperative projects that display shoreline stabilization using soft shoreline designs to create or protect HSC spawning habitat.
	4.2 The jurisdictions will promote research to define the water quality requirements for horseshoe crabs.	2010 Continue	Maryland Coastal Bay volunteer spawning survey began recording temperatures to understand the horseshoe crab spawning behavior in the Maryland Coastal Bays.
	4.3 The jurisdictions will continue to work with the Chesapeake Bay Program, the Coastal Bay Initiative, and water quality improvement goals for the Bay and coastal areas.	Continue	The Chesapeake 2000 agreement commits to improving habitat and water quality for living resources in the Bay. The Comprehensive Coastal Management Plan (CCMP) includes strategies and actions to improve Coastal Bays water quality and habitat conditions.

#### Acronyms

ASMFC- Atlantic States Marine Fisheries Commission  
 CBP - Chesapeake Bay Program  
 COMAR - Code of Maryland Regulations  
 CPUE - Catch per Unit Effort  
 FMP - Fishery Management Plan  
 HSC - Horseshoe Crab

MDNR – Maryland Department of Natural Resources  
 NMFS – National Marine Fisheries Service  
 USFWS - US Fish and Wildlife Service  
 VAC - Code of Virginia





## 2015 Maryland FMP Report (June 2016)

### Section 13. King Mackerel (*Scomberomorus cavalla*) and Spanish Mackerel (*Scomberomorus maculatus*)

Spanish mackerel commercial harvest from the Atlantic Coast increased in 2014 after a 4-year decline from the peak in 2010 (4.3 million lbs.). Recreational harvest and release estimates from the coast decreased in 2014 but were similar to 2011 and 2012 values. Spanish mackerel migrate between Florida and New York and are found in Maryland and Virginia's waters in the warmer summer months. Florida and North Carolina are responsible for most of the commercial and recreational harvest of Spanish mackerel.<sup>1</sup> King mackerel are a coastal pelagic fish that seasonally are found in the lower Chesapeake Bay but are rarely caught in the Maryland. King mackerel and Spanish mackerel are managed under the same plan within the Chesapeake Bay. Based on the South Atlantic coastal stock assessments, neither species is overfished or experiencing overfishing<sup>1,2</sup>

#### Chesapeake and Atlantic Coast FMP

The Chesapeake Bay and Atlantic Coast King and Spanish Mackerel Fishery Management Plan (CBK/SM FMP) was adopted in 1994. The plan follows the coastal management requirements. The CBK/SM FMP was reviewed in 2014 and was determined to be an appropriate framework for managing mackerel in Maryland. The two species are managed jointly under the Atlantic States Marine Fisheries Commission's (ASMFC) 1990 FMP for Spanish Mackerel and the federal Coastal Migratory Pelagics (CMP) FMP adopted in 1983 by the South Atlantic Fishery Management Council (SAFMC). Since 1985, amendments have been adopted by the SAFMC making changes to the allocation of commercial quotas, changes to at-sea transfer rules and changes that increase the total allowable catch of Spanish mackerel. Framework Amendment 2 has been finalized and went into effect in August, 2015. Amendment 2 establishes a trip limit in the southern zones; but will not affect Maryland or Virginia. Amendment 26 is in progress and will update catch limits, boundaries, commercial quotas by zone, and bag limit allowances. For specific details on each of the amendments, go to: <http://www.safmc.net/Library/CoastalMigratoryPelagicsmackerel>. Atlantic coastal states comply with the provisions of the 1990 Spanish Mackerel ASMFC FMP, Omnibus Amendment 1 (2011) and Addendum I to the Omnibus Amendment (2013) by implementing creel limits, size limits and seasonal closures that closely mirror the SAFMC CMP FMP requirements. To view ASMFC FMP documents, go to: <http://www.asmfc.org/species/spanish-mackerel>.

#### Stock Status

There is no formal stock assessment for either mackerel species in the Chesapeake Bay. A stock assessment conducted by the Southeast Data, Assessment, and Review Process (SEDAR 28) in 2012 (revised in 2013) concluded that the Spanish mackerel

Atlantic stock is not overfished and overfishing is not occurring. The coastal stock was overfished in the 1980's and early 1990's, which led to harvest control regulations and a rebuilding of the depleted stocks. Management measures have been successful at rebuilding the Spanish mackerel stock. The ratio of biomass to Bmsy has been increasing.<sup>3</sup> A stock assessment for the Atlantic king mackerel migratory group was completed in 2014 (SEDAR 38) and concluded that the stock is not overfished and overfishing is not occurring. However, there is some concern over low recruitment and possible northward shifts in distribution.<sup>2</sup>

#### Current Management Measures

The coastal annual catch limit (ACL) for Spanish mackerel was set at 6.063 million pounds under CMP Framework Amendment 1 to the federal FMP (2014). Fifty-five percent of the ACL is allocated to the coastal commercial fishery and 45% to the coastal recreational fishery. The commercial portion of the ACL was further divided with 19.9% going to the northern fishing area and 80.1% to the southern fishing area (Amendment 20b, 2014). The north-south split occurs at the SC-NC border. King mackerel are also managed under an ACL with an annual commercial quota. Although the Atlantic king mackerel management area extends to the mid-Atlantic region, the SAFMC is responsible for providing management oversight on catch and bag limits for the recreational fishery and catch, gear and seasonal limits for the commercial fishery.

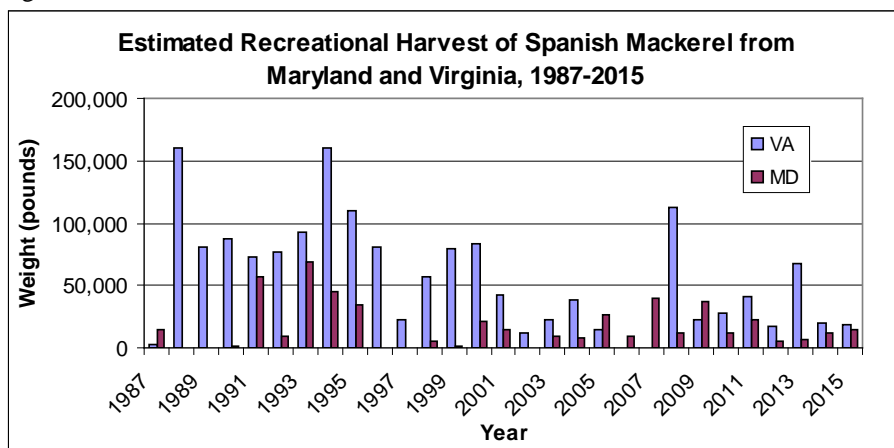
The Chesapeake Bay jurisdictions manage Spanish mackerel through size and creel limits as well as closures consistent with federal management measures. All states from New York to Florida implemented the requirements of the 2011 Omnibus Amendment for Spanish mackerel, Spot and Spotted Seatrout. Maryland and Virginia require a 14" minimum total length limit with a creel limit of 15 Spanish mackerel for recreational fishermen and a 3,500 pound per trip limit for commercial fishermen. The king mackerel size limit is 27" in Virginia with a creel limit of 3 fish for recreational fishermen in Virginia. Maryland has not developed regulations for king mackerel because they are rarely encountered in Maryland state waters. Commercial harvest reporting is required. Cull panels are used to reduce bycatch from pound nets set in the Potomac River by the Potomac River Fisheries Commission (PRFC). PRFC regulations for both species mirror those of Maryland.

Following public hearings, ASMFC approved an omnibus amendment for spot, seatrout and Spanish mackerel in August, 2011. The amendment includes an update to the coastal plan and includes commercial and recreational management measures and recommendations, adaptive management options, *de minimis* thresholds and exemptions, monitoring recommendations and requires each jurisdiction to submit an implementation plan and annual compliance report.<sup>4,5</sup> The amendment also requires recreational fishermen to land their catch with the head and fins intact. Maryland changed its regulations in 2012 to comply with the omnibus amendment.

## The Fisheries

In most years, the estimated recreational harvest of Spanish mackerel is greater in Virginia than in Maryland (Figure 1). Catch estimates in the recreational fishery are imprecise with proportional standard errors in excess of 50 for most years in both Maryland and Virginia. In all years, commercial landings of Spanish mackerel from Virginia waters greatly exceeded those from Maryland (Figure 2). Annual recreational landing estimates for king mackerel have been highly variable for both states, ranging from zero to 137,300 pounds in Virginia and zero to 47,000 pounds in Maryland.<sup>6</sup> Over the past ten years, annual commercial landings for king mackerel have ranged from zero to 511 pounds in Virginia and zero to 249 pounds in Maryland.<sup>2</sup>

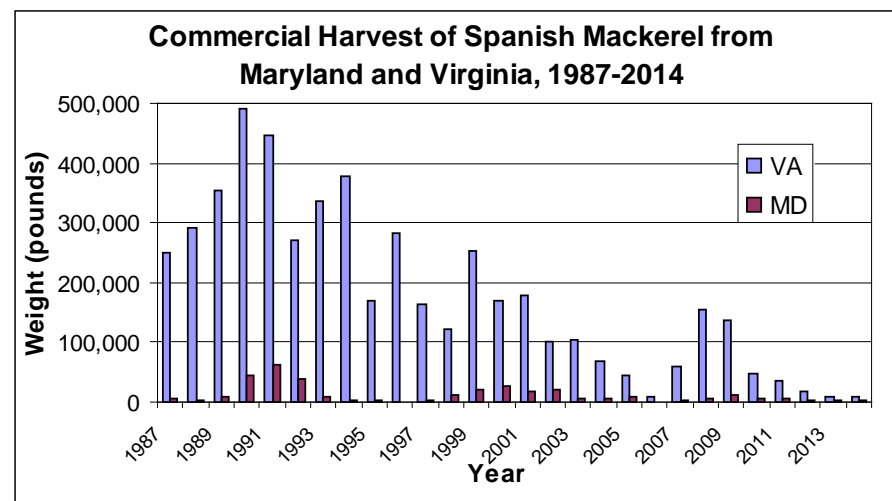
Figure 1.



### Issues/Concerns

The 2014 Review of the ASMFC FMP for Spanish mackerel recommended additional research and monitoring. High priority recommendations included collecting basic fisheries data for better stock assessment accuracy; developing methods for fishery-independent monitoring; determining better estimates of recruitment, natural and fishing mortality rates and stock size; and implementing ecosystem-based management.

Figure 2.



### References

- <sup>1</sup> Atlantic States Marine Fisheries Commission. 2015. Review of the Atlantic States Marine Fisheries Commission Fishery Management Plan for Spanish mackerel (*Scomberomorus maculatus*). Arlington, Virginia.
- <sup>2</sup> SEDAR. 2014. SEDAR 38 - South Atlantic King Mackerel Stock Assessment Report; SEDAR, North Charleston, SC. 501pp. available online at: [http://sedarweb.org/docs/sar/SEDAR\\_38\\_SA\\_SAR.pdf](http://sedarweb.org/docs/sar/SEDAR_38_SA_SAR.pdf)
- <sup>3</sup> SEDAR. 2012. SEDAR 28 – South Atlantic Spanish mackerel Stock Assessment Report. SEDAR, North Charleston SC. 444 pp. available online at: [http://www.sefsc.noaa.gov/sedar/Sedar\\_Workshops.jsp?WorkshopNum=28](http://www.sefsc.noaa.gov/sedar/Sedar_Workshops.jsp?WorkshopNum=28)
- <sup>4</sup> 2012. Rickabaugh, H.W. Jr. Maryland's Plan for Implementing Requirements Pertaining to Spanish Mackerel within ASMFC's Omnibus Amendment for Spot, Spotted Seatrout, and Spanish Mackerel.
- <sup>5</sup> 2015. Messer, K.M. Maryland Spanish Mackerel (*Scomberomorus maculatus*) Compliance Report to the Atlantic States Marine Fisheries Commission – 2014. May, 2016.
- <sup>6</sup> Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division, Marine Recreational Information Program May 3, 2016.
- <sup>7</sup> Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division, commercial harvest query May 3, 2016.

**1994 Chesapeake and Atlantic Coast King and Spanish Mackerel Management Plan Implementation Table (update 06/16)**

<b>Section</b>	<b>Action</b>	<b>Date</b>	<b>Comments</b>
Stock Status	Action 1.1.1 A) Virginia will enforce a 14" TL minimum size limit and a 10 fish/person/day bag limit for Spanish mackerel.	1991 Continue	Minimum size and creel limits in place. Creel limit increased to 15 fish/person/day. VA implemented a 3,500 pound commercial limit in 2012. Spanish mackerel must be landed with head and fins intact.
	Action 1.1.1 B) Maryland will enforce a 14" TL minimum size limit for both the recreational and commercial fisheries and a 10 fish/person/day bag limit for Spanish mackerel.	1993 Continue	Minimum size and creel limits in place. Creel limit increased to 15 fish/person/day. MD has a commercial limit of 3,500 pounds Spanish mackerel per vessel per day. MD implemented a 3500 pound commercial limit in 2012. Spanish mackerel must be landed with head and fins intact.
	Action 1.1.2 A) Virginia will enforce a 5 fish/person/day bag limit for king mackerel.	1991 Continue	Minimum size and creel limits in place. Creel limit reduced to 3 fish/person/day.
	Action 1.1.2 B) Maryland will enforce a 5 fish/person/day bag limit for king mackerel.		MD has not developed regulations for king mackerel since most of the catch is outside state waters. Fishermen must abide by the limits imposed in the EEZ.
	Action 1.1.3. Virginia and Maryland will enforce a 20" FL or 23" TL minimum size limit for king mackerel.		Minimum size limit of 27" established in VA.
	Action 1.1.4. Virginia and Maryland will close their respective commercial and recreational fisheries for king and Spanish mackerel when such closures are in effect in Federal waters.	1995	Closures will be in compliance with South Atlantic Fishery Management Council (SAFMC) recommendations.
Monitoring catch and quotas, and research needs.	Action 2.1.1. Virginia and Maryland will require mandatory reporting of commercial landings	Continue	Both states are in compliance with reporting requirements.
	Action 2.1.2. Virginia and Maryland will supplement the Marine Recreational Statistics Program. MD will require charter boat logbooks.	Continue	Coastal charter boat logbook system was improved in 1994. Improvements in estimating recreational harvest are in progress under the NOAA Marine Recreational Information Program (MRIP)

<b>1994 Chesapeake and Atlantic Coast King and Spanish Mackerel Management Plan Implementation Table (update 06/16)</b>			
<b>Section</b>	<b>Action</b>	<b>Date</b>	<b>Comments</b>
	Action 2.1.3. Jurisdictions will support stock assessment research for mackerel stocks.	Continue	VA samples Spanish mackerel for length and weight. The ASMFC omnibus amendment was approved in 2011 and was implemented July 1, 2012. The amendment includes monitoring and management recommendations. The most recent stock assessment for the south Atlantic stock of Spanish mackerel was completed in December of 2012 and revised in 2013. A new King Mackerel Stock Assessment Report was completed in August 2014 for South Atlantic and Gulf of Mexico.
Waste/sublegal bycatch and hook and release mortalities	Action 3.1.1. Virginia will evaluate the use of escape panels as a means of reducing undersized bycatch. VA will enforce a 2 7/8" minimum mesh size for gill nets.	Completed	VA conducted studies on escape panels in pound nets and found they were successful at reducing bycatch.
	Action 3.1.2. Jurisdictions will support angler educational programs.	Continue	In 2008, Project FishSmart was organized by UMCES to develop a process for developing a consensus position on fisheries management options by a stakeholder group comprised of biologists, environmental organizations, tackle shop owners, charter boat operators, anglers, commercial fishermen, and tournament organizers. The pilot project species was King Mackerel and the goal of the project was to prevent overfishing and preserve a year-round fishery, with recommendations being adopted Nov 7, 2008. A report was submitted to the South Atlantic Fishery Management Council that recommended three options for consideration (UMCES, 2008), which were in its public scoping document. No new efforts have been focused on mackerel but the Bay jurisdictions continue angler education whenever possible.
	Action 3.1.3. Virginia will monitor bycatch sold as crab bait from the pound net and haul seine fisheries.	1995	

<b>1994 Chesapeake and Atlantic Coast King and Spanish Mackerel Management Plan Implementation Table (update 06/16)</b>			
<b>Section</b>	<b>Action</b>	<b>Date</b>	<b>Comments</b>
Habitat Issues	Action 4.1.1. Jurisdictions will continue to work with the Chesapeake Bay Programs, the Coastal Bays initiative, and water quality improvement goals for the Bay and coastal areas.	Continue          <b>2015</b>	The CBP completed a Chesapeake Bay Watershed Agreement in 2014, which sets new goals and outcomes for restoration and protection of the Chesapeake Bay and its watershed. A copy of the agreement can be found on the CBP website at <a href="http://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignatures-Hires.pdf">http://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignatures-Hires.pdf</a> The Agreement has fish habitat, forage fish, SAV and water quality outcomes that when reached will enhance habitat and prey availability for adult Spanish mackerel. <b>During 2015, bay jurisdictions developed two-year (2016-2017) work plans for each outcome.</b>

Acronyms:

ACL = Annual Catch Limit

ASMFC = Atlantic States Marine Fisheries Commission

CMP = Coastal Migratory Pelagics

CBP = Chesapeake Bay Program

EEZ = Exclusive Economic Zone

PRFC = Potomac River Fisheries Commission

SAFMC = South Atlantic Fisheries Management Council

SEDAR = South East Data, Assessment, and Review Process

UMCES = University of Maryland Center for Environmental Studies

## 2015 Maryland FMP Report (September 2016)

### Section 14. Eastern Oyster (*Crassostrea virginica*)

Oyster biomass in the Maryland portion of Chesapeake Bay has declined slightly since last year, a result of recent declines in recruitment and an increase in harvest. The biomass index for 2015 was the third highest in the 26 year time series, reflecting strong survivorship of the 2010 and 2012 year classes. Both MSX and dermo disease levels increased since last year, but both diseases remain below long-term average levels. The 2015 baywide spatfall index, a measure of reproductive success and an index of potential population increase, was 34.2 spat/bushel: 50% higher than the 31-year median value and three times as high as last year's value.

Maryland remains committed to restoring five oyster tributaries. Oyster restoration reached a milestone in 2015 with the completion of initial reef construction and seeding in Harris Creek. The Harris Creek effort is the largest oyster restoration project ever attempted in the U.S. Work continues in the Little Choptank River and the Tred Avon River, Maryland's other active tributaries. Of note in the Tred Avon River, was the construction of 16 acres of seeded habitat in 2016. Eight acres of oyster reef under the U.S. Army Corps of Engineers (USACE) was placed on hold at the request of the Maryland Department of Natural Resources (MDNR) pending the release of a 5 year review report of the sanctuary program.<sup>1</sup> Based upon favorable results in the report and a supportive recommendation by the Maryland Oyster Advisory Commission (OAC), the MDNR Secretary asked the USACE to resume the project. Two remaining restoration tributaries are slated for selection in 2017. The selections will be based on recommendations by the OAC and public input.

#### Chesapeake Bay Oyster Management

The Chesapeake Bay Oyster Management Plan was adopted in 1989 and revised in 1994 and 2004. The 2004 management plan provides both a general framework and specific guidance for implementing a strategic, coordinated, multi-partner management effort for oysters in the Bay.<sup>2</sup> The management plan defines several strategies for rebuilding and managing native oyster populations: evaluating the use of sanctuaries and harvest reserves to obtain optimum ecological and economic benefits; rebuilding habitat; managing harvest; increasing hatchery production; evaluating the impediments to aquaculture; improving coordination among the oyster partners; and developing a bay-wide database to track restoration projects. The 2004 management plan was reviewed and amended in 2010. Amendment 1 to the management plan allows aquaculture and clamming within sanctuaries, the use of new enforcement measures to protect sanctuary areas, and the implementation of sanitation guidelines.<sup>3</sup> The Plan Review Team concluded that the framework for managing oysters was still appropriate but that the strategies and actions had changed considerably because of the Maryland 10-point Oyster Restoration and Aquaculture Development Plan. The 10-point plan increased the network of oyster sanctuaries from 9% of available habitat to 24%, identified areas for oyster

aquaculture with a streamlined permitting process, and recommended a more targeted, scientifically managed, sustainable public fishery. The sanctuary expansion leaves 176,035 acres of natural oyster bar available for the public oyster fishery. Based on these initiatives, the Plan Review Team recommended a complete revision of the management plan. Revision of the plan is on hold, however, until the Maryland OAC has a chance to review the department's July 2016. The report assessed sanctuaries, public shellfish fishery areas, and aquaculture program.<sup>1</sup> The OAC is in the process reviewing the report and is expected to make recommendations to the MDNR on adjustments to sanctuary and public fishery areas. The Maryland OAC was established in 2007 and new commissioners were appointed in 2016. The Secretary of MDNR assigned the OAC three tasks: to recommend whether or not to proceed with oyster restoration in the Tred Avon River, to recommend two additional tributaries for large-scale oyster restoration, and to suggest adjustments to oyster sanctuary and public fishery areas if warranted.

An oyster workgroup established by the Sustainable Fisheries Goal Implementation Team of the Chesapeake Bay Program in 2010, developed quantitative oyster restoration metrics, defined sampling protocols, and provided assessment techniques for sanctuary reefs. The group completed a consensus document (December 2011) describing a minimum suite of goals and metrics.<sup>4</sup> A restored oyster reef should have a minimum of 15 oysters and 15 grams of biomass per square meter covering at least 30% of the reef with at least two year classes of oysters on each reef.<sup>2</sup>

In 2014, the Chesapeake Bay Program adopted the Chesapeake Watershed Agreement.<sup>5</sup> Since then, a management strategy and a biennial work plan (2016-17) were completed that detail necessary actions to reach the oyster outcome: the restoration of oyster reefs in 10 tributaries by 2025.<sup>6</sup> To date, six tributaries have been selected for oyster restoration, Harris Creek, the Little Choptank River and Tred Avon River in Maryland and the Lynnhaven, Lafayette and Piankatank Rivers in Virginia. The restoration projects are a joint effort among the state agencies (MDNR and VMRC)\*, federal agencies (NOAA, USACE)\*, non-profit organizations (ORP, NFWF, TNC, and CBF)\*, and consulting scientists (University of Maryland, VIMS, SERC, and Morgan State University)\*. Both Maryland and Virginia are in the process of determining the next tributaries for restoration. The Maryland OAC will be providing input on the two next tributaries for restoration in Maryland during 2017.

#### Stock Status

Based on harvest reports and the DNR dredge survey data, the oyster population has improved over the past few years. The 2015 Maryland oyster biomass index (a measure of relative oyster abundance and weight) dipped slightly from the two previous year's record highs, which had more than doubled the 2010 Index (Figure 1). Nonetheless, the 2015 biomass index value of 1.77 was the third highest of the 26-year time series, reflecting the high oyster survivorship over the past few years,

particularly the strong 2010 and 2012 year classes. The slight decline was the result of mediocre spat sets over the past three years and an increase in harvesting activity. The 2015 spatfall index, a measure of reproductive success and an index of potential population increase, was 34.2 spat/bushel, 50% higher than the 31-year median value and three times as high as last year's value.<sup>7</sup> Most of this gain occurred in southern Maryland where the north shore of the lower Potomac River experienced the best spat set in nearly a third of a century. However, spatfall generally was average to poor up-bay from Solomons, with large expanses of the upper and middle Bay and the upper Potomac River receiving no spat whatsoever (Figure 2). By comparison, the lower Potomac River received its highest spat set in 33 years. The Potomac River Fisheries Commission (PRFC) closed this area to harvest to protect the spat. To mitigate the loss of harvest opportunity, several hand-tong areas in the upper Potomac were opened to hand-scraping. The protected areas will reopen for the 2016-2017 season and the upper Potomac areas will revert to hand-tong only. Production of oyster larvae and spat by the hatchery at the University of Maryland's Center for Environmental Science (UMCES), Horn Point, remained high with 945 million spat and 3.6 billion larvae produced in 2015.

Two oyster parasites, *Perkinsus marinus* (dermo) and *Haplosporidium nelsoni* (MSX) impact oyster survival and population growth. The distribution and abundance of both diseases are influenced by environmental factors, especially temperature and salinity, and can vary from year to year. During 2015, the prevalence (percentage of oysters with the disease) of dermo disease was 61% (lower than the 31-year average) with a mean infection intensity of 2.1 (a value close to average). MSX continued at low levels (2015 prevalence 7%), mainly as a result of lower salinities unfavorable to the disease. As a result, total natural oyster mortality (including disease-related mortality) during 2015 was relatively low at 14%.<sup>7</sup>

Stock assessment methodology studies were conducted in 2009-2010.<sup>8</sup> The studies included a spatial analysis to determine the appropriate scale for oyster population processes and the development of two oyster stock assessment models. The models were fitted to harvest data from the fishery and relative density data from the fall dredge survey. The models estimated mortality rates and abundance. Both approaches found a substantial decrease in oyster abundance during the study periods. Recommendations were made to improve data collection from the fishery and the fall survey. MDNR has addressed some of the recommendations by requiring more accurate harvest data (catch & effort). For the fall survey, the number of bars where all oysters in a sample were measured was expanded to approximately 30% of the sample locations.

In 2016, the Maryland General Assembly passed the Sustainable Oyster Population and Fishery Act, requiring the MDNR, in conjunction with the UMCES, to conduct a stock assessment and develop biological reference points for management of the oyster fishery. Maryland DNR has begun coordination with the UMCES in this endeavor.

## Current Management Measures

There are three concurrent approaches to managing oysters in the Chesapeake Bay: ecological restoration; a sustainable public fishery; and aquaculture. Ecological restoration will meet the goal of the Chesapeake Bay Program's Watershed Agreement (2014) to restore oysters to 10 tributaries by 2025 (5 each in Maryland and Virginia). Harris Creek was selected as Maryland's first restoration area. Initial restoration efforts (reef construction and seeding or seeding only on suitable bottom) in Harris Creek were completed in 2015 with 350.9 acres planted with oyster seed or substrate with oyster seed. Three years after planting, the first 12 reefs to be restored within the creek all meet the minimum restoration density of 15 oysters/m<sup>2</sup> over 30% of the reef area.<sup>9</sup> The Little Choptank River was selected as Maryland's second priority area for targeted oyster restoration with a goal of 440 acres. As of 2015, 127.5 acres of reef have been constructed in the Little Choptank River and initial restoration is complete on 45.8 acres. The Tred Avon has been selected as Maryland's third area for oyster restoration with a goal of 147 acres. As of 2015, USACE has constructed 16 acres of reef and initial restoration efforts (substrate and seed) are complete on 2.6 acres. After a delay in restoration efforts to await the results of the oyster review (July 2016), the USACE will resume the construction of oyster reefs in the Tred Avon in 2016.

Maryland's oyster harvest has been approximately 100,000 bushels annually since 2002. Historically, the annual harvest averaged 2.5 million bushels (1920-1969) and 1.3 million bushels (1970-2002) (Figure 3). The preliminary harvest estimate for the 2015-2016 season is 383,090 bushels, similar to last season's harvest. The relatively higher harvest is due to strong recruitment in 2010 and 2012. Harvest season, workday and workweek lengths, regional gear restrictions, a 3" cull size, and daily catch limits by gear type are enforced for the public fishery. MDNR began implementing a procedure for tagging each container (bushel) of oysters during the 2011-2012 oyster season. Tagging procedures follow the requirements of the National Shellfish Sanitation Program to protect human health by allowing any contaminated shellfish to be traced to a specific harvest area.

Oyster legislation passed in 2011 included the expansion of lease areas, authority for MDNR to revoke commercial licenses for poaching violations, transfer of the Seafood Marketing and Aquaculture Program from the Department of Agriculture to the DNR, and a requirement for the Department of Environment to use the most reliable data to determine whether shellfish production areas pose risks to consumer health. A \$2.2 million financial assistance program was established to aid watermen in aquaculture endeavors. An aquaculture training and education program is also underway. The program includes a series of training publications and the sponsorship of two statewide aquaculture conferences. Through a partnership with ORP, MDNR provides field support for in-the-water activities of oyster aquaculture production. MDNR has implemented an electronic notification system for

leaseholders. Beginning in 2013, leaseholders were required to submit monthly harvest reports. Oyster aquaculture continues to expand in Maryland. In 2015, 62 lease applications were received and 56 leases were issued. As of July 31, 2016, there were 386 leases totaling 6,062 acres in use for growing shellfish. The preliminary harvest estimate from leases in 2015 was 50,637 bushels. The preliminary harvest estimate from leases from January 1 through July 31, 2016 is 41,292 bushels.

In February 2016, Virginia began moving toward a limited-entry fishery by freezing the number of Oyster All Gear User Fee holders. If an oyster harvester does not renew the Oyster Resource User Fee in a particular year, it will be lost. Transfers are allowed between direct family members as well as any oyster harvester that has 40 days of harvest the previous calendar year. Once the number of fee holders drops to 600, there will be a lottery for any open spots in the fishery.

The PRFC has instituted a cooperative aquaculture program where those who pay a fee may harvest oysters planted on a managed reserve. In 2015, the program planted 3,960 bushels of triploid spat on 11 acres. Watermen harvested 1,641 bushels of market-sized triploid oysters from a 5 acre reserve planted earlier.

### **Citizen Involvement**

The Marylanders Grow Oysters (<http://www.oysters.maryland.gov>) program engages waterfront property owners in growing young oysters in cages suspended from private piers. The young oysters are protected during their first year and then planted on local sanctuaries. The program has planted about 8 million oysters in sanctuaries since it began in 2008, and has grown from about 850 cages the first year to over 7,500 cages in 2015. The program includes approximately 3,000 growers on 31 tributaries. Additionally, over 2,000 school students through educational programs are involved in oyster gardening as part of their curriculum.

### **Issues/Concerns**

A major issue for oyster recovery is the continued degradation and loss of habitat. It has been estimated, but not definitively confirmed, that approximately 70% of oyster habitat has been lost from 1980 to 2009.<sup>10</sup> A healthy and robust oyster resource in the bay relies on appropriate substrate for the setting of young oysters. The preferred substrate, natural oyster shell, is scarce; there is not enough fresh shell to meet the needs of the public fishery, aquaculture, and restoration. Currently, MDNR directs most fresh shell to the Horn Point hatchery because in most areas of the bay it is more cost effective to put the fresh shell with spat attached on the bottom rather than relying on natural spat set.

The shortage of shells has led to the use of alternative substrates to restore oyster reefs. In 2013 and 2014, MDNR used 90,127 cubic yards of fossil oyster shell from Florida and 133,471 cubic yards of Maryland stone to construct oyster reefs in Harris Creek and the Little Choptank River. To encourage recycling of oyster shells, the ORP has developed the Shell Recycling Alliance, a group of 300 restaurant owners, caterers, seafood distributors and citizens, as a mechanism for collecting shells for habitat and seed. Since the inception of the program in 2010, 90,000 MD bushels of shell have been recycled with an additional 26,005 bushels in 2015. Since July 2013, residents and businesses can receive a tax credit per bushel of recycled oyster shell up to \$750 per year. This year MDNR applied for an application to dredge shell from Man O' War Shoal to acquire shell for enhancement of oyster habitat. A decision from USACE is pending.

The increase in sanctuary areas and aquaculture activities require additional law enforcement. Natural Resources Police (NRP) are using the Maritime Law Enforcement Information Network (MLEIN). The network is a system of cameras and radar units that can monitor vessel location and movements. Although this system was primarily intended to provide homeland security and assistance to distressed boaters, it allows NRP to gather and store evidence of illegal activity, especially in sanctuary areas. MLEIN has resulted in more arrests and more convictions of poachers than in previous years. An improved penalty system has resulted in license suspensions and revocations.

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**\*Acronyms**

- CBF – Chesapeake Bay Foundation
- MDNR – Maryland Department of Natural Resources
- MLEIN – Maritime Law Enforcement Information Network
- NFWF – National Fish and Wildlife Foundation
- NOAA – National Oceanic and Atmospheric Administration
- NRP – Natural Resources Police
- OAC – Oyster Advisory Commission
- ORP – Oyster Recovery Partnership
- PRFC – Potomac River Fisheries Commission
- SERC – Smithsonian Environmental Research Center
- TNC – The Nature Conservancy
- UMCES – University of Maryland Center for Environmental Science
- USACE – U. S. Army Corps of Engineers
- VIMS – Virginia Institute of Marine Science
- VMRC – Virginia Marine Resources Commission

Figure 1. Maryland oyster biomass index, a measure of relative oyster abundance and weight, 1993 - 2015. Values are relative to 1993 biomass, which was set at a value of 1.<sup>7</sup>

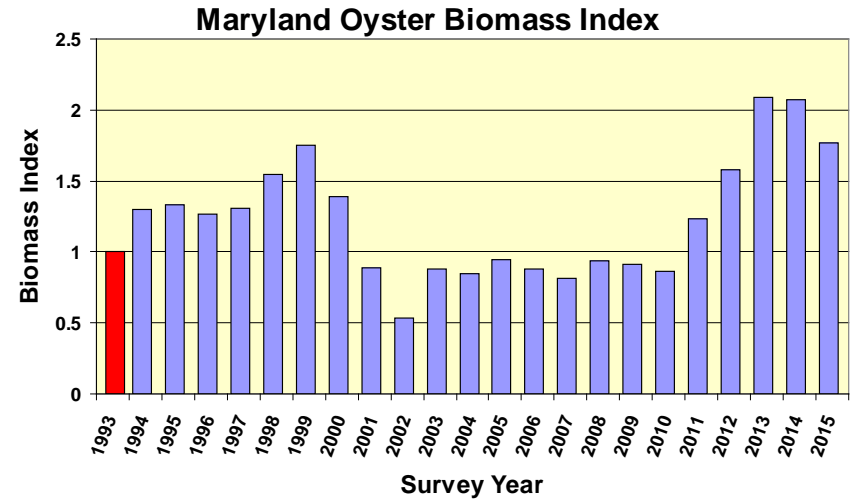


Figure 2. Maryland spatfall intensity index (spat per bushel) from "key bars" including rankings of statistically similar indices, 1985-2015 (MDNR Fall Survey Report, 2015). The statistical tiers provide an indication of the extent and contribution of spat from different geographic areas. To illustrate: although the 1997 spat index was the second highest index on record and an order of magnitude higher than other Tier 3 indices, it was a Tier 3 level because only 5 out of 53 key bars accounted for over 75% of the index.<sup>7</sup>

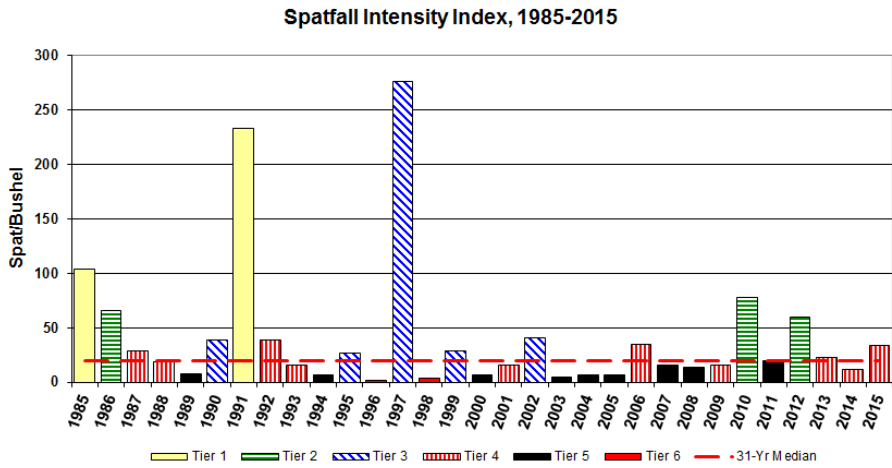
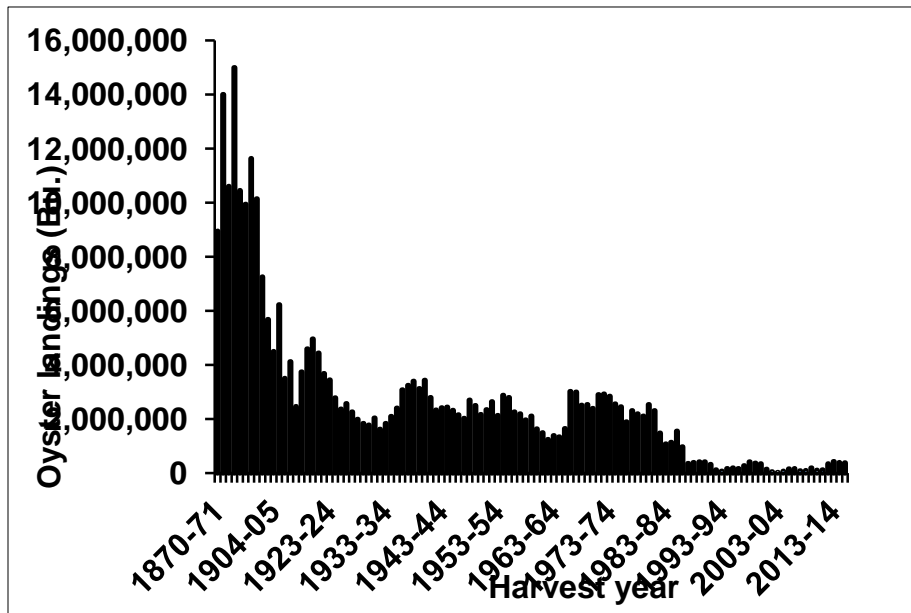


Figure 3. Maryland commercial oyster harvest, 1870 – 2015.  
Landings data for 2015-2016 are preliminary.



<b>2004 Oyster Management Plan (OMP) Implementation Table</b> (updated 9/2016)			
<b>Section</b>	<b>Action</b>	<b>Date/ Responsible agencies</b>	<b>Comments</b>
Disease Strategy 3.1A. Utilize disease management in all aspects of restoration & harvest to minimize spreading disease  3.1B. Develop & implement disease strategies within each of the 3 designated salinity zones.	3.1 Conduct an analysis of how disease management might affect overall survival and productivity. Answer the following question: What management strategies will help increase biomass over a large scale and in the long-term?	Continue Univ. of MD, VIMS, MDNR, and VMRC.	Modeling and assessment frameworks were utilized through the PEIS process to evaluate the benefits of disease management strategies. They included developing and testing of disease tolerant strains for aquaculture; implementing geographically distinct, large-scale oyster restoration (VIMS/NOAA funding); and producing disease-free spat on shell (ORP/UMCES). Scientific research results indicate the need for a cautionary approach to using disease resistant strains for restoration (see Action 6.3.1). Maryland has adopted a new approach for managing against oyster disease. Maryland will use a targeted restoration approach to facilitate the evolution of natural disease resistance, while managing against the spread of disease. Sanctuaries located in areas with salinities >14 ppt will encourage the development of disease resistance through natural selection. <b>However, the supply of larvae from low-salinity disease refuges may slow the development of disease resistance.</b>
	3.2 Increase hatchery production to supplement natural recruitment and mitigate the prevalence of <i>P.marinus</i> (refer to Chapter VI Hatchery Production for additional details)	Continue Univ. of MD, VIMS, MDNR, aquaculture industry	Additional State and Federal funding has resulted in an increase in hatchery production from 38 million spat in 2000 to over 1.2 billion in 2013. Over the years hatchery production has increased: 750 million spat (2009); ~450 million spat (2010); over 600 million spat (2011); over 800 million spat (2012), 1.2 billion spat (2013), and 972 million spat (2014). <b>The hatchery produced 945 million spat in 2015.</b> Production is dependent on spawning success in the hatcheries, availability of cultch, and long-term funding to operate the hatcheries at full capacity. VIMS started an Oyster Aquaculture Training program to provide skilled technicians in oyster husbandry for both hatchery and field operations. ORP has supported UMCES hatchery infrastructure and capacity (MDNR/NOAA funding).
	3.3 Establish broodstock sanctuaries in heavily infected areas to possibly produce disease resistant seed. (See Chapter IV Sanctuaries for more details).	Open MDNR, VMRC, ORP, VA Corps	Sanctuaries have been established in a variety of areas throughout the Bay to produce self-sustaining populations of oysters. <b>Sanctuary areas were evaluated in 2016 and the Maryland Oyster Advisory Commission is formulating recommendations on changes to sanctuary areas.</b>
	3.4 Develop, implement and maintain a seed policy to reduce and minimize disease impacts.	2004 2007 Continuing	MDNR developed a new policy with additional restrictions, however, beginning in 2007 no seed was available to move and very little was moved in 2008 & 2009 to the present. VIMS has a long standing advisory to the state (VMRC) against moving diseased seed. Both MD & VA have oyster advisory committees to provide advice on seed policy issues as they arise.

	<p>3.5 Implement oyster surveys as necessary to obtain the best estimates of oyster population data: a) Increase the frequency &amp; spatial intensity of sampling; b) Seek additional funding.</p>	<p>On-going</p>	<p>MDNR funded a project (UMCES) to develop spatially-explicit assessment tools for the oyster stock in Chesapeake Bay. The project evaluated current data collection, recommended improvements to data collection and evaluated the feasibility of including environmental factors into assessment models. Maryland has addressed some of the recommendations by requiring more accurate harvest data and increasing the number of fall survey samples in which all oysters are measured. DNR/ MGS &amp; NOAA are continuing to coordinate field operations to characterize benthic habitat. DNR is surveying oyster sanctuaries to obtain population estimates. <b>In 2016 the Maryland General Assembly passed the Sustainable Oyster Population and Fishery Act, requiring MDNR, in conjunction with the UMCES, to conduct a stock assessment develop biological reference points for management of the oyster fishery. MDNR and UMCES have begun coordination on this endeavor.</b></p>
<p>Sanctuaries Strategy 4.1 A network of clearly marked oyster sanctuaries will be established throughout the Chesapeake Bay and its tributaries</p> <p>Strategy 4.2. Utilize the steps outlined in the OMP for establishing oyster sanctuaries throughout the bay.</p>	<p>4.2.1 Decisions on where to locate sanctuaries will be guided by the Virginia Oyster Restoration Plan developed by VIMS and VMRC and Maryland's Priority Restoration Areas developed by MDNR and the Maryland Oyster Roundtable Steering Committee. The maps will be used as a preliminary tool to focus restoration activities (The MD Oyster Roundtable has been replaced by the Oyster Advisory Commission)</p>	<p>2004 2009 On-going</p>	<p>MDNR supported a study to determine the best productive oyster bars within Maryland and used the results to develop a 10 point Oyster Restoration and Aquaculture Development Plan. Based on this study, new sanctuaries were established in 2010. <b>The Maryland OAC will recommend changes to the Maryland sanctuaries based on a 2016 review of sanctuary performance.</b> Six tributaries have been selected for oyster restoration, Harris Creek, the Little Choptank River and Tred Avon River in Maryland and the Lynnhaven, Lafayette and Piankatank Rivers in Virginia. <b>Initial restoration has been completed in Harris Creek and continues in the remaining five tributaries. The Maryland OAC is in the process of recommending two additional tributaries for restoration.</b></p>
	<p>4.2.2 Utilize existing protocols &amp; standard operating procedures for recording or charting GPS coordinates for oyster sanctuaries in order to verify locations and track restoration progress.</p>	<p>Beginning in 2005 2008/2009 On-going</p>	<p>Protocols have been developed to delineate and mark sanctuary areas. Bay jurisdictions continue to track restoration progress. <b>Maryland oyster sanctuaries are marked with buoys; locations are shown on maps provided to watermen. Restoration progress is tracked using a geo-database.</b></p>
	<p>4.2.3 Evaluate the use of alternative cultch material because all restoration efforts depend on the availability of suitable habitat and traditional shell dredging cannot support the scale of the current &amp; future sanctuary initiative.</p>	<p>On-going</p>	<p>A study on alternative cultch material in MD was conducted in various salinities &amp; the report is on file with MDNR. VIMS and the USACE released a report on the effectiveness of alternative materials (2006). The function of alternative substrates is to provide a firm base for a constructed oyster bar. Alternate materials to replace natural oyster shell can be expensive. MDNR used Florida fossil shell to construct reefs in Harris Creek and Little Choptank River. The shell performed well both as a substrate for natural settlement and as a platform for spat on shell. <b>MDNR has applied for a permit to dredge shell from Man o' War Shoal and is awaiting a decision from the USACE.</b></p>

	4.2.4 Develop and implement techniques to locate and recover buried shell or shell with layers of sedimentation using vacuuming, bar cleaning or other innovative methods.	2005 2009 On-going	MD obtained a permit for a reclamation program that will provide up to 25 million bushels of shell. The MDNR/MGS and NCBO bottom survey program provided information to prioritize areas and facilitated decisions on shell reclamation techniques. In 2012, 550,850 bushels of previously-planted shells were reclaimed; 370,900 bushels were placed on fishery bars and 179,950 bushels were purchased by leaseholders. ORP started a Shell Recycling Alliance and collected approximately 15,000 bushels of shell in 2012. Beginning in 2013, a tax credit up to \$750 is allowed for recycling oyster shell.
	4.2.5 Increase hatchery production to support restoration needs. Current seed levels are too low to effectively stock sanctuaries (see Chapter VI Hatchery and Aquaculture).	2005	See comment for Action 3.2. The question of what is an effective quantity of hatchery seed in sanctuaries is unknown.
	4.2.6 Monitor areas to evaluate oyster population status and measure progress towards the commitment to increase oyster biomass by 10-fold.	On-going MDNR, VIMS	<b>The 2015 estimate of Maryland oyster biomass was down slightly from the previous two years, but still the third highest in the 26 year time series and 77% greater than the 1993 baseline.</b> Maryland's biomass estimate is based on the annual fall survey data and an estimate of available oyster habitat. Documentation for MD's methodology for calculating biomass estimates is available in the PEIS. There is a need to improve the data, especially the habitat estimates that support the biomass calculations. <b>MGS and NOAA are using sonar to refine habitat estimates.</b> Criteria for determining a restored oyster reef were adopted in 2011. Jurisdictions are focusing on restoring targeted tributaries, Harris Creek, Little Choptank River and Tred Avon River (MD) and the Lynnhaven, Lafayette and Piankatank Rivers (VA). <b>The first reefs constructed and seeded in Harris Creek meet the minimum density goal of 15 oysters/m<sup>2</sup> over 30% of the bottom.</b>
Sanctuaries (cont'd) Strategy 4.3 Management actions within sanctuaries are primarily based on salinity zones and focus on three key factors: growth, reproduction and disease. The zonal approach to management provides general guidelines for selecting project objectives and anticipating project results in each area	Strategy 4.3.A: Zone 1 (5ppt to <12ppt) Increase biomass & enhance reef habitat. Enhance reef/ bottom habitat to increase oyster biomass and promote the development of living oyster reefs with broad size/age class structure that supports a diverse reef community  Action 4.3.A.1 Identify priority areas in Zone 1 that would have the most success at reaching the defined project objectives  Action 4.3.A.2 Rehabilitate and maintain oyster bottom habitat to provide planting substrate for seed oysters and optimal conditions for larval settlement  Action 4.3.A.3 Plant hatchery produced SPF seed, if necessary, over several years to establish an oyster population with a diverse age class structure	2005 <b>On-going</b>	MD is implementing a 10-Point Oyster Restoration Plan that focuses on targeted restoration strategies, expands the sanctuary program, rehabilitates oyster habitat, manages against disease, increases hatchery production, and enhances law enforcement. <b>The first three tributaries chosen for large-scale oyster restoration are located in Zone 2 to balance good reproduction with lower disease pressure.</b>

	<p>Strategy 4.3.B: Zone 2 (12-14ppt) Transition Area: The boundaries of Zone 2 shift because of variations in rainfall and resulting salinity. Consequently, Zone 2 will exhibit fluctuations in spat settlement and disease mortality. Projects in this zone must utilize current environmental data during planning.</p> <p>Action 4.3.B.1 Critically examine long-term environmental conditions and develop relevant project objectives for sanctuaries in Zone 2.</p> <p>Action 4.3.B.2 In the areas that have predominantly Zone 1 characteristics, utilize Zone 1 guidelines and in areas that have predominantly Zone 3 characteristics, utilize Zone 3 guidelines.</p>		
	<p>Strategy 4.3.C (&gt;14ppt) Develop Disease Tolerance: It is not certain that disease resistance can develop via a management approach in Zone 3. The strategy will be to promote the development of disease resistance where disease mortality is high</p> <p>Action 4.3.C.1 Reestablish and maintain bottom habitat for oyster spat settlement and growth of disease resistant adults</p> <p>Action 4.3.C.2 Monitor Zone 3 sanctuaries to determine the effects of disease mortality</p> <p>Action 4.3.C.3 Utilize Zone 3 as an area to test laboratory strains of disease resistant oysters</p> <p>Action 4.3.C.4 Limit the use of natural seed to sanctuaries in Zone 3. The use of natural seed in repletion areas is allowed as long as disease protocols are followed.</p>		
<p>Sanctuaries (cont'd)</p> <p>Strategy 4.4 The jurisdictions will establish oyster sanctuaries to promote maximum ecological value</p>	<p>Action 4.4.1 Identify areas of special interest throughout the Bay, especially areas that may retain larvae (maybe auto-recruiting), and protect them using the sanctuary status</p>	<p><b>On-going</b></p>	<p>The Great Wicomico, Lynnhaven and Lafayette Rivers have been identified as areas of special interest in VA. MD has established sanctuaries based on protecting 25% of the state's most productive areas as identified by an analysis of the annual fall survey data. <b>UMCES developed a model to predict where oyster larvae will be transported throughout Harris Creek and surroundings. This research will help identify locations for restoration activities that may result in larval retention and supply of larvae to areas outside the sanctuary. The USACE Master Plan for Native Oyster Restoration contains estimates of flushing time for many tributaries, a parameter contributing to larval retention.</b></p>
<p>Strategy 4.5 Implement the actions described in chapter III to address disease problems.</p>	<p>Action 4.5.1 Utilize only SPF hatchery seed in sanctuaries designated for oyster biomass accumulation, Zone 1 and Zone 2.</p>	<p>On-going</p>	<p>Two workshops held in 2007 provided guidance on the role of hatchery-based oysters used for restoration. Using domesticated strains has not improved survival or resulted in higher recruitment. Preserving local wild stocks is preferred since data suggest some level of natural disease</p>

In addition, the jurisdictions will take further action to minimize the spread of disease	Action 4.5.2 Place hatchery seed on newly created sanctuary bottom and not on top of infected oyster populations in order to prevent rapid infection of the disease-free seed	On-going	resistance is occurring (VIMS). <b>2015 Maryland dermo disease prevalence was below the long-term average. MSX prevalence increased and the parasite's range expanded up-bay. Although mortality remains low, it is difficult to separate the effects of environmental conditions, especially temperature and salinity, from improved survival due to disease resistance.</b>
	Action 4.5.3 Continue to prohibit the movement of infected oysters from higher salinity waters onto newly or previously created sanctuaries in Zone 1		
Sanctuaries (cont'd) Strategy 4.6 To facilitate the enforcement of closed areas, especially sanctuaries, implement the following actions:	Action 4.6.1 Sanctuaries will be placed in geographically distinct areas with enough space to create a buffer zone between harvest and sanctuary areas to enable enforcement	Began in 2003 and continue	State agencies are responsible for marking sanctuary areas but sanctuaries continue to experience enforcement problems. New enforcement strategies have been developed to address this issue. See strategy 5.4. During 2009, MDNR provided educational materials to the court system and implemented a pilot program in Anne Arundel County to establish a Natural Resource Day in court. This system has proven successful and more than half of Maryland counties attempt to group natural resources cases. MDNR also provided in-service training to NRP officers on all fishery issues especially regarding oysters. The use of MLEIN has led to more arrests and conviction than in previous years. The new penalty system has resulted in license suspensions and revocations. <b>Sanctuaries are marked with buoys and the locations marked in closure books distributed to all watermen.</b>
	Action 4.6.2 Sanctuaries will be buoyed and marked		
	Action 4.6.3 The public and judiciary will be notified about sanctuary areas through educational initiatives, public announcements and stakeholder meetings		
	Action 4.6.4 New enforcement measures will be identified and implemented. Additional manpower will be recommended if necessary		
Managing Harvest Strategy 5.1 Establish sanctuaries & special management areas thereby reducing F & develop appropriate biological reference pts.	Action 5.1.1 Establish a network of sanctuaries (refer to Section 1.IV for details) and special management areas throughout the Bay to limit harvest and increase oyster production	Continue	In 2008 4% of quality oyster habitat was in sanctuary. This area was increased to 9% in 2009. In 2010, the MD 10-pt Plan increased the total area designated as oyster sanctuaries to 24%. The plan allows approximately 176,035 acres of natural oyster bars for the public oyster fishery. <b>The Maryland OAC is currently reviewing the sanctuary and fishery areas and may recommend changes.</b> VA has a combination of 3-dimensional oyster reefs and acreage set aside as sanctuary areas. More than 100 reefs have been constructed throughout VA's portion of the Chesapeake Bay.
	Action 5.1.2 Define appropriate biological reference points for the oyster resource based on the results of the bay wide stock assessment	2007/2008 2010	MD is working on developing BRPs. Wilberg and Miller's (2010) study indicated that exploitation rates have been around 25%. Assessments of oyster populations on specific bars are being conducted. <b>Harvester tagging regulations have yielded data on bar-specific exploitation rates and serve as a check on dealer reports. These data may be used in the development of BRPs. MDNR will be working with UMCES to develop a stock assessment and biological reference points for management of the oyster population.</b>
	Action 5.1.3 Utilize the disease guidelines and actions presented in Section 1.III in all aspects of special management areas and the fishery	2005	Continuing
	Action 5.1.4 Control oyster harvest to reach an appropriate F determined by the Oyster Scientific Committee.	2007/2008	Oyster harvest is controlled through a number of regulations by MDNR & VMRC. If BRPs are determined, a target and threshold F will be defined. <b>Virginia has initiated an effort to reduce the number of oyster harvesters by freezing and then lowering the number of Oyster All Gear User Fee holders. PRFC has instituted a cooperative aquaculture program in which people may pay a fee to harvest oysters planted in a managed reserve.</b>



Strategy 5.2. Develop guidelines for managing fishing effort and monitoring oysters in open and closed areas.	Action 5.2.1 a) Determine the criteria for opening and closing areas; b) Monitor population; c) Determine level of acceptable exploitation; d) Regulate harvest and gear type; e) Develop additional monitoring if necessary; f) Close area when harvest criteria are met.	2005 On-going	Criteria for opening/closing harvest reserves have been developed. The managed reserves are opened to harvest only upon approval by the State and when 50% or more of the oysters are 4" in size. The 4" size limit allows the oysters an additional year to provide ecological services <b>and an extra year to reproduce. Reserves located in sanctuaries were harvested for a final time, with those areas then becoming part of the surrounding sanctuary. All but 2 of the remaining harvest reserves have reverted to the public fishery.</b>
	Action 5.2.2 Utilize the site selection criteria set forth in the OMP to select special management areas (see Section 2 for details).	2005 Continuing	All oyster partners are managing oysters according to the salinity zones specified in section 2. Zone 1 (5-12 ppt) management involves the enhancement of populations by the planting of shell and seed. Zone 3 (>15 ppt) management involves the development of disease-resistant natural populations as well as the maintenance of hard substrate for spat settlement. Zone 2 (12-14 ppt) involves a mixture of these approaches.
	Action 5.2.3 a) MDNR will utilize the ORT STAC to review & make recommendations on where to locate harvest reserve areas; b) VA will utilize their current system to review and make recommendations on open & closed areas.	Continue 2007	The ORT STAC is no longer active. In 2007, MD established an Oyster Advisory Commission (OAC) to develop new strategies for rebuilding and managing the oyster resource. The OAC's recommendations resulted in MD's 10 point oyster management plan. The plan includes increasing the area and number of sanctuaries, encouraging aquaculture, and the support of a more targeted, sustainable, scientifically-managed oyster fishery. <b>The OAC is currently reviewing sanctuary and public fishery areas and may recommend changes.</b>
	Action 5.2.4 Identify and implement regulatory & legislative changes needed for managing open & closed harvest areas.	2006	<b>MDNR opens and closes areas via public notice or the regulatory process, including scoping and public comment. Harvest reserves are opened by public notice.</b> VMRC utilizes the Commission process.
	Action 5.2.5 a) Evaluate how rotating open & closed areas contributes to reproduction, oyster biomass & harvest; b) Based on the harvest reserve biological data, reevaluate the criteria (Action 5.2.1) for opening & closing areas & modify actions as necessary.	2005 On-going	Monitoring is underway and evaluation is on-going. <b>Models are lending insight into the conditions under which rotational harvest is sustainable. Counties will propose rotational harvest schemes to be reviewed by DNR.</b>
Strategy 5.3 a) Follow project guidance criteria specified in section 2 when developing repletion program work plans; b) Maintain the MDNR work plan review process	Action 5.3.1 Modify the MD repletion program through the established ORT Steering & Scientific Committees to reduce and minimize disease impacts: a) Establish criteria to limit and/or restrict seed movement to certain regions depending on environmental conditions & disease levels; b) Avoid transplanting older year classes that have higher levels of disease than young spat; c) Rotate and/or clean seed areas; d) Allow old seed areas to lie fallow and/or be harvested; e) Utilize the disease results from the Fall survey; f) Transplant wild seed as soon as possible.	2004 On-going	MDNR no longer implements a repletion program. <b>Instead, spat-on-shell produced by state hatcheries and private growers are placed on public bars for harvest. The program is funded by industry fees.</b>
	Action 5.3.2 MD will evaluate the effects of the repletion program on oyster population dynamics and habitat; and document how it contributes to an increase in oyster biomass & habitat.	2006	No repletion effort currently in progress.
Strategy 5.4 Strengthen the enforcement of oyster closures in sanctuaries & special management areas.	Action 5.4.1 Evaluate and implement the appropriate enforcement measures.	2005 MNR, VMRC 2010	The MD Natural Resources Police (NRP) has begun to utilize the radar and camera vessel monitoring technology. The system, Maritime Law Enforcement Information Network (MLEIN), is largely a national security tool that has been adapted to aide enforcement of fishery laws.

	Action 5.4.2 Prohibit the culling of oysters while underway to minimize the movement of infected oysters.	On-going MDNR, VMRC	
Hatchery and Aquaculture Considerations Strategy 6.1 Utilize hatchery-produced seed to augment natural reproduction reduce disease effects & increase biomass.	Action 6.1.1 Develop an inter-lab certification program for oyster diseases. Utilize the molecular diagnostic protocols for certifying SPF oyster seed developed by the VIMS Shellfish Pathology Laboratory.	2005	Program was completed and currently used by VIMS, UMCES, and MDNR.
	Action 6.1.2 MD will increase hatchery production of SPF seed to support the 10-fold increase in oyster biomass: a) Increase & maintain as necessary the operating funds for each MD hatchery facility; b) Evaluate & optimize the efficiency of each facility in order to ensure maximum production of spat.	On- going MDNR, ORP, UMD	<b>States are focusing on restoring targeted tributaries: Harris Creek, Little Choptank River, and the Tred Avon River (MD) and the Lynnhaven, Lafayette and Piankatank Rivers (VA). MD hatchery production has increased and spat are being placed in the three MD tributaries.</b> See comments for Action 3.2
	Action 6.1.3 Continue the protocol for certifying and using SPF seed: a) establish standards & refine criteria; b) use only SPF seed in sanctuaries located in Zone 1 (< 12ppt).	Continue VIMS, MDNR, UMD	Implemented and continuing.
	Action 6.1.4 The U.S. Army Corps of Engineers (USACE) will conduct an analysis of hatchery project production in relationship to environmental benefits as part of its long-term restoration planning, and determine whether augmenting or building new hatchery (ies) is warranted	2008 ACOE	The master plan examines and evaluates the problems and opportunities related to oyster restoration and formulates a plan for implementing large-scale bay-wide restoration. This action was expected to be addressed as part of the Native Oyster Master Plan by the USACE. However, the plan establishes guidelines for restoration and not specific actions.
Hatchery and Aquaculture Considerations (cont'd)	Action 6.1.5 Virginia will increase hatchery production of disease resistant seed to support the 10-fold increase in oyster production: a) Increase and maintain as necessary, the operating funds for oyster breeding in Virginia; b) Evaluate the feasibility of a public or a public-private hatchery	Ongoing VMRC, VIMS	VIMS/VMRC conducted a pilot project to promote capacity building of private hatchery and grow-out infrastructures in order to provide oyster spat-on-shell for restoration (NOAA funding FY04 continued in FY06). VIMS is currently training oyster technicians for aquaculture work both in the hatchery and in the field.
	Action 6.1.6 Virginia will develop strategies for effective seeding of reefs and their effects on recruitment, especially in relation to the spread of disease resistance in the wild population.	2005 VMRC, VIMS	VIMS is conducting research on these questions through NOAA funding.
Strategy 6.2 Continue to track the genetic background of broodstocks used in hatcheries for restoration or replenishment activities	No specific actions recommended at this time.	To be determined MDNR, VMRC	There is some concern about reduced genetic variability of selectively bred oysters compared to wild oysters. In 2007, oyster disease experts recommended to discontinue transplanting infected natural seed; to discontinue bar cleaning for disease; to use hatchery-produced seed for augmenting natural stocks; to create sanctuaries and enforce a harvest moratorium; and consider larval dispersal mechanisms when creating oyster sanctuaries.

<p>Strategy 6.3 Develop recommendations for using disease resistant strains of native oysters for restoration. Selectively bred oyster strains should be used for restoration only in areas where native oysters are locally depleted.</p>	<p>Action 6.3.1 Assess and evaluate the use of disease resistant stocks as a tool for increasing disease resistance in the native oyster population in the Bay.</p>	<p>2007</p>	<p>The participants at the 2007 OMP Workshop concluded that the development of alternative strains for use in restoration should not be pursued thereby preserving the natural ability of oysters to develop disease resistance. There was also consensus that domesticated disease-resistant strains were acceptable for aquaculture endeavors.</p>
	<p>Action 6.3.2 Monitor restoration activities to clarify the interaction between selectively bred strains and wild stocks of oysters.</p>	<p>2005 UMCES, ORP, VMRC</p>	<p>Carlsson et al (2008) evaluated the contribution of a selectively bred, domesticated oyster strain to recruitment in the Great Wicomico, Lynnhaven, York, and Elizabeth Rivers from 2002 to 2006. They were unable to detect a significant contribution of the domestic strain to wild-produced spat.</p>
<p>Strategy 6.4 The members of the OMP drafting team will review the MD task force report &amp; recommend changes to the OMP as appropriate regarding aquaculture strategies &amp; actions</p>	<p>Action 6.4.1 Amend the OMP as necessary to incorporate new strategies and actions regarding aquaculture.</p>	<p>2009 2010 Currently on hold</p>	<p>The vision of the new Maryland 10-Point Oyster Plan is “to establish a private aquaculture industry that emerges as a major economic contributor to the State of Maryland while maintaining a more targeted and scientifically managed wild oyster fishery that is sustainable.” Chapter 173 of the Legislative Acts of 2009 passed new aquaculture leasing statutes that completely changes how Maryland regulates, administers, and manages aquaculture and leasing of shellfish. Grants have been secured to help people with start-up and operational costs for new oyster farms. <b>The federal and state permitting processes have been streamlined.</b> The first Aquaculture Enterprise Zone (AEZ) was established by regulation in October 2009 in the Patuxent River near Broomes Island. <b>The AEZ has not yet been permitted by USACE, so leases there are not yet available.</b> Amendment 1 to the OMP was adopted in 2010. The amendment allows aquaculture and clamming activities within the larger, expanded sanctuary (areas closed to shellfish harvest and focused restoration activities) program; the use of new enforcement measures to protect sanctuary areas; and the implementation of sanitation guidelines. During 2010, the OMP was reviewed. The PRT recommended that the plan be revised. <b>Results from Maryland’s 2016 evaluation of sanctuaries, harvest areas, and aquaculture areas will be used to develop any new management strategies and actions.</b></p>
<p>Monitoring and Information Management Strategy 7.1 A) Utilize the results of the oyster stock assessment as an estimate of oyster abundance in the Bay; B) Use the 1994 biomass value as a baseline to track progress towards the 10-fold objective.</p>	<p>Action 7.1.1 Conduct monitoring programs that are consistent in terms of sampling procedure, timing of sampling, types of data collected, and analysis and provide the results to a central database or databases.</p>	<p>Continue</p>	<p>Monitoring programs have been reviewed. UMCES has provided recommendations on how to improve existing fishery-independent and fishery-dependent data collection methodology. MDNR Shellfish Program has taken the recommendations under consideration. <b>The 1993 biomass value is now being used as the baseline for assessment of population change. Bar-specific harvester tagging in conjunction with dealer reporting is leading to improved estimates of exploitation rates. Monitoring protocols for assessing sanctuary restoration success are being developed. In support of a bay-wide stock assessment, a gear calibration study was conducted to compare Virginia’s patent tong sampling to Maryland’s dredge sampling.</b></p>

	Action 7.1.2 Establish a Technical Committee to develop data management guidelines for handling oyster data.	2005	Original committee meeting did not result in specific guidelines.
	Action 7.1.3 Develop and maintain a database to track oyster restoration projects and provide web-based access.	open MDNR, VMRC, NOAA	NOAA compiled an inventory of all oyster restoration project implemented in recent years in both states (2007). NOAA also established a full database of implementation and monitoring data for all oyster restoration projects completed with federal funding, beginning in FY07 and ongoing.
	Action 7.1.4 The Chesapeake Bay Program will conduct an annual oyster symposium		An Oyster Workshop was convened in December 2007. Oyster restoration is a regular agenda topic for the CBP's Sustainable Fisheries Goal Implementation Team. An Oyster Summit is scheduled for February 2016 to provide a forum to discuss oyster issues in the Chesapeake Bay.
	Action 7.1.5 Promote the research recommendations listed in Section 2.	2005 2009	All oyster partners. Research recommendations will be developed during the OMP revision process.

Acronyms:

BRPs = Biological Reference Points  
CBP = Chesapeake Bay Program  
MGS = Maryland Geological Survey  
MDNR = Maryland Department of Natural Resources  
MLEIN = Maritime Law Enforcement Information Network  
NCBO = NOAA Chesapeake Bay Office  
NOAA = National Oceanographic and Atmospheric Administration  
NRP = Natural Resources Police  
OAC = Oyster Advisory Commission  
OMP = Oyster Management Plan  
ORP = Oyster Recovery Partnership  
PEIS = Programmatic Environmental Impact Statement  
PRT= Plan Review Team  
SPF = Specific Pathogen Free  
STAC = Scientific and Technical Advisory Committee  
UMCEES = University of Maryland Center for Environmental & Estuarine Studies  
UMCES = University of Maryland Center for Environmental Studies  
USACE = U.S. Army Corps of Engineers  
VIMS = Virginia Institute of Marine Science  
VMRC = Virginia Marine Resources Commission

## 2015 Maryland FMP Report (June 2016)

### Section 15. Red Drum (*Sciaenops ocellatus*)

A red drum benchmark stock assessment was conducted in 2015, and the population models for the northern and southern regions were deemed appropriate for management use by peer-review in early 2016. The Atlantic States Marine Fisheries Commission's (ASMFC) South Atlantic State/Federal Fisheries Management Board (Board) had some concerns with the stock assessment due to data limitations and life history characteristics of red drum. These concerns will be addressed by the Red Drum Technical Committee so the Board can determine if the stock assessment will be used to advise management of the species.

#### Fishery Management Plans (FMPs)

The Atlantic States Marine Fisheries Commission (ASMFC) adopted a Fishery Management Plan (FMP) in 1984 to protect the red drum spawning stock. The ASMFC adopted Amendment 1 (1991) to the FMP with the goal to attain optimum yield from the fishery over time. Amendment 2 was adopted in 2002 to require states to comply with recreational limits to meet the target fishing mortality. Addendum I (2013) identifies key habitats and habitats of concern for red drum. The coastal FMP management unit is currently defined as states from Florida to New Jersey.

The Chesapeake Bay Red Drum Fishery Management Plan (CBRD FMP) was adopted in 1993 to address overfishing and to follow the ASMFC guidelines. Management measures since 2000 have resulted in reduced fishing mortality. Stock assessment needs, habitat and water quality concerns were also addressed.

#### Stock Status

Status of the red drum stock is derived from the Atlantic coast stock assessment. In the 1980s and 1990s the coastal red drum stock was overfished and management measures were implemented to reduce fishing mortality (F) and rebuild the stock. Two management units were defined: the northern stock (NC to NJ) and the southern stock (FL to SC). The 2009 ASMFC stock assessment found that the stocks were relatively stable, as far as could be determined with data limitations, and that overfishing was likely not occurring.<sup>1</sup> The threshold and target are based on an escapement rate that provide a 30% and 40% static spawning potential ratio (sSPR), respectively. The sSPR is based on female biomass and egg production. An sSPR below 30% indicates that overfishing is occurring. The average sSPR has exceeded the overfishing threshold since 1994 with one exception in 2002 and the northern stock has been above the target since 1996.<sup>2</sup>

In preparation for the 2015 benchmark stock assessment, the Board approved the terms of reference and began coastwide data compilation in 2014. The benchmark

stock assessment was reviewed in 2015 by the Southeast Data, Assessment, and Review (SEDAR). This assessment used a new model to assess coastal red drum stocks. In order to improve upon the previous stock assessment's statistical-catch-at-age (SCA) model (2009) which was hampered by data limitations, the stock assessment subcommittee used the Stock Synthesis 3 model (SS3). At the time of the SEDAR review, the SS3 base run models for the northern and southern regions were still under construction. Therefore, the review focused on how to modify, stabilize, and improve the SS3 models for management use.<sup>3</sup> Following the SEDAR review the Stock Assessment Subcommittee implemented the suggestions of the SEDAR review panel and were successful in producing stable models, completing sensitivity analyses, and exploring retrospective patterns. These final models were seen by a subset of the SEDAR review panel early in 2016, and were deemed appropriate for management use.<sup>4</sup>

There is no formal red drum stock assessment for Chesapeake Bay. In most years, red drum are not frequent visitors to Maryland's portion of the Chesapeake Bay due to lower salinities. More red drum are reported from Virginia waters, where salinities are higher, than are reported in Maryland. Schools of red drum below the minimum and over the maximum size limit may be seen in years of low freshwater flow such as 2012, a year of unusually high catches.

#### Current Management Measures

Red drum are managed through size limits and creel limits in compliance with all current ASMFC FMP requirements. All harvests occur in state waters. Maryland allows recreational fishermen to take 1 fish per day between 18" and 27". Charter boat logs show that anglers in Maryland release most of the red drum they catch.<sup>2</sup> Commercial fishermen in Maryland are allowed 5 fish per day with a slot limit of 18"-25". As of January 1, 2015 Virginia allows a slot limit of 18"-26" and a possession limit of 3 fish per day for recreational fishermen and a slot limit of 18"-25" and a creel limit of 5 fish per day for commercial fishermen. The Potomac River Fisheries Commission (PRFC) has a slot limit of 18"-25" and a possession limit of 5 fish per day for recreational and commercial fishermen. There are no closed seasons for the recreational or commercial fisheries.

#### The Fisheries

The commercial harvest from the Chesapeake Bay has averaged 8,030 lbs. since 2000 (Figure 1). It makes up a rather small proportion (10-20%) of the total commercial catch from the Atlantic coast. The majority of the commercial catch from the Atlantic coast is from North Carolina. Three southern states have given red drum game fish status and prohibit commercial harvest (FL, GA, & SC). Coastal commercial landings have declined since the 1980s.<sup>2</sup>

Red drum are one of the most highly sought recreational species along the southern Atlantic coast. In Maryland's portion of the Chesapeake Bay, red drum are only seasonally available for a relatively short period in late summer to early fall. Consequently, the estimates for recreational total catch from Maryland are low. The total recreational estimates from Virginia can be much higher especially when the estimated number includes red drum that are caught and released because they are below the minimum size limit (Figure 2).

Figure 1. Commercial red drum landings reported to NMFS by Maryland and Virginia: 1982-2014.<sup>6</sup> Maryland's 2015 commercial red drum landings are preliminary<sup>7</sup> and Virginia's 2015 commercial red drum landings are not yet available.

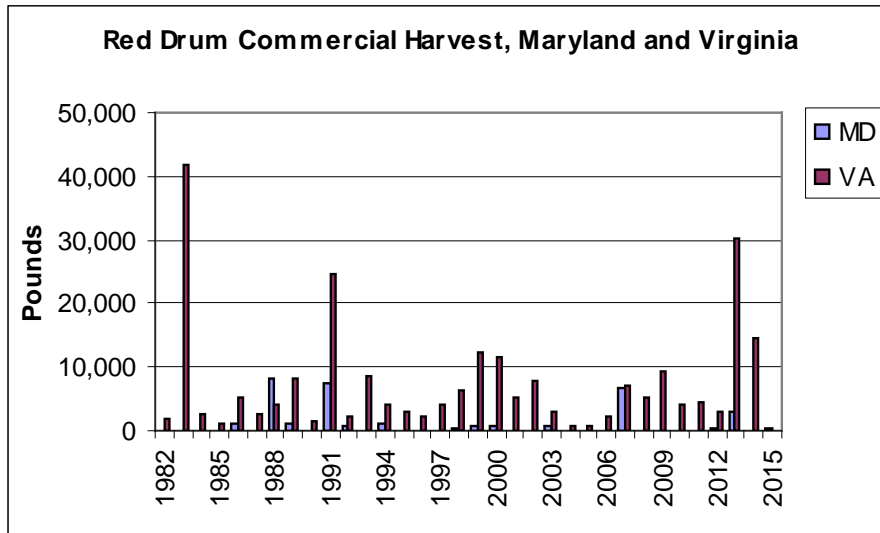
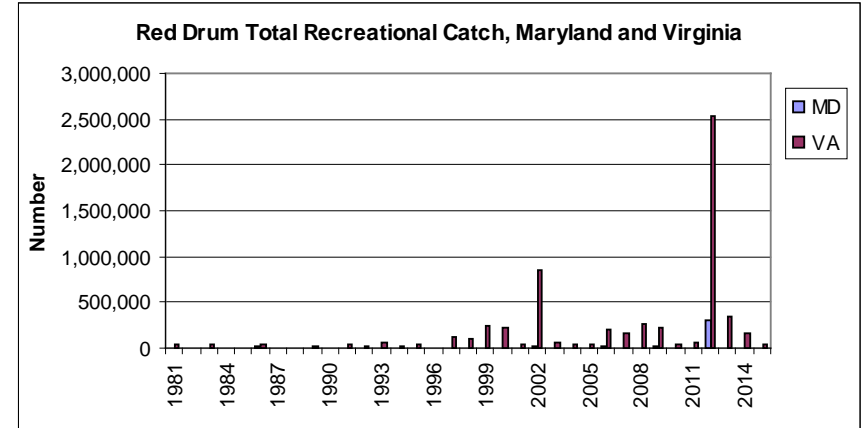


Figure 2. Total recreational red drum MRIP catch estimate for Maryland and Virginia, all modes combined, 1982-2015.<sup>8</sup> (Includes fish caught and released)



### Issues/Concerns

Red drum have been identified by ASMFC as a priority species in need of research. Coastal states are developing a cooperative plan to collect more age/length data to improve stock assessment modeling results particularly for the adult portion of the population. Maryland will continue to monitor commercial pound nets and fish houses and measure red drum when they are encountered.

The Maryland Sport Fisheries Advisory Commission asked the Maryland DNR in 2013 to consider allowing recreational fishermen to take one large red drum. Since red drum are managed by the ASMFC, allowing any harvest of fish over 27 inches would require an amendment to the FMP. Such an amendment is unlikely in the absence of supporting data and increased monitoring.

Submerged aquatic vegetation (SAV) beds are important red drum habitat. Efforts by EPA and state programs to achieve SAV restoration and water clarity goals will continue. In 2013, ASMFC approved Addendum I to Amendment 2 to the Red Drum Fishery Management Plan.<sup>5</sup> Addendum I revised the habitat section to include the most current science on red drum habitat requirements for spawning, egg and larvae, juvenile, subadult, and adult life history stages. Habitat identification and description, habitats of concern, and potential threats to recovery and sustainability were also defined.

## References:

- <sup>1</sup> SEDAR. 2009. SEDAR 18: Stock Assessment Report Atlantic Red Drum. Southeast Data, Assessment, and Review. North Charleston, South Carolina. <http://sedarweb.org/sedar-18>
- <sup>2</sup> 2015 Review of the Atlantic States Marine Fisheries Commission Fishery Management Plan for Red Drum (*Sciaenops ocellatus*) 2014 Fishing Year. 22p.
- <sup>3</sup> SEDAR. 2015. SEDAR 44: Stock Assessment Report Atlantic Red Drum. Southeast Data, Assessment, and Review. North Charleston, South Carolina. <http://sedarweb.org/sedar-44>
- <sup>4</sup> SEDAR. 2015. Addendum II to the SEDAR 44 Red Drum Stock Assessment Report. Southeast Data, Assessment, and Review. North Charleston, South Carolina.
- <sup>5</sup> Addendum I to Amendment 2 to the red drum fishery management plan: *Habitat Needs & Concerns*. Approved August, 2013. 24p
- <sup>6</sup> Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division. June 25, 2015. <http://www.st.nmfs.noaa.gov/commercial-fisheries/index>
- <sup>7</sup> Lipkey, Genine K. 2015. Maryland Red Drum (*Sciaenops ocellatus*) Compliance Report to the Atlantic States Marine Fisheries Commission – 2014. Maryland Department of Natural Resources, Fisheries Service, June 2015. 6p.
- <sup>8</sup> Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division. June 25, 2015. <http://www.st.nmfs.noaa.gov/st1/recreational/index.html>
- <sup>9</sup> Chesapeake Bay Program. Submerged Aquatic Vegetation (SAV) Outcome Justification. [http://www.chesapeakebay.net/publications/title/submerged\\_aquatic\\_vegetation\\_sav\\_outcome\\_justification](http://www.chesapeakebay.net/publications/title/submerged_aquatic_vegetation_sav_outcome_justification)
- <sup>10</sup> SAV in Chesapeake Bay and Coastal Bays. VIMS William & Mary Virginia Institute of Marine Sciences. [http://web.vims.edu/bio/sav/sav12/exec\\_summary.html](http://web.vims.edu/bio/sav/sav12/exec_summary.html)

<b>1993 Chesapeake Bay and Atlantic Coast Red Drum Management Plan Implementation Table (updated 6/16)</b>			
<b>Section</b>	<b>Action</b>	<b>Date</b>	<b>Comments</b>
1. Overfishing	1.1.1 Virginia will continue to enforce a 5 fish creel limit and an 18 inch minimum size limit with one fish over 27in in the recreational fishery.	1992 Modified in 2003          Modified in 2015 Continue	In compliance with coastal recommendations. VA has adopted a slot limit and now allows harvest of 18-26" red drum. A new possession limit of 3 fish has been adopted for both recreational and commercial harvest. The 2009 peer reviewed ASMFC stock assessment found the resource to be relatively stable with overfishing not occurring. Next coastal stock assessment is scheduled for 2015.  <b>Effective January 1, 2015, VA will allow recreational fishermen 3 fish per day between 18"-26" and commercial fishermen 5 fish per day between 18"-25".</b>
	1.1.2 Maryland and the PRFC will implement a 5 fish creel limit and an 18 in minimum size limit with one fish over 27in in the recreational fishery	1994 Modified in 2003 Continue	In compliance with coastal recommendations. MD has a recreational size limit for red drum of 18-27" and a commercial size limit of 18-25". The possession limit is 1 fish/day for the recreational fishery and 5 fish/day for the commercial fishery. PRFC has a size limit of 18-25" and a possession limit of 5 fish for both recreational and commercial harvest.
	1.2a Jurisdictions will investigate the potential for using bycatch reduction devices in nonselective fisheries	1992 Continue	The bycatch of immature red drum has not been a problem in Chesapeake Bay fisheries because small fish are infrequently encountered. Bycatch reduction devices that are currently in place should increase the escapement of juvenile red drum.
	1.2b Virginia and Maryland will work with the South Atlantic Fishery Management Council (SAFMC) and ASMFC to develop and require more efficient gear to reduce bycatch and/or discards.	1992 Continue	MD and VA appointed representatives to the ASMFC/SAFMC Red Drum Advisory Panel. MD and VA have representatives on the ASMFC technical committee. MD does not currently have a representative on the Red Drum Advisory Panel.



<b>1993 Chesapeake Bay and Atlantic Coast Red Drum Management Plan Implementation Table (updated 6/16)</b>			
<b>Section</b>	<b>Action</b>	<b>Date</b>	<b>Comments</b>
2. Stock Assessment and Research Needs	2.1 Jurisdictions will support fecundity research and tagging studies to determine movements of juvenile red drum and develop juvenile indices. Maryland and Virginia will continue the Baywide trawl survey of estuarine finfish species and crabs.	1993 Continue	The VA red drum tagging program is ongoing. The tagging program includes a fishery independent study and a volunteer recreational study. Tag recapture data indicates a southward, late fall migration of juvenile red drum out of the Bay and along the Virginia coast. Future tag returns should provide information about the movements of these fish upon reaching sexual maturity. The Chesapeake Bay Multispecies Monitoring and Assessment Program (ChesMMAP) continues but the collection of red drum is not sufficient to guide any stock assessment. The Maryland Shoal Water (blue crab) Trawl Survey continues (data for fish and crabs). ASMFC has recommended that all states implement a tagging program for red drum. ASMFC has continued to facilitate standardized ageing protocols and consistency among laboratories.
	2.2 VMRC Stock Assessment Program will continue to collect biological data from commercial catches of red drum	1993 Ongoing	There is little fishery dependent information on larger, reproductive red drum and limited fishery-independent information (ASMFC). The large adults are primarily found offshore where fishing for red drum is prohibited.
	2.3a Jurisdictions will continue collecting commercial fisheries statistics.	Continue	Maryland's Chesapeake Bay red drum harvest remains insignificant, although the 2013 harvest was the largest since 2007. Virginia's commercial fishery reported 30,150 pounds of red drum harvested in 2013, the largest since 1983. <b>Preliminary commercial landings for 2015 are 298 lbs. (MD)</b> <sup>7</sup>
	2.3b Virginia will implement a limited and/or delayed entry program and a mandatory reporting system for commercial licenses.	1993 Continue	Implemented in January 1993.

<b>1993 Chesapeake Bay and Atlantic Coast Red Drum Management Plan Implementation Table</b> (updated 6/16)			
<b>Section</b>	<b>Action</b>	<b>Date</b>	<b>Comments</b>
	2.3c Virginia and Maryland will continue to supplement the Marine Recreational Statistics Program	Continue	<p>In 2014, VA anglers received citations for 925 red drum over 46" in length that were caught and released which represented 18% of all tournament entries.</p> <p><b>MD anglers submitted 18 red drum in 2014 and 9 red drum in 2015 to the catch and release tournament award citation program. MD charter boat logs reported 16 red drum caught in 2015, 2 of which were harvested.</b></p> <p>The Marine Recreational Information Program (MRIP) has replaced MRFSS with refined estimates of recreational harvest and total catch. <b>Proportional standard errors (PSE) have dropped below 50 in the past four years for VA, indicating that recreational red drum harvest estimates were more precise in VA's waters, the same is not true for MD.</b></p>
	2.3d Maryland will continue a sampling program using pound nets and trawls.	Continue	<p>Maryland conducts fishery dependent sampling from pound nets in the Chesapeake Bay. Twenty-one red drum were sampled in 2008 (mean 361mm TL, range 237-541mm TL). None were collected in 2009 and 2010 and only two were collected and released in 2011.<sup>8</sup> In 2012, biologists sampled 458 red drum from pound nets; of this total, 455 were under the 18" minimum TL and 3 were over the 25" maximum TL size limit. <b>No red drum were encountered by this survey in 2015.</b></p>

1993 Chesapeake Bay and Atlantic Coast Red Drum Management Plan Implementation Table (updated 6/16)			
Section	Action	Date	Comments
3. Habitat Issues	3.1 Jurisdictions will continue to set specific objectives for water quality goals and review management programs established under the Chesapeake 2000 agreement	Continue	<p>New water quality and SAV goals were adopted by the Chesapeake Bay Program signatory states in 2014 as part of the new Chesapeake Watershed Agreement, for more information a summary of the agreement can be viewed at the following link <a href="http://www.chesapeakebay.net/documents/ChesapeakeBayWatershedAgreementFINAL.pdf">http://www.chesapeakebay.net/documents/ChesapeakeBayWatershedAgreementFINAL.pdf</a></p> <p>SAV beds are important red drum habitat. A 21% overall decrease in SAV acreage was calculated in 2012 from areas mapped in both 2011 and 2012. The largest SAV declines were noted for upper and middle Chesapeake Bay. Among Chesapeake Bay sites, only the Potomac River and middle James River locations showed any increases from 2011 to 2012. <b>In 2015, there were an estimated 91,621 acres of SAVs in the Chesapeake Bay. This estimate surpasses the 2017 restoration target, and puts progress ahead of schedule to meet the 185,000 acre SAV restoration goal. The next target is 130,000 acres by 2025.</b><sup>9</sup></p> <p>The Delmarva Peninsula Coastal Bays (Assawoman, Isle of Wight, Sinepuxent, Chicoteague and Southern VA Coastal Bays) declined 8% from 13,455 acres in 2011 to 12,326 acres in 2012<sup>10</sup>. The 2013 SAV estimate was 10,872 acres. Due to turbid conditions in 2014 not all regions could be mapped and only partial totals were reported.</p>

Acronyms:

ASMFC = Atlantic States Marine Fisheries Commission  
 Board = South Atlantic State/Federal Fisheries Management Board  
 CBRD FMP = Chesapeake Bay Red Drum Fisheries Management Plan  
 EPA = US Environmental Protection Agency  
 F = fishing mortality  
 FMP = Fishery Management Plan

SAV = Submerged Aquatic Vegetation  
 SAFMC = South Atlantic Fisheries Management Council  
 SCA = Statistical Catch at Age  
 SEDAR = Southeast Data Assessment and Review

MRFSS = Marine Recreational Fisheries Statistics Survey  
MRIP = Marine Recreational Information Program  
NMFS = National Marine Fisheries Service  
PFRC = Potomac River Fisheries Commission

SS3 = Stock Synthesis 3  
sSPR = static spawning potential ratio  
VIMS = Virginia Institute of Marine Science  
VMRC = Virginia Marine Resource Commission

## 2015 Maryland FMP Report (August 2016)

### Section 16. Scup (*Stenotomus chrysops*)

A coastwide assessment of the scup stock along the Atlantic Coast was completed in 2015. Relative to new biological reference points, the scup stock is not overfished and overfishing is not occurring (based on data through 2014). Current estimates of increased stock abundance are attributed to low fishing mortality (F) and higher levels of recruitment over the last twenty years.<sup>1</sup> Scup commercial harvest in Maryland was minimal and highly variable from the late 1960's through 2012 compared to other Atlantic Coast states. Commercial scup landings from the Maryland winter trawl fishery have been increasing in recent years, although preliminary estimates for 2015 indicate a decrease in landings. Scup are rarely caught by recreational anglers in Maryland offshore or inshore. However, scup is a major recreational fishery along the northeastern Atlantic coast.

#### Fishery Management Plans (FMPs)

No Chesapeake Bay Program fishery management plan (FMP) has been developed for scup. The Maryland Department of Natural Resources' authority to manage scup as a species in need of conservation was established in 1994.<sup>2</sup>

Scup are jointly managed by the Atlantic States Marine Fisheries Commission (ASMFC) and the Mid-Atlantic Fishery Management Council (MAFMC). The ASMFC manages scup fisheries in state waters (out to three miles) while the MAFMC manages scup fisheries in federal waters (3-200 miles offshore). Scup were incorporated into the ASMFC and MAFMC summer flounder FMPs in 1996. Since then, a series of amendments and addenda have been implemented to modify management measures.

ASMFC Addendum IV (2001) established procedures that simplified, clarified, and expedited the setting and implementation of fishery specifications. Addendum V (2002) established state-specific quota for the summer fishery. Addenda III (2001), VII (2002), IX (2003), XI (2004), and XIII (2004) implemented catch and minimum size limits

for recreational fisheries. Addendum XVI (2005) established measures to ensure prompt implementation of compliance requirements. Addendum XX (2009) clarified the procedures for state-to-state quota transfers. The MAFMC established an initial overfishing definition with Amendment 12 in 1999. In 2007, the MAFMC established a rebuilding plan with Amendment 14, established annual catch limits and accountability measures with Amendment 15 (2011), and modified the measures with Amendment 19 (2014). Several frameworks (addenda) have been implemented since 1996. Amendment 17 (2015) was approved by the MAFMC to comply with the standardized bycatch reporting methodology (SBRM) requirements of the Magnuson-Stevens Act. The amendment (1) explains the methods and processes by which bycatch is currently monitored and assessed for Greater Atlantic Region fisheries; (2) determines whether these methods and processes need to be modified and/or supplemented; (3) establishes standards of precision for bycatch estimation for all Greater Atlantic Region fisheries; and (4) documents the SBRMs established for all fisheries managed through the FMPs of the Greater Atlantic Region.<sup>3</sup>

#### Stock Status

The Scup Benchmark Stock Assessment Report was completed in August 2015. The ASMFC 2015 scup stock assessment determined scup are not overfished and overfishing is not occurring relative to the revised biological reference points (BRPs) and data through 2014.<sup>1</sup> The fishing mortality rate (F) was estimated to be 0.049, below the fishing mortality threshold reference point = FMSY = F40% = 0.177. Spawning Stock Biomass (SSB) was estimated to be 219,066 metric tons (MT) = 483 million lbs., above the biomass target reference point = SSBMSY = SSB40% = 92,044 MT = 203 million lbs.<sup>1</sup> New reference points were defined in the assessment and can be found at: <http://www.asmfc.org/uploads/file/55d238fb2015ScupBenchmarkStockAssessment.pdf>

## Current Management Measures

The ASMFC/MAFMC determine an annual Acceptable Biological Catch (ABC) that is divided into an Annual Catch Limit (ACL) for the commercial and recreational fisheries (includes harvest and discards). The majority of coastwide scup harvest is allocated to the commercial fishery (78%). The remaining 22% of harvest is allocated to the recreational fishery.<sup>1</sup> Maryland's commercial fishery is open all year with a minimum size limit of 9" in state waters and 9" in federal waters.<sup>4</sup> All commercial harvesters in federal waters must have a federal permit.

The annual coastwide commercial quota is divided among three fishing seasons: January-April (Winter I = 45%), May-October (Summer = 39%), and November- December (Winter II = 16%). Winter fisheries are managed with trip limits. Winter I is 50,000 pounds per trip until 80% of quota is caught at which point it will drop to 1,000 pounds per trip.<sup>5</sup> Winter II landings were set at 18,000 pounds per trip.<sup>6</sup> The summer fishery in state waters is managed by quota; Maryland's allocation is 0.012%.<sup>7,8</sup> There are no state quotas for federal waters. Fishing gear mesh size and escape panel regulations have been implemented for the commercial fishery.

Recreational harvest regulations differ between state and federal waters. In Maryland and states south of Delaware, the minimum size limit is 8" with a possession limit of 50 fish per person per day.<sup>6</sup> In 2015, scup limits were 50 fish per day with a 9" size limit in federal waters.

## The Fisheries

In Maryland, the commercial scup harvest occurs in winter as part of the mixed black sea bass/scup/summer flounder fishery. Scup are primarily harvested by trawl, although juveniles are often caught in black sea bass pots. Scup harvest can be highly variable among years (Figure 1). Commercial scup harvest was 54,200 pounds in 2011; 8,260 pounds in 2012; 315,400 pounds in 2013, 527,953 pounds in 2014 and 25,869 pounds in 2015 (Figure 1).<sup>9</sup> However, available

commercial scup landings are limited because some of the data are confidential. The increase in harvest in 2013 and 2014 was the result of several boats from New Jersey landing in Maryland and does not indicate a change in local abundance of fish.

Recreational landings data are not available for much of the 1980s and 1990s (Figure 2). The Marine Recreational Information Program (MRIP) estimated that recreational anglers harvested 18 scup in 2010, 11 scup in 2011, and 0 scup through 2015<sup>10</sup> (Figure 2). The mean proportional standard error (PSE) for these harvest data was 71. A PSE value greater than 50 indicates a very imprecise estimate.

## Issues/Concerns

Maryland commercial scup harvest has not returned to pre-1970 levels. Scup harvest occurs offshore and is highly variable. The MAFMC has proposed modifying the southern scup gear restricted area (GRA). The proposal would modify the boundaries of the area and would increase access to traditional squid fishing areas while still protecting juvenile scup. Public comment on the proposal will be open until mid-September 2016. For more detail, go to : <http://www.mafmc.org/actions/scup-gear-restricted-areas-framework>

Shifts in the distribution of fish along the Atlantic coast have been due to increasing water temperature have been demonstrated. Scup exhibit more northerly trends in distribution in the spring. Changes in the center of biomass may have implications for the fishery especially in state quota management. Fish that were once available in one area may no longer be available in that area.<sup>11</sup>

Figure 1. The commercial harvest of scup in Maryland since 1950.<sup>9</sup> Harvest data is not available for the years 1996, 2001-2003, and 2006-2008. Data for 2015 is preliminary.

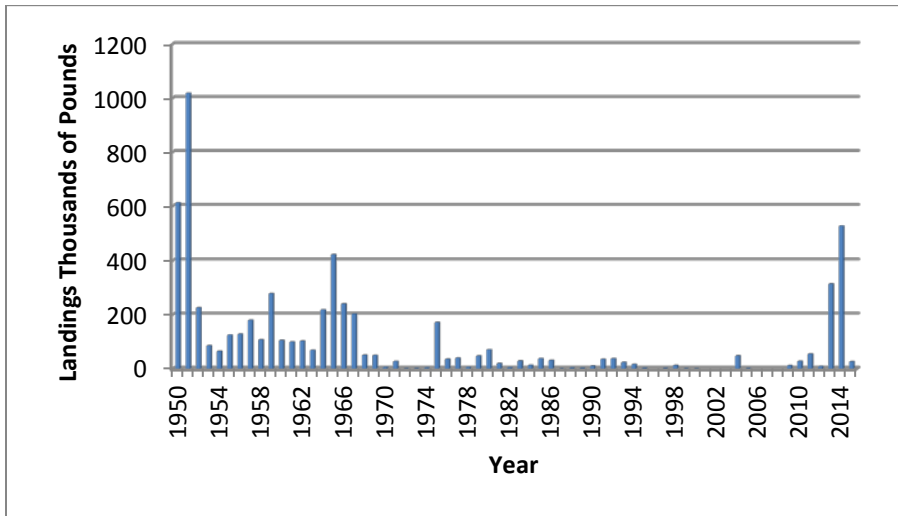
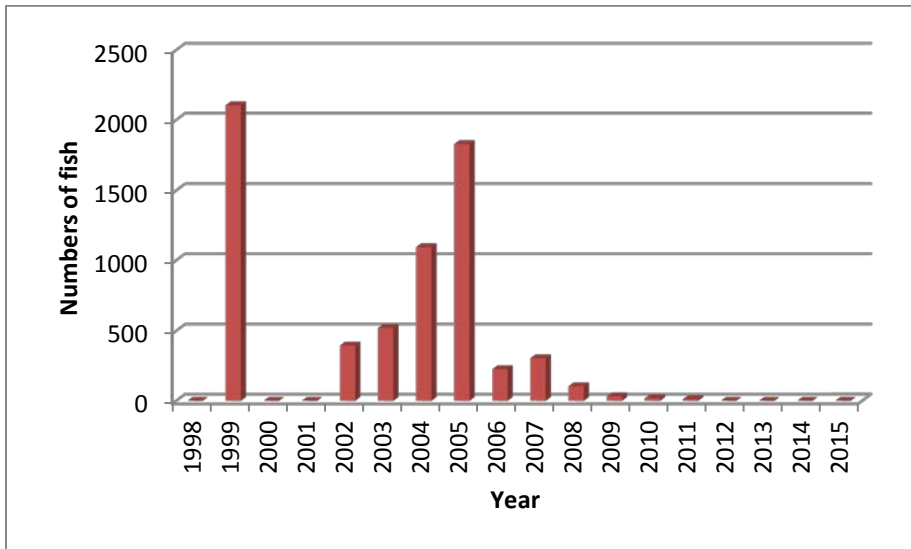


Figure 2. The recreational scup harvest in Maryland since 1998.<sup>10</sup>



## References

- <sup>1</sup> Northeast Fisheries Science Center. 2015. 60th Northeast Regional Stock Assessment Workshop (60th SAW) Assessment Report. US Dept. Commer, Northeast Fish Sci Cent Ref Doc. 15-08; 870 p. doi: 10.7289/V5W37T9T. <http://nefsc.noaa.gov/publications/crd/crd1508/>
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- <sup>3</sup> Mid-Atlantic Fisheries Management Council 2015. Standardized Bycatch Reporting Methodology An Omnibus Amendment to the Fishery Management Plans of the Mid-Atlantic and New England Regional Fishery Management Councils
- <sup>4</sup> Doctor, S. 2016. Maryland's 2015 annual compliance report for scup. Maryland Department of Natural Resources. Stevensville, MD.
- <sup>5</sup> Mid-Atlantic Fishery Management Council. 2013. Scup Advisory Panel Information Document. <http://static.squarespace.com/static/511cdc7fe4b00307a2628ac6/t/52444638e4b0bb95409582fb/1380206136186/Scup%20AP%20FPR%20Info%20Doc%20August%202013.pdf>
- <sup>6</sup> Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. (2014). Fisheries of the Northeastern United States; Summer Flounder, Scup, and Black Sea Bass Fisheries; 2014 Summer Flounder Specifications; 2015 Summer Flounder, Scup, and Black Sea Bass Specifications; 2014 Research Set-Aside Projects (Federal Register No. 79(61)).
- <sup>7</sup> Atlantic States Marine Fisheries Commission. 2002. Addendum V to the scup fishery management plan: Summer period commercial scup allocation. Atlantic States Marine Fisheries Commission. Washington, DC.

<sup>8</sup> Atlantic States Marine Fisheries Commission. 2009. Addendum XX to the summer flounder, scup, and black sea bass fishery management plan: Commercial quota transfer provisions for black sea bass and scup (summer period only). Atlantic States Marine Fisheries Commission. Washington, DC.

<sup>9</sup> Personal communication from the NOAA Fisheries, Northeast Regional Office. March 23, 2016:  
[http://www.nero.noaa.gov/ro/fso/reports/reports\\_frame.htm](http://www.nero.noaa.gov/ro/fso/reports/reports_frame.htm)

<sup>10</sup> Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division. March 23, 2016:  
<http://www.st.nmfs.noaa.gov/recreational-fisheries/index>.

<sup>11</sup> Bell, R.J, Richardson, D.E., Hare, J. A., Lynch, P.D., and Fratantoni, P. S. 2015. Disentangling the effects of climate, abundance, and size on the distribution of marine fish: an example based on four stocks from the Northeast US shelf. ICES Journal of Marine Science, 72:1311-1322



## 2015 Maryland FMP Report (June 2016)

### Section 17. Striped Bass (*Morone saxatilis*)

In 2015, the Maryland striped bass fishery was managed under the Atlantic States Marine Fisheries Commission (ASMFC) Addendum IV. New regulations were enacted for the spring trophy season and Atlantic coast to achieve a 25% harvest reduction relative to 2013. The remaining Chesapeake Bay seasons were managed to achieve a 20.5% harvest reduction relative to 2012. Data collected during 2015 are currently being reviewed to determine the effects of Addendum IV management changes at the coastwide level. The 2015 juvenile abundance index was more than twice the long-term average and similar to the above average 2011 year class. Addendum IV harvest restrictions will continue in 2016. The ASMFC Striped Bass Technical Committee will conduct an update to the stock assessment in 2016 with data through 2015.

#### Fishery Management Plans (FMPs)

In 1989 the Chesapeake Bay Program developed the Chesapeake Bay Striped Bass Fishery Management Plan (CBSB FMP) to coordinate management among Bay jurisdictions and to comply with ASMFC FMP requirements. The CBSB FMP was amended in 1998. Amendment 1 formally adopted ASMFC's Amendment 5 management framework for the Chesapeake Bay. Amendment 5 (1995) to the ASMFC FMP required an annual juvenile abundance survey in Maryland and Virginia to monitor for recruitment. Maryland's Juvenile Abundance Index (JAI) began in 1954 and Virginia's in 1955. The CBSB plan and amendment have been regularly updated and periodically reviewed. The most recent review was conducted in 2013/2014. The Maryland Plan Review Team (PRT) concluded that the use of coastal management indices [fishing mortality (F), spawning stock biomass (SSB) and juvenile abundance] are sufficient for decision-making in the Chesapeake Bay. The PRT recommended the development of a new amendment to incorporate the recent coastal management framework and recommended utilizing ecosystem-based management specific to the Chesapeake Bay when feasible.

The ASMFC developed the Interstate Fisheries Management Plan for Striped Bass in 1981 (ASMFC FMP). Several amendments and addenda to the ASMFC FMP have been adopted to make adjustments to management measures (1985-2001). Amendment 6 (2003) to the ASMFC FMP replaced all previous ASMFC management documents for striped bass. It includes provisions for target and threshold control rules to effectively manage mortality, spawning potential, and age diversity. Addendum I (2007) implemented additional data collection requirements to improve discard estimates. Addendum II (2010) revised the recruitment failure threshold from an annually variable value (1957 – present) to a set value (1957 – 2009) of 1.60. Addendum III (2012), standardized the use of commercial harvest tags coastwide to reduce illegal harvest. Addendum IV was developed and approved in 2014 to reduce the Atlantic coast fishing mortality (F) rate in 2015 to a level at or below the target. In Maryland, harvest reductions include a 25% reduction in the Atlantic and Chesapeake Bay trophy fisheries from 2013 harvest and a 20.5% reduction in the summer/fall and winter fisheries from 2012 harvest levels (<http://www.asmfc.org/species/atlantic-stripped-bass>).

A NOAA Chesapeake Bay Fisheries Ecosystem Advisory Panel developed a Fisheries Ecosystem Plan (FEP) for CB in 2006. Maryland Sea Grant was contracted to facilitate FEP development for five keystone Chesapeake Bay species including striped bass. State, federal, and academic representatives completed a series of issue briefs in 2009 that identified current and future ecosystem stressors: habitat (warming, flow, eutrophication/ hypoxia, pollution/contamination, and watershed development), food web (forage and predation), stock assessment (recruitment variability, exploitation, disease, and connectivity), and socioeconomic (livelihoods, recreation, and consumption). The briefs were forwarded to a Quantitative Ecosystem Team (QET) tasked with development of measurable targets and reference points. No targets or reference points have been developed to date. For more information on the EBFM process, go to ([www.mdsg.umd.edu/programs/policy/ebfm/](http://www.mdsg.umd.edu/programs/policy/ebfm/)).

#### Stock Status

Although the striped bass stock is not overfished and overfishing is not occurring, model projections indicate that SSB could fall below the threshold in the future. Striped bass are managed under biological reference points (BRPs) for F and SSB. BRPs were updated in the ASMFC's 2013 Benchmark Stock Assessment Report for Atlantic Striped Bass. The new target F for striped bass in coastal waters is 0.18 and the  $F_{\text{threshold}}$  is 0.22. Separate BRPs for Chesapeake Bay were not developed in the 2013 Stock Assessment report but the Technical Committee will continue to work on developing Chesapeake Bay reference points.<sup>2</sup> In the meantime, the Chesapeake Bay stock will be assessed under the coastwide reference points.

Levels of F from the 2015 stock assessment update ( $F=0.205$ ) exceeded the target level, but remained below the threshold level. The new target female SSB was 72,032 metric tons (159 million pounds) with the  $SSB_{\text{threshold}}$  at 57,626 metric tons (127 million pounds). The coastwide SSB in the 2015 stock assessment update was 63,918 metric tons (140 million pounds) which is above the threshold but below the target.<sup>1</sup> Since continued harvest at existing levels was predicted to reduce SSB below  $SSB_{\text{threshold}}$  by 2015 and raise F above the  $F_{\text{threshold}}$ , Addendum IV was approved to reduce harvest levels beginning in 2015. Addendum IV restrictions will continue even though SSB has increased from the 2013 stock assessment. A stock assessment update will be completed in 2016 with data through 2015. The most recent ASMFC Atlantic Striped Bass Stock Assessment Update (2015) can be found at: [http://www.asmfc.org/uploads/file/564106f32015AtlStripedBassAssessmentUpdate\\_NoV2015.pdf](http://www.asmfc.org/uploads/file/564106f32015AtlStripedBassAssessmentUpdate_NoV2015.pdf)

Maryland DNR has conducted the Estuarine Juvenile Finfish Survey since 1954 to measure young of year (YOY) striped bass abundance and to calculate a juvenile abundance index (JAI). The JAI is a predictor of year class strength and is used to monitor YOY recruitment success. If the MD striped bass JAI falls below a value of 1.60 for three consecutive years, it would trigger management action by the ASMFC.<sup>4</sup> The 2015 JAI was well above average at 10.67. The 2013 and 2014 JAI were [near average](#) near average at 3.42 and 4.06, respectively, after a historic low of 0.49 in

2012<sup>5</sup> (Figure 1). The Maryland JAI is one of six indices that are calculated for different regions of the Atlantic coast including Maine, New York, New Jersey, Virginia, and North Carolina.<sup>4</sup>

### Current Management Measures

Addendum IV established new management measures to achieve mandatory reductions in recreational and commercial removals for the 2015 season. The Chesapeake Bay is managed under a separate commercial quota that is allocated among the Bay jurisdictions. Maryland's 2015 Chesapeake Bay striped bass commercial quota was 1.47 million lbs., a 24% decrease from 2014 (Figure 2).<sup>6</sup> The 2015 commercial quota allocated to the common pool fisheries was 20,048 pounds for hook and line and 30,085 pounds for drift gill net. The remaining quota was allocated to the individual transferable quota (ITQ) fishery with no gear-specific restrictions.<sup>6</sup> The Maryland Atlantic commercial quota was 90,727 pounds and could be harvested with drift gill net or otter trawl. The recreational (including charter) fishery in Chesapeake Bay attained reductions in the trophy and summer/fall harvests through changes in size limits (Figure 3).<sup>6</sup> Striped bass regulations may be adjusted annually based on ASMFC requirements and stakeholder concerns.

Watermen and the Maryland Department of Natural Resources (MD DNR) began implementation of a catch shares management system with the 2014 commercial season. Each waterman had the option to remain in the traditional common pool management framework or switch to an ITQ management framework. The common pool fishery has a single quota shared among all participants. An ITQ guarantees each participating waterman a portion of the commercial quota. Quota allocation is based on a waterman's historical landings record through February 29, 2012. Watermen have the ability to temporarily transfer quota to other watermen with an ITQ.

Commercial fisheries are managed using quotas and seasonal restrictions by gear type: pound net, haul seine, hook and line, and drift gill net. In 2015, the quota was decreased by 20.5% for Chesapeake Bay and by 25% for Atlantic Ocean commercial fisheries to meet Addendum IV compliance requirements. Maryland's Chesapeake Bay commercial fisheries operated with an 18" – 36" total length slot limit. All fisheries, except gill net, were open from June 1 – November 30. The pound net fishery was open from Monday – Saturday and the haul seine fishery was open from Monday – Friday. The hook and line ITQ sector was open from Monday – Thursday while open days for the common pool sector varied during the fishing season. The drift gill net fishery was open from January 1 – February 28 and December 1-31. The ITQ sector operated from Monday – Friday while open days for the common pool sector varied during the fishing season. The Atlantic Ocean drift gill net and otter trawl fisheries had a 24" total length minimum size limit. Atlantic coast fisheries were open from Monday – Friday on January 1 – April 30 and October 1 – December 31.

Striped bass caught by the commercial fishery must be individually tagged and landed at a certified check station prior to sale.<sup>4</sup> Each fish is counted and weighed. Check stations verify each fisherman's daily harvest record on the fisherman's harvest permit.

Fishermen submit monthly harvest reports to MD DNR. Check stations call in harvest numbers and submit a weekly report. Fishermen and check stations have the option to submit harvest data electronically through FACTS or SAFIS reporting systems. Check stations are randomly sampled by MD DNR biologists to collect age, length and weight data for federal compliance reporting.

Recreational harvest is managed with a number of seasonal and spatial restrictions. No recreational harvest of striped bass is allowed in the Chesapeake Bay and Potomac River during the January 1 – February 28 catch and release fishery. Regulations to control recreational catch and release effort during the pre-spawn period (March 1 - the third Friday in April) were implemented in 2010. During this time, anglers are prohibited from using stinger hooks, required to use barbless hooks when trolling, required to use circle hooks or J hooks with a gap < ½" when using bait, and allowed up to six lines per boat when trolling. Fishing is allowed in the mainstem Chesapeake Bay below Brewerton Channel (Patapsco River), Tangier and Pocomoke sounds, and tributaries except those identified as striped bass spawning rivers. The 2015 spring trophy season took place from April 18 – May 15, but harvest was restricted to the Chesapeake Bay mainstem south of Brewerton Channel (Baltimore) down to the MD/VA line, Pocomoke Sound, and Tangier Sound. The regulations changed for the 2015 trophy season due to implementation of Addendum IV. Anglers were allowed to keep one fish 28 to 36 inches or one fish over 40 inches (no harvest 36-40 inches).

Allowable fishing locations were less restrictive from May 16 – 31: Chesapeake Bay mainstem from Hart-Miller Island (Baltimore) to the MD/VA border; the lower five miles of the Chester, Choptank, and Patuxent rivers; Pocomoke Sound, and Tangier Sound. All Chesapeake Bay and tributary waters are open to striped bass fishing from June 1 – December 20. The 2015 creel and size limits from May 16 – December 20 were two fish per person per day 20-28 inches, or one fish per person per day 20-28 inches and one fish per person per day over 28 inches. The fishery transitions to catch and release only on December 21 and continues thru December 31. The use of eel as bait is prohibited from December 21 – May 31 to prevent deep hooking which increases mortality.

Spring recreational regulations differ somewhat for upper Chesapeake Bay waters including the Susquehanna Flats. The striped bass fishery is catch and release only from December 21 – May 3. The fishery is closed from May 4 – 15. The 2015 fishery reopened with a 1 fish per person per day creel at 20 – 26 inches from May 16 – 31.

The 2015 Atlantic coast recreational fishery regulations changed to a limit of 1 fish per person per day of 28 inches or greater. The US Secretary of Commerce enacted a moratorium on striped bass harvest in federal waters (Exclusive Economic Zone or EEZ) in 1990. The moratorium remains in effect.

The 2016 spring trophy season regulations were changed to 1 fish with a minimum size limit of 35 inches. The 2016 summer/fall recreational regulations will be the same as 2015. The 2016 Atlantic recreational fishery started with 1 fish per person per day of 28 inches or greater. A public notice was issued on May 24, 2016 to change the regulations

to 2 fish per person per day from 28 to 38 inches or greater than 44 inches effective June 1, 2016.

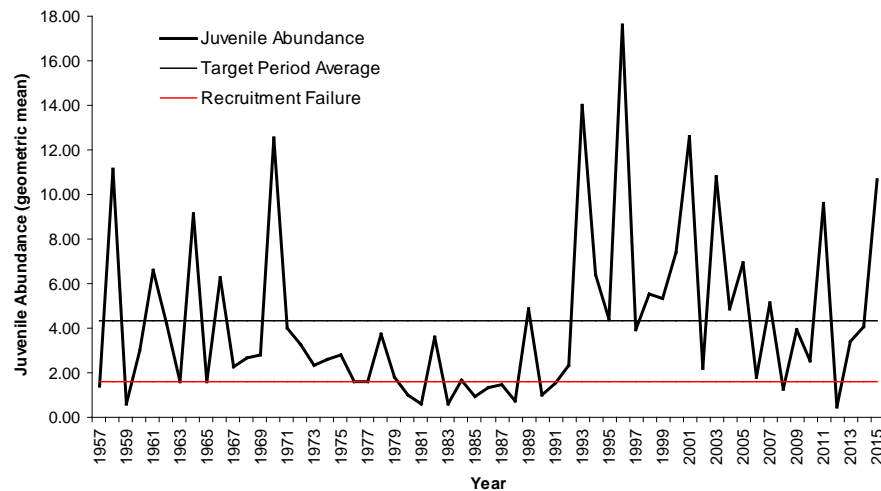
Maps of closed, catch and release, and harvest areas can be found at <http://dnr2.maryland.gov/fisheries/Pages/striped-bass-maps.aspx>. An overview of commercial regulations can be found at <http://www.dnr.state.md.us/fisheries/regulations/table.asp?c=commercial> and recreational regulations at <http://www.eregulations.com/maryland/fishing/striped-bass/>. The complete list of commercial and recreational harvest restrictions are printed in the Code of Maryland Regulations (COMAR).

### The Fisheries

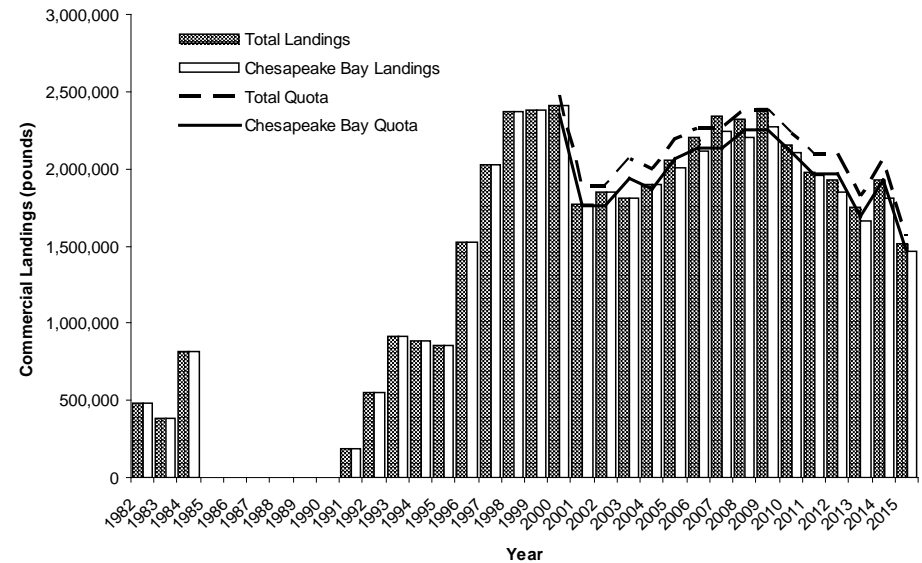
The 2015 Maryland commercial fishery in Chesapeake Bay harvested an estimated 1.47 million lbs.; 663,144 lbs. from the winter gill net fishery and 806,346 lbs. from the summer/fall fishery (Figure 2).<sup>6</sup> Atlantic coast landings were estimated at 43,677 lbs.<sup>5</sup>

The NOAA Marine Recreational Information Program (MRIP) estimated recreational harvest in Maryland for 2015 was 3.10 million lbs.: 3.08 million lbs. from Chesapeake Bay and 13,848 lbs. from Atlantic Coast (Figure 3).<sup>6</sup> Of the 2015 Chesapeake Bay harvest, 30,533 spring migratory fish (649,857 lbs.) were harvested by the trophy fishery (Figure 4).<sup>6</sup> The estimated discard mortality for striped bass is 9%, equal to 280,580 fish or 579,082 lbs. in 2015.<sup>6</sup>

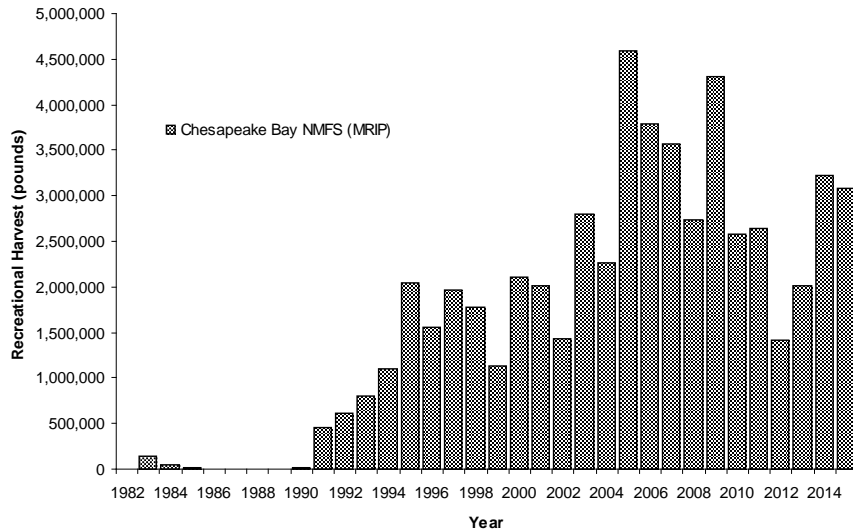
**Figure 1. Striped bass juvenile abundance index geometric mean values: 1957 – 2015.**<sup>5,6</sup> The red line represents the recruitment failure definition (1.60) and the black line defines the target period average (1959-1972) of stable recruitment. The moratorium was in place from 1985 to 1989.



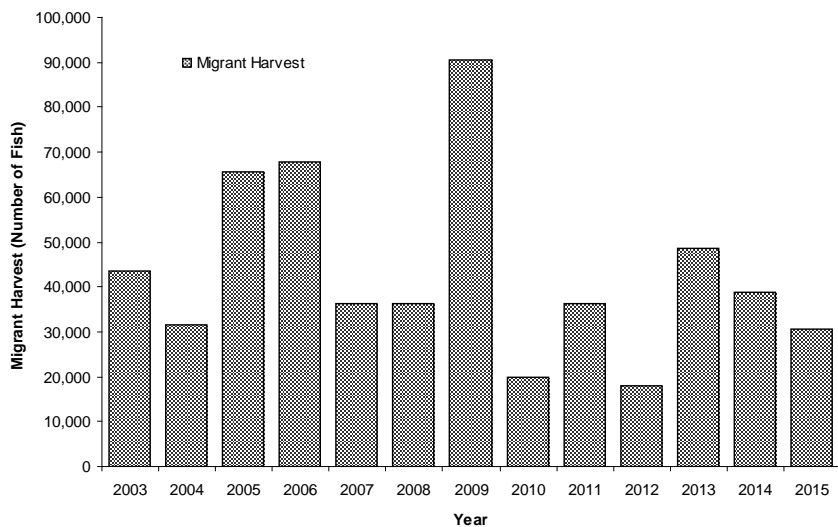
**Figure 2. Total commercial striped bass landings (Atlantic and Chesapeake Bay)<sup>6</sup> and Chesapeake Bay landings<sup>6</sup> in Maryland from 1982 to 2015.** Total and Chesapeake Bay quota are shown for 2003-2015. Striped bass harvest moratorium was in effect from 1985 to 1989. (<http://www.asmfc.org/species/atlantic-striped-bass>).



**Figure 3. Maryland recreational (including charters) striped bass landings from 1981-2015.**<sup>6,7</sup> Striped bass harvest moratorium was in effect from 1985 to 1989.



**Figure 4. Maryland striped bass migrant harvest from 2003 to 2015.**<sup>6</sup> Trophy migrant harvest data submitted as an appendix to the ASMFC annual compliance reporting.



### Issues/Concerns

The striped bass stock has been undergoing a decline in SSB and an increase in F. Projections from the 2015 stock assessment update indicated that SSB could fall below its threshold and that F could increase above its threshold. Continued implementation of Addendum IV from the ASMFC will be critical in reducing harvest and preventing a further decline in SSB.

Tagging data indicate that natural mortality (M) has been increasing, particularly in Chesapeake Bay, and is above the assumed value. Increased M in Chesapeake Bay may be linked to the increased prevalence of mycobacteriosis<sup>8</sup> or other factors affecting health. Nutritional status of striped bass has been discussed as a possible health index. Nutrition-based reference points were recently proposed by Jacobs et al. (2013).<sup>9</sup> Further study of mycobacteriosis infections in striped bass and its relation to M is needed.

The ASMFC Striped Bass Technical Committee will continue to evaluate stock-specific reference points in producer areas, including the Chesapeake Bay, Delaware Bay and Hudson River.

The DNR Fish Ecosystem and Habitat Program is working to develop striped bass forage indicators using the data from striped bass health monitoring, relative abundance, natural mortality, fall diet studies and forage relative abundance. Striped bass from the upper Bay feed on a variety of prey including menhaden, bay anchovy, spot and blue crab. The model and indicators will be reviewed by the ASMFC Biological Ecological Reference Point Group and then determine the next steps.

**As a natural prey item for striped bass, spot are important to the commercial hook and line fishery and the recreational fishery as live bait. Restrictions on spot harvest and/or size limits could significantly impact these fisheries.**

### References

- <sup>1</sup> Atlantic States Marine Fisheries Commission. 2015. Atlantic Striped Bass Stock Assessment Update (October 2015). Prepared by Striped Bass Technical Committee, ASMFC.
- <sup>2</sup> Atlantic States Marine Fisheries Commission. 2014. Addendum IV to Amendment 6 to the Atlantic Striped Bass Interstate Fishery Management Plan. Atlantic States Marine Fisheries Commission, Washington D.C.
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- <sup>4</sup> Atlantic States Marine Fisheries Commission. 2010. Addendum 2 to Amendment 6 to the Atlantic striped bass interstate fishery management plan. Atlantic States Marine Fisheries Commission. Washington DC.
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- <sup>7</sup> Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division. <http://www.st.nmfs.noaa.gov/index>
- <sup>8</sup> Striped Bass Stock Assessment Subcommittee and Striped Bass Tagging Subcommittee. 2013. Atlantic States Marine Fisheries Commission striped bass stock assessment update 2013. Atlantic States Marine Fisheries Commission. Alexandria, VA.
- <sup>9</sup> Jacobs, J. M., R. M. Harrell, J. Uphoff, H. Townsend, and K. Hartman. 2013. Biological reference points for the nutritional status of Chesapeake Bay striped bass. North American Journal of Fisheries Management. 33: 468-481.

**1989 Chesapeake Bay Striped Bass Management Plan Implementation Table (updated 6/2016)**

Strategy	Action	Date	Comments
<p>1 - Overharvesting, Reduced Spawning Stock and Poor Recruitment: Controlling fishing mortality will be the primary method of maintaining adequate striped bass stocks. Optimum yield per fish will be more closely approached by establishing minimum sizes greater than historic limits. Long term fishery maintenance must be based on a management objective commensurate with reproductive success. The number of eggs per striped bass is directly related to fish size and age. Females will be protected so that more can reach their spawning potential. As reproductive potential is protected and spawning stock increases, more young striped bass should enter the fishery.</p> <p>Two types of fisheries have been defined by the ASMFC:                      1) A conservative transitional fishery, which would go into effect after the Maryland striped bass juvenile index has reached a 3-year-average of 8.0; and (2) A more robust recovered fishery, to be considered when a certain percentage of the female spawning stock is composed of striped bass females equal to or greater than age VIII. The percentage will be determined by the ASMFC.</p>		<p>Completed</p> <p>1995</p> <p>1995 On-going</p> <p>2003</p> <p>2010</p> <p>Continue</p> <p>2014</p> <p>2015</p> <p><b>2016</b></p>	<p>Target was 1990 for a transition fishery.</p> <p>The stock was deemed restored in 1995.</p> <p>Juvenile abundance data is used by ASMFC to estimate coastal SSB and SCA of coastal stock.</p> <p>Amendment VI changed the JAI recruitment failure definition from 90% to 75% of the index for three consecutive years.</p> <p>Addendum 2 to Amendment 6 established a fixed recruitment failure value of 1.60.</p> <p>Strong recruitment of 1993, 1996, 2001, 2003, 2011, and 2015 year classes</p> <p>Addendum IV approved to implement management measures to reduce F in order to increase SSB.</p> <p>New regulations implemented as required by Addendum IV.</p> <p><b>Trophy season regulations adjusted, but still implemented as required by Addendum IV.</b></p>
<p>1.1 Fishing mortality will be controlled by several means to protect striped bass stocks. Harvest restrictions will be set to provide a fishing mortality rate of 0.25 (equivalent to about 18% of the legal sized fish being harvested) during a <u>transition</u> fishery and a rate of 0.5 (equivalent to about 32% of the legal sized fish being harvested) during a <u>recovered</u> fishery, in accordance with ASMFC guidelines (these percentages may change slightly as additional calculations are made by the ASMFC). Adult stock levels, stock composition, and the Maryland striped bass young-of-the-year index (or other juvenile indices as approved by ASMFC) will be used in determining needed restrictions.</p>	<p>1.1.1 The District of Columbia, Maryland, Virginia, and the Potomac River Fisheries Commission will utilize a combination of harvest restrictions to meet target fishing mortality rates. Controls may include seasonal quotas, daily bag limits, minimum size limits, seasons, time restrictions, gear restrictions, license requirements, and other actions. Maryland's annual quota will be presented as total sport and commercial landings.</p>	<p>2000 Continue</p> <p>February 2003 Continue</p> <p>2009</p> <p>On-going</p>	<p>All CB jurisdictions have implemented regulations to prevent exceeding <math>F_{target}</math>.</p> <p>CBP jurisdictions have the option to implement stricter regulations than required under ASMFC Amendment 6.</p> <p>The overfishing definition is <math>F_{msy}=0.34</math>. If coastwide estimated mortality rates exceed the target rate for 2 consecutive years, the ASMFC will develop management measures.</p> <p>Bay jurisdictions are in compliance with ASMFC guidelines. CB F remains below the target of 0.27.</p>

**1989 Chesapeake Bay Striped Bass Management Plan Implementation Table (updated 6/2016)**

Strategy	Action	Date	Comments
		<b>2013 Continue</b>	<p>See Strategy 1.2 comments for size limits and Strategy 2.4.1 comments for seasons and time restrictions.</p> <p><b>BRPs were changed in the update to the 2013 ASMFC Coastal Stock Assessment. New BRPs are a target F=0.18 and threshold F=0.22.</b></p>
1.2 Size limits and fishing mortality rates will be set to allow sufficient recruitment to the spawning stock.	1.1.2 Maryland, the Potomac River Fisheries Commission and Virginia will cap commercial harvest during the transitional fishery with a quota not to exceed 20% of the average annual commercial harvest as reported for the period 1972-1979. No commercial fishing is permitted in the District of Columbia.	1990	Implemented.
		1995	The stock was deemed restored.
		On-going	<p>ASMFC requires that the recreational minimum size limit for striped bass in Chesapeake Bay is 18" except for the spring trophy season. The minimum size limit for striped bass during the spring trophy season in MD is 28".</p> <p>2015</p> <p>Addendum IV requires the recreational minimum size limit for striped bass in the Chesapeake Bay to be 20 inches except in the trophy season. The trophy season has a minimum size limit of 28 inches and a no take slot limit from 36 to 40 inches.</p> <p><b>2016</b></p> <p><b>Addendum IV requires the recreational minimum size limit for striped bass to be 20 inches. The trophy season regulations are changed from a slot limit to a 35 inch minimum size limit.</b></p>
	1.2.2 Maryland, Virginia and the Potomac River Fisheries Commission will prohibit the keeping and sale of sublegal (fish smaller than the minimum size) striped bass by-catch.	On-going	ASMFC prohibits the sale of sub-legal striped bass (<28"). All striped bass are individually weighed, measured, and tagged at certified check-in stations.
	1.2.3 As a conservation measure, the District	On-going	DC, MD, PRFC, and VA recreational fisheries

**1989 Chesapeake Bay Striped Bass Management Plan Implementation Table (updated 6/2016)**

Strategy	Action	Date	Comments
	of Columbia, Maryland, Virginia and the Potomac River Fisheries Commission will establish a consistent maximum legal size for striped bass in the Chesapeake Bay and its tributaries.		are managed with a combination of the 20" – 28" slot limit and a 28" minimum size limit: 2 fish 20" - 28", or 1 fish 20" - 28" and 1 fish ≥28". Spring trophy season size limits for MD and PRFC are 1 fish ≥28" and VA allows 1 fish ≥32". There is not a spring trophy season in DC.  Commercial fishery size limits: MD is 18" – 36" for all gear and seasons; PRFC is 18" – 36" from February 15 – March 25 and ≥ 18" from June 1 – December 15, and for gill net ≥ 18" from November 12 – February 14; VA minimum size is 18" all season with a 28" maximum from March 26 – June 15. Commercial fishing is prohibited in DC.
1.3 Fishing mortality rates will be set to ensure a viable female spawning stock of age VIII and older females, and stocks will continue to be enhanced with hatchery production.	1.3.1 During a transition fishery, mortality will be controlled to protect age VIII or older females until they comprise at least a certain percentage (as determined by the ASMFC) of the female spawning population.	2011	Female fish ages 8+ have increased in abundance.  Minimum percent of age 8+ females has not been specified by ASMFC.
	1.3.2 A fishery on a recovered stock will be controlled so that females age VIII or older continue to comprise at least a certain percentage (as determined by the ASMFC) of the female spawning stock.	Discontinued  Ongoing - Adjusted during stock assessment	ASMFC uses a VPA to estimate SSB.  A statistical catch at age (SCA) model is used to estimate SSB. Since 2008, $SSB_{threshold} = 66.2$ million lbs. and $SSB_{target} = 82.7$ million lbs.  Minimum percent of age 8+ females has not been specified by ASMFC.
	1.3.3 Maryland and Virginia will continue hatchery production to enhance striped bass spawning stocks in areas that are still depleted. The District of Columbia will work with the Maryland and Virginia hatchery programs to enhance striped bass spawning stocks.	1993 VA 1995 MD	MD and VA discontinued stocking striped bass.
	1.3.4 Hybrid striped bass stocking and the introduction of non-native stocks will be restricted in the Chesapeake Bay and its tributaries in accordance with ASMFC guidelines. The Maryland Department of Natural Resources, the Pennsylvania Fish and Boat Commission and the U.S. Fish & Wildlife Service will discuss stocking issues	Magothy - 1982 Patuxent - 1984 Pennsylvania – 1990	MD, PA, and USFWS discontinued stocking hybrid striped bass.



**1989 Chesapeake Bay Striped Bass Management Plan Implementation Table (updated 6/2016)**

Strategy	Action	Date	Comments
<p>2 - Regulatory and Enforcement Issues: In order to control fishing effort and fishing mortality rates, harvest and sale regulations will be developed and implemented. Guidelines will be set for monitoring the resource and harvest restrictions. The individual jurisdictions will comply with ASMFC goals and criteria for the striped bass fishery and, where possible, have compatible fishing regulations. Areas of harvest pressure and times when harvesting pressure will be heaviest will be defined in order to facilitate adequate enforcement.</p> <p>2.1 The striped bass harvest will be equitably allocated among user groups on a yearly basis.</p>	<p>regarding the Susquehanna River.</p> <p>2.1.1 The Maryland quota will be allocated as follows – 42.5% commercial; 42.5% recreational; 15% charter. Virginia and the Potomac River Fisheries Commission will use various restrictions in fishing seasons and bag limits to equitably allocate and restrict harvest among the commercial, recreational and charter boat fisheries.</p>	<p>On-going</p> <p>2013 2014</p>	<p>Quota allocation is periodically reviewed. Recreational and charter allocations have since been combined to be 57.5%.</p> <p>The CBSB FMP was reviewed including quota allocation in 2013/2014 by a plan review team. The team recommended the development of a new amendment to adopt the current ASMFC coastal management framework.</p>
	<p>2.1.2 Maryland will terminate the fishing season for each of its three component fisheries when their individual quota is reached, regardless of time during the season. Virginia will terminate its commercial fishing component when its harvest quota is reached, regardless of time during the season. The Potomac River Fisheries Commission will terminate its fishing seasons when the allowable harvest under ASMFC’s Striped Bass Plan is reached, regardless of the time during that season.</p>	<p>On-going</p>	<p>MD Department of Natural Resources, VA Marine Resources Commission, and PRFC have authority to close their fisheries when quotas are projected to be reached.</p>
<p>2.2 Maryland, Potomac River Fisheries Commission and Virginia will establish commercial gear restrictions to limit fishing effort and sublegal by-catch, and to facilitate enforcement.</p>	<p>2.2.1 Maryland, the Potomac River Fisheries Commission and Virginia will establish a minimum gill net mesh size designed to reduce sublegal by-catch mortality to negligible levels.</p>	<p>On-going</p>	<p>CB jurisdictions are in compliance.</p>
	<p>2.2.2 Maryland and Virginia will require that gill nets be marked, tended, and recovered (except for Virginia’s stake nets) daily. The Potomac River Fisheries Commission will continue a fixed location for each gill net licensed in the Potomac.</p>	<p>On-going</p>	<p>CB jurisdictions are in compliance.</p>
	<p>2.2.4 Maryland and Virginia will establish annual quotas for their commercial fisheries.</p>	<p>On-going</p>	<p>State quotas are determined by ASMFC. CBSB FMP includes provisions for how jurisdictions allocate among sectors. MD adopted an allocation policy in 2012.</p>
<p>2.3 Selling and buying procedures and timely reporting requirements will be established to monitor and regulate harvest.</p>	<p>2.3.1 A) Maryland will establish check-in stations for the commercial sale of striped bass.</p>	<p>On-going</p>	<p>CB jurisdictions are in compliance.</p>
	<p>2.3.1 B) Virginia dealers and commercial watermen that harvest striped bass will be required to have a special permit to sell striped bass.</p>	<p>On-going</p>	<p>CB jurisdictions are in compliance.</p>

**1989 Chesapeake Bay Striped Bass Management Plan Implementation Table (updated 6/2016)**

Strategy	Action	Date	Comments
	2.3.1 C) The sale of striped bass caught by recreational or charter boat fishermen will be prohibited.	On-going	CB jurisdictions are in compliance.
	2.3.2 Maryland and Virginia will establish a weekly reporting system for licensed commercial fishermen and a daily reporting system for buyers during the commercial season. Maryland and Virginia will provide the Potomac River Fisheries Commission with information obtained through their mandatory buyer reporting provisions. The Potomac River Fisheries Commission will reduce the time period required for the finfish reporting system from monthly to weekly.	<p>2006 2009</p> <p>2010</p> <p>2011</p> <p>2011</p> <p>2014 <b>Continue</b></p>	<p>Electronic reporting was established for check stations and fishermen.</p> <p>Commercial Harvest Reports must be submitted to MDNR Fisheries Service within 10 days after the end of the month being reported. After 10 days the report is late. Watermen having late reports will be identified on the MDNR commercial webpage and in the Maryland Watermen’s Gazette. Official violations are recorded for a license if a harvest report is not received within 50 days after the due date. Two or more reporting violations may result in license suspension.</p> <p>MD Senate Bill 655 and House Bill 1225 increased the penalty for commercial fishing with a suspended license, a revoked license, or without a license. The fine is up to \$25,000 and imprisonment for up to one year.</p> <p>MD House Bill 1252, established a misdemeanor charge and up to two years imprisonment for the unlawful capture of &gt;\$20,000 worth of striped bass (based on sale proceeds).</p> <p>Maryland is conducting a SB Pilot Permit system for the commercial fishery. This e-reporting system should improve the accuracy of harvest reports. <b>Beginning in 2016, the e-reporting system was expanded to all finfish.</b></p>
2.4.1 Fishing seasons will be established for the recreational, charter boat and commercial fisheries. The length of the season may be adjusted as needed, including when quotas are reached (see Action 2.1.2), by opening and closing areas to fishing, or with other actions as appropriate. Seasons will be consistent among jurisdictions to the extent possible.	2.4.1 A) The District of Columbia will establish a recreational fishing season within the period June through December.	Completed	The season opens in May and concludes at the end of December.
	2.4.1 B) Maryland will establish fishing seasons within the following periods: o The commercial gill net season will be within the period November through March 15.	<p>On-going</p> <p>Dates modified &amp; subject to</p>	<p>Fishing season dates are annually reviewed by ASMFC.</p> <p><b>Chesapeake Bay pound net was Jun –Dec.; haul seine and hook and line fisheries were</b></p>







**1989 Chesapeake Bay Striped Bass Management Plan Implementation Table (updated 6/2016)**

Strategy	Action	Date	Comments
			commercial fishing license if found by an Administrative Law Judge to have knowingly committed an egregious violation or repeat violation against striped bass including: using illegal gear; harvesting during closed seasons; harvesting from a closed area; violating established harvest, catch or size limits; or violating tagging and reporting requirements.
<p>3 - Stock Assessment and Research Needs: The Chesapeake Bay Stock Assessment Committee (CBSAC) will continue to improve the coordination of stock assessment pursuant to the Chesapeake Bay Stock Assessment Plan. Stock identification studies should be expanded, especially for the Chesapeake &amp; Delaware Canal and along the coast, to provide information on stock mixing. The contribution of hybrids and hatchery produced fish to the wild population needs to be determined. A review of hooking mortality and other by-catch mortality rates would allow greater precision in establishing fishing mortality controls. Studies on larval survival and growth in relation to environmental variables would provide a better understanding of the factors affecting year class strength.</p>		<p>On-going</p> <p>Completed</p> <p>2009</p> <p>2008 – 2011</p> <p>2012-2013</p> <p>2014</p> <p>2015</p> <p>2016</p>	<p>MD and VA have instituted tagging programs to estimate migration and mortality rates.</p> <p>Gillnet survey is used to collect population data.</p> <p>Studies demonstrating the effectiveness of circle hooks for reduced gut hooking and release mortality have been completed.</p> <p>Research has linked striped bass recruitment with climate cycles. Wood &amp; Austin, 2009, Synchronous multidecadal fish recruitment patterns in Chesapeake Bay, USA.</p> <p>SARC determined stock is not overfished is not undergoing overfishing.</p> <p>A benchmark stock assessment was completed in 2013.</p> <p>An update to the benchmark stock assessment was completed and the stock was not overfished and overfishing was not occurring, but management triggers were met and lead to approval of Addendum IV</p> <p><b>An update to the stock assessment was completed in October 2015 (using data through 2014) The stock was not overfished and overfishing was not occurring, however, SSB was projected to fall below the threshold level and harvest reductions were triggered.</b></p> <p><b>An update to the stock assessment will be completed to determine the stock status</b></p>

**1989 Chesapeake Bay Striped Bass Management Plan Implementation Table (updated 6/2016)**

Strategy	Action	Date	Comments
<p>3.1 The jurisdictions will continue to obtain stock information on striped bass in Chesapeake Bay.</p>	<p>3.1 The District of Columbia will continue monitoring aspects of striped bass population dynamics. Maryland will continue surveys of the spawning and premigratory striped bass stock in the Chesapeake Bay. Virginia will initiate surveys on its spawning stock of striped bass. Collection of tissue and scale samples to augment tagging information and stock identification will be considered.</p>	<p>On-going  On-going</p>	<p>MD has a gill net survey to monitor the spring spawning stock.  MD and VA tag fish for the USFWS Cooperative Coastal Striped Bass Tagging Program to monitor migratory and resident striped bass population dynamics. ASMFC does not require DC to tag fish.</p>
<p>3.2 Efforts will be made to improve our understanding of factors that affect reproduction and recruitment to the fishery.</p>	<p>3.2 The District of Columbia, Maryland and Virginia, in cooperation with federal agencies, will review and update existing data, and initiate new studies that target: striped bass reproduction and early life history, especially in relation to environmental parameters; natural mortality; and catch-release mortality induced by various fishing methods.</p>	<p>2007 Continue  2009 Continue  On-going</p>	<p>Addendum I to Amendment 6 of the ASMFC FMP requires states to implement angler education about catch and release best practices.  Tagging data indicates striped bass natural mortality (M) may be increasing unless CB emigration has increased. Increased M may reflect an increased incidence of mycobacteriosis, decreased prey availability, or poor water quality.  Tagging study design and implementation requirements are coordinated with ASMFC. Tag return data provide information on migration rates and mortality. The data is then used to improve management measures.</p>
<p>4 – Declining Water Quality: Adequate spawning and nursery areas with good water quality are critical for striped bass survival. Although causes for the decline in reproduction may differ between years and between spawning areas, several water quality aspects are identified as reducing survival of young. State and Federal studies will continue to examine the effects of environmental contaminants on striped bass. 4.1 Identify those water quality factors, both natural and man-induced, which affect striped bass reproduction and survival, and focus on the control of those factors.</p>	<p>4.1 The first four action items are commitments under the 1987 Chesapeake Bay Agreement. The DCFM, MDNR, PRFC and VMRC are not the agencies responsible for carrying out the actual commitments, but are involved in setting the objectives of the programs to fulfill the commitments. The achievement of these commitments will lead to improved water quality and enhanced biological production that can only benefit striped bass populations. The DCFM, MDNR, PRFC and VMRC fully support these commitments.</p>	<p>1990 On-going  2010  2012 – 2013 2014</p>	<p>Water quality issues are also addressed in the Chesapeake 2000 Agreement and most recently in the 2009 Executive Order.  US EPA established a Chesapeake Bay TMDL “pollution diet” mandating nutrient and sediment reductions for compliance with the Clean Water Act.  Chesapeake Bay jurisdictions adopted a new Chesapeake Bay Watershed Agreement which outlines new goals and outcomes for protecting and restoring the Bay. The document is available at <a href="http://www.chesapeakebay.net/chesapeakebaywatershedagreement/page">http://www.chesapeakebay.net/chesapeakebaywatershedagreement/page</a> The forage outcome and work plan is particularly important for striped bass.</p>

**1989 Chesapeake Bay Striped Bass Management Plan Implementation Table (updated 6/2016)**

Strategy	Action	Date	Comments
	<p>1 - The first commitment adopted under the 1987 Chesapeake Bay Agreement was a report titled, "Habitat Requirements for Chesapeake Bay Living Resources". This document listed the habitat requirements for selected target species including striped bass. The report is being revised and updated by a workgroup of the Living Resources Subcommittee. When complete in May, 1990, the habitat requirements contained in the report will be used to aid managers in improving water quality:</p> <p>a) Assist in the revision of water quality standards and criteria as needed,                      b) Develop a Habitat Requirements Use Report which will detail resource needs by river segment,                      c) Assist in the 1991 Nutrient Re-evaluation by providing living resource habitat requirement for use in the 3-D Model (The model will compare existing water quality with the habitat requirements and project whether the requirements would be met under various nutrient removal scenarios), and                      d) Assist in the implementation of the nutrient, toxics and conventional pollutant control strategies by identifying critical habitat needs.</p>	<p>1991</p> <p>2001 2007 Completed</p> <p>1990 On-going</p>	<p>Document published.</p> <p>CB jurisdictions have implemented management strategies to protect striped bass habitat. MD spawning areas are protected from harvest March through May.</p> <p>An ecosystem-based fishery management process was facilitated by MD Sea Grant. Habitat issues/stressors were defined for striped bass.</p> <p>Chesapeake Bay Program develops, revises, and monitors goals and strategies for living resources (blue crab, menhaden, oyster, shad, and striped bass. For more information:  <a href="http://www.chesapeakebay.net/issues/issue/blue_crabs">http://www.chesapeakebay.net/issues/issue/blue_crabs</a>  <a href="http://www.chesapeakebay.net/issues/issue/menhaden">http://www.chesapeakebay.net/issues/issue/menhaden</a>  <a href="http://www.chesapeakebay.net/issues/issue/oysters">http://www.chesapeakebay.net/issues/issue/oysters</a>  <a href="http://www.chesapeakebay.net/issues/issue/shad">http://www.chesapeakebay.net/issues/issue/shad</a>  <a href="http://www.chesapeakebay.net/issues/issue/striped_bass">http://www.chesapeakebay.net/issues/issue/striped_bass</a></p>
	<p>4.1 2 –Development and adoption of a basinwide plan that will achieve a reduction of nutrients entering the Chesapeake Bay:</p> <p>a) Construct public and private sewage facilities.                      b) Reduce the discharge of untreated or inadequately treated sewage.                      c) Establish and enforce nutrient and conventional pollutant limitations in regulated discharges.                      d) Reduce levels of nutrients and other conventional pollutants in runoff from agricultural and forested lands.                      e) Reduce levels of nutrients and other conventional pollutants in urban runoff.</p>	<p>1990 On-going</p>	<p>Currently addressed through the Chesapeake Bay Program's 2 year milestones towards reaching the 2025 water quality goals.</p> <p>Chesapeake Bay Program develops, revises, and monitors goals and strategies for nutrient reduction. For more information:  <a href="http://www.chesapeakebay.net/issues/issue/nutrients">http://www.chesapeakebay.net/issues/issue/nutrients</a></p>
	<p>4.1 3 – Development and adoption of a basinwide plan for the reduction and control</p>	<p>1990 On-going</p>	<p>Chesapeake Bay Program develops, revises, and monitors goals and strategies for chemical</p>



**1989 Chesapeake Bay Striped Bass Management Plan Implementation Table (updated 6/2016)**

Strategy	Action	Date	Comments
	<p>of toxic materials entering the Chesapeake Bay system from point and nonpoint sources and from bottom sediments:</p> <p>a) Reduce discharge of metals and organic compounds from sewage treatment plants receiving industrial wastewater.</p> <p>b) Reduce the discharge of metals and organic compounds from industrial sources.</p> <p>c) Reduce levels of metals and organic compounds in urban and agricultural runoff. Reduce chlorine discharges to critical finfish areas.</p>		<p>contaminants. For more information: <a href="http://www.chesapeakebay.net/issues/issue/chemical_contaminants">http://www.chesapeakebay.net/issues/issue/chemical_contaminants</a></p>
	<p>4.1 4 – Development and adoption of a basinwide plan for the management of conventional pollutants entering the Chesapeake Bay from point and nonpoint sources:</p> <p>a) Manage sewage sludge, dredge spoil and hazardous wastes.</p> <p>b) Improve dissolved oxygen concentrations in the Chesapeake Bay through the reduction of nutrients from both point and nonpoint sources.</p> <p>c) Continue study of the impacts of acidic conditions on water quality.</p> <p>d) Manage groundwater to protect the water quality of the Chesapeake Bay.</p> <p>e) Continue research to refine strategies to reduce point and nonpoint sources of nutrient, toxic and conventional pollutants in the Chesapeake Bay.</p>	<p>1990 On-going</p>	<p>Chesapeake Bay Program develops, revises, and monitors goals and strategies for sediment, wastewater, stormwater runoff, and agriculture. For more information: <a href="http://www.chesapeakebay.net/issues/issue/sediment">http://www.chesapeakebay.net/issues/issue/sediment</a> <a href="http://www.chesapeakebay.net/issues/issue/wastewater">http://www.chesapeakebay.net/issues/issue/wastewater</a> <a href="http://www.chesapeakebay.net/issues/issue/sediment">http://www.chesapeakebay.net/issues/issue/sediment</a> <a href="http://www.chesapeakebay.net/issues/issue/stormwater_runoff">http://www.chesapeakebay.net/issues/issue/stormwater_runoff</a></p>
	<p>4.1 5 – The development and adoption of a plan for continued research and monitoring of the impacts and causes of acidic atmospheric deposition into the Chesapeake Bay and its tributaries. This plan is complemented by Maryland’s research and monitoring program on the sources, effects, and control of acid deposition as defined by Natural Resources Article Title 3, Subtitle 3A, (Acid Deposition: Sections 3-3A-01 through 3-3A-04):</p> <p>a) Determine the relative contributions to acid deposition from various sources of acid deposition precursor emissions and identify any regional variability.</p>	<p>1990 On-going</p>	<p>Chesapeake Bay Program develops, revises, and monitors goals and strategies for air pollution. For more information: <a href="http://www.chesapeakebay.net/issues/issue/air_pollution">http://www.chesapeakebay.net/issues/issue/air_pollution</a></p>

<b>1989 Chesapeake Bay Striped Bass Management Plan Implementation Table (updated 6/2016)</b>			
<b>Strategy</b>	<b>Action</b>	<b>Date</b>	<b>Comments</b>
	b) Assess the consequences of the environmental impacts of acid deposition on water quality. c) Identify and evaluate the effectiveness and economic costs of technologies and mitigative techniques that are feasible to control acid deposition into the Chesapeake Bay.		

## Acronyms

ACCSP – Atlantic Coastal Cooperative Statistics Program  
ASMFC – Atlantic States Marine Fisheries Commission  
BRP – Biological Reference Points  
CB – Chesapeake Bay  
CBP – Chesapeake Bay Program  
CBSAC – Chesapeake Bay Stock Assessment Committee  
COMAR – Code of Maryland Regulations  
DCFM – District of Columbia Department of Consumer and Regulatory Affairs,  
Fisheries Management Section  
EBFM – Ecosystem-based Fisheries Management  
EPA – Environmental Protection Agency  
F – Fishing Mortality  
FACTS – Fishing Activity and Catch Tracking System  
FMP – Fishery Management Plan  
ITQ – Individual Transferable Quota  
JAI – Juvenile Abundance Index  
M – Natural Mortality  
MDNR – Maryland Department of Natural Resources  
MSY – Maximum Sustainable Yield  
NOAA – National Oceanic and Atmospheric Administration  
NRP – Maryland Natural Resources Police  
PRFC – Potomac River Fisheries Commission  
SAFIS – Standard Atlantic Fisheries Information System  
SARC – Stock Assessment Review Committee  
SCA – Statistical Catch at Age  
SFAC – Sport Fish Advisor Commission  
SSB – Spawning Stock Biomass (females)  
TFAC – Tidal Fish Advisory Commission  
TMDL – Total Maximum Daily Load  
USFWS – U.S. Fish and Wildlife Service  
VMRC – Virginia Marine Resources Commission  
VPA – Virtual Population Assessment  
YOY – Young of Year

## 2015 Maryland FMP Report (September 2016)

### Section 18. Summer Flounder (*Paralichthys dentatus*)

The coastal stock of summer flounder peaked in 2010 and has declined slightly since then but is above the threshold. Regional abundance seems to have shifted recently.<sup>1</sup> As a result, a regional, rather than state-by-state, conservation equivalency approach was implemented for summer flounder in 2016. In general, conservation equivalency is an approach taken by a state or region that differs from the specific requirements of the FMP but is designed to achieve the same level of fishing mortality. Established state recreational harvest allocations will not be altered. All states within a region have the same size limit, possession limit, and season.<sup>2</sup> Maryland's region includes Virginia and Delaware. For this region, the minimum recreational size is 16" with a 4 fish per person per day limit.<sup>1,2</sup>

#### Fishery Management Plans (FMPs)

In 1991, the Chesapeake Bay jurisdictions adopted the Chesapeake Bay Summer Flounder Fishery Management Plan (CBSF FMP). The CBSF FMP implemented management measures to reduce fishing mortality (F) and increase the spawning stock biomass (SSB). CBSF FMP strategies and actions were based on guidelines established by the Atlantic States Marine Fisheries Commission (ASMFC) and the Mid-Atlantic Fishery Management Council (MAFMC). As the summer flounder stock improved, the Chesapeake Bay jurisdictions developed Amendment 1 to the CBSF FMP in 1997. This amendment adopted all future reference points and quotas determined by the ASMFC and MAFMC. Jurisdictions continue to implement commercial and recreational management measures as needed to meet these requirements. The CBSF FMP Amendment 1 also implemented a system of individual fishing quota (IFQ) permits for the commercial fishery. The CBSF FMP was reviewed in 2014. The Plan Review Team concluded that the CBSF FMP and amendment were appropriate for managing the resource and recommended another review after the development of a comprehensive MAFMC/ASMFC amendment in 2018.

In the late 1980s, the Atlantic coast summer flounder stock was overfished and depleted. A coastal Fishery Management Plan for Summer Flounder was initially developed in 1982 by the ASMFC. The coastwide plan established a 14" minimum size and specified trawl net mesh size for fishing in state waters ( $\leq 3$  miles from shore). The MAFMC developed a complementary Fishery Management Plan for the Summer Flounder Fishery in 1988 to govern the federal waters ( $> 3$  miles from shore). The MAFMC's FMP required fishermen to abide by the more conservative of state or federal requirements. Summer flounder management was consolidated into a joint ASMFC and MAFMC fisheries management plan.

From 1991 to 1995, MAFMC adopted seven amendments to adjust summer flounder management actions. ASMFC and MAFMC adopted amendments 8 and 9 to incorporate scup and black sea bass, respectively, into the summer flounder FMP. Between 1997 and 2007 ASMFC adopted two amendments (10 and 13) and 8 addenda (III, IV, VIII, and XV-XIX) to modify summer flounder management. In that same time period, MAFMC adopted five amendments (10-13, 15, 16, and 19) and five frameworks (1, 2, and 5-7) to modify summer flounder management. ASMFC adopted Addendum XXV in 2014 to implement regional conservation equivalency for one year (2014). Addendum XXVI (2015) was needed to extend the regional management approach into 2015, and addendum XXVI (2016) extended the regional management approach until 2017.

In 2014, the MAFMC began a comprehensive strategic planning process to reevaluate the management of summer flounder that will ultimately result in the development of a new amendment (currently scheduled for implementation in 2018). During 2015, the MAFMC conducted meetings and a special workshop to develop new goals and objectives. During 2016, the working group will be developing a range of management alternatives and a draft Environmental Impact Statement for consideration.

## Stock Status

Summer flounder inhabit coastal waters from the North Carolina/South Carolina border north to the US/Canadian border and are managed as a single stock. A benchmark stock assessment was completed in 2013<sup>3</sup> with an update to the assessment in 2015.<sup>4</sup> Based on the 2015 update (data through 2014), the summer flounder stock is not overfished but overfishing is occurring. The 2015 update provides evidence that fishing mortality (F) has been underestimated and spawning stock biomass (SSB) has been overestimated since 2011. The updated biological reference points are a F threshold =  $F_{MSY\ proxy} = F_{35\%} = 0.309$  and a biomass target  $SSB_{MSY\ proxy} = SSB_{35\%} = 62,394\ mt = 137.555\ million\ lbs.$  The current  $F = 0.359$  and the  $SSB = 88.9\ million\ lbs.$  As a result of this finding, the commercial quota decreased to 8.12 million pounds in 2016.

## Management Measures

The National Marine Fisheries Service (NMFS), in conjunction with MAFMC, determine coastwide annual catch limits (ACL), commercial quota, and recreational harvest limit (RHL). Commercial coastwide quota is allocated among states based on their historic proportion of landings. Maryland is allocated 2.04% of the coastwide commercial quota and 2.9% of the RHL.<sup>5</sup> States can implement conservation equivalency that may result in different regulatory combinations from state-to-state as long as they stay within the ACL. Commercial and recreational quota overages are deducted from the following year's quota.

Maryland implements catch share management to equitably distribute the commercial quota among harvesters in Atlantic coastal waters, coastal bays and tributaries, Chesapeake Bay (primarily bycatch) and the Potomac River. The catch share system assigns a specific individual fishing quota (IFQ) to each fisherman which allows them to manage their business for best economic yield. Commercial hook and line harvest is managed with a 16" minimum length and all other gears have a 14" minimum length. Commercial fishermen without an IFQ are restricted to 100 lbs. per person per day in coastal waters and 50

lbs. per person per day in tidal waters (Chesapeake Bay). The commercial season is year round. PRFC manages the Potomac River with a 14" minimum size. Net design and mesh size are also regulated.

The Maryland recreational summer flounder fishery was open year round in 2015. Minimum length was 16" and harvest was limited to 4 fish per person per day. PRFC manages the Potomac River recreational harvest with a 16" minimum size limit and 4 fish per person per day limit.

Maryland monitors summer flounder abundance, size, and age with an annual Coastal Bays trawl survey, beach seine survey, and commercial trawl landings from near-shore Atlantic waters. The Maryland Department of Natural Resources (MDNR) initiated the Maryland Volunteer Angler Summer Flounder Survey (MVASFS) in 2005. The results from these four surveys are used by ASMFC, MAFMC, and Maryland to develop regulations for the following year's summer flounder fisheries.

## The Fisheries

Maryland's 2015 commercial fishery harvested 186,360 pounds (DNR data). Ninety-six percent of the total was reported as harvested by otter trawl. The 2015 Maryland commercial quota was 225,716 pounds. Recreational landings of summer flounder were 44,437 fish with a combined weight of 103,613 pounds in 2015.<sup>7</sup>

Figure 1. Maryland commercial summer flounder harvest in pounds, 1958-2015.

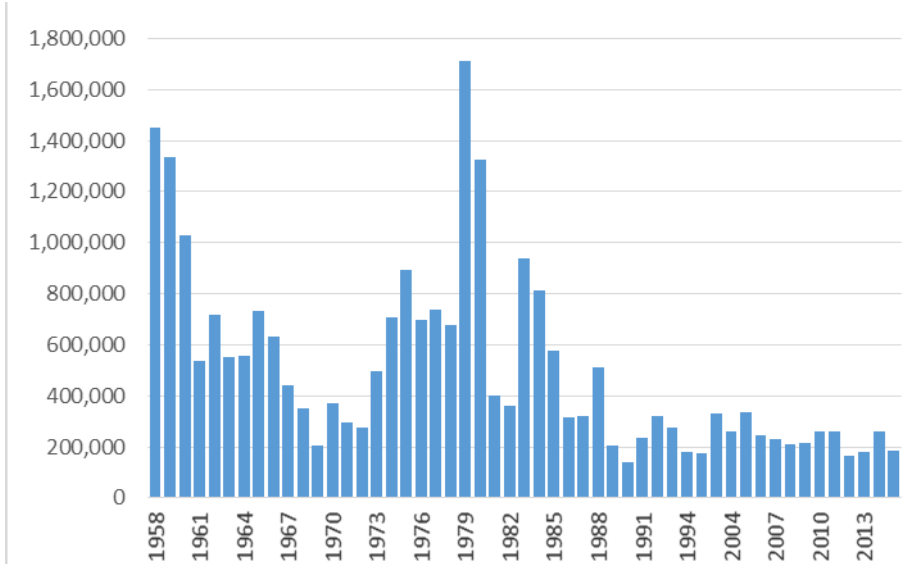
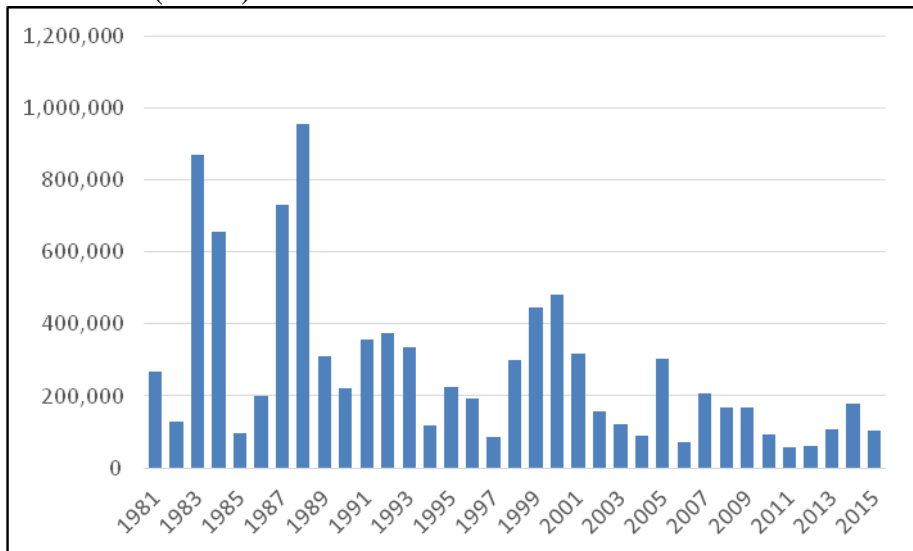


Figure 2. Estimated recreational summer flounder harvest in pounds, 1981-2015 (MRIP).



## Issues/Concerns

Some commercial harvesters from the lower mid-Atlantic are beginning to travel northward to catch summer flounder. For example, harvesters from North Carolina will travel by boat to New Jersey. The commercial sector has requested permission to land summer flounder at a port located where they are fishing rather than traveling back to their home port. A potential consequence of such a change would be a reallocation of state commercial quotas.

A poleward expansion of summer flounder distribution has been evident since 2009.<sup>8</sup> The poleward expansion of summer flounder may be a response to warming water temperature<sup>9</sup> or to fishery regulations that increased the proportion of larger summer flounder. Larger fish are found in cooler northern waters resulting in the northward shift of the species' center of biomass.<sup>10</sup> As a result of changes in distribution and concerns about management, the ASMFC and MAFMC will take the change under consideration during their comprehensive review of the summer flounder management framework.

## References

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- <sup>3</sup> Northeast Fisheries Science Center. (2013). 57th northeast regional stock assessment workshop (57th SAW) assessment report (No. Ref Doc. 13-16) (p. 967). Woods Hole, MA: U.S. Department of Commerce, Northeast Fisheries Science Center. Retrieved from <http://www.nefsc.noaa.gov/nefsc/publications/>
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- <sup>5</sup> Doctor, S. 2016. Maryland's 2015 summer flounder (*Paralichthys dentatus*) compliance report to the Atlantic States Marine Fisheries Commission. Maryland Department of Natural Resources. Annapolis, Maryland.
- <sup>6</sup> Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division. <http://www.st.nmfs.noaa.gov/index>. Accessed March 23, 2016.
- <sup>7</sup> Personal communication from the NOAA Fisheries Service, Northeast Regional Office, Fisheries Statistics Office. Accessed Sept 27, 2016.. [http://www.nero.noaa.gov/ro/fso/reports/reports\\_frame.htm](http://www.nero.noaa.gov/ro/fso/reports/reports_frame.htm)
- <sup>8</sup> Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. (2014). Fisheries of the Northeastern United States; Summer Flounder, Scup, and Black Sea Bass Fisheries; 2014 Summer Flounder Specifications; 2015 Summer Flounder, Scup, and Black Sea Bass Specifications; 2014 Research Set-Aside Projects (Federal Register No. 79(61)).
- <sup>9</sup> Nye, J. A., Link, J. S., Hare, J. A., & Overholtz, W. J. (2009). Changing spatial distribution of fish stocks in relation to climate and population size on the Northeast United States continental shelf. *Marine Ecology Progress Series*, 393, 111–129. doi:10.3354/meps08220
- <sup>10</sup> Bell, R. J., Hare, J. A., Manderson, J. P., & Richardson, D. E. (2014). Externally driven changes in the abundance of summer and winter flounder. *ICES Journal of Marine Science*, 71(5). doi:10.1093/icesjms/fsu069





<b>Amendment #1 to the 1991 Chesapeake Bay Summer Flounder Fishery Management Plan Implementation Table (updated 9/2016)</b>			
<b>Strategy</b>	<b>Action</b>	<b>Date</b>	<b>Comments</b>
		2013	limits are adjusted for over/under harvest. A series of combined pound/day and pound/species (Atlantic croaker, black sea bass, scup, squid, scallop, and Atlantic mackerel) restrictions have been implemented.
		2014-2015	MD's commercial hook & line minimum size was reduced from 16" to 14". Min.size for other gear types is 14". PRFC and VA minimum size is 14".
	1.1b) The jurisdictions will implement recreational seasons, creel limits and minimum size limits to meet the annual coastal recreational harvest limits recommended by the MAFMC/ASMFC.	2001	ASMFC implements coastwide system for conservation equivalency.
		2003	ASMFC sets State-specific recreational harvest targets.
		2005	ASMFC established a program to allow the recreational summer flounder coastwide allocations to be subdivided into regions.
		2014	Regional management was implemented in place of conservation equivalency. MD, DE, and VA are being managed as a single region with all jurisdictions having the same regulations: 16" minimum length and 4 fish/person/day creel.
		<b>2015</b>	<b>Regional management was continued for 2015</b>
	1.1c) Maryland and Virginia will maintain the traditional commercial fishery by requiring a special landings permit for the Atlantic commercial summer flounder fishery. The jurisdictions will develop, define and adopt criteria to determine eligibility for participation in the fishery.	1998	MD has implemented a summer flounder catch share system. The catch share allocation equitably distributes the quota among harvesters based on past harvest. IFQ allows fishermen to manage harvest for best economic yield.
		2003	
		Continue	
		2005	
		On-going	VA issues permits for vessels and dealers.

**1991 Chesapeake Bay Summer Flounder Fishery Management Plan Implementation Table (updated 9/2015)**

<b>Strategy</b>	<b>Action</b>	<b>Date</b>	<b>Comments</b>
1.1) Maryland, Virginia and the PRFC will propose changes in the minimum size regulations, creel limits and seasons in the recreational fishery to conform to guidelines set by MAFMC. Maryland and Virginia will comply with commercial quotas, mesh sizes and other commercial restrictions enacted by MAFMC. These recommendations are intended to provide greater spawning stock biomass from each flounder year-class and provide a greater yield-per-recruit.	1.1a) Maryland, the PRFC and Virginia will propose an increase in their minimum size limit for recreationally caught flounder from 13 inches to 14 inches.	1992	Initiated increasing minimum size 13" to 14" ASMFC revised overfishing definition.
		1998	See Amendment 1, Strategy 1.1, Action 1.1b
	1.1b) Maryland, Virginia and the PRFC will propose creel limits and seasonal restrictions in compliance with MAFMC recommendations. A six fish creel limit will be proposed as one measure to meet these recommendations. A recreational fishing season extending from May 15 – Sept. 30 may also be required to reduce fishing mortality. Virginia will continue to enforce its ten fish per day limit until such time as MAFMC recommendations can be implemented.	1998	See Amendment 1, Strategy 1.1, Action 1.1b
	1.1c) Commercial size limits will remain at 13" for Virginia and Maryland in conformance with MAFMC recommendations. The PRFC will propose a 14" minimum commercial size limit for its commercial flounder fisheries to provide parity with the recreational fishery. A 5.5 inch diamond or 6 inch square minimum cod end mesh size will be implemented in all directed flounder trawl fisheries.	1998	See Amendment 1, Strategy 1.1, Action 1.1a
	1.1d) Commercial fisheries will be subject to quotas set by MAFMC and	1993	ASMFC State allocations changed.

**1991 Chesapeake Bay Summer Flounder Fishery Management Plan Implementation Table (updated 9/2015)**

Strategy	Action	Date	Comments
	administered by the states. All flounder landed by a vessel registered in a state will be counted towards that state's quota, without regard to the actual fishing location. Commercial fisheries in each state will be closed when that state's quota is reached. The PRFC will propose a moratorium on its commercial flounder fisheries from January through June, inclusive, to compliment the seasonal closure proposed for the recreational fishery, in addition to conforming to MAFMC quota closures.	<p>1995</p> <p>1998</p> <p>2012</p> <p>2013</p> <p><b>2014 Continue</b></p>	<p>ASMFC capped coastwide quota &amp; adjusted stock rebuilding schedule.</p> <p>ASMFC revised overfishing definition. See Amendment #1, Strategy 1.1, Action 1.1a</p> <p>MD receives 2.04% of the coastwide commercial TAL. A portion of MD's TAL is allocated to PRFC. VA is allocated 21.3% of the coastwide quota.</p> <p>A coastwide benchmark stock assessment was completed in 2013 (with data through 2012). Updated BRPs were adopted. The coastal summer flounder stock is not overfished and overfishing is not occurring.</p> <p><b>The MAFMC began a major review of the summer flounder component of their management framework</b></p>
1.2) Management agencies will continue to promote the implementation of minimum mesh size in the directed flounder trawl fisheries sufficient to allow escapement of immature female flounder. Management agencies will urge the Mid-Atlantic Fisheries Management Council to enact a mesh size compatible with these management goals in the directed flounder trawl fisheries to complement the mesh size	<p>1.2a) Virginia and Maryland will implement a 5.5 inch diamond or 6 inch square minimum cod end mesh size in all directed flounder trawl fisheries to allow escapement of immature female flounder. Virginia and the PRFC will continue their bans on trawling in state waters.</p> <p>1.2b) Virginia and Maryland will work with the Mid-Atlantic Fisheries Management Council to adopt a 5.5 inch diamond or 6 inch square minimum cod end mesh size for the EEZ flounder trawl fishery consistent with the objectives of the Baywide Plan and MAFMC's</p>	<p>On-going</p> <p><b>2014 Continue</b></p>	<p>Mesh size restrictions have been implemented.</p> <p>Mesh size restrictions have been implemented.</p> <p><b>MAFMC has begun a major review of their management framework for summer flounder.</b></p>

**1991 Chesapeake Bay Summer Flounder Fishery Management Plan Implementation Table (updated 9/2015)**

Strategy	Action	Date	Comments
requirements enacted through the Baywide Plan.	recommendations for conservation of the resource.		
1.3) Virginia, Maryland and the Potomac River Fisheries Commission will investigate the incidental bycatch of small flounder in non-directed fisheries and participate in coastal deliberations to protect small flounder in other coastal states.	1.3a) Maryland will collect information from its pound net and ocean trawl fisheries to develop management strategies for reducing the non-directed bycatch of small flounder and other species. Options for consideration include minimum mesh sizes, season and area restrictions, culling practices, escape panels and fishing efficiency devices.	On-going	MD collects summer flounder abundance, size, and age data from commercial trawlers fishing near-shore Atlantic waters.
	1.3b) Virginia will continue to monitor the species composition and biological characteristics of bait harvested in its pound net fishery. The VMRC will take action, as needed, to reduce the incidental bycatch of small flounder in the bait fishery.	On-going	Monitoring of pound net bait fish harvest is not required.
	1.3c) Maryland, PRFC, and Virginia will work through the Mid-Atlantic Fisheries Management Council and the Atlantic States Marine Fisheries Commission to encourage protection of immature flounder.	On-going	Immature flounder are conserved via gear and harvest restrictions.
2.1) Maryland, Virginia and the Potomac River Fisheries Commission will continue to support stock identification research to determine the extent of stock mixing in the Chesapeake Bay flounder population.	2.1) The jurisdictions will continue to support stock identification research, particularly stock composition tagging studies being conducted at Virginia's Institute of Marine Science (VIMS) and the University of Maryland. Coordinated studies on the relative contribution of various estuaries, including the Chesapeake Bay, to the coastal flounder	1995 On-going	VIMS and the VMRC cooperatively support the Virginia Game Fish Tagging Program. The tagging program trains and maintains an experienced group of volunteer recreational anglers who tag and release the fish they catch. More information is available at: <a href="http://www.vims.edu/research/units/centerspartners/map/recfish/index.php">http://www.vims.edu/research/units/centerspartners/map/recfish/index.php</a>
		2014	MD does not have a summer flounder tagging

<b>1991 Chesapeake Bay Summer Flounder Fishery Management Plan Implementation Table (updated 9/2015)</b>			
<b>Strategy</b>	<b>Action</b>	<b>Date</b>	<b>Comments</b>
	stock will be initiated.		program.  <b>Regional stock management was implemented for 2014 and continues into 2016.</b>
2.2) Virginia will continue to support stock assessment work conducted by the VMRC and index of abundance research performed by Virginia Institute of Marine Science (VIMS).	2.2) VMRC's Stock Assessment Program will continue to collect biological data (age, size, sex) from commercial catches of summer flounder. VIMS will continue to monitor abundance of juvenile flounder through its young-of-the-year and juvenile flounder survey trawl indices.	On-going	Data collection is required by ASMFC and MAFMC.
2.3) Maryland, Virginia and the Potomac River Fisheries Commission will continue to support interjurisdictional efforts to maintain a comprehensive data base on coastwide level.	2.3) Maryland, Virginia and the PRFC will continue to collect fisheries landings data on summer flounder as part of ongoing commercial fisheries statistics programs. Virginia will continue to pursue adoption and implementation of a limited and/or delayed entry program and a mandatory reporting system for commercial licensees. Maryland and Virginia will continue to supplement the Marine Recreational Fisheries Statistics Survey to obtain more detailed catch statistics at the state level. Through FISHMAP, Maryland will begin a pound net sampling project to collect information on summer flounder and other species.	On-going  2006	Data collection is required by ASMFC and MAFMC.  FISHMAP program was discontinued.
2.4) Maryland and Virginia will continue their joint and individual efforts in providing the information needed to determine the relationship	2.4) Maryland and Virginia will continue the Baywide trawl survey of estuarine finfish species and crabs to measure size, age, sex distribution, abundance and CPUE. Maryland will continue seaside	1977 On-going 1989 On-going	MD DNR conducts a summer blue crab trawl survey.  VIMS and MD DNR collaboratively conduct a winter dredge survey of blue crabs.



**1991 Chesapeake Bay Summer Flounder Fishery Management Plan Implementation Table (updated 9/2015)**

Strategy	Action	Date	Comments
Agreement. The achievement of the Bay commitments will lead to improved water quality and enhanced biological production.	The Agreement and documents developed pursuant to the Agreement call for: 1) Developing habitat requirements and water quality goals for various finfish species.	2014	wetlands. For more information: <a href="http://www.chesapeakebay.net/issues">http://www.chesapeakebay.net/issues</a>  The CBP has developed a Chesapeake Watershed Agreement (2014) with fisheries and habitat outcomes. Summer flounder is not a focal species.
	3.1 2) Developing and adopting basinwide nutrient reduction strategies.	1990 On-going	Chesapeake Bay Program develops, revises, and monitors goals and strategies for nutrient reduction. For more information: <a href="http://www.chesapeakebay.net/issues/issue/nutrients">http://www.chesapeakebay.net/issues/issue/nutrients</a>
	3.1 3) Developing and adopting basinwide plans for the reduction and control of toxic substances.	1990 On-going	Chesapeake Bay Program develops, revises, and monitors goals and strategies for chemical contaminants. For more information: <a href="http://www.chesapeakebay.net/issues/issue/chemical_contaminants">http://www.chesapeakebay.net/issues/issue/chemical_contaminants</a>
	3.1 4) Developing and adopting basinwide management measures for conventional pollutants entering the Bay from point and nonpoint sources.	1990 On-going	Chesapeake Bay Program develops, revises, and monitors goals and strategies for sediment, wastewater, stormwater runoff, and agriculture. For more information: <a href="http://www.chesapeakebay.net/issues/issue/sediment">http://www.chesapeakebay.net/issues/issue/sediment</a> <a href="http://www.chesapeakebay.net/issues/issue/wastewater">http://www.chesapeakebay.net/issues/issue/wastewater</a> <a href="http://www.chesapeakebay.net/issues/issue/stormwater_runoff">http://www.chesapeakebay.net/issues/issue/stormwater_runoff</a>
	3.1 5) Quantifying the impacts and identifying the sources of atmospheric inputs on the Bay system.	1990 On-going	Chesapeake Bay Program develops, revises, and monitors goals and strategies for air pollution. For more information: <a href="http://www.chesapeakebay.net/issues/issue/air_pollution">http://www.chesapeakebay.net/issues/issue/air_pollution</a>
	3.1 6) Developing management strategies to protect and restore wetlands and submerged aquatic vegetation.	1990 On-going	Chesapeake Bay Program develops, revises, and monitors goals and strategies for wetland and submerged aquatic vegetation restoration. For more information:

1991 Chesapeake Bay Summer Flounder Fishery Management Plan Implementation Table (updated 9/2015)			
Strategy	Action	Date	Comments
			<a href="http://www.chesapeakebay.net/issues/issue/wetlands">http://www.chesapeakebay.net/issues/issue/wetlands</a> <a href="http://www.chesapeakebay.net/issues/issue/bay_grasses">http://www.chesapeakebay.net/issues/issue/bay_grasses</a>
	3.1 7) Managing population growth to minimize adverse impacts to the Bay.	1990 On-going	Chesapeake Bay Program develops, revises, and monitors goals and strategies for land development. For more information: <a href="http://www.chesapeakebay.net/issues/issue/development">http://www.chesapeakebay.net/issues/issue/development</a>

### Acronyms

ASMFC – Atlantic States Marine Fisheries Commission  
 CBP – Chesapeake Bay Program  
 ChesFIMS – Chesapeake Bay Fishery-Independent Multispecies Survey  
 ChesMMAP – Chesapeake Bay Multispecies Monitoring and Assessment Program  
 CPUE – Catch per Unit Effort  
 EEZ – Exclusive Economic Zone  
 FISHMAP – Fishery Independent Sampling and Habitat Mapping  
 FMP – Fishery Management Plan  
 IFQ – Individual Fishing Quota  
 MAFMC – Mid-Atlantic Fishery Management Council  
 MD DNR – Maryland Department of Natural Resources  
 NEAMAP – Northeast Area Monitoring and Assessment Program  
 NMFS – National Marine Fisheries Service  
 PRFC – Potomac River Fisheries Commission  
 SAW – Stock Assessment Workshop  
 TAL – Total Allowable Landings  
 VAC – Code of Virginia  
 VIMS – Virginia Institute of Marine Science  
 VMRC – Virginia Marine Resource Commission



## 2015 Maryland FMP Report (September 2016)

### Section 19. Tautog (*Tautoga onitis*)

Tautog, also known as blackfish, are predominately a recreational species. They are frequently encountered in the Atlantic Ocean and the Coastal Bays and infrequently in Maryland's portion of the Chesapeake Bay. The International Game Fish Association (IGFA) World Record tautog was caught off Ocean City, Maryland in January 2015; this fish was 23 years old. Although the oldest tautog aged in Maryland has been 28 years old, they are known to reach 40 years old. Tautog prefer reef structure and typically do not migrate more than 20 miles. Spawning occurs in the Atlantic Ocean during May and June and juvenile fish can be found in the eel grass beds within Maryland's Coastal Bays. Tautog are managed by the Atlantic States Marine Fisheries Commission (ASMFC). The current coastwide management uses a single stock approach but will be changing to a regional management approach with the development of an amendment in 2017. While tautog are overfished on a coastwide basis, overfishing is not occurring in the Delmarva region.<sup>1</sup>

#### Fishery Management Plans (FMPs)

The Chesapeake Bay and Atlantic Coast Tautog Fishery Management Plan (CBT FMP) was adopted in 1998 by the Chesapeake Bay Program to perpetuate the stock and maintain existing fisheries. The CBT FMP adopts ASMFC guidelines and requirements. The CBT FMP was reviewed in 2011. The review evaluated the goals, objectives, strategies, and actions within the 1998 FMP and concluded that the current management framework is appropriate for managing the stock.

The ASMFC Fishery Management Plan for Tautog (1996) defined overfishing and established an interim fishing mortality rate (F) of 0.24, a final target  $F = 0.15$ , and a minimum size of 14". Addenda I (1997) and II (1999) successively extended the implementation timeframe for  $F_{\text{target}}$ . Addendum III (2002) revised the  $F_{\text{target}}$  reference point to 0.21 and a biological reference point of 40% spawning stock biomass (SSB, 0.29). Overfishing was defined as  $F_{\text{threshold}} = 0.29$ . Addendum IV (January 2007) established biological reference points to determine if tautog are overfished:  $SSB_{\text{target}} = 59$  million lbs. and  $SSB_{\text{threshold}} = 44$  million lbs. Tautog biomass was below average for 8 years and a rebuilding  $F_{\text{target}}$  of 0.20 was implemented. The addendum stipulated that only recreational regulations would be implemented to reduce F. Addendum V (April 2007) removed the provision that restricted regulations to the recreational fishery. Addendum VI (2011) required a reduction in  $F_{\text{target}}$  to 0.15: a 53% coast wide reduction in harvest. Following Technical Committee recommendations, the 53% coastwide harvest reduction was revised to 39% in early 2012.<sup>2</sup> Maryland implemented regulations in 2013 to achieve the required reduction. Maryland is required to submit an annual compliance report to ASMFC. As a result of the 2015 ASMFC stock assessment, the tautog Management Board began the development of draft Amendment 1 to consider a

regional approach to managing and to assessing the stock. The draft amendment is scheduled for completion in 2017.

#### Stock Status

Over the years, the ASMFC has conducted benchmark (full) stock assessments for tautog (1999, 2005, 2015) and one update in 2011 that was revised in 2012. The most recent stock assessment (2014/2015) utilized data through 2013. This assessment conducted analyses for the coastwide stock population and for multiple regions as discrete stock populations. Based on the coastwide stock, tautog continue to be overfished and overfishing is still occurring.<sup>1</sup> Tautog SSB has remained below the threshold value since 1989.<sup>1</sup> However, based on the regional assessment approach, the Southern New England (MA-CT) stock is overfished and overfishing is occurring; the NY-NJ stock is overfished, but overfishing is not occurring; and the Delmarva stock is overfished, but overfishing is not occurring.<sup>1</sup> The ASMFC Technical Committee recommended a stock assessment update in 2016 with the ability to modify the regions to include Long Island Sound as an additional region for analyses.

Tautog are sampled by Maryland's Coastal Bays Finfish Investigation (CBFI) program. The 2015 tautog relative abundance indices from the CBFI Trawl and Beach Seine Survey were not different from the grand means. Tautog were captured in three of 140 trawls (2%) and in four of 38 beach seines (11%). Tautog ranked 52nd out of 74 species in overall finfish abundance. The trawl and beach seine CPUEs were 0.2 fish/hectare and 0.1 fish/haul, respectively. The CBFI Submerged Aquatic Vegetation Habitat Survey results showed higher tautog mean abundance compared to the CBFI Trawl and Beach Seine Survey. There were 83.2 tautog/hectare in SAV beds with 50-75% SAV coverage and 29.1 tautog/hectare in SAV beds with  $\leq 25\%$  SAV coverage.

#### Current Management Measures

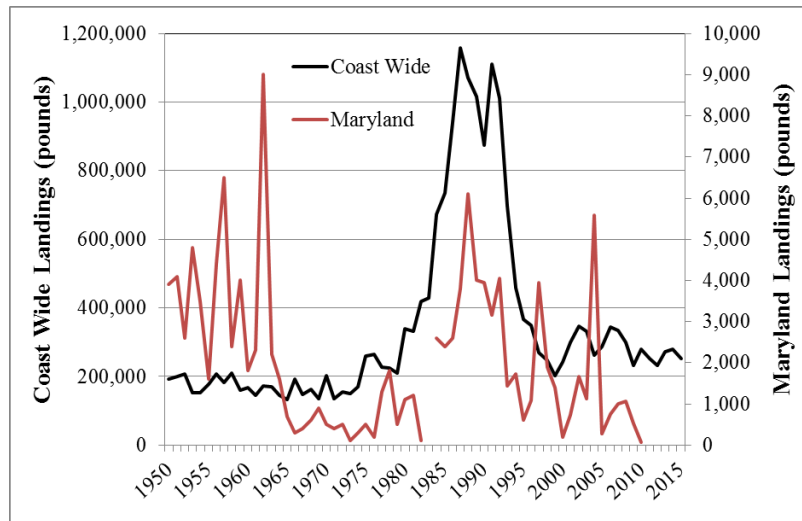
Maryland's tautog regulations have not changed since 2013. Both commercial and recreational fisheries have a minimum size limit of 16". Fisheries in tidal and coastal waters are limited to 4 fish per person per day during January 1 – May 15 and during November 1 – 26. Harvest is reduced to 2 fish per person per day from May 16 – October 31. Tautog harvest is prohibited from November 27 – December 31. Commercial harvesters are allowed to use hook and line, net, pot, trap, trot line, and seine. One panel on pots and traps must be attached with degradable fasteners to prevent ghost fishing if the pot is lost. Recreational anglers are restricted to hook and line.

## The Fisheries

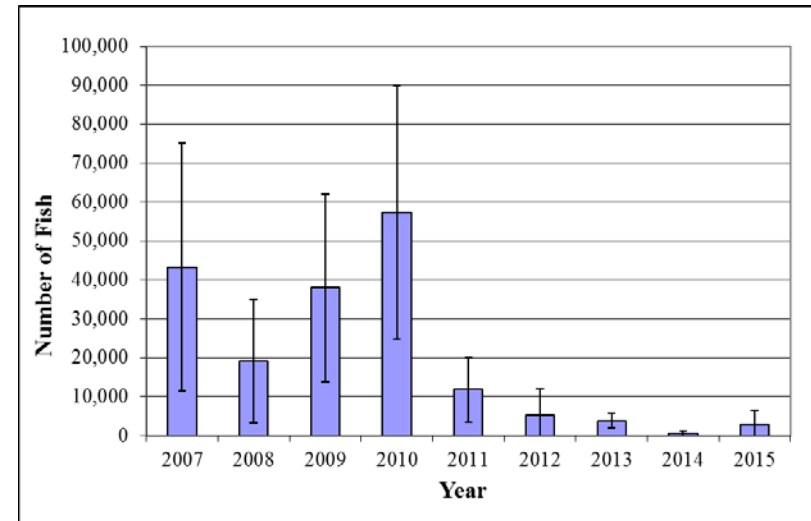
Maryland's commercial and recreational tautog harvests are minor components of the coastwide landings and comprise approximately 1% of the total. Commercial landings have remained at low levels since 2007 due to the limited possession allowance (Figure 1).<sup>5</sup>

The Marine Recreational Information Program (MRIP) estimate of recreational tautog harvest (A + B1) from Maryland during the 2015 fishing season was 2,988 fish (Figure 2).<sup>6</sup> Estimated harvest has decreased since 2010 with the lowest recreational landings occurring in 2014. The 2015 recreational harvest was comprised of three modes: fishing from shore (65%), charter boat (30%) and party boat (5%). Tautog are not well-sampled by the MRIP program, resulting in higher proportional standard errors (PSEs; approximately 20-25% in recent years at the regional level) and larger year-to-year fluctuations in catch estimates, often driven by small numbers of fish recorded during the intercept survey.<sup>1</sup>

**Figure 1. Maryland and coastwide commercial tautog landings 1950-2015. Data Source: Atlantic Coastal Cooperative Statistics Program (note different scales).**



**Figure 2. Maryland estimated recreational tautog harvest (A + B1; number of fish): 2007-2015(MRIP data).**



## Issues/Concerns

Adult tautog are dependent on hard bottom structure such as reefs, ship wrecks, stones or artificial structures. Juveniles require SAV beds and protected coastal embayments for development. While SAV has increased in the Chesapeake Bay, the Coastal Bays have experienced a decrease in SAV beds. These habitats are essential for a sustainable population. This species congregates around structures, is slow growing, has a late age at maturity and is long-lived; making it susceptible to overfishing. Tautog are considered a delicious meal, and illegal live markets are a concern to management and law enforcement. Regional management will likely benefit this species and anglers in the near future.

## References

- <sup>1</sup> Atlantic States Marine Fisheries Commission. 2015. Tautog Benchmark Stock Assessment and Peer Review Reports. Arlington, Virginia
- <sup>2</sup> Atlantic States Marine Fisheries Commission. 2015. Review of the Atlantic states marine fisheries commission fishery management plan for tautog (*Tautoga onitis*):

Fishing year 2013. Atlantic States Marine Fisheries Commission. Arlington, Virginia.

<sup>3</sup> Maryland Department of Natural Resources. 2016. Maryland's 2015 tautog (*Tautoga onitis*) compliance report to the Atlantic States Marine Fisheries Commission. Maryland Department of Natural Resources, Fisheries Service. Annapolis, Maryland.

<sup>4</sup> Doctor, S., Tyler, T., Weedon, C. and A. Willey. 2015. MDDNR-Fisheries Service, Investigation of Maryland's Coastal Bays and Atlantic Ocean Finfish Stocks, USFWS Federal Aid Project, F-50-R-24.

<sup>5</sup> The Atlantic Coastal Cooperative Statistics Program (ACCS), 2016, Non-confidential data.

<sup>6</sup> Marine Recreational Information Program (MRIP), National Marine Fisheries Service, 2016, Fisheries Statistics Division.

1998 Chesapeake and Atlantic Coast Tautog Fishery Management Plan Implementation Table (updated 6/2016)			
Strategy	Action	Date	Comments
1) Implement minimum size and possession limits applicable to the commercial and recreational fisheries to prevent overexploitation. Monitor size composition of landings in the recreational fishery to prevent compression of age structure in the population. Use size composition of fish in the recreational fishery and total landings in the commercial fishery as triggers to implement further management of the fishery, should statistically significant compression of the age structure occur. This plan recommends that the Secretary of Commerce implement minimum size and possession regulations for tautog in the EEZ that are in accordance with state minimum size requirements contained in the plan. It is the intention under the Atlantic Coastal Fisheries Conservation and Management Act to have EEZ fisheries regulated consistent with state possession and landing laws, and that the more stringent of state or federal law will apply regardless of whether fish are caught in the EEZ or in state waters.	1.1) VA, MD and PRFC will implement a minimum size limit of 14" in the recreational and commercial tautog fisheries. Minimum size limits may be changed as more data becomes available on stock condition and biological reference points are re-evaluated.	1998 2003 2005 Continue	MD commercial and recreational fisheries have a 16" minimum size, 4 fish/person/day from January 1 – May 15, 2 fish/person/day from May 16 – October 31, 4 fish/person/day from November 1 – 26, and is closed from November 27 – December 31. VA has a 16" minimum size, 3 fish/person/day creel, and a recreational closure from May 1 – Sept 19. VA commercial fishery has a 15" minimum size, no catch limit, and seasonal closures from January 22 – last day of February and May 1 - October 31. PRFC has a 14" minimum size limit and no harvest restrictions for both commercial and recreational fisheries.
	1.2) VA, MD and PRFC will reduce fishing mortality to interim and target rates, as defined by ASMFC, through a combination of possession limits, gear, seasons, and/or other restrictions. Target rates may be changed and management measures adjusted as more data becomes available to manage the stock. Due to differences in F between MD and VA, different management strategies may be necessary to reach the target F set by ASFMFC. The jurisdictions will continue to work towards a unified, Baywide management strategy.	1998 2000 2003 2005 2011  2011 2012  2015-2017	A benchmark coastal stock assessment was completed in 2005 (using data from 1981-2004). Results indicate that F declined from 0.71 to 0.299. Overfishing was redefined as $F_{40\%SSB}=0.29$ . The most recent 3-year average ( $F=0.389$ ) exceed the ASMFC rebuilding target ( $F=0.2$ ), so tautog are being overfished. Tautog have a $SSB_{2009}$ of 23.5 million lbs, 20.8 million lbs below the $SSB_{threshold}$ meaning tautog are currently overfished.  ASMFC Addendum VI was implemented to reduce F to 0.15, a 53% reduction, and prohibit possession of tautog caught in federal waters. MD's 2012 harvest reduction was decreased from 48% to 39%.  <b>Based on the 2015 tautog benchmark stock assessment, the coastal stock is overfished and overfishing is occurring. <sup>1</sup> Besides assessing tautog as one unit stock along the coast, a regional stock assessment approach was evaluated. As a result, ASMFC has initiated the development of an amendment for a regional approach with region-specific reference points and is scheduled for completion in 2017.</b>
	1.3) VA and MD waters will continue to require degradable fasteners in tautog pots and traps utilizing either: <ul style="list-style-type: none"> <li>• Untreated hemp, jute, or cotton string of 3/16" (0.48 mm) or smaller</li> <li>• Magnesium alloy, timed float releases (pop-up devices) or similar magnesium alloy fasteners</li> </ul>	1997 Continue	A pot and trap shall have hinges on one panel/door made of untreated hemp or jute string 3/16" (4.8 mm) diameter or smaller, magnesium alloy fasteners or ungalvanized/uncoated iron wire of 0.094" (2.39 mm) diameter.

1998 Chesapeake and Atlantic Coast Tautog Fishery Management Plan Implementation Table (updated 6/2016)			
Strategy	Action	Date	Comments
	<ul style="list-style-type: none"> <li>Ungalvanized or uncoated iron wire of 0.09" (2.39 mm) or smaller.</li> </ul>		
<p>2.1) VA and MD will work with Virginia Institute of Marine Science, Old Dominion University, University of Maryland, Smithsonian Institute and National Marine Fisheries Service's Marine Recreational Fisheries Statistics Survey to conduct research into the size, age and sex composition of tautog in the Chesapeake Bay. The agencies' stock assessment departments will continue to collect information on size composition to monitor the status of tautog stocks. This stock assessment data will be used to determine a baseline of age and sex distribution for the local stock, significant deviation from which will be used as a trigger mechanism to determine the need for future management measures.</p>	<p>2.1) The management agencies will gather data on age, size and sex distribution to be used as a baseline measurement of a healthy population and will encourage research into the possibility of sex-reversal in the tautog population.</p>	<p>Continue 1989-1999 Continue</p> <p>2014</p>	<p>Annual fecundity estimates are much higher than previously thought. All states are required to collect data to support the coast wide stock assessment. Data are collected from cooperating head boat captains, trawl, and seine.</p> <p>A DNA analysis of tautog was conducted to determine if there is genetic separation in the coastal stock. Maryland is participating in this study, results pending publication.</p>
	<p>2.1 A) VA will continue the Baywide trawl survey of estuarine finfish species and crabs to measure size, age, sex, distribution, abundance and CPUE.</p>	<p>Continue</p>	<p>Data from the Baywide trawl survey is used in the ASMFC stock assessment. However, very little data is collected on tautog.</p>
	<p>2.1 B) VA implemented a mandatory reporting system for commercial licensees beginning January 1, 1993. Maryland's mandatory reporting system has been in effect since 1944 (excluding eel). Improved reporting of commercial landings, along with more detailed information on catch location and effort are some of the expected benefits of these programs.</p>	<p>Continue</p>	<p>Commercial reporting has been improved through more stringent penalties for late reporting and no reporting.</p> <p>MD commercial landings have been &lt;1% of the coastal harvest since 2007.</p>
	<p>2.1 C) VA will continue to supplement the Marine Recreational Fisheries Statistics Survey to obtain more detailed catch statistics at the state level. VA's new recreational saltwater fishing license may provide funding for more extensive surveys of the state's recreational fishery.</p>	<p>2009 Continue</p> <p>2011 Continue</p> <p>2011 On-going</p>	<p>MD contracted to have supplemental MRFSS recreational data collected.</p> <p>MD implemented a coastal recreational saltwater license requirement.</p> <p>The MRFSS survey is being improved through implementation of the MRIP program. NMFS requires all states to register recreational fishermen to create a more robust data base to estimate recreational harvest.</p> <p><b>The Marine Recreational Information Program (MRIP) estimated total recreational harvest (A + B1) of 2,988 tautog from Maryland during 2015.</b></p>
	<p>2.1 D) MD's Coastal Bays Fisheries Investigation will be expanded by conducting a creel survey from recreational headboats. The survey will collect biological data on tautog such as sex, length, age and information on recreational fishing effort.</p>	<p>1972 Continue</p> <p>1999 Continue</p>	<p>Juvenile tautog are sampled during the summer and fall coastal bays trawl and seine survey (not designed to target tautog).</p> <p>MD Coastal Bays Fisheries Investigation (CBFI) annually collects age, length, and sex data plus tissue samples for DNA analysis. Tautog are purchased from several commercial fishermen or collected by hook and</p>

1998 Chesapeake and Atlantic Coast Tautog Fishery Management Plan Implementation Table (updated 6/2016)			
Strategy	Action	Date	Comments
		2015	line. <b>From the CBFI, tautog were captured in three of 140 trawls (2%) and in four of 38 beach seines (11%). The trawl and beach seine CPUEs were 0.2 fish/hectare and 0.1 fish/haul, respectively. There were 83.2 tautog/hectare in SAV beds with 50-75% SAV coverage and 29.1 tautog/hectare in SAV beds with ≤ 25% SAV coverage.</b>
2.2) The jurisdictions will promote research to determine the extent of migration and mortality in localized tautog populations. As reliance of this species on structure for both food and shelter may limit populations in the Chesapeake Bay area, studies designed to determine the relationship between population size and available shelter and food sources should likewise be encourages.	2.2) Research on migration of tautog between areas is encouraged. Tagging experiments to provide data on tautog migration may be funded from sales of saltwater fishing licenses. The Virginia Game Fish Tagging Program will be continued.	Continue  2007 On-going  Continue	A study on the seasonal occurrence of tautog in the lower CB indicates that most fish tagged and released in inshore waters remain inshore for the winter rather than move offshore (Arendt, Lucy and Munroe, 2001).  VA initiated Marine Sportfish Collection Project to collect sex, length, and age data. Freezers were set up for recreational anglers to donate whole fish or carcasses.  VA initiated Saltwater Fisherman’s Journal where anglers log their fishing experiences and anecdotal information.
3.1.1) Restoration of aquatic reefs could lead to increased habitat for tautog. Jurisdictions will continue to expand and improve their current oyster restoration programs with periodic program evaluations to ensure maximum success.	3.1.1A) MD and VA will continue the implementation of the 1994 Oyster FMP which combines the recommendations of both the Virginia Holton Plan and the Maryland Roundtable Action Plan. Strategies in both VA & MD have taken a new focus as the programs intensify efforts to manage around the devastating oyster diseases, Dermo and MSX, currently infecting Chesapeake Bay oysters.	Continue 2003 2004   2008   2009 - 2010  2012 <b>Continue</b>	The 1994 Oyster FMP was revised and adopted in 2004. It incorporated concepts from the 1994 FMP and the Aquatic Reef Habitat Plan. Sanctuary and special management areas are protected from harvest and oyster habitat is being restored.  <i>Crassostrea virginica</i> (native oyster) and not <i>Crassostrea ariakensis</i> (Asian oyster) will be used for reef development following the Environmental Impact Statement for Oyster Restoration in Chesapeake Bay Including the Use of a Native and/or Nonnative Oyster.  MDNR has expanded the oyster sanctuary network from 9% to 25% (app. 9,000 acres) of the available oyster habitat. Both recreational and commercial fish species will benefit from improved/protected oyster bar habitat.  MD & VA operate through each state’s interagency team to implement restoration projects. Currently, MD has projects in Harris Creek, Little Choptank and Tred Avon. Oyster aquaculture is increasing. <b>6,062acres</b> of active

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Strategy	Action	Date	Comments
			aquaculture have been permitted from 2011 to July 2016).
	3.1.1B) MD and VA will continue the implementation of the Aquatic Reef Habitat Plan. "The purpose of the Aquatic Reef Habitat Plan is to guide the development and implementation of a regional program to rebuild and restore reefs as habitat for oysters and other ecologically valuable aquatic species."	2007 Continue  Continue  2010 On-going	MD ARC, MARI, and Maryland's Artificial Reef Management Plan were created and several reefs have been built in the Bay.  Reefs are qualitatively monitored with underwater video. There is no set sampling schedule or protocol.  ARC and MARI have begun support for shallow water (<20 ft.) reef projects.
3.1.2) The creation of new artificial reefs and the expansion and improvement of preexisting reefs will provide additional habitat for the tautog population.	3.1.2A) Jurisdictions will continue to maintain, expand, and improve their artificial reef programs. Since 1995, VA has developed 3 new reef sites within the Bay and expanded several existing sites, deploying more than 6,000 designed structures (concrete tetrahedrons) and over 5,000 tons of concrete rubble. MD has designated 3 sites as oyster sanctuaries where harvest is not allowed: Plum Point, lower Severn River and Cambridge. MD will also be examining the efficacy of small hill sanctuaries at 3 sites: Tangier, Choptank and Strong Bay (Chester R.).	1996-2006  2007 On-going  Continue  2008  2011  On-going	MD terminated its program in 1996. Artificial reef development was administered in the Chesapeake Bay by MD Environmental Service and in the Atlantic Ocean by the Ocean City Reef Foundation (OCRF).  MD Artificial Reef Committee and the MD Artificial Reef Initiative (MARI) were established to develop reefs in cooperation with OCRF. Both MARI and OCRF accept private donations while MD contributes funds when available for reef development projects.  In VA, artificial reefs are being funded through Recreational Advisory Board. All artificial reefs are created with funds from recreational license revenues adhere to gear type prohibitions.  44 NY subway cars were deployed off Ocean City.  USN Destroyer <i>Radford</i> was reefed on August 10, 2011. The vessel has since broken into 3 pieces but remains upright.  MARI and OCRC continue to develop existing and new artificial reefs as funding and materials become available.  For the most up-to-date information on the MD artificial reef program go to <a href="http://www.dnr.maryland.gov/fisheries/reefs/">http://www.dnr.maryland.gov/fisheries/reefs/</a> and for the VA artificial reef program go to <a href="http://mrc.virginia.gov/vsrfdf/reef.shtm">http://mrc.virginia.gov/vsrfdf/reef.shtm</a>
	3.1.2B) VA has recently prohibited the use of all gear except recreational rod and reel, hand-line,	Continue	MD and VA both adopted legislation that prohibits hydraulic clamming (and crab dredging in VA) in or near

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Strategy	Action	Date	Comments
	spear, or gig on four artificial reefs in state waters. The result of this regulation is similar to the MAFMC/ASMFC Special Management Zones that protect vital tautog habitat.		SAV beds. MD has a prohibition on hydraulic dredging in coastal bays. It is allowed in MD Chesapeake Bay waters, but not within a delineated SAV bed. There is no required setback from the bed.
3.2.1) Jurisdictions will continue efforts to: “achieve a net gain in SAV distribution, abundance, and species diversity in the Chesapeake Bay and its tributaries over current populations”.	3.2.1.1A) Protect existing SAV beds from further losses due to increased degradation of water quality, physical damage to the plants, or disruption to the local sedimentary environment as recommended by the Chesapeake Bay Submerged Aquatic Vegetation Policy Implementation Plan.	Continue	MD and VA prohibit hydraulic clamming and crab dredging (VA) in or near SAV beds. MD prohibits hydraulic dredging within delineated SAV beds, but there is no required setback.
	3.2.1.1B) The Guidance for Protecting Submerged Aquatic Vegetation in Chesapeake Bay from Physical Disruption was developed in response to the above action and should be used by agencies making decisions that influence SAV survival in Chesapeake Bay. The following recommendations from the guidance document should be strongly considered when making decisions that impact SAV, with special emphasis on SAV that falls within the salinity range of juvenile. 1. Protect SAV and potential SAV habitat from physical disruption. Implement a tiered approach to SAV protection, giving highest priority to protecting Tier I and Tier II areas but also protecting Tier III areas from physical disruption. 2. Avoid dredging, filling or construction activities that create turbidity sufficient to impact nearby SAV beds during SAV growing season. 3. Establish an appropriate undisturbed buffer around SAV beds to minimize the direct and indirect impacts on SAV from activities that significantly increase turbidity.	Continue	MD implemented a living shorelines program in 1970 to encourage vegetative shoreline stabilization.  Regulations are in place to prohibit dredging through SAV beds. Tiered designation and prioritization of SAV beds has not been implemented. Avoidance of dredging, filling and construction impacts to SAV is strictly enforced by MDE and USACE with input from DNR, USFWS, and NMFS. MD has not established undisturbed buffers. VA has established buffer criteria.
		2003	The revised SAV goal adopted by Chesapeake Bay Program was restoration of 185,000 acres of SAV by 2010 and planting 1,000 acres of SAV by 2008.
		2008	MD legislated that shoreline stabilization projects must use living shoreline techniques unless demonstrated to be infeasible.
		2012	The SAV planting goal was revised to be the planting of 20 acres per year.
		2014 Continue	A new Chesapeake Watershed Agreement was adopted in 2014. The Bay jurisdictions developed a SAV outcome (goal) and a management strategy as a framework for reaching the goal. Biennial work plans (2016-2017) were developed to reach the baywide goal of 130,000 acres by 2025. The jurisdictions have already met the interim goal of 91,000 acres by 2017.
	3.2.1.2) Set and achieve regional water and habitat quality objectives that will result in restoration of SAVs through natural revegetation as recommended	Continue	Water quality criteria have been adopted and there is a water quality outcome in the 2014 Chesapeake Watershed Agreement.



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	by the Chesapeake Bay SAV Policy Implementation Plan.		<a href="http://www.chesapeakebay.net/restoringwaterquality.aspx?menuitem=14728">http://www.chesapeakebay.net/restoringwaterquality.aspx?menuitem=14728</a> .
	3.2.1.3) Set regional SAV restoration goals in terms of acreage, abundance, and species diversity considering historical distribution records and estimates of potential habitat as recommended by the Chesapeake Bay SAV Policy Implementation Plan.	2003 Continue	Chesapeake Bay Program adopted a revised the SAV goal to plant 1,000 acres of SAV by 2008; 173 acres have been planted to date ( <a href="http://www.chesapeakebay.net/indicators/indicator/planting_bay_grasses">http://www.chesapeakebay.net/indicators/indicator/planting_bay_grasses</a> ). The SAV planting goal was revised in 2012 to the planting of 20 acres per year. One acre was planted during 2013. The restoration goal is 185,000 acres of SAV (see 3.2.1A). VIMS annually surveys SAV distribution in Chesapeake Bay. 2013 SAV acreage was 59.9 thousand and 2014 estimated acreage is 75,835. <b>In 2015, 91,621 acres of SAV were mapped in Chesapeake Bay and its tributaries. Notable changes in SAV distribution were measured between 2015 and 2014. SAV increased 21% from 75,438 ac to 91, 621 ac.</b>
3.2.2) The jurisdictions will use The Submerged Aquatic Vegetation Habitat Requirements and Restoration Targets: A Technical Synthesis as a guide to set quantitative levels of relevant water quality parameters necessary to support continued survival, propagation and restoration of SAV, as well as established the regional SAV restoration target goals defined earlier in this section.	3.2.2) When choices must be made in selecting SAV restoration projects, to fund and support under the Chesapeake Bay SAV Policy Implementation Plan, specific attention should be given to action items that lead to the protection and restoration of SAV found within the juvenile tautog habitat range.	Continue	More emphasis is being placed on multispecies benefits when considering restoration projects. Long-term survival of SAV plantings has been limited. STAC reviewed the SAV restoration projects and concluded they were operationally successful but functionally unsuccessful. SAV aerial surveys continue.
3.3)In 1998, the Chesapeake Executive Council adopted the Chesapeake Bay Wetlands Policy in recognition of the ecological and economic importance that wetlands play in the Chesapeake Bay. The Wetlands Policy establishes an immediate goal of no net loss with a long-term goal of a net resource gain for tidal and nontidal wetlands. It identifies specific actions necessary to achieve both the short term goal of the Policy, “no net loss” and the long term goal of “a net resource gain for tidal and nontidal wetlands.”	3.3) The jurisdictions should strive towards achieving the following, especially in the salinity range of tautog. a) define the resource through inventory and mapping activities b) protect existing wetlands c) rehabilitate, restore and create wetlands d) improve education e) further research.	Continue  2006 Continue  2009 Continue	Wonders of Wetlands (WOW) curriculum was developed  GIS mapping activities are underway to target protection and restoration of habitat resources. Habitats are not targeted to benefit a specific species.  MD is developed a Blue Infrastructure that includes mapping structural habitat and SAV.  Wetland mosquito ditches from the 1930s-1940s are being modified to reduce tidal flow and restore wetland hydrology and function.

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Strategy	Action	Date	Comments
		2011 On-going	Between 2010 and 2011, 3,775 acres of wetlands were established or re-established and 107,239 acres were enhanced or rehabilitated.
		2013/2014 On-going	The new Chesapeake Bay Program Watershed Agreement has a wetlands outcome to create or reestablish 85,000 acres of wetlands and enhance the function of wetlands on an additional 150,000 acres.  Between 2010 and 2014, approximately 6,200 acres of wetlands were established or restored on agricultural lands in the Bay watershed.
3.4.1) Jurisdictions will continue efforts to improve Baywide water quality through the efforts of programs established under the 1987 Chesapeake Bay Agreement. In addition, the jurisdictions will implement new strategies, based on recent program reevaluations, to strengthen deficient areas.	3.4.1A) Based on 1992 baywide nutrient reduction plan reevaluation, the jurisdictions will: a) expand program efforts to include the tributaries b) intensify efforts to control nonpoint sources of pollution from agriculture and developed areas c) improve on current point and nonpoint source control technologies.	Continue	Maps that indicate regions of concern for living resources have been developed.
		2009	See Chesapeake Bay Program website for updates on nutrient reduction. <a href="http://www.chesapeakebay.net/status_reducingpollution.aspx?menuitem=19859">http://www.chesapeakebay.net/status_reducingpollution.aspx?menuitem=19859</a> .
		2009	President Barack Obama’s executive order recommitted federal agencies to Bay restoration and regulatory enforcement.
		2010	EPA established a Bay wide TMDL (aka: pollution diet). Each jurisdiction must establish 2 year milestones for progress towards meeting its TMDL.
		2012	Legislation has been passed for restrictions on new developments using septic systems.
		2013	Legislation for a stormwater fee based on impervious surface coverage was enacted.
		2014 Continue	2014 Chesapeake Watershed Agreement outcome is to achieve a 60% reduction of nutrient and sediment pollution.
	3.4.1B) Based on the 1994 Chesapeake Bay Program Toxics Reduction Strategy Reevaluation Report, the jurisdictions will emphasize the following 4 areas: a) pollution prevention: target “regions of concern” & “areas of emphasis”	Continue	See Chesapeake Bay Program website for updates on nutrient reduction. <a href="http://www.chesapeakebay.net/status_reducingpollution.aspx?menuitem=19859">http://www.chesapeakebay.net/status_reducingpollution.aspx?menuitem=19859</a>

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Strategy	Action	Date	Comments
	b) regulatory program implementation: insure that revised strategies are consistent with and supplement pre-existing regulatory mandates c) regional focus: identify and classify regions according to the level of contaminants d) directed toxics assessment: identify areas of low level contamination, improve tracking and control nonpoint sources.	2014 Continue	Chesapeake Bay Program is monitoring levels of mercury, PCBs, PAHs, organophosphate and organochloride pesticides.  There are two outcomes for toxic contaminants in the 2014 Chesapeake Watershed Agreement: develop a research agenda and best management practices pertaining to toxics and develop a policy to reduce and prevent toxic contaminants.
	3.4.1C) The jurisdictions will continue to develop, implement, and monitor their tributary strategies designed to improve bay water quality.	Continue April 2003	Ambient water quality criteria of DO, water clarity, and chlorophyll-a have been adopted for the Chesapeake Bay.
3.4.2 The Chesapeake Bay Program partners will “Plan for and manage the adverse environmental effects of human population growth and land development in the Chesapeake Bay watershed.” In 1996, the Chesapeake Bay Program accepted the Priorities for Action for Land, Growth and Stewardship in the Chesapeake Bay Region as a framework to address land use and development pressures in the Chesapeake Bay. This approach recognizes that communities are the basic unit for addressing growth, land-use and long-term stewardship of the natural environment. These priorities are voluntary actions which are expected to be accomplished through a variety of public and private partners, including but not limited to the Chesapeake Bay Program. Jurisdictions will forward the goals of the Priorities for Action, which encourage sustainable development patterns. Given the fact that tautog are particularly vulnerable to suspended solids which abrade epithelial tissues and to decreasing SAV and shellfish beds which serve as habitat and feeding areas, the goals of the Priorities for Action which are germane to nutrient and sediment load reduction will be promoted.	3.4.2) Encourage efficient development patterns which reduce nutrient and sediment loads to the Chesapeake Bay and promote responsible land management practices and decisions regarding present and future development by pursuing the following: 1) Revitalize existing communities. Revitalization efforts can assist existing communities and help reduce sprawl by encouraging the use of state-of-the-art storm water management and pollution prevention strategies. 2) Encourage efficient development patterns. Ecologically sound, efficient development patterns encourage higher population density; compact and contiguous development. Benefits to the Bay include reduced impervious surfaces; conservation of farms, forests, and wetlands. 3) Foster resource protection and land stewardship. Cooperation and linkages among local watershed protection planning efforts should be increased to foster a regional sense of stewardship toward the bay’s natural resources. The development of new policies that integrate natural and community infrastructure in public and private planning, development and protection efforts will further this goal.	Continue	See Chesapeake Bay Program website for updates on land stewardship. <a href="http://www.chesapeakebay.net/status_protectingwatersheds.aspx?menuitem=19876">http://www.chesapeakebay.net/status_protectingwatersheds.aspx?menuitem=19876</a>  MD developed curriculum “Where Do We Grow from Here?” about population growth and its impacts on the Bay.  The 2014 Chesapeake Watershed Agreement includes outcomes for stewardship, environmental literacy and land conservation.

## **Acronyms**

ARC - Artificial Reef Committee  
ASMFC – Atlantic States Marine Fisheries Commission  
CB – Chesapeake Bay  
CCA MD – Coastal Conservation Association of Maryland  
CPUE – Catch per Unit Effort  
DO – Dissolved Oxygen  
EEZ – Exclusive Economic Zone  
F – Fishing Mortality  
FMP – Fishery Management Plan  
GIS – Geographic Information System  
MAFMC – Mid-Atlantic Fishery Management Council  
MARI - Maryland Artificial Reef Initiative  
MD DNR – Maryland Department of Natural Resources  
NMFS – National Marine Fisheries Service  
OCRFB - Ocean City Reef Foundation  
PAH – Polycyclic Aromatic Hydrocarbon  
PCB – Polychlorinated Biphenyl  
PRFC –Potomac River Fishery Commission  
SAV – Submerged Aquatic Vegetation  
USACE – United States Army Corps of Engineer  
USFWS – United States Fish and Wildlife Service  
USN – United States Navy  
VIMS – Virginia Institute of Marine Science

## 2015 Maryland FMP Report (June 2016)

### Section 2. Alosines: a) Shad, and b) Herring

#### a) American shad (*Alosa sapidissima*) and hickory shad (*Alosa mediocris*)

The American shad juvenile index from the Maryland portion of the Chesapeake Bay reached a record high in 2015, indicating a successful spawn. The Potomac River American shad juvenile index was greater than all other system indices and was the highest index observed for this species since the inception of the juvenile survey in 1954. Adult American shad abundance continued to increase in 2015 in all monitored Chesapeake Bay tributaries, but still remains well below historic values. Hickory shad populations on both the Patuxent River and Choptank River were deemed self-sustaining in 2014. The stocking program shifted focus in 2015, conducting exploratory surveys on the Pocomoke River, Marshyhope Creek, Chester River, Sassafras River, Elk River, Northeast River, and the Patapsco River for baseline hickory shad data in order to determine restoration need.

#### Fishery Management Plans (FMPs)

The Atlantic States Marine Fisheries Commission (ASMFC) adopted the Interstate Fishery Management Plan for Shad and River Herring in 1985. In response, Chesapeake Bay jurisdictions implemented the Chesapeake Bay Alosid [*sic*] Management Plan (CB Alosine FMP) in 1989 to coordinate shad and river herring management among Chesapeake Bay jurisdictions. The CB Alosine FMP identified declining abundance, over-fishing, insufficient research and monitoring, and habitat loss as problems. The plan set guidelines to continue the American shad moratorium in Maryland and reduce exploitation rates in Virginia; remove stream blockages and reopen historic habitat; and continue stocking hatchery-raised fish. The CB Alosine FMP Amendment 1 (1998) continued the shad moratorium, initiated review of criteria to reopen a shad fishery, and initiated development of measurable restoration targets.

The ASMFC implemented Amendment 1 to the Interstate Fishery Management Plan for Shad & River Herring in 1999. The amendment mandated a 40% reduction in the American shad ocean intercept fishery by 2003 and a closure by 2005. In-river commercial fisheries were also limited; not to exceed a fishing mortality rate of 30% of the maximum spawning potential of an unfished population ( $F_{30}$ ). Technical Addendum I (2000) made adjustments to state fishery independent and dependent monitoring programs, but did not affect Maryland's obligations. Addendum I (2002) clarified hatchery-rearing requirements for *Alosa* species. Amendment 3 (2010) was enacted by ASMFC in response to the continued lack of improvement in American shad abundance. Amendment 3 established an instantaneous total mortality (fishing

and natural) benchmark of  $Z_{30}$ , refined the juvenile recruitment failure definition to be more conservative, mandated states to monitor bycatch and discards, and required states with commercial and/or recreational (excluding catch and release) American shad fisheries to have approved fishing and habitat sustainability plans. Potomac River Fisheries Commission (PRFC) submitted a sustainable fishery management plan for American shad in 2012. Habitat restoration plans were approved by ASMFC for Maryland, District of Columbia, and Virginia in 2014 and can be found on the ASMFC website (<http://www.asmf.org/species/shad-river-herring>). The ASMFC has scheduled a stock assessment update for American shad for 2018.

The adequacy of the CB Alosine FMP, including Amendment 1, was evaluated in 2012 to determine if the strategies and actions provided an appropriate management framework for addressing management changes implemented by ASMFC. The plan review team (PRT) determined that the CB Alosine FMP's strategies and actions were adequate to meet ASMFC compliance requirements and Chesapeake Bay management goals. Following input from the Maryland Sport Fisheries Advisory Commission and the Tidal Fisheries Advisory Commission, the PRT recommended no changes to the CB Alosine FMP. However, if and when the stock has adequately recovered and a limited fishery is ready to be opened, an amendment will need to be developed.

In 2006, the National Oceanic and Atmospheric Administration's (NOAA) Chesapeake Bay Fisheries Ecosystem Advisory Panel adopted a Fisheries Ecosystem Plan for Chesapeake Bay. In 2009, Maryland Sea Grant facilitated development of Ecosystem-based Fisheries Management for Chesapeake Bay Alosine Background and Issue Briefs (American shad, hickory shad, alewife herring, and blueback herring; (<http://www.mdsg.umd.edu/sites/default/files/files/EBFM-Alosines-Briefs.pdf>) in cooperation with state, federal, and academic representatives. The issues section examined four stressor categories: habitat (migratory barriers, flow and water quality, land-use ecology, and physical alteration), food web (forage, competition, predation, freshwater ecology, and vectors of biological material), stock dynamics (stock assessment history, anthropogenic mortality, life history, connectivity, and stock structure), and socioeconomic (cultural, economic, and environmental considerations, restoration, and management guidelines).

#### Stock Status

American shad harvest in Maryland declined in the late 1950s and reached historic low levels in the mid-1970s where it has remained<sup>1</sup> (Figure 1). The Maryland Department of Natural Resources (MD DNR) population estimates for the Conowingo Dam tailrace indicate that American shad abundance increased from 1998 to 2001, decreased after 2001 through 2007, and has remained relatively stable at low levels with a slight increase in recent years.<sup>1,2</sup> The 2015 American shad population estimate for the Susquehanna River below Conowingo Dam was 139,973

fish<sup>1,2</sup> (Figure 2). Unlike the abundance trend, the number of American shad passed over Conowingo Dam at the East Fish Lift has declined in recent years. In 2015, 8,341 American shad passed through the east fish lift, the lowest recorded passage since 1989.<sup>3</sup>

American shad abundance in the Potomac River is measured using an index based on the number of pounds per pound net day. The Potomac River restoration target is 31.1 lbs.; the mean commercial pound net landings during the 1950s. Abundance has steadily increased since 2000 and has exceeded the restoration target since 2011 (Figure 2; E. Cosby, PRFC, pers. comm.).

Abundance of wild (non-hatchery reared) and repeat (spawned in previous years) spawning American shad varies among river systems. Approximately 60% of American shad in the Conowingo Dam tailrace were of wild stock during 2015. Sixty-four percent of male and 68% of female American shad in the Potomac River were repeat spawners in 2015.<sup>2</sup> In the Choptank River, adult American shad are not frequently encountered by monitoring surveys and 92% of juveniles in 2014 were hatchery reared. Since there is evidence of natural reproduction in the Choptank River, the restoration program has expanded sampling in order to locate where staging and spawning occurs.<sup>4</sup>

Hickory shad populations in the Patuxent and Choptank rivers were determined to be self-sustaining in 2014 after 11 and 18 years, respectively, of stocking efforts. The proportion of wild, spawning adult hickory shad in the Patuxent River has been  $\geq$  80% in 8 of the last 10 years and was 91% in 2014.<sup>5</sup> The proportion of wild, spawning adult hickory shad in Choptank River from 2001 - 2013 has varied between 29% - 85%. In 2014, 74% of spawning adults were wild.<sup>5</sup> A stable population of spawning adult hickory shad has been present in the lower Susquehanna River since 1996<sup>5</sup> without any stocking. Sixty-one percent of female and 57% of male hickory shad in Deer Creek were repeat spawners during 2015.<sup>1</sup>

### **Current Management Measures**

Harvest of American shad from the Chesapeake Bay has been prohibited by Maryland since 1980, by PRFC since 1982, and by Virginia since 1994. Maryland allows commercial fishermen a 2 fish per day bycatch of dead American shad for personal use. No sale of American shad bycatch is allowed in Maryland. Virginia maintains an American shad bycatch permit for the gillnet fishery. Bycatch permit holders are allowed up to 10 fish per vessel from permitted areas as long as a greater number of spot, croaker, bluefish, catfish, striped bass, or white perch are landed. PRFC allows a 2% bycatch of American shad by volume of the total catch, with a 2 bushel per day limit per licensed fishermen. Pennsylvania and New York also prohibit harvest of American shad in the Susquehanna River basin. All Atlantic coast states closed their American shad ocean intercept fisheries in 2005.

Maryland enacted a hickory shad moratorium in 1981. Virginia prohibited hickory shad harvest in 1994. The District of Columbia and PRFC prohibited hickory shad harvest in 1992 and 1995, respectively.

The National Marine Fisheries Service (NMFS) enacted the New England Fishery Management Council's (NEFMC) Amendment 5 to the Atlantic Herring FMP in 2014.<sup>6</sup> Amendment 5's objectives to improve monitoring and minimize bycatch of river herring catch are anticipated to also reduce at-sea mortality of shad.<sup>6</sup>

The Mid-Atlantic Fishery Management Council (MAFMC) adopted Amendment 14 (2014) to the Atlantic Mackerel, Squid, and Butterfish FMP to improve monitoring of these fisheries and to limit shad mortality in the Atlantic mackerel fishery. The MAFMC approved an incidental shad and river herring catch cap of 196,211 pounds for the Atlantic mackerel fishery for 2015.<sup>7</sup> The shad and river herring estimated incidental catch from the Atlantic mackerel fishery for 2015 was 28,373 pounds, combined, and comprised 14.46% of the incidental catch cap.<sup>7</sup> The shad and river herring incidental catch cap was set at 180,779 pounds for the 2016 Atlantic mackerel fishery.<sup>7</sup>

The National Marine Fisheries Service (NMFS) did not approve all measures in Amendment 14. An increase in observer coverage was disapproved.<sup>8</sup> The MAFMC and NEFMC hope to address the need for increased observer coverage in the Omnibus Industry-Funded Monitoring Amendment currently in development. NMFS has the final decision on what management recommendations will be adopted for fisheries in federal waters. The MAFMC has begun the process of re-assessing whether it is necessary to include shad and river herring as stocks in the Atlantic Mackerel, Squid, and Butterfish FMP. The current timeline requires a decision by October 2016.

### **The Fisheries**

In Maryland, commercial bycatch mostly occurs during the spring pound net fishery. Pound nets are found in tributaries and the upper Chesapeake Bay.<sup>1</sup> Bycatch is limited to 2 dead American shad for personal use per day.

The Marine Recreational Information Program (formerly Marine Recreational Fisheries Statistics Survey, MRFSS) stopped collection of American shad and hickory shad recreational data in 2009. Recreational catch and release fisheries for American and hickory shad occur in the tailrace below Conowingo Dam. Catch and release fisheries – primarily hickory shad – also occur in Deer Creek and Octoraro Creek, tributaries to the lower Susquehanna River. Maryland DNR conducts a voluntary angler logbook survey and an annual creel survey of shoreline anglers along the Conowingo Dam tailrace.<sup>2</sup> Beginning in 2014, anglers can participate in

the logbook survey online through MD DNR's website (<http://dnrweb.dnr.state.md.us/fisheries/surveys/login.asp>). Data from the American shad logbook and angler surveys indicate a decrease in catch rate since 2000 (Figure 3).<sup>1,2</sup> The trend mirrors the catch rate trend of the MD DNR tagging survey (Figure 3). An active catch and release recreational fishery for both shad species also occurs in the Potomac, Patuxent, and Choptank rivers.<sup>4</sup> Current shad release mortality in the recreational fishery is unknown. In 1998, catch and release mortality of 309 American shad at the Conowingo Dam tailrace was calculated to be 0.97%.<sup>9</sup> Mortality from the current recreational fishery is believed to be negligible.<sup>1</sup>

### Issues/Concerns

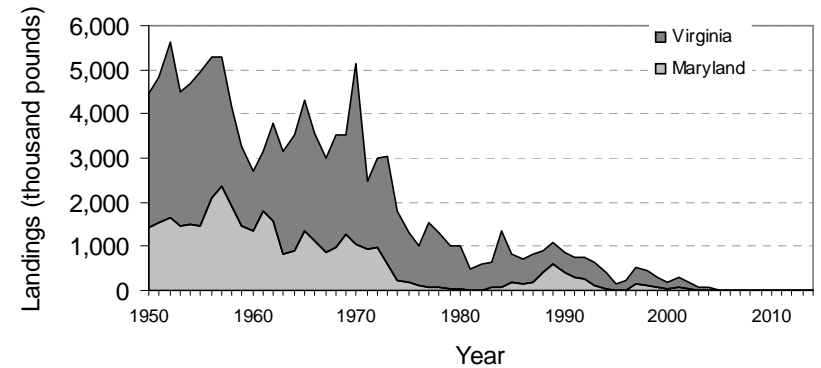
Conowingo Dam is the most significant remaining blockage to American shad migrating up the Susquehanna River in Maryland even though there is a fish lift. Although American shad are captured in the lift, hickory shad have rarely been documented using the fish lift.<sup>1,3</sup> Relicensing for the Conowingo hydroelectric project continues to be reviewed by the Federal Energy Regulatory Commission.<sup>1</sup> One of the primary issues of the relicensing process is effective fish passage at the dam. Exelon, the company that owns the dam, has agreed to improve fish passage. The specifics of the improvements are expected to be finalized when a new license is issued, possibly in 2018. It will then take several years to implement the fish passage improvements.

Comparisons between scale age and a fish's known age revealed a notable amount of bias and error.<sup>10</sup> Percent agreement among 13 biologists varied between 50% and 77%. Ageing accuracy was greatest for shad ages 3-6 (34% - 49%) but decreased significantly for age 7 fish (12%) and age 8 fish (4%). Otolith sampling is not a feasible option because of the depressed stock status. The accuracy of using scales to determine repeat spawning remains problematic.<sup>10</sup>

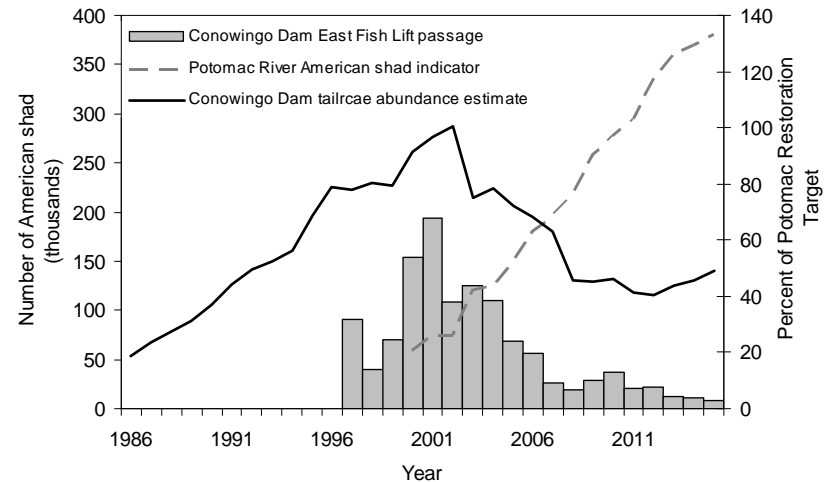
The effect of multiple mortality sources such as ocean bycatch, dam turbines, pollution, and predation on shad abundance is unknown. Additional data are required to estimate natural, anthropogenic, and fishery mortalities to develop appropriate biological benchmarks.

Currently, Maryland does not monitor bycatch and discard of American shad as specified in ASMFC Amendment 3. Although the Maryland commercial finfish reporting forms have a designation for discards/bycatch, fishermen are not required to report bycatch or discards.

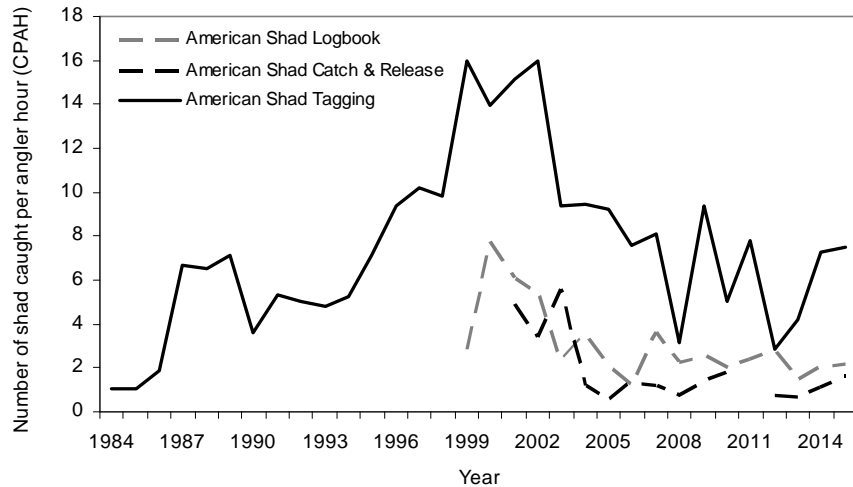
**Figure 1. Time series of commercial landings of American shad, 1950-2014 in Maryland and Virginia.<sup>11</sup>**



**Figure 2. American shad passed at Conowingo Dam's east fish lift (1997-2015),<sup>2</sup> American shad population estimate for the Conowingo Dam tailrace (1986-2015),<sup>3</sup> and the status of American shad restoration in the Potomac River (2000-2015; E. Cosby, PRFC, pers. comm.).**



**Figure 3. Average catch per angler hour from the MD DNR tagging study (1984-2015), the recreational angler logbook survey for American shad (1999-2014), and American shad catch and release fishery below Conowingo Dam (2001-2014, no data for 2011).<sup>3</sup>**



## References

- <sup>1</sup> Lipkey, G. K. 2014. Maryland's 2015 compliance report: American shad (*Alosa sapidissima*) hickory shad (*Alosa mediocris*) alewife herring (*Alosa pseudoharengus*) blueback herring (*Alosa aestivalis*). Maryland Department of Natural Resources, Annapolis, Maryland.
- <sup>2</sup> Maryland Department of Natural Resources. 2016. Chesapeake Bay Finfish Habitat Investigations. US FWS Federal Aid Project F-61-R-9 2012 – 2015. Maryland Department of Natural Resources, Annapolis, Maryland.
- <sup>3</sup> Pennsylvania Fish and Boat Commission. 2014. Susquehanna River American shad. [http://www.fish.state.pa.us/shad\\_susq.htm](http://www.fish.state.pa.us/shad_susq.htm)
- <sup>4</sup> Stence, C. P., M. W. Baldwin, and M. Bowermaster. 2016. American shad restoration in three Maryland rivers. US FWS Federal Aid Project F-57-R Segment 16 Progress Report. Maryland Department of Natural Resources, Annapolis, Maryland.

- <sup>5</sup> Stence, C. P., M. W. Baldwin, and M. Bowermaster. 2015. Hickory shad restoration in three Maryland rivers. US FWS Federal Aid Project F-57-R Segment 16 Progress Report. Maryland Department of Natural Resources, Annapolis, Maryland.
- <sup>6</sup> Federal Register 79(30) February 13, 2014 Rules and Regulations. Final Rule. Fisheries of the Northeastern United States; Atlantic Herring Fishery; Amendment 5.
- <sup>7</sup> Personal communication from the National Marine Fisheries Service, Greater Atlantic Region Fisheries Office. Northeast Region Quota Monitoring Report. July 2, 2015. [http://www.greateratlantic.fisheries.noaa.gov/ro/fso/reports/reports\\_frame.htm](http://www.greateratlantic.fisheries.noaa.gov/ro/fso/reports/reports_frame.htm)
- <sup>8</sup> Federal Register 79(36) February 24, 2014. Rules and Regulations. Final Rule. Fisheries of the Northeastern United States; Atlantic Mackerel, Squid and Butterfish Fisheries; Amendment 14.
- <sup>9</sup> Lukacovic, R. 1998. Mortality of American shad caught and released by anglers below Conowingo Dam. Maryland Department of Natural Resources, Fisheries Service. Fisheries Technical Report Series, Number 21.
- <sup>10</sup> McBride, R. S., M. L. Hendricks, and J. E. Olney. 2005. Testing the validity of Cating's (1953) method for age determination of American shad using scales. Fisheries, 30:10, 10-18.
- <sup>11</sup> Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division. <http://www.st.nmfs.noaa.gov/index>



## b) Alewife herring (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*)

Maryland's river herring spring spawning runs in the upper bay region have shown an increasing trend since 2013. In previous assessments, scientists have identified the need for a standardized approach to data collection for river herring. This need was addressed at the River Herring Data Collection Standardization Workshop held in 2015: a joint effort of the National Marine Fisheries Service (NMFS) and the Atlantic States Marine Fisheries Commission (ASMFC). The workshop report makes short term and long term recommendations for current and future river herring surveys

([http://www.asmfc.org/uploads/file/56fc3c6dRH\\_DataCollectionStandardizationWorkshopSummary\\_March2016.pdf](http://www.asmfc.org/uploads/file/56fc3c6dRH_DataCollectionStandardizationWorkshopSummary_March2016.pdf)). In 2015, the NMFS and the ASMFC also published a coastwide conservation plan for river herring that utilizes input from experts throughout the range of the species, collectively called the River Herring Technical Expert Working Group (TEWG), on the NMFS website (<http://www.greateratlantic.fisheries.noaa.gov/protected/riverherring/conserv/index.html>).

### Fishery Management Plans (FMPs)

ASMFC adopted the Interstate Fishery Management Plan for Shad and River Herring in 1985. In 1989, Chesapeake Bay States implemented the Chesapeake Bay Alosid [*sic*] Management Plan (CB Alosine FMP) to coordinate shad and river herring management. The CB Alosine FMP identified declining abundance, over-fishing, insufficient research and monitoring, and habitat loss as problems. The plan set guidelines to reduce river herring fishing mortality and remove impediments to access of historic habitat.

The ASMFC enacted Amendment 2 (2009) to address coastwide declines in alewife and blueback herring stocks and address the lack of fishery-dependent and independent monitoring for these species. Amendment 2 required states to have an ASMFC approved river herring sustainability plan by 2012 or close their river herring fisheries. Sustainability plans require development of a river herring juvenile index, a monitoring plan for spawning adults, and collection of commercial and recreational fisheries statistics including bycatch data. Maryland closed its river herring fisheries due to a decline and persistently low levels of river herring in Maryland. As required by ASMFC, Maryland submits an annual compliance report.

In 2006, the National Oceanic and Atmospheric Administration's (NOAA) Chesapeake Bay Fisheries Ecosystem Advisory Panel adopted a Fisheries Ecosystem Plan for Chesapeake Bay. In 2009, Maryland Sea Grant facilitated development of an Ecosystem-based Fisheries Management for Chesapeake Bay Alosine Background and Issue Briefs (American shad, hickory shad, alewife herring, and

blueback herring) in cooperation with state, federal, and academic representatives (<http://www.mdsg.umd.edu/sites/default/files/files/EBFM-Alosines-Briefs.pdf>). The issue section examined four stressor categories: habitat (migratory barriers, flow and water quality, land-use ecology, and physical alteration), food web (forage, competition, predation, freshwater ecology, and vectors of biological material), stock dynamics (stock assessment history, anthropogenic mortality, life history, connectivity, and stock structure), and socioeconomic (cultural, economic, and environmental considerations, restoration, and management guidelines). The NMFS and the ASMFC coastwide conservation plan (2015) is intended to be a dynamic web-based plan that can be easily updated and has the following goals: identify key research needs for assessment and conservation, increase coordination of river herring research and conservation, identify funding sources for river herring research and conservation, identify conservation actions to address threats, cultivate research groups to address key topics, improve information to be used in the next assessment, improve information used in conservation efforts, further conservation efforts to address threats, and increase outreach about river herring.

### Stock Status

The ASMFC's 2012 river herring stock assessment determined that alewife and blueback herring populations are depleted coastwide.<sup>1</sup> Furthermore, mean age and maximum length have decreased in some systems. The next ASMFC river herring stock assessment update is scheduled for 2017.

Maryland Department of Natural Resources (MD DNR) conducted the third year of a fishery independent river herring gill net survey in the North East River, developed to assess the spawning stock of alewife and blueback in the upper bay region. In 2015, 1,200 river herring were sampled, an increase from the 722 encountered in 2014.<sup>2</sup> Forty-six percent of alewife herring were repeat spawners and 30% of blueback herring were repeat spawners in 2015. The total instantaneous mortality was 1.3 for alewife and 1.7 for blueback.<sup>2</sup> Seine surveys are used to calculate juvenile abundance indices (JAI) which have varied without trend since 1980.<sup>2,3</sup> The JAIs for alewife and blueback herring were above average in 2015 for the Chesapeake Bay region.<sup>2</sup>

### Current Management Measures

Maryland, Virginia, and the Potomac River Fisheries Commission instituted a recreational and commercial river herring moratorium, January 1, 2012. All river herring and river herring products imported into Maryland must include a bill of sale from a state with an approved river herring fishery<sup>3</sup> (Maine, New Hampshire, New York, North Carolina, and South Carolina).

The NMFS enacted the New England Fishery Management Council's (NEFMC)

Amendment 5 to the Atlantic Herring FMP in 2014.<sup>4</sup> Amendment 5's objectives to improve monitoring and minimize bycatch of river herring catch are anticipated to also reduce at-sea mortality of shad.<sup>4</sup>

The MAFMC adopted Amendment 14 (2014) to the Atlantic Mackerel, Squid, and Butterfish FMP to improve monitoring of these fisheries and limit shad and river herring mortality in the Atlantic mackerel fishery. The MAFMC approved an incidental shad and river herring catch cap of 196,211 pounds for the Atlantic mackerel fishery for 2015. The shad and river herring estimated incidental catch from the Atlantic mackerel fishery for 2015 was 28,373 pounds: 14.46% of the incidental catch cap.<sup>5</sup> The shad and river herring incidental catch cap was set at 180,779 pounds for the 2016 Atlantic mackerel fishery.<sup>5</sup>

The NMFS did not approve all measures in Amendment 14. An increase in observer coverage was disapproved.<sup>6</sup> The MAFMC and NEFMC hope to address the need for increased observer coverage in the Omnibus Industry-Funded Monitoring Amendment currently in development. NMFS has the final decision on what management recommendations will be adopted for fisheries in federal waters. The MAFMC has begun the process of re-assessing whether it is necessary to include shad and river herring as stocks in the Atlantic Mackerel, Squid, and Butterfish FMP. The current timeline requires a decision by October 2016.

### **The Fisheries**

Alewife and blueback herring recreational fishery data have not been available from the Marine Recreational Information Program since 2009. All commercial and recreational river herring fisheries in Maryland are under a moratorium. No river herring were reported landed by commercial harvesters in 2015.<sup>3</sup> When the fishery was open, commercial landings of river herring appeared to cycle from high to low approximately every 20 years (Figure 1). During that time, a decreasing trend in landings was evident. Commercial river herring landings were in decline around the mid-1900s and declined precipitously after 1968 (Figure 1). River herring landings have failed to rebound since 1976. Recreational catch and release angling is allowed. Limited data is available, but this recreational fishery is believed to be minimal.<sup>3</sup> Maryland DNR has monitored alewife and blueback herring from the Nanticoke River and other portions of Chesapeake Bay since 1980, and began monitoring the North East River spawning run in 2013.

### **Issues/Concerns**

In 2013 a river herring ageing workshop<sup>7</sup> took place to compare age estimates and methodologies among Atlantic coast states. River herring age is determined from scales using the same methodology as for American shad (previously discussed), although some states also use otoliths for age determination. River herring of known

age were not available to determine the accuracy of age estimates: obtaining accurate ageing is an imperative data gap. The workshop determined that age estimates of a fish tended to differ between labs, presumably due to different sample preparation and ageing methodologies. Otoliths were often aged younger than scales for young fish and aged older than scales for older fish. The extent of bias was affected by reader experience, species (alewife versus blueback), river system, and environmental conditions. Standardization of ageing methods and validation of scale ages are needed. At the Data Collection Standardization Workshop held in November 2015, it was recommended that paired otolith and scale samples should be collected from all fish sacrificed for biological sampling.<sup>8</sup>

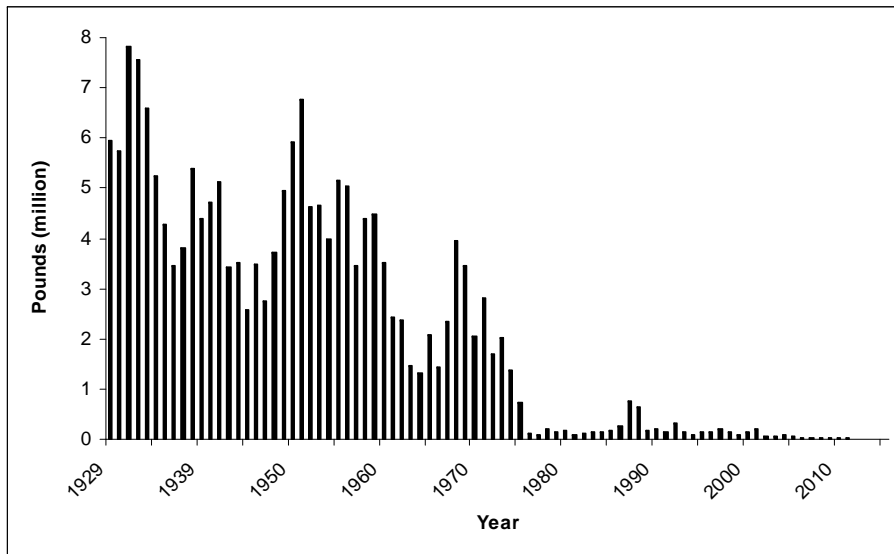
Misidentification of river herring species is relatively common. Alewife and blueback are easily confused and they have also been confused with young hickory shad and American shad. At the Data Collection Standardization Workshop held in November 2015, it was recommended that field identification should be validated, when possible, with a more rigorous laboratory-based method.<sup>8</sup>

River herring mortality sources include harvest, bycatch, discard, pollution, and predation. In Maryland, mortality from hydroelectric turbines is considered insignificant because they are rarely encountered in Conowingo Dam's fish lifts and passed upstream.<sup>3</sup> Ocean trawl bycatch of juvenile river herring in the Atlantic mackerel and Atlantic herring fisheries is of particular concern.<sup>1</sup> Genetic studies indicate 78% of blueback herring bycatch from the New England Atlantic Herring fishery is of Mid-Atlantic origin.<sup>9</sup> The NEFMC and MAFMC will continue to address river herring as bycatch and incentivize avoidance by fishermen. Additional at-sea observer data would improve development of management benchmarks.

Adult access to suitable spawning habitat has historically been impeded by blockages of various types and size. Dams are a common type of barrier. Although building fishways has been an option for moving fish upstream, these structures are not a hundred percent efficient at passing fish. Removal of blockages is the preferred method for reopening spawning habitat. Maryland's Fish Passage Program is responsible for working on projects to reopen spawning habitat for anadromous fish. Two large dams on the Patapsco River were removed (Union and Simkins - 2010), but two dams remain on the river's mainstem. Removal of Bloede Dam, the lower most dam on the river, requires relocating a 42" sewer line and retrenching a 13" sanitary line. The project partners have determined that a passive release of sediment (mostly sand and gravel) from the impoundment is the best management approach. Phase 1 of the project is scheduled to begin in spring 2017. Removal of the dam structure is expected to begin in winter 2017/2018. More detailed information can be found at: <http://dnr2.maryland.gov/fisheries/Pages/fishpassage/bloede.aspx>. The Fish Passage Program is also updating its online Fish Passage Prioritization Tool and working with partners to develop an incentive program to help make dam removal more attractive for private owners.

National Resources Defense Council petitioned the NMFS in 2011 to designate alewife and blueback herring as threatened species. In 2013, NMFS determined that designation of either species as threatened or endangered was not warranted. ([http://www.nero.noaa.gov/prot\\_res/CandidateSpeciesProgram/RiverHerringSOC.htm](http://www.nero.noaa.gov/prot_res/CandidateSpeciesProgram/RiverHerringSOC.htm)). Following the determination not to list alewife and blueback herring as endangered species, NMFS, partnering with ASMFC, began an initiative to proactively conserve the coastwide population of river herring. This initiative established the TEWG, composed of individual experts from state and federal agencies, academia, the fishing industry, federally recognized tribes, and conservation organizations from the East Coast of the United States and Canada to provide knowledge and guidance for a coastwide conservation plan. The NMFS promised to revisit the ESA listing of river herring in 2018.

**Figure 1. Time series of commercial landings of shad river herring (alewife and blueback, 1929-2015) in Maryland.<sup>3,9</sup>**



## References

<sup>1</sup> Atlantic States Marine Fisheries Commission. 2012. River herring benchmark stock assessment volume I. Stock Assessment Report No. 12-02 Atlantic States Marine Fisheries Commission. Arlington, Virginia.

<sup>2</sup> Maryland Department of Natural Resources. 2016. Chesapeake Bay finfish habitat investigations. US FWS Federal Aid Project F-61-R-9 2012 – 2015. Maryland Department of Natural Resources, Annapolis, Maryland.

<sup>3</sup> Lipkey, G. K. 2016. Maryland's 2015 compliance report: American shad (*Alosa sapidissima*), hickory shad (*Alosa mediocris*), alewife herring (*Alosa pseudoharengus*) blueback herring (*Alosa aestivalis*). Maryland Department of Natural Resources, Annapolis, Maryland.

<sup>4</sup> Federal Register 79(30) February 13, 2014 Rules and Regulations. Final Rule. Fisheries of the Northeastern United States; Atlantic Herring Fishery; Amendment 5

<sup>5</sup> Personal communication from the National Marine Fisheries Service, Greater Atlantic Region Fisheries Office. Northeast Region Quota Monitoring Report. July 2, 2015. [http://www.greateratlantic.fisheries.noaa.gov/ro/fso/reports/reports\\_frame.htm](http://www.greateratlantic.fisheries.noaa.gov/ro/fso/reports/reports_frame.htm)

<sup>6</sup> Federal Register 79(36) February 24, 2014. Rules and Regulations. Final Rule. Fisheries of the Northeastern United States; Atlantic Mackerel, Squid and Butterfish Fisheries; Amendment 14.

<sup>7</sup> Atlantic States Marine Fisheries Commission. 2014. 2013 river herring ageing workshop report. Atlantic States Marine Fisheries Commission. Arlington, Virginia. [http://www.asmfc.org/files/Science/RiverHerringAgeingWorkshopReport\\_August2014.pdf](http://www.asmfc.org/files/Science/RiverHerringAgeingWorkshopReport_August2014.pdf)

<sup>8</sup> Atlantic States Marine Fisheries Commission. 2016. Report on the River Herring Data Collection Standardization Workshop. Atlantic States Marine Fisheries Commission. Arlington, Virginia. [http://www.asmfc.org/uploads/file/56fc3c6dRH\\_DataCollectionStandardizationWorkshopSummary\\_March2016.pdf](http://www.asmfc.org/uploads/file/56fc3c6dRH_DataCollectionStandardizationWorkshopSummary_March2016.pdf)

<sup>9</sup> Hasselman, D.J, E.C. Anderson, E.E. Argo, N.D. Bethoney, S.R. Gephard, D.M. Post, B.P. Schondelmeier, T.F. Schultz, T.V. Willis, and E.P. Palkovacs. 2016. Genetic stock composition of marine bycatch reveals disproportional impacts on depleted river herring genetic stocks. Canadian Journal of Fisheries and Aquatic Sciences. 73:951-963. DOI: 10.1139/cjfas-2015-0402.

<sup>9</sup> Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division. <http://www.st.nmfs.noaa.gov/index>

1998 Amendment 1 to the 1989 Chesapeake Bay Alosid [*sic*]Management Plan Implementation Table (updated 6/2016)

Strategy	Action	Date	Comments
<p>1.1 1 The Bay jurisdictions will reevaluate the criteria for reopening a fishery in the Chesapeake Bay during the Alosid [<i>sic</i>] FMP revision process. Until new criteria are determined, the moratorium will remain in place for American and hickory shad in the Chesapeake Bay.</p>	<p>1.1 The Bay jurisdictions will continue the moratorium on American shad in Chesapeake Bay.</p>	<p>1989 On-going</p>	<p>The Bay jurisdiction will reevaluate the criteria for reopening a fishery in Chesapeake Bay once a need for a revision of the FMP is designated. The coastal intercept fishery was closed December 2004. The Bay moratorium remains in place for American and hickory shad.</p>
		<p>2009 - 2011</p>	<p>MD Sea Grant coordinated development of a Chesapeake Bay Ecosystem-based FMP.</p>
		<p>On-going</p>	<p>Chesapeake Bay jurisdictions continue to follow ASMFC requirements. <a href="http://www.asmfc.org/species/shad-river-herring">http://www.asmfc.org/species/shad-river-herring</a></p>
		<p>2012</p>	<p>PRFC developed an ASMFC approved sustainability plan for American shad.</p>
		<p>2014</p>	<p>MD, DC, &amp; VA developed ASMFC approved shad habitat plans. <a href="http://www.asmfc.org/files/ShadHabitatPlans/AmShadHabitatPlan_MD.pdf">http://www.asmfc.org/files/ShadHabitatPlans/AmShadHabitatPlan_MD.pdf</a></p>
<p>1.2 A special target-setting task force was charged to “establish measurable restoration targets” for American shad in the Bay. Eight spawning/nursery areas that historically supported substantial recreational and commercial fisheries were used to develop tributary-specific, quantitative recovery targets. The task force recommended that the stock recovery targets proposed for American shad be incorporated into the Alosid [<i>sic</i>] management plan.</p>	<p>1.2 The bay jurisdictions will incorporate the shad restoration targets into the revised Alosine FMP</p>	<p>1999</p>	<p>River specific targets were proposed in 1997, but no action was taken.</p>
		<p>2007</p>	<p>STAC held a 2007 workshop on Alosine targets. The white paper did not include targets.</p>
		<p>2008 On-going</p>	<p>The CBP shad abundance index was expanded from the Susquehanna River to include the James, York, and Potomac Rivers. The index is based on fish passage on the Susquehanna and James Rivers, commercial bycatch CPUE on the Potomac River, and gill net CPUE on the York River. The CBP Sustainable Fisheries GIT revised the shad abundance indicator. The James River index was modified to include both lower James and Bashers Dam data. An index for the Rappahannock River was added. Indices for the York, Potomac, and Susquehanna rivers were not changed.</p>
		<p>2012</p>	<p>Between 2014 and 2015, shad abundance decreased from 44 to 30% of the goal. For more</p>
		<p>2015</p>	<p>decreased from 44 to 30% of the goal. For more</p>

1998 Amendment 1 to the 1989 Chesapeake Bay Alosid [ <i>sic</i> ] Management Plan Implementation Table (updated 6/2016)			
Strategy	Action	Date	Comments
		2010	<p>information:  <a href="http://www.chesapeakebay.net/indicators/indicator/american_shad_abundance">http://www.chesapeakebay.net/indicators/indicator/american_shad_abundance</a></p> <p>No relationship exists between adult and juvenile shad abundance limiting the usefulness of a JAI. Any relationship that may exist is masked by at-sea mortality.</p>

1989 Chesapeake Bay Alosid [ <i>sic</i> ] Management Plan Implementation Table (updated 6/2016)			
Strategy	Action	Date	Comments
<p>1.1.1 Removing the moratorium on Maryland American shad will not occur until the stocks of American shad in the upper Bay are fully recovered. Reestablishing a fishery will occur when annual population estimates in the upper Bay increase for three consecutive years and stock size reaches at least 50% of historical levels (approximately 500,000 fish) during one of those three years. Regulations will be established to ensure that initial annual exploitation in the upper Bay does not exceed 10% when the fishery is opened. Stock levels will be determined from an annual stock estimation study and exploitation rates will be established based on recreational and commercial surveys.</p>	<p>1.1.1 American shad abundance in the upper Bay has improved but has not sufficiently recovered to warrant an open fishery. American shad abundance is also low in other Maryland river systems. Maryland will continue the moratorium on American shad in the Chesapeake Bay.</p>	1980 On-going	<p>Shad stocks have fluctuated since the moratorium began in 1980. Spawning adult population is estimated annually for the Conowingo Dam tailrace. Population estimates for shad in the Upper Bay ended due to the loss of commercial pound nets in the Susquehanna Flats. Criteria to reopen the fishery have not been determined. Limited hickory and American shad bycatch harvest is allowed from the Potomac River pound net and gill net fisheries.</p>
		1982 On-going	<p>PRFC has had a moratorium on directed shad harvest in Potomac River since 1982.</p>
		1992 On-going	<p>DCFM implemented a moratorium on shad harvest within District of Columbia waters of the Potomac River in 1992.</p>
		1998	<p>CBAMP Amendment 1 supersedes Strategy 1.1.1 restoration criteria</p>
		2013	<p>No stock allocation for Alosa species has been developed due to the moratorium. Resource allocation will be revisited when Alosa stocks are deemed recovered.</p>
<p>1.1.2 Virginia will follow ASMFC recommendations for a 25% exploitation rate for alosids [<i>sic</i>].</p>	<p>1.1.2 Virginia will utilize the Virginia Marine Resources Commission's Stock Assessment Program and the fishery surveys of the Virginia</p>	1994	<p>VA implemented a moratorium on the harvest of American and hickory shad from the Bay in 1994.</p>

1989 Chesapeake Bay Alosid [*sic*] Management Plan Implementation Table (updated 6/2016)

Strategy	Action	Date	Comments
	Institute of Marine Science to assess current Alosid [ <i>sic</i> ] exploitation is above the 25% rate, Virginia will take the appropriate steps to limit fishing effort.	Continue  2010 On-going  2012 On-going	ASMFC allows a limited American shad commercial bycatch harvest in the James, York, and Rappahannock rivers for the anchored and staked gill net fisheries. VA has an allowable catch for Native American tribes.  PRFC adopted a moratorium on directed harvest of river herring for the Potomac River.  VA implemented a river herring moratorium January 1, 2012 as specified by ASMFC.
1.2 Maryland will recommend management of river herring on a system by system basis. Criterion for closing a system to river herring harvest will be based on juvenile indices from 1985 through 1989 and commercial harvests over the last 10 years. Maryland, Pennsylvania and Virginia will recommend that harvest from all systems slated for restoration be regulated or closed. Technical criterion will be submitted to ASMFC for reevaluation of the 0% exploitation rate for river herring in Maryland. In addition, Maryland will control the harvest of river herring by one or a combination of the following harvest limits; harvest season; areal closures; or gear restrictions. Virginia will use similar measures to control harvests of river herring, American shad and hickory shad.	1.2 River herring harvest will be controlled. Types of management actions which will be considered in the regulation of river herring are as follows: <u>Harvest</u> – Quotas would be a reasonable regulation if the size of the spawning stock in a given year was predictable <u>Seasons</u> – Setting a season during a segment of the “average” spawning period to regulate exploitation <u>Areal closures</u> – Restrict exploitation in those areas where the potential for harvest is greatest such as restricted portions of migratory routes or at migration barriers <u>Gear restrictions</u> – Restrict large-volume harvesting by pound nets and/or haul seines	2012 On-going          2012	Commercial harvest of river herring declined due to low market demand and uncertain stock status. Commercial and recreational river herring fisheries were closed on January 1, 2012. All river herring and river herring products imported into MD and VA must include a bill of sale. MD and VA do not have an ASMFC approved sustainable fishery plan for river herring.  PA prohibited the harvest of river herring in the Susquehanna River watershed.
1.3 Maryland will continue the moratorium on the fishery for hickory shad and consider opening a recreational fishery when the American shad stocks have recovered.	1.3 Management actions and strategies for American shad and hickory shad will not be separated due to the paucity of information available for hickory shad and by nature their similar life history.	1981, 1992, 1995 On-going   1994 Continue  2010 Continue   2014	MD (1981) and DC (1992) and PRFC (1995) continue moratorium on hickory shad. Recent monitoring results suggest hickory shad are rebuilding in the Bay.  Larval and juvenile hickory shad have been stocked in the Patapsco, Patuxent, Choptank, and Nanticoke rivers. Shad are no longer stocked in Marshyhope Creek (Nanticoke River). Stocking has been focused on the Choptank River. From 1994-2015, 44.5 million American shad and 111.6 million hickory shad have been stocked.  Hickory shad are considered self-sustaining in the

1989 Chesapeake Bay Alosid [*sic*] Management Plan Implementation Table (updated 6/2016)

Strategy	Action	Date	Comments
1.4 Pennsylvania will continue to prohibit the harvest of American shad in the Susquehanna River and its tributaries, and American and hickory shad in the Conowingo Reservoir while restoration efforts are in progress.	1.4 As restoration of alosids [ <i>sic</i> ] progresses over dams in the Susquehanna River, additional regulations in Pennsylvania will be promulgated to protect these species until a degree of restoration is achieved	On-going  Continue	Patuxent and Choptank rivers. PA prohibits the harvest of American and hickory shad in the Susquehanna River watershed. Insufficient recreational catch data are available post-2008.  There is a recreational catch and release fishery below Conowingo Dam.
2.1 Maryland, Pennsylvania and Virginia will continue to participate in the ongoing ASMFC-coordinated coastal fishery stock identification and ocean landing studies of alosids [ <i>sic</i> ].	2.1 Maryland, Pennsylvania and Virginia will participate in the ongoing ASMFC alosid [ <i>sic</i> ] management program, both in Board and Scientific and Statistical Committee activities, with the goal of providing adequate protection to the component of the coastal stock which returns to the Chesapeake Bay to spawn.	On-going  1997  1999  2007  2012  2012-2013  2014 ongoing	MD, VA, and PRFC participate in the ASMFC shad management board and technical committee.  ASMFC conducted a stock assessment in 1997.  Amendment 1 to the ASMFC shad plan adopted a strategy to keep fishing mortality below $F_{30}$ .  ASMFC Amendment 3 specified the American shad total mortality threshold to $Z_{30}$ for the coastal stock. ASMFC completed a stock assessment in 2007. The ASMFC Review Panel recommended the development of population specific reference points.  American shad and river herring mortality rates have increased. Alosa bycatch in ocean fisheries are contributors, but data is limited. Bycatch mortality in Chesapeake Bay has not been estimated.  The ASMFC Management Board approved the 2012 river herring stock assessment.  MAFMC adopted Amendment 14 which imposes a 520,000 lb. Alosa bycatch limit to the Atlantic mackerel fishery. NEFMC has adopted Amendment 5 to the Atlantic herring FMP. Both amendments will improve bycatch reporting.  MD and VA participated in the TEWG for river herring coordinated by NMFS and ASMFC to inform and develop a coastwide conservation plan for river herring.
2.2 Virginia will follow ASMFC recommendations	2.2 A) Implement a coastal shad tagging program	1991	Tagging studies indicated that the coastal fishery is

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Strategy	Action	Date	Comments
to reduce shad harvest to a 25% exploitation rate.	to determine which stocks are being exploited in the intercept fishery	Continue  On-going	mixed and highly variable from year to year. Continuation of tagging programs is recommended.  DNA data is used to identify populations within the mixed ocean stock. MD and VA obtain tissue samples for research upon request.
	2.2 B) Control the coastal intercept fishery through a combination of gear restrictions, seasonal and area closures, and harvest limits	1993 2005 On-going	ASMFC Amendment 1 required closure of the coastal intercept fishery by December 2004.
	2.2 C) Continue to monitor and document its territorial sea intercept fishery for American shad	1993 On-going	VA is required to monitor coastal commercial harvest.
2.3.1 Virginia will follow ASMFC recommendations to reduce river herring harvest to a 25% exploitation rate.	2.3.1 Virginia will control river herring harvest during spawning migrations through gear restrictions and spawning area closures.	1992 On-going	The harvest of river herring has declined for a number of reasons including a loss of spawning habitat due to dams, commercial fishing, and as by-catch in the Atlantic herring and Atlantic mackerel ocean fisheries.
		2012 Completed	Action 2.3.1 was superceded by the ASMFC's 2012 moratorium on river herring harvest.
2.3.2 Maryland and Virginia will ensure that river herring by-catch in the foreign and domestic mackerel fisheries is minimized.	2.3.2 Maryland and Virginia will monitor river herring by-catch through the mid-Atlantic Fishery Management Council and support the following recommendations: a) The foreign fishery will stay 20 miles offshore. 2.3.2 b) Maximum by-catch of 1% for river herring in the foreign and domestic mackerel fisheries with a cap on total allowable by-catch.	In effect On-going	River herring bycatch is monitored under Amendments 14 and 15 to the MAFMC Atlantic Mackerel/Squid/Butterfish FMP.  NAFO monitors international fishing fleets.
		In effect On-going  2015	River herring bycatch is monitored by the MAFMC, NEFMC, NMFS, and NAFO.  <b>MAFMC approved an 180,779 pound incidental shad and river herring bycatch limit for the Atlantic mackerel fishery for 2016. The fishery will close early if the incidental bycatch limit is exceeded.</b>
		2012-2015	<b>MAFMC under Amendment 14, approved an 180,779 lb. Alosa bycatch limit to the Atlantic mackerel fishery for 2016. NMFS has approved NEFMC Amendment 5 to the Atlantic herring FMP. Both amendments will improve at-sea observer bycatch reporting and monitoring.</b>
3.1 The jurisdictions will collect specific data on alosid [ <i>sic</i> ] species to improve stock assessment	3.1 A) Maryland will continue the alosid [ <i>sic</i> ] juvenile survey and develop an index of stock	Continue	VIMS, MD DNR and DCFM have Alosine juvenile surveys and calculate indices for each species.



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Strategy	Action	Date	Comments
databases.	abundance. Virginia will continue to collect shad and herring juvenile abundance data with the objective of developing a baywide index of abundance for these species. (Currently being implemented) The juvenile index will be used in conjunction with adult stock estimates to trigger regulatory changes and harvest rates.	2009  Continue  2010 Discontinued	The last several years indicate an increase in juvenile Alosines.  ASMFC Amendment 2 requires river herring JAI surveys. VA & MD continue to provide data to coastal stock assessment  Preliminary stock recruit indices for river herring were developed and presented to the ASMFC's Herring Stock Assessment Sub-committee (SAS). The effect of bycatch, environmental factors, and stock change on the relationship requires further study. No trends were detected for American shad and there was insufficient data for hickory shad. Initial stock-recruit analyses indicated that a river herring JAI was a predictor of future year class strength. The SAS decided not to pursue development of the indices.
	3.1 B) Maryland will continue research projects for American shad in the upper Bay and Nanticoke River which provide annual estimates of adult shad. (Currently being implemented)	Continue Discontinued  2009 Continue  2011   2013 Continue	Adult shad tagging project on the Nanticoke River was ended due to a lack of tag returns.  ASMFC Amendment 2 requires adult river herring spawning/population assessment. The Nanticoke River commercial survey is the data source for the river herring spawning population assessment. The Nanticoke River commercial survey will continue during the moratorium. <b>In 2015, river ice conditions prevented this assessment, but it will resume in 2016.</b>  A fishery independent gill net survey was conducted in the Northeast River to monitor spawning river herring.
	3.1 C) Virginia will improve assessment of current fishing rates on shad stocks in territorial waters and seek to improve catch and effort data through mandatory reporting. (1990)	1995 Continue	Commercial landing data have been improved on a coastwide basis with the establishment of ACCSP. Limited American shad bycatch fisheries exist.
	3.1 D) The VMRC Stock Assessment Program will provide additional fishery dependent data collection	On-going	Required by the ASMFC.

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Strategy	Action	Date	Comments
	for Virginia's shad fisheries (on-going)		
	3.1 E) Virginia will initiate an ocean intercept tagging program to determine stock composition in the coastal shad fishery (1990)	1991-1992 Completed  2005	Tagging work completed in 1992. Results indicated coastal catch is mixed and highly variable.  Ocean intercept shad fishery was closed.
	3.1 F) Maryland will examine the exploitation rates of alewife and blueback herring in selected tributaries of the Chesapeake Bay and improve the accuracy and utility of herring landings. (1990)	1990 On-going  Continue	Mortality rates are calculated for river herring in the Nanticoke River. Exploitation rate estimation has not been a priority.  MD began a moratorium on river herring in 2012.
	3.1 G) Virginia will cooperate with research institutes to implement a survey of selected shad and herring spawning grounds, compiling information on basic spawning stock characteristics including relative adult abundance, juvenile abundance, size, age and sex ratios. (Currently being implemented)	1990 Completed  2009  2009 On-going	A map of historic shad and herring spawning areas has been completed.  Tributary-specific targets were considered. The FMPC and ad hoc Fish Passage workgroups met to discuss how to address the development of targets. No targets were adopted.  CBSAC sponsored a workshop to evaluate different methodologies and recommended a multi-metric approach.  ASMFC Amendment 2 requires adult river herring spawning/population assessment and Amendment 3 (2010) requires adult American shad spawning/population assessment.
	3.1 H) American shad abundance will be investigated in the Potomac River, a system of historic importance, through a joint effort by Maryland, Virginia, and District of Columbia. (1991)	1991 On-going  2011	MD striped bass juvenile seine and gill net surveys collect American shad data.  DCFM has been sampling the upper Potomac for shad and river herring since 1991.  The juvenile survey on the Potomac indicates shad are increasing in abundance especially since 2000. Juvenile shad indices have ranged from 1.05 (2010) to 13.3 (2004). The 2011 JAI was 1.99 (GM). The abundance of juvenile Alosa spp is highly variable and involves density dependent processes that regulate year class strength.

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Strategy	Action	Date	Comments
		<b>2015</b>	The PRFC American shad pound net survey indicates that CPUE in the <b>Potomac River is 133% of the ASMFC restoration target.</b>
<p>4.1 The Chesapeake Bay Program’s Fish Passage Workgroup has analyzed the problem of impediments to Alosid [<i>sic</i>] migration and presented its recommendations for acceptance in December 1988. Maryland will develop a multi-faceted program based on the program’s recommendations to restore spawning habitat to migratory fishes by removing blockages. Virginia, through its Anadromous Fish Restoration Committee, will develop a comprehensive inventory of dams and other impediments restricting the migration of the shad and river herring to their historical spawning grounds and establish fish passage facilities. The Pennsylvania Fish Commission (PFC) will continue to refine its inventory of low head dams through SRAFRFC and continue to promote fish passage at structures on the Susquehanna River tributaries having the potential for Alosid [<i>sic</i>] spawning and nursery habitat. Maryland, Virginia, District of Columbia, U.S. Fish and Wildlife Service and Corps of Engineers will continue its work for fish passage at Little Falls and Rock Creek.</p>	<p>4.1 The District of Columbia, Maryland, Pennsylvania and Virginia will implement the plan adopted by the Fish Passage Workgroup to remove barriers. Projects include:</p> <p>A) Permanent fish passage facilities are being designed and will be constructed at Conowingo Dam at a cost of \$12.5 million. (1989)</p>	<p>Variable</p> <p>Completed</p> <p>2010</p> <p>2011</p> <p>Continue</p> <p>2012</p> <p>2009 - 2012</p> <p>2014 Ongoing</p>	<p>Actions 4.1A - 4.1C, 4.1E, and 4.1G - 4.1I have been completed. Actions 4.1D, 4.1F, and 4.1J – 4.1L are underway.</p> <p>Conowingo Dam East Fish Lift is operational.</p> <p>SRAFRFC adopted the Migratory Fish Management and Restoration Plan for the Susquehanna River Basin in 2002, which was revised in 2010. This plan sets restoration goals for all Alosine species.</p> <p>The last significant blockage in MD for spawning American shad passage is the Conowingo Dam.</p> <p>Shad passage at Conowingo is being evaluated as part of the FERC relicensing process. Shad upstream passage efficiency at Conowingo was estimated in 2010 at 45% and in 2012 at 26%. American shad telemetry study detected fall-back behavior, where many fish enter the East Fish Lift, but leave without passage.</p> <p>Fish passage and habitat studies conducted as part of the FERC relicensing process are available at: <a href="http://www.exeloncorp.com/locations/ferc-license-renewals/Conowingo/Pages/Documents.aspx">http://www.exeloncorp.com/locations/ferc-license-renewals/Conowingo/Pages/Documents.aspx</a></p> <p>FERC has not renewed the license for the Conowingo Project. The project is currently operating on an annual license under the provisions of the old license. The current license expired on September 1, 2014. The federal and state agencies are still working out the details for balancing hydropower production with all the other uses of the lower Susquehanna River including environmental considerations.</p> <p><b>Exelon has agreed to improve fish passage at</b></p>

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Strategy	Action	Date	Comments
			<b>Conowingo Dam. The details will be determined prior to the license renewal: tentatively scheduled for 2018.</b>
	4.1 B) Design planning and implementation of fishways at Holtwood, Safe Harbor and York Haven dams on the Susquehanna River. (In progress)	1986 Completed	Fishways have been constructed. Fishway improvements are periodically implemented to boost fish passage efficiency.
		2010 Continue	Holtwood Dam fishway is being renovated to improve upstream passage of Alosa. <b>All improvements were completed by 2015.</b>
		2015	<b>York Haven Power Company, LLC plans for a “nature-like” fishway were approved by Dauphin County commissioners and building is slated to begin in 2018-2020.</b>
	4.1 C) A comprehensive inventory of dams and other impediments restricting the migration of shad and river herring to their historical spawning grounds has been completed. (1989)	1990  2011/2012 Completed And On-going	Action completed.  The Nature Conservancy in conjunction with NOAA, USFWS, MD DNR, PA FBC, VGIF, CBP, USACE, American Rivers, VCU, and Chesapeake Bay Trust completed a GIS based Chesapeake Fish Passage Prioritization tool to prioritize dam removal based on ecologically relevant metrics. The tool is currently being used and was updated in 2014/2015. Another update is slated for 2017/2018.
	4.1 D) Removal of stream blockages, re-stocking efforts, and construction of fish ladders at sites of barriers on priority streams and rivers will begin. (1990)	Continue  1989-2007 Ongoing  2009  2010	1,838 miles of Chesapeake Bay stream habitat was reopened in PA, VA, and MD for anadromous fish from 1988 through 2005.  VA has removed 6 dams, breached 3, and built passage structures at 9 as of 2015. Several fish passage projects are being pursued. VA dam removal status is available at <a href="http://www.dgif.virginia.gov/fishing/fish-passage/">http://www.dgif.virginia.gov/fishing/fish-passage/</a>  Between 1989 and 2013, approximately 2,576 miles of habitat were reopened to anadromous and resident fish.  From 1986 to 2003, >340 million American shad fry and fingerlings were cultured and released in

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Strategy	Action	Date	Comments
		Continue 2011	Susquehanna, James, Pamunky, Mattaponi, Rappahannock, Potomac & Choptank rivers. Rappahannock River stocking began in 2003.
		2011-2013 Completed	Patuxent River hickory shad have been restored and stocking discontinued. Limited monitoring will continue. Marshyhope stocking was discontinued after 2011. Choptank River hickory shad have been restored and stocking discontinued. American shad are only stocked in the Choptank River as of 2011.  Additional wells were drilled at Manning hatchery and liners added to existing ponds to accommodate increased river herring culture.
		2010 on-going	Union Dam and Simkins Dam on Patapsco River were removed. Removal of Bloede Dam on the Patapsco River is scheduled for 2017.
		2013 Continue	Experimental stocking of American shad, hickory shad, and river herring in the Patapsco River began in 2013. <b>602,593 alewife, 310,000 American shad, 328,000 blueback, and 1,127,500 hickory shad were stocked in 2015. This was the terminal year of stocking for this project, but monitoring will continue for an additional 2 years. MD DNR is seeking additional funds for continued stocking.</b>
		2014 On-going	The 2014 CB Watershed Agreement (prompted by Executive Order 13508) included an outcome for opening 1,000 miles of migratory fish passage by 2025 (baseline mileage 2,041).
	4.1 E) A demonstration fish ladder project has been developed with the Chesapeake Bay Foundation and the town of Elkton as an example with public access. (1989)	Completed	Elkton dam fishway was built in 1993. Thousands of herring and resident fish have used the fishway to access 12 miles of upstream habitat for spawning, forage, and cover. Fish Passage staff documented over 7,000 alewife and blueback herring using the fishway in 1999.  Town of Elkton created a bypass channel around the dam which increased from bank incision and erosion

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Strategy	Action	Date	Comments
		2014	<p>upstream. Sediment accumulation has increased at the entrance and exit of the fishway that has to be dredged roughly every 2 years. The number of herring using the fishway has significantly decreased since 2005, which corresponds with the time frame for the coast wide decline of both shad and herring.</p> <p>In 2009, there was some evidence of river herring spawning upstream of the Elkton Dam. In 2014, river herring were observed below the fish ladder but sediment deposits are inhibiting fish from using the ladder. The town of Elkton is responsible for maintaining the ladder and will make provisions for improving access when their MDE permit is renewed in 2016.</p>
	4.1 F) A program to reduce turbine mortalities by implementing guidance and avoidance techniques, i.e., use of fish attraction or avoidance devices to guide shad away from turbines to “sluice gate”.(1991)	1992 1994 1997 2001  2009-2013 Completed	<p>YOY American shad survival from passage through a Kaplan turbine (Conowingo Dam) is 95%. YOY shad survival was 90% for a single runner Francis turbine at Holtwood Dam. YOY shad survival at double runner Francis turbines was 77% at York Haven Dam and 83% at Holtwood Dam.</p> <p>Exelon Generating Company LLC funded a study to estimate YOY American shad mortality from a single runner Francis turbine at Conowingo Dam during the FERC relicensing process. YOY survival was 90%. Entrainment of adult, out-migrating American shad is projected to be high. Adult shad survival is 80-90% at Francis turbines and 84% at Kaplan turbines.</p>
	4.1 G) Fish passage facilities on the James and Rappahannock Rivers will be established. (Currently being implemented )	1999 Completed  2005 Completed	<p>Vertical slot fishway completed at Boshers Dam on the James River, the last in the fall zone of Richmond. This reopened 137 miles of the mainstem James and over 150 miles of major tributaries.</p> <p>Embrey Dam was removed from the Rappahannock River reopening 106 miles of the Rappahannock and Rapidan rivers.</p>
	4.1 H) The recently constructed passage facility on the Chickahominy River at Walker’s Dam will be evaluated for its effectiveness. (1990)	1989 Completed	A double Denil fishway on Walkers Dam was rebuilt in 1989 by the City of Newport News to allow passage of migratory fish. Alosa, blueback herring,

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Strategy	Action	Date	Comments
			alewife and American shad have been documented using the fishway.
	4.1 I) Fish passage facilities at Little Falls Dam on the Potomac River will restore about 10 miles of spawning habitat and at Rock Creek park will open an additional 5 miles of spawning habitat.	1999 - 2000 Completed	A hydraulic model and construction of Little Falls Dam fish passage has been completed. Fish passage effectiveness has been difficult to measure.
	4.1 In addition to the strategies detailed in the Fish Passage Plan, several aspects must be coordinated with the Fishery Management Plan:  J) Sources of adult fish used for restocking areas will be coordinated with other states and agencies. (1990)	Continue  Continue	Hatchery-rearing methods are standardized. MD, VA, and PA strip spawn. DE hatchery spawning is hormone free. Jurisdictional coordination is good.  All American shad broodstock used by MD, VA, PA, and USFWS are from the Potomac River. MD stocks larval, early juvenile, and late juvenile stages to improve stocking success rate. PA stocks some American shad from the Delaware and Susquehanna Rivers.
	4.1 K) The reintroduction of alosid [ <i>sic</i> ] stocks will require specific regulatory measures to protect the newly-introduced fish until populations have been established.	Continue  2010  2011  2013	Moratorium in place for American and hickory shad. Hickory shad data is insufficient for most tributaries to determine population status.  Juvenile downstream survival has to be improved at dams having Francis turbines: Holtwood and York Haven.  Normandeau studies at Safe Harbor (2008) and Conowingo (2012) indicate ~86% survival of adult American shad during downstream passage.  Moratorium is in place for river herring.  Allocation of shad and herring resources among stakeholders has been deferred until the species stocks are declared restored.
	4.1 L) Monitoring is essential in gauging the impact of fish passage projects on restoration efforts.	1999 Continue  Continue	ASMFC Amendment 2 encourages assessment of fishway passage efficiency/inefficiency for river herring.  Boshers Dam vertical slot fishway is monitored for passage each spring. American shad plus 23 other species are known to use the passage.

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Strategy	Action	Date	Comments
		Continue	Fishways are monitored on a limited basis as new ladders are constructed. A 10 year fish passage monitoring goal of 50% coverage is being considered. Fishway efficiency has been difficult to measure. Passage indices should be explored.
<p>4.2 Restoration of shad and river herring to suitable unoccupied habitats will be accomplished by introducing hatchery-raised juveniles or transplanting gravid adults. Present policy fully supports the transplantation of adult shad using fish passage facilities at Conowingo Dam under the assumption of reasonable outmigration. However, if outmigration is not obtained, then the effects of transporting adults from the population below the dam needs to be reevaluated.</p>	<p>4.2.1) Maryland and Pennsylvania will continue to work within SRAFRFC's ongoing programs as described in the annual work plan to evaluate methods for ensuring successful downstream passage for juveniles and adults. This will include spill, diversion devices, and bypass systems.</p>	<p>Continue 2002 2010</p> <p>2014</p>	<p>SRAFRFC adopted a new Alosine Management and Restoration Plan for the Susquehanna River Basin in 2002. Restoration Plan was revised in 2010 <a href="http://www.dec.ny.gov/docs/fish_marine_pdf/r7fsraf_cfinal.pdf">http://www.dec.ny.gov/docs/fish_marine_pdf/r7fsraf_cfinal.pdf</a></p> <p>York Haven Power Company, LLC plans for a "nature-like" fishway were approved by Dauphin County commissioners and building is slated to begin in 2018-2020.</p>
	<p>4.2.2 A) Maryland, Pennsylvania, and Virginia working within SRAFRFC, will promote using Susquehanna River brood stock for hatchery production.</p>	<p>Discontinued 2002</p> <p>Continue</p>	<p>Brood stock are no longer collected from the Susquehanna River. MD, VA, PA, and USFWS use American shad brood stock collected from the Potomac River. 10% of eggs collected from Potomac River brood stock must be returned to the Potomac as mitigation for egg removals. Susquehanna River American shad spawned at MD hatcheries have had poor fertilization rates. Funding is not available to determine the cause. Population level impact of poor fertilization rates in the wild stock [<i>in situ</i>] has not been determined.</p> <p>Normandeau Associates, Inc. spawns Susquehanna River American shad for experimental stocking in PA. The fish are collected at the Conowingo Dam's west fish lift.</p>
	<p>4.2.2 B) Virginia will expand funding to the recently constructed Pamunky/Mattaponi Indian Reservation shad hatcheries.</p>	<p>1993</p> <p>Continue</p>	<p>Funding was from VMRC, but is now provided by VDGF.</p>
<p>4.3.1 Technical issues concerning water quality standards for dissolved oxygen and minimum flows in the Susquehanna River below Conowingo Dam have been negotiated.</p>	<p>4.3.1 The following technical issues have been accepted.</p> <p>A) Adoption of Maryland water quality standard for dissolved oxygen of 5.0 mg/liter in the Susquehanna River below Conowingo Dam (1989)</p>	<p>Continue</p>	<p>Standards were implemented in 1989 and have been monitored ever since. New water quality criteria for living resources have been adopted. Water quality sampling protocols are being reviewed during the FERC relicensing process.</p>



1989 Chesapeake Bay Alosid [*sic*] Management Plan Implementation Table (updated 6/2016)

Strategy	Action	Date	Comments
	B) Installation of turbine venting systems and intake air injection capabilities (1991)	1988 – 1991 Completed	All 7 Francis turbines now have turbine venting systems and partial intake air injection system.
	C) Operation of turbines as necessary to meet the DO standard (1989)	Continue	Power generation is adjusted as needed.
	D) Monitored spills as necessary (1989)	Continue	Water releases are closely monitored to maximize pool volume.
	E) A schedule of minimum and continuous flows (1989)	Continue	The dam and reservoir are managed to meet required water flows. However, the minimum flow (cfs) is not continuously maintained, but rather allowed to fluctuate below the minimum within the management window. The minimum flow requirement is not daily but rather the average monthly flow. Flow requirements are being negotiated.
4.4 Maryland DNR has proposed new criteria for use in the revised water use classification and water quality standards system setting standards for temperature, dissolved oxygen, pH, amount of suspended solids and a number of “priority pollutants” in anadromous fish spawning areas.	4.4 Establish new categories in the water classification system to guide resource management based on the physical habitat and water quality characteristics. The revised system would define anadromous fish spawning areas as either Class II waters (fresh, nontidal warm water streams, creeks and rivers) or Class III waters (tidal estuarine waters and Chesapeake Bay).	2007  2011  2014 On-going	Maps delineating particular habitats of concern are used for developing water quality standards.  Revised habitat prioritization maps have been completed by CBP.  Jurisdictions adopted the Chesapeake Watershed Agreement (2014) to set specific restoration goals and timeframes. For more information: <a href="http://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignatures-Hires.pdf">http://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignatures-Hires.pdf</a>
4.5 The District of Columbia, Maryland, Pennsylvania and Virginia will cooperatively evaluate the available scientific data on the effects of impaired water quality on alosids [ <i>sic</i> ] as a means of developing more effective water quality criteria for spawning and hatching areas and take action now to reduce pollution from several sources.	4.5) The first three action items are commitments under the 1987 Chesapeake Bay Agreement. Maryland DNR, PFC, DC and VMRC will not carry out the specific commitments, but are involved in setting the objectives of the programs to fulfill the commitments and reviewing the results of the action programs. The achievement of these commitments will lead to improved water quality and enhanced biological production.  A) Develop and adopt a basinwide plan that will achieve a 40% reduction of nutrients entering the Chesapeake Bay by the year 2000. 1) Construct public and private sewage facilities.	On-going Variable	Chesapeake Bay Program develops, revises, and monitors goals and strategies for nutrients, wastewater, sediment, stormwater, agriculture, development, and chemical contaminants. For more information: <a href="http://www.chesapeakebay.net/issues/issue/nutrients">http://www.chesapeakebay.net/issues/issue/nutrients</a> <a href="http://www.chesapeakebay.net/issues/issue/wastewater">http://www.chesapeakebay.net/issues/issue/wastewater</a> <a href="http://www.chesapeakebay.net/issues/issue/sediment">http://www.chesapeakebay.net/issues/issue/sediment</a> <a href="http://www.chesapeakebay.net/issues/issue/stormwater_runoff">http://www.chesapeakebay.net/issues/issue/stormwater_runoff</a> <a href="http://www.chesapeakebay.net/issues/issue/agriculture">http://www.chesapeakebay.net/issues/issue/agriculture</a> <a href="http://www.chesapeakebay.net/issues/issue/development">http://www.chesapeakebay.net/issues/issue/development</a>

1989 Chesapeake Bay Alosid [*sic*] Management Plan Implementation Table (updated 6/2016)

Strategy	Action	Date	Comments
	<p>2) Reduce the discharge of untreated or inadequately treated sewage.</p> <p>3) Establish and enforce nutrient and conventional pollutant limitations in regulated discharges.</p> <p>4) Reduce levels of nutrients and other conventional pollutants in runoff from agricultural and forested lands.</p> <p>5) Reduce levels of nutrients and other conventional pollutants in urban runoff.</p>	<p>2000</p> <p>2007</p> <p>2009</p> <p>2009</p> <p>2010 2012 On-going</p> <p>2014 On-going</p>	<p><a href="#">ment</a></p> <p>New commitments were established in the Chesapeake 2000 Agreement. For Alosines, priority populations will be identified and tributary-specific targets developed.</p> <p>STAC sponsored a workshop during 2007 to develop restoration targets.</p> <p>Executive Order 13508 by President Barack Obama required federal agencies to increase cooperation and leadership, coordinate with state and local government, and enforcement of Clean Water Act.</p> <p>EPA is mandating restoration criteria and actions for Chesapeake Bay States. EPA developed a Chesapeake Bay watershed TMDL. States must have EPA approved plans with 2 year milestones or face fines and other sanctions. Various jurisdictions have filed legal challenges to the EPA TMDL. Jurisdictions submitted Phase I watershed implementation plans (WIP) in 2010 and Phase II WIPS in 2012</p> <p>Jurisdictions adopted the Chesapeake Watershed Agreement (2014) to set specific restoration goals and timeframes. For more information: <a href="http://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignatures-Hires.pdf">http://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignatures-Hires.pdf</a></p>
	<p>4.5 B) Develop and adopt a basinwide plan for the reduction and control of toxic materials entering the Chesapeake Bay system from point and nonpoint sources and from bottom sediments.</p> <p>1) Reduce discharge of metals and organic compounds from sewage treatment plants receiving industrial wastewater.</p> <p>2) Reduce the discharge of metals and organic compounds from industrial sources.</p> <p>3) Reduce levels of metals and organic compounds</p>	<p>On-going</p> <p>2014 On-going</p>	<p>Chesapeake Bay Program develops, revises, and monitors goals and strategies for chemical contaminants. For more information: <a href="http://www.chesapeakebay.net/issues/issue/chemical_contaminants">http://www.chesapeakebay.net/issues/issue/chemical_contaminants</a></p> <p>Jurisdictions adopted the Chesapeake Watershed Agreement (2014) to set specific restoration goals and timeframes. For more information: <a href="http://www.chesapeakebay.net/documents/FINAL_C">http://www.chesapeakebay.net/documents/FINAL_C</a></p>



1989 Chesapeake Bay Alosid [*sic*] Management Plan Implementation Table (updated 6/2016)

Strategy	Action	Date	Comments
	1) Determine the relative contributions to acidic deposition from various sources of acid deposition precursor emissions and identify any regional variability. 2) Assess the consequences of the environmental impacts of acid deposition on water quality. 3) Identify and evaluate the effectiveness and economic costs of technologies and non-control mitigative techniques that are feasible to control acid deposition into the Bay.		<a href="http://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignatures-Hires.pdf">http://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignatures-Hires.pdf</a>

**Acronyms:**

ACCSP – Atlantic Coastal Cooperative Statistics Program  
 ASMFC – Atlantic States Marine Fisheries Commission  
 CBAMP – Chesapeake Bay Alosa Management Plan  
 CBP - Chesapeake Bay Program  
 CBSAC – Chesapeake Bay Stock Assessment Committee  
 Cfs – Cubic feet per second  
 CPUE – Catch per unit effort  
 DCFM – District of Columbia Fisheries Management  
 DO – Dissolved oxygen  
 EPA – Environmental Protection Agency  
 FERC – Federal Energy Regulatory Commission  
 FMP - Fishery Management Plan  
 GIS – Geographic information system  
 GIT – Goal implementation team  
 GM – Geometric mean  
 JAI – Juvenile abundance index  
 MAFMC – Mid-Atlantic Fisheries Management Council  
 MD DNR – Maryland Department of Natural Resources  
 NAFO – Northwest Atlantic Fisheries Organization  
 NEFMC – New England Fishery Management Council  
 NMFS – National Marine Fisheries Service  
 NOAA – National Oceanic and Atmospheric Administration  
 PA FBC – Pennsylvania Fish and Boat Commission  
 PFC – Pennsylvania Fish Commission  
 PRFC – Potomac River Fisheries Commission  
 SAS – Stock assessment sub-committee  
 SRAFRC – Susquehanna River Anadromous Fish Restoration Committee

STAC - Chesapeake Bay Program, Scientific and Technical Advisory Committee  
 TEWG – Technical Expert Working Group  
 TMDL – Total maximum daily load  
 USACE – United States Army Corps of Engineers  
 USFWS – United States Fish and Wildlife Service  
 VCU – Virginia Commonwealth University  
 VGIF – Virginia Game and Inland Fish  
 VIMS – Virginia Institute of Marine Science  
 VMRC – Virginia Marine Resource Commission  
 WIP – Watershed implementation plan  
 YOY – Young of year

## 2015 Maryland FMP Report (May 2016)

### Section 20. a) Weakfish (*Cynoscion regalis*); b) Spotted Seatrout (*C. nebulosus*)

A bench mark stock assessment was completed in 2015 and accepted for management action by the Atlantic States Marine Fisheries Commission (ASMFC) in 2016. The stock remains depleted and natural mortality remains high. New biological reference points (BRPs) were adopted in 2016 based on total mortality (natural and fishing mortality combined). Current total mortality was below the target in 2014 for the first time in 13 years, but will need to continue below the target for several years to allow the stock to recover. No change in management was recommended by the ASMFC Weakfish Board.

#### Fishery Management Plans (FMPs)

The Chesapeake Bay Weakfish and Spotted Seatrout Fishery Management Plan (CBW/SS FMP) was adopted in 1990 to enhance and perpetuate the Chesapeake Bay's weakfish and spotted seatrout stocks. Since then, the plan was revised in 2003 and addresses only weakfish and not spotted seatrout (see spotted seatrout 'notes' at the end of the weakfish update). The revised plan was developed in response to the improvement in the status of the weakfish stock from overfished (below a threshold) to fully exploited (fished at MSY) and included new biological data pertinent to the Chesapeake Bay. The CBW FMP follows the compliance requirements set forth in the ASMFC Amendment 4 to the Interstate Weakfish Management Plan (2002) and several addenda (2003-2009). Maryland is required to submit annual compliance reports to ASMFC for both weakfish and spotted seatrout.

The CBP plan was reviewed by the Maryland DNR Fisheries Service (FS) weakfish and spotted seatrout plan review team (PRT) in 2012/2013. A report was presented to the Tidal Fisheries Advisory Committee and Sport Fisheries Advisory Committee as part of the plan review process. The PRT recommended no changes to spotted seatrout or weakfish allocation, but noted a need for additional socioeconomic data.

#### Stock Status

A benchmark stock assessment was prepared in 2015, peer reviewed and accepted for management by ASMFC in 2016. The Atlantic coastwide weakfish stock is considered depleted, and has been since 2002. The term "depleted" is used when factors other than fishing mortality have contributed to a decline in biomass. A Bayesian statistical catch at age model was used to examine time varying natural mortality in addition to fishing mortality and recruitment. New BRPs based on total mortality were adopted, with the threshold set at 30% and the target set at 20%. The 2014 total mortality was below the threshold but above the target, indicating a

sustainable level of mortality in the terminal year of the model. This was the first time in 13 years total mortality was below the threshold. However, SSB remains very low. Natural mortality increased significantly in the early 2000s then stabilized at a high level which led to an increase in total mortality. Fishing mortality from 2011 to 2014 was low, but total mortality remained high enough to preclude the start of a recovery prior to 2014. More years of data will be necessary to determine if the improvement seen in 2014 is accurate and persists into the future. Maryland's fishery dependent and independent monitoring has shown both a decrease in mean adult age and low juvenile abundance. Despite current restrictive management measures, the depleted weakfish stock is unlikely to recover quickly without a decrease in natural mortality.<sup>1</sup> Prevailing theories for the increase in natural mortality are predation, competition and changes in climate, but no definitive cause has been determined.

#### Current Management Measures

Management measures implemented by ASMFC's Addendum IV required states to implement a 1 fish recreational creel limit and a 100 pound commercial trip bycatch limit, which translates to a 60% reduction in commercial and recreational exploitation. The Chesapeake Bay jurisdictions implemented new restrictions in 2010 to meet or exceed the ASMFC requirements on harvest and bycatch. In Maryland, the recreational creel limit was decreased to one fish and commercial bycatch limits were implemented. These restrictions continued through 2015.

Maryland DNR conducts fishery dependent and fishery independent monitoring for important recreational and commercial fish species. Adult weakfish are sampled from pound nets. Maryland is required to provide biological data to ASMFC from the commercial catch based on per metric ton of commercial landings. Based on preliminary landings, Maryland was required to provide 14 lengths and 9 age samples for 2015 (and met the requirement). Juvenile fish are sampled from Maryland's Chesapeake Bay and Coastal Bays. Juvenile weakfish mean catch per hectare was higher in the 1990s and reached lows in 2008 and 2012. There was an increase in juvenile weakfish production in both the Bay and Coastal Bays in 2013 and 2014 but remained below the long-term mean. In 2015, the trawl and beach seine relative abundance indices were significantly below the grand mean.

#### Fisheries

Both estimated recreational harvest and commercial landings of weakfish decreased in the early 2000s to very low values (Figures 1 & 2). Harvest estimates and landings values have remained at historically low levels. The preliminary recreational harvest estimates in 2015 were 2,750 fish in Maryland and 4,174 fish in Virginia.<sup>3</sup> Many of the recent year values for both state have had high proportional standard error (PSE), indicating these estimates are imprecise. The declining commercial landings trend began in 1999. Maryland and Virginia's 2014 commercial

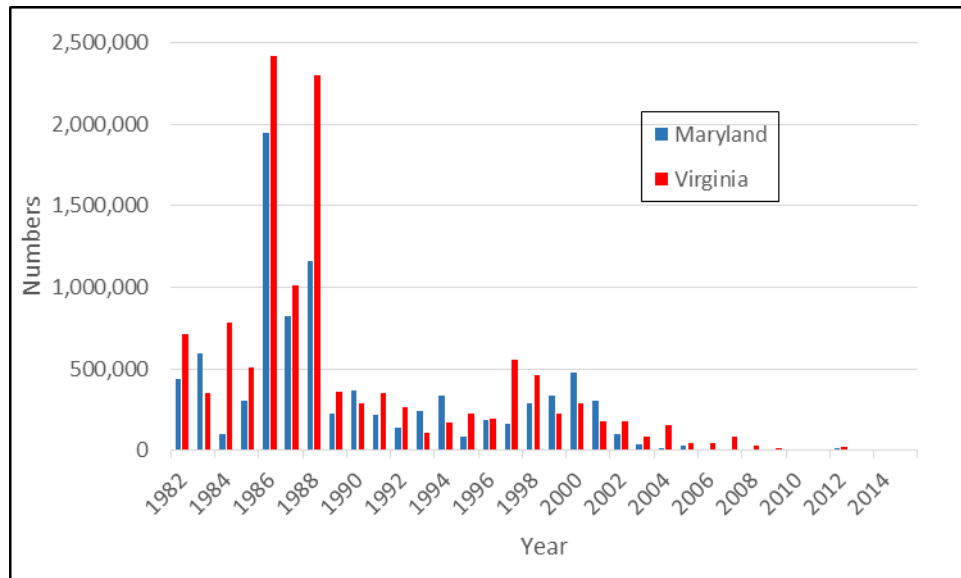
landings were 2,175 and 22,450 lbs<sup>4</sup>, respectively. Landings values for the past five years are the lowest on record for both states for the entire NMFS time series (1950-2014)<sup>4</sup>

### Issues/Concerns

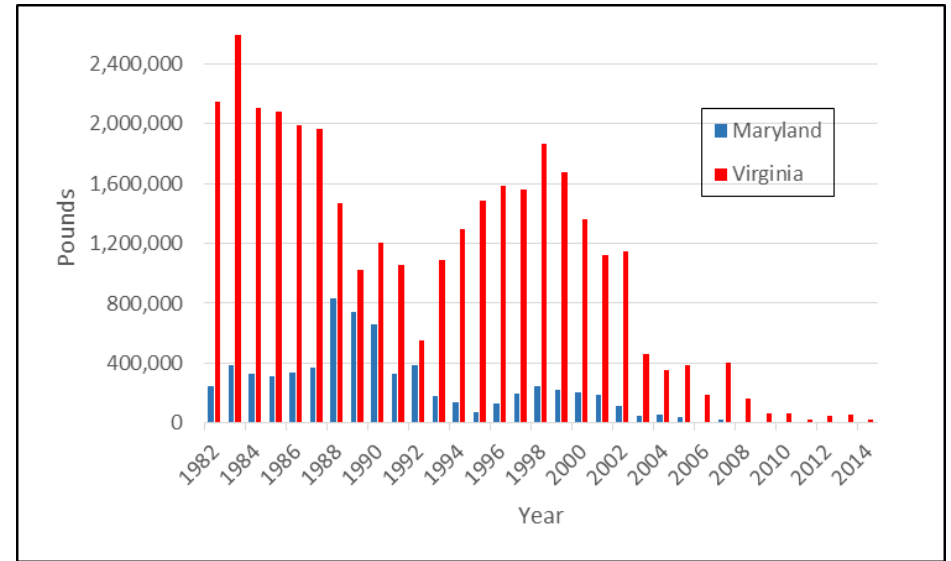
Factors such as predation, competition, and environmental changes, have increased natural mortality and appear to have a stronger influence on weakfish stock dynamics than harvest. Production of weakfish juveniles has not led to increased adult biomass.<sup>1</sup>

The ASMFC weakfish plan review team has reported its recommendations for management, biological research, social and economic research, and habitat studies.<sup>2</sup> Biological research recommendations were listed under high, medium, and low priorities. High priority recommendations include increased observer coverage to quantify discards, quantify trawl bycatch, stock identification and movements, evaluation of predation with a multispecies model, analysis of the spawner-recruit relationship and monitor weakfish diet over a broad regional scale.

**Figure 1. Maryland and Virginia estimated recreational weakfish harvest in numbers, 1982-2015.<sup>3</sup> (2015 values are preliminary).**



**Figure 2. Maryland and Virginia commercial weakfish landings, 1981-2014.<sup>4</sup>**



### References

- <sup>1</sup> ASMFC personal communication May 2016. Stock assessment documents not yet finalized.
- <sup>2</sup> ASMFC. 2015. 2014 Review of the Atlantic States Marine Fisheries Commission Fishery Management Plan for Weakfish (*Cynoscion regalis*) 2014 Fishing Year. Arlington, VA 21p.
- <sup>3</sup> Personal communication from the National Marine Fisheries Service, Marine Recreational Information Program, Fisheries Statistics Division May 13, 2016.
- <sup>4</sup> Personal communication from the National Marine Fisheries Service, Commercial Fisheries Statistics, Fisheries Statistics Division May 13, 2016.

<b>2003 Chesapeake Bay Program Weakfish Fishery Management Plan Implementation</b> (updated 7/16)			
<b>Section</b>	<b>Action</b>	<b>Implementation</b>	<b>Comments</b>
<p><b>Stock Status</b> Management Strategy: CBP jurisdictions will adopt biological reference points (BRPs) that reflect the most current status of the weakfish stock. As data becomes available on multi-species interactions and ecological considerations such as species interactions, food webs, bycatch, biodiversity and habitat, the BRPs should be modified accordingly.</p>	<p><u>Action 1.1</u> MD, PRFC (Potomac River Fisheries Commission) and VA will adopt the Atlantic States Marine Fisheries Commission's (ASMFC) recommendations for the coast wide management of weakfish</p>	<p>Annually reviewed and adjusted if necessary</p>	<p><b>The ASMFC conducted a peer reviewed stock assessment in 2015 that indicated the stock is depleted and has been since 2002. The biomass decline is the result of increasing natural mortality while F remains low. Size and age structure of the stock has decreased. New stock assessment and new total mortality based BRPs were approved, May 2016. Total mortality was between the target and threshold in 2014 (the terminal year of the model) after being above both for 13 years. Stock biomass is still very low and will require several years of low total mortality to recover.</b></p>
	<p><u>Action 1.2</u> In order to achieve the fishing target rates defined by the adopted BRPs, CBP jurisdictions will utilize a combination of size limits and possession limits, and/or seasons or areas to manage the commercial and recreational fishery in state waters.</p>	<p>Annually</p>	<p>ASMFC Addendum IV to Amendment 4 of the weakfish FMP requires that the recreational creel does not exceed 1 fish/person/day in the CBP jurisdictions. Commercial landings must be limited to 100 pounds per vessel, day or trip, whichever is the longer period of time for directed fisheries and bycatch must be limited to 100 pounds per vessel, per day or trip for all non-directed fisheries. The finfish trawl fishery allowance for undersized fish must be reduced to 100 fish. The CBP jurisdictions are in compliance; all met the recreational harvest restrictions and met or exceeded the commercial harvest restrictions. The requirements have remained in effect since 2010.</p>
<p><b>The Fishery Management Strategy:</b> The CBP jurisdictions will regulate the commercial and recreational fishery based on the most recent status of the stock and the established fishing targets.</p>	<p><u>Action 2.1</u> The CBP jurisdictions will consider regional differences when determining state allocation issues and regulations.</p>	<p>As necessary</p>	<p>The Maryland Sport Fish Advisory Commission recommended a weakfish moratorium but no action was taken. Fishing mortality has been decreased over the years but there remains a significant amount of non-fishing mortality,</p>
	<p><u>Action 2.2</u> The CBP jurisdictions will consider the economic impacts of management measures on the fishery and promote</p>	<p>Dependent on the availability of economic data</p>	<p>Collection of economic data for the commercial fishery should include dockside values, the number of commercial vessels, the number of commercial fishermen, and the economic returns from the commercial fishery. Data collection for the recreational fishery</p>

<b>2003 Chesapeake Bay Program Weakfish Fishery Management Plan Implementation</b> (updated 7/16)			
<b>Section</b>	<b>Action</b>	<b>Implementation</b>	<b>Comments</b>
	the utilization of economic data in the management decision process.		should include the number of anglers, the number of directed trips, and angler expenditures. Detailed data collection will enable the development of bio-economic models that can estimate costs or benefits to consumers resulting from fishery regulations.
	<u>Action 2.3</u> The CBP jurisdictions continue to support the use of BRDs in non-directed fisheries and the appropriate mesh sizes in directed fisheries, to reduce the fishing mortality on small weakfish.	Annually	ASMFC Addendum III to Amendment 4 of the weakfish FMP aligns BRD certification requirements between state and federal waters along with the SAFMC shrimp bycatch reduction device requirements.
<b>The Fishery</b> Research and Monitoring: The CBP jurisdictions will continue to monitor the biological characteristics of the weakfish stock in the Chesapeake Bay and coordinate monitoring activities within the Bay and the Atlantic coast.	<u>Action 3.1</u> The CBP jurisdictions will continue fishery dependent sampling and improve catch data. Economic information from the recreational and commercial fisheries will also be reviewed.	Continue	Monitoring data provides information on abundance, age structure, and growth parameters. Addendum I to Amendment 4 to ASMFC's Weakfish FMP stipulates that states must collect otolith ages and fish lengths based on each states landing values, to provide data for coast wide stock assessments. <b>In 2015, otoliths were removed from 21 weakfish during the MD pound net sampling in Chesapeake Bay, and only ages 1 and 2 were present.</b>
	<u>Action 3.2</u> The CBP jurisdictions will conduct fishery independent sampling and collect data on abundance, age structure and recruitment.	Continue	Weakfish juvenile abundance from the Maryland Blue Crab Trawl Survey in Pocomoke and Tangier sounds generally increased from 1989 to 1996, remained at relatively high levels through 2001, then generally decreased from 2003 to 2008, and have remained moderate to low. <b>The Chesapeake Bay juvenile geometric mean in 2015 was similar to 2013 and 2014 values and remained below the time series mean.</b> A second JI index s generated from the Coastal Bay Trawl survey. <b>The geometric mean from this survey decreased in 2015 and was ranked 23<sup>th</sup> among the 27 years surveyed.</b>
	<u>Action 3.3</u> CBP jurisdictions will continue to coordinate state activities with the Atlantic Coast Cooperative Statistics Program (ACCSP).	Continue	The ACCSP Coordinating Council approved the Atlantic States Fisheries Data Collection Standards document in May, 2012. This document will be used to direct partner data collection.
	<u>Action 3.4</u> The CBP jurisdictions will begin to	On-going	Data from the ChesMMAF Survey, CHESFIMS (2001-2006) projects may be used to evaluate species interactions and



<b>2003 Chesapeake Bay Program Weakfish Fishery Management Plan Implementation</b> (updated 7/16)			
<b>Section</b>	<b>Action</b>	<b>Implementation</b>	<b>Comments</b>
<p><b>Habitat</b> Management Strategy: CBP jurisdictions will monitor and regulate activities which may be harmful to weakfish habitat.</p>	<p>collect and examine stomach contents data and examine the effects of environmental variables upon weakfish growth rates. Activities, which contribute to the degradation and or loss of habitat types that weakfish utilize throughout their life history stages will be monitored and regulated by CBP jurisdictions.</p>	<p>On-going Revised in 2014</p> <p>2014</p>	<p>relationships. Results and trends can then be incorporated into CBP fishery management plans. ASMFC weakfish stock assessment (2006) incorporated a striped bass predator function allowing weakfish stock decline to be modeled. CBP jurisdictions support the commitments of the Chesapeake Bay 2000 Agreement. These activities include reducing the discharge of toxic pollutants or excessive nutrients into the Chesapeake Bay and its tributaries, interruption or changes in water discharge patterns, deposition of solid waste, sewage sludge or industrial waste into Bay (which may lead to anoxic conditions), rapid coastal development, unregulated agricultural practices, net coastal wetland loss, or the dredging of contaminated sub-aqueous soils.</p> <p>The CBP developed a Watershed Agreement (2014) with new and updated habitat outcomes. For more information see: <a href="http://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignatures-HIres.pdf">http://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignatures-HIres.pdf</a></p>
	<p><u>Action 4.1</u> The CBP jurisdictions will monitor and regulate land-based activities and water-based activities that may negatively impact Chesapeake Bay water quality and weakfish spawning, rearing and foraging areas.</p>	<p>Continue</p>	<p>The MD DNR water quality protection database focuses on watershed lands that are most important for improving water quality.</p>
	<p><u>Action 4.2</u> The CBP jurisdictions will monitor important weakfish forage species to insure that activities, such as directed fisheries or incidental bycatch in non-directed fisheries, do not adversely affect abundance. These managed species, which serve as forage for weakfish include Atlantic croaker, spot, Atlantic menhaden, and blue crab. If fishing activities are contributing to higher F's on forage species, additional</p>	<p>Continue</p> <p>2014 On-going</p>	<p>Data from the ChesMMA, CHESFIMS (2001-2006), and the MD Winter Trawl Survey will provide data on important forage species for weakfish. The CHESFIMS survey was discontinued after 2005 and a modified year in 2006 due to lack of funding.</p> <p>The CBP developed a Watershed Agreement (2014) with new forage species outcome. For more information see: <a href="http://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignatures-HIres.pdf">http://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignatures-HIres.pdf</a></p>

<b>2003 Chesapeake Bay Program Weakfish Fishery Management Plan Implementation</b> (updated 7/16)			
<b>Section</b>	<b>Action</b>	<b>Implementation</b>	<b>Comments</b>
<b>Ecosystem Interactions Management Strategy:</b>	management measures may be necessary.		
	<u>Action 4.3</u> The CBP jurisdictions will monitor the abundance of weakfish forage species that are not managed under CBP FMPs, such as bay anchovies, and Atlantic silversides, using on-going monitoring and surveys.	Continue	The MD Estuarine Juvenile Finfish Survey and VIMS Juvenile Abundance Monitoring Surveys (formerly known as the VIMS Trawl Survey and the VIMS Juvenile Seine Survey) will continue to monitor the abundance of important, non-managed forage species in the Chesapeake Bay.
	<u>Action 4.4</u> The CBP jurisdictions will continue to identify predator/prey interactions, both inter- and intraspecies competition and other interactions that might affect the management of weakfish. As multispecies interactions are evaluated and quantified, biological reference points and management strategies may be adjusted.	On-going  2014 Continue	Data from the ChesMMA, CHESFIMS (2001-2006), and the MD Winter Trawl Survey will be collected and analyzed by CBP jurisdictions to identify possible inter-and intra-species relationships. ASMFC weakfish TC incorporated a striped bass predator function into the 2006 weakfish stock assessment to model the weakfish stock decline since 1998. No new recommendations have been developed.  The CB Watershed Agreement (2014) has a forage species outcome that will evaluate predator/prey interactions. <b>A forage management strategy was developed in 2014/2015 and a biennial work plan was developed for 2016 and 2017.</b> The work plan includes actions to identify important forage species, evaluate a process for developing indicators and develop a process to manage for key predators.

**Acronyms:**

ASMFC = Atlantic States Marine Fisheries Commission  
 BRD = bycatch reduction device  
 BRPs = biological reference points  
 CHESFIMS = Chesapeake Bay Fishery Independent Multispecies Fisheries Survey  
 ChesMMA = Chesapeake Bay Multispecies Monitoring and Assessment Program  
 CBP = Chesapeake Bay Program  
 F = mortality due to fishing  
 FMP = fishery management plan  
 PRFC = Potomac River Fisheries Commission  
 PSE = Proportional Standard Error  
 SAFMC = South Atlantic Fishery Management Council  
 SSB = spawning stock biomass

TC = technical committee  
 VIMS = Virginia Institute of Marine Science  
 YOY = young of the year fish

## **b) Spotted Seatrout Notes:**

The Atlantic States Marine Fisheries Commission (ASMFC) adopted the Fishery Management Plan (FMP) for Spotted Seatrout in 1984 for states from Maryland to Florida. An Omnibus Amendment (2011) was developed to bring spotted seatrout under the authority of the Atlantic Coastal Fisheries Cooperative Management Act (1993) and the ASMFC charter (1995). A corrected version of the omnibus amendment with Technical Addendum 1a was adopted on February 9, 2012.<sup>1</sup> The omnibus amendment includes recommended measures to protect the spotted seatrout spawning stock and requires a coastal minimum length limit.

The spotted seatrout was included in the 1990 Bay Program Chesapeake Bay *Weakfish and Spotted Seatrout Fishery Management Plan*. The management plan was revised in 2003 to include only weakfish. Since 1990, there has been no new management plan for spotted seatrout but updates have been completed on a regular basis. The 1990 FMP was reviewed by the Maryland DNR Fisheries Service (FS) Weakfish and Spotted Seatrout FMP Plan Review Team (PRT) in 2012/2013. A report was presented to the Sportfisheries and Tidal Fisheries Advisory Commissions. The Tidal Fisheries Advisory Commission recommended no action but the Sport Fisheries Advisory Commission recommended that the Maryland DNR FS consider raising the minimum size limit and decreasing the creel limit. Maryland increased the commercial size limits, decreased the recreation creel limit and instituted a daily commercial catch limit in 2013.

### **Stock Status**

A coast-wide stock assessment of spotted seatrout has not been completed because this species is considered to be largely non-migratory. State assessments have been completed on local stocks (NC, SC, GA, FL) with state-by-state variability and no regional trend. ASMFC has not recommended a coastal stock assessment because of lack of biological and fisheries data. The lack of a stock assessment makes it difficult to implement an effective management framework. .

## **Fisheries**

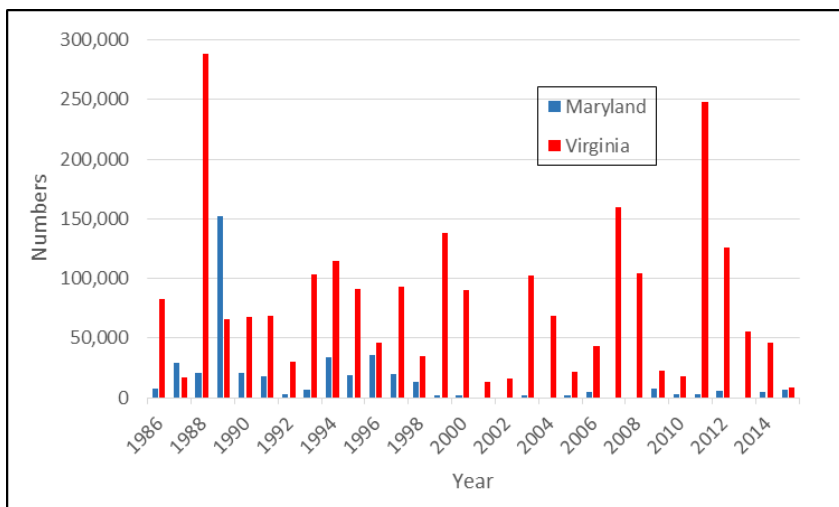
The Marine Recreational Information Program (MRIP) estimated that Maryland recreational harvest has ranged from zero to 7,933 fish from 2005 to 2015, with higher catches occurring in the late 1980s and mid 1990s (Figure 3). Most estimates have a high proportional standard error (PSE) value which indicates the estimates are highly uncertain in most years. Catch-and-release estimates in the past 10 years have ranged from 2,331 to 107,017 fish per year, but have been highly variable with no trend and very high PSE values. The Virginia recreational harvest estimates have been consistently higher than Maryland's with lower PSE values and ranged from 8,880 to 247,736 fish per year from 2005 to 2015, and 2015 was the lowest value of the time series. The 2015 values are preliminary for both states. Release estimates for Virginia over the same time period have ranged from 82,935 to 1,214,620 fish per year. Maryland commercial landings since 1982 have been less than 2,000 pounds most years, except for a peak in landings from 1996 to 2002, when landings averaged 20,515 pounds per year (Figure 4). Virginia's commercial landings have averaged 23,094 pounds per year since 1982, but experienced an unusually large peak in 2012 with 116,768 pounds reported.

### **Management Objectives and Measures:**

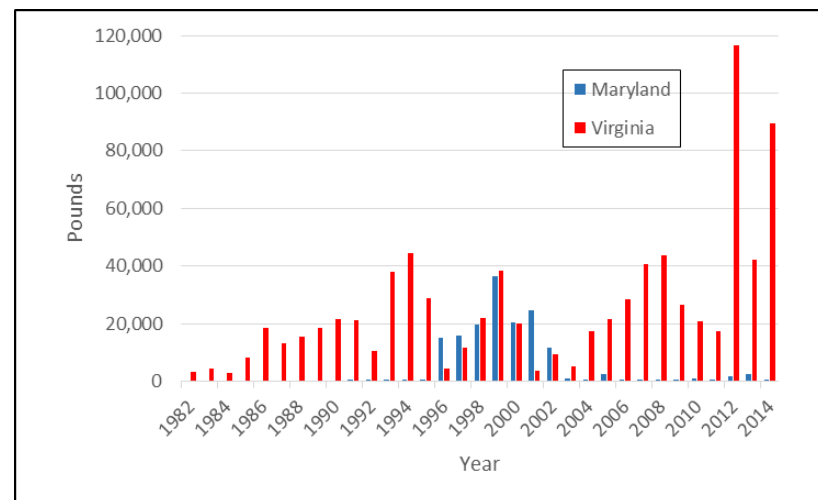
The ASFMC FMP requires a size limit of 12" minimum total length. All states have complied with this minimum. Net mesh sizes corresponding to this size limit for directed fisheries, data collection, and state stock assessments were also recommended. Maryland, Virginia and PRFC have 14" recreational size limits with a 4 fish creel limit in Maryland, a 5 fish creel limit in Virginia, and a 10 fish creel limit for the Potomac mainstem (PRFC). In Virginia there is a limit of only 1 fish over 24 inches, and Virginia closed its recreational fishery from March 1 through July 31, 2014 to protect the spawning stock following a winter kill. The Maryland commercial size limit is 14" with minimum 3-3/8 inches trawl and 3 inch stretched gill net meshes (the same mesh size restrictions apply to weakfish) and a 150 pound per trip harvest limit for all gear. The Virginia commercial hook & line fishery must adhere to the same size and bag limits as the Virginia recreational fishery. Virginia also has an annual commercial quota of 51,104 pounds and a size limit of 14 inches for all gears combined. PRFC has a 14 inch commercial size limit.

The ASMFC considered withdrawing its FMP for spotted seatrout, relinquishing management to the individual states in 2015. The relatively non-migratory nature of spotted seatrout and inability to conduct a coastwide stock assessment limit the ability of the ASMFC to properly manage this species. Action was postponed indefinitely, due to some states FMPs linking management authority to the ASMFC FMP. Once affected states rectify their management authority through their regulator process, the transfer of management authority from ASMFC to the states will be reconsidered.

**Figure 3. Estimated recreational harvest for spotted seatrout from Maryland and Virginia, 1986-2015.<sup>3</sup> (MRIP data: 2015 estimates are preliminary)**



**Figure 4. Commercial spotted seatrout landings from Maryland and Virginia, 1982-2014.<sup>2</sup> (NMFS data)**



**References:**

- <sup>1</sup> ASMFC. 2012. Fishery Management Report of the Atlantic States Marine Fisheries Commission. Omnibus Amendment to the Interstate Fishery Management Plans for Spanish Mackerel, Spot, and Spotted Seatrout. Approved February 9, 2012. 161 p.
- <sup>2</sup> Personal communication from the National Marine Fisheries Service, Commercial Fisheries Statistics, Fisheries Statistics Division May 13, 2015.
- <sup>3</sup> Personal communication from the National Marine Fisheries Service, Marine Recreational Information Program, Fisheries Statistics Division May 13, 2015.

## 2015 Maryland FMP Report (August 2016)

### Section 21. White Perch (*Morone americana*)

From the novice to the more experienced angler, the white perch is one of the most sought after species by recreational anglers in Maryland. An estimated 305,182 pounds were harvested by recreational fishermen in 2015.<sup>1</sup> White perch generally rank in the top five commercially harvested finfish in Maryland. They are generally sold locally at reasonable prices often at roadside venues and provide a high quality seafood product to Maryland consumers.

#### Maryland FMP

A Maryland Fishery Management Plan (FMP) for White Perch was drafted in 1990 but was never formally adopted by reference into Maryland regulations. The Maryland FMP continues to provide a framework for managing the white perch resource. The FMP includes descriptions of the life history, fisheries, economic perspective, resource status, habitat issues, FMP status, management unit, status of traditional fishery management approaches, and data needs. The management framework includes goals and objectives, problem areas, and management strategies. The 1990 plan was reviewed in 2005 and again in 2011. No changes are recommended to the management of white perch in Maryland at this time.

#### Stock Status

The 2009 Maryland stock assessment noted that biomass was above minimum stock levels and estimated fishing mortality (F) was lower than necessary to maintain stock abundance. The assessment cautiously noted that some indices of commercial catch-per-unit-effort (CPUE) were trending lower while recreational CPUE trended higher. The 2009 stock assessment used a surplus production model for the Maryland portion of the Chesapeake Bay and a Catch Survey Analysis (CSA) in the Choptank River.<sup>2</sup> The 2011 white perch stock assessment used a different modeling approach to better describe the white perch populations regionally. The CSA model results described population dynamics in the Upper Bay and Choptank River from 2000 to 2010. The most recent stock assessment (2015) used the same methodology as 2011 but included the latest three years of data (2012-2014).

White perch relative abundance in the upper Bay was above the average in 2013 and below average in 2014. White perch relative abundance in the upper Bay in 2015 was more than double the average (Figure 1). There is less available data for Lower Bay white perch populations. For those areas, both fishery-dependent and fishery-independent indices were examined.<sup>2</sup> Although biological reference points (BRP) have not been formally established, an  $F_{\text{target}}=0.60$  was suggested. Between 2000 and 2013, F has not exceeded the  $F_{\text{target}}$ .<sup>3</sup> Based on the proposed target F, overfishing is not occurring.

Both Maryland and Virginia calculate young of the year (YOY) indices for white perch. Results from recent years have shown average to below average YOY abundances. In 2013, resident white perch showed about average reproduction and the stock was well above average in 2014 and 2015 (Figure 2).<sup>3</sup> In addition to YOY surveys, an adult white perch index was calculated with data from the Potomac River Striped Bass Spawning Stock Survey.

#### Current Management Measures

White perch are managed in coordination with striped bass because they overlap in habitat. They are also caught using some of the same commercial gear types such as drift gill nets, although fyke nets are also used to harvest white perch. White perch are managed as a single stock throughout its range in Maryland's portion of the Chesapeake Bay. The commercial fishery is regulated with gear and area restrictions and an 8" minimum size limit if caught by net. There is no size limit for fish caught by hook & line in the commercial and recreational fishery. There is no closed season or creel limit in either white perch fishery. Virginia has no size, creel, or season limits for recreational or commercial fishing.

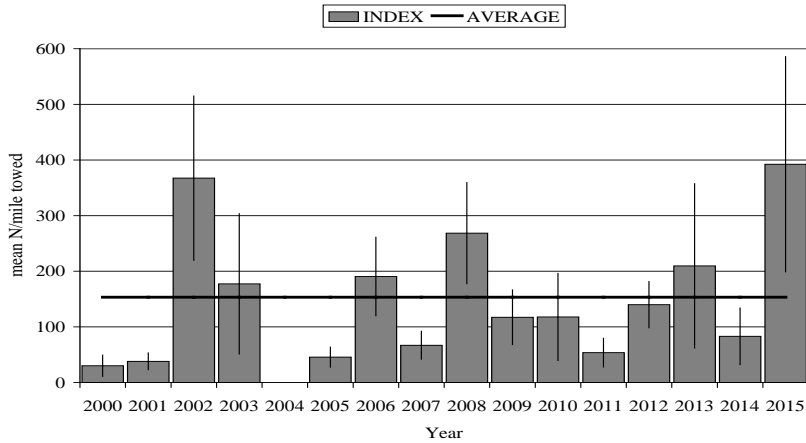
#### The Fisheries

Maryland commercial landings in 2013 were 1.24 million pounds with an estimated value of 1.32 million dollars (Figure 3).<sup>1</sup> Maryland commercial landings for white perch were 1.5 million pounds in 2014 with an estimated value of \$1.04 million dollars. The preliminary harvest for 2015 is 787,643 pounds with an estimated value of 1 million dollars. The estimated recreational harvest of 305,182 pounds in 2015 was below the long-term average of 587,130 lbs. (1981-2015) (Figure 4). New recreational fishing records were established in 2016. The Atlantic division record was exceeded on July 30 with a 1.65 pound white perch. The non-tidal division record was set on August 2 with a 1.74 pound white perch.

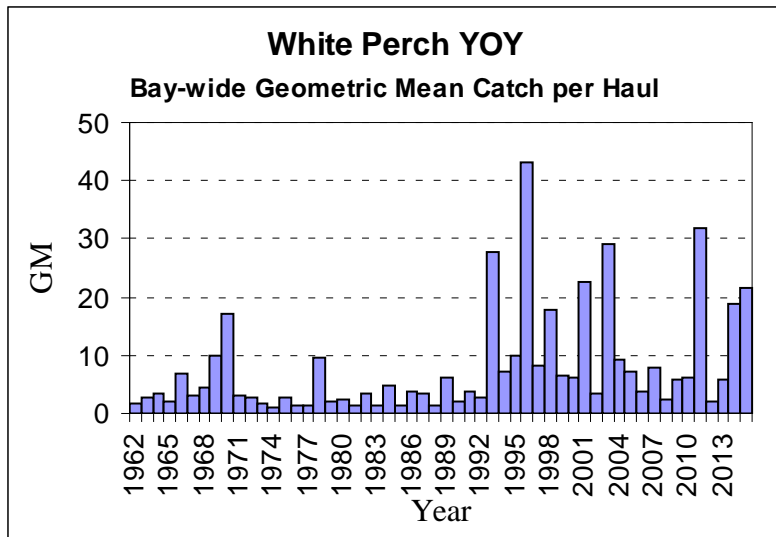
#### Issues/Concerns

White perch harvests have recently rebounded from a period of lower reports in the mid-2000's (Fig.3). Fishing mortality has been low except for the most recent years and the species is considered relatively resilient. The juvenile index is variable. High young-of-year CPUE values were found in 2001, 2003 and 2004 and were followed by high gill net catches in 2004 – 2006. Fishery independent sampling after 2007 produced inconclusive results.<sup>2</sup> The Fisheries Service FMP plan review team stated that water quality and habitat are issues of concern for white perch.

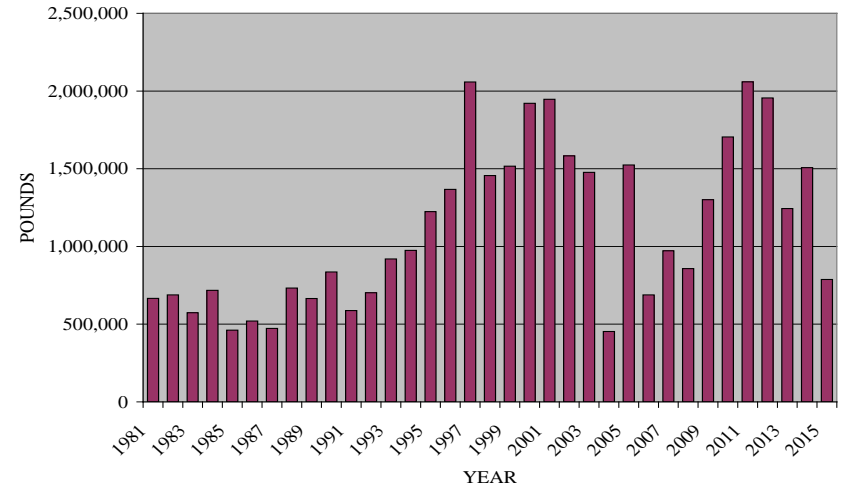
**Figure 1. Age 1 white perch relative abundance from upper Chesapeake Bay winter trawl survey. Not sampled in 2004, small sample sizes 2003 and 2005.**



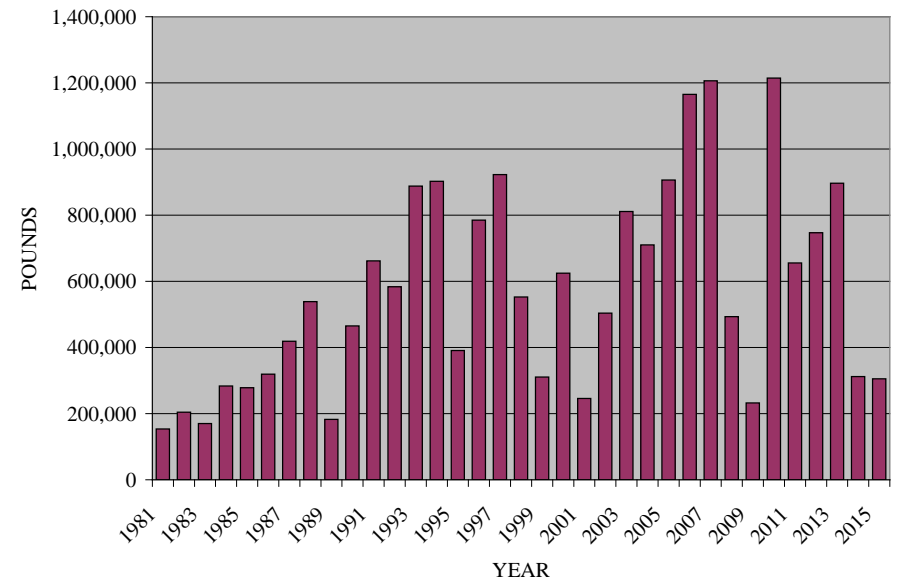
**Figure 2. Maryland young-of-year geometric mean catch per haul for white perch, 1962 – 2015. (EJFS data)**



**Figure 3. Commercial landings of white perch from Maryland, 1981-2015. <sup>1</sup>**



**Figure 4. Estimated recreational white perch harvest from Maryland, 1981-2015. <sup>2</sup>**



**References:**

<sup>1</sup> Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division, Commercial Fisheries. June 13, 2016.

<sup>2</sup> Piavis, P.G. and E. Webb III. 2015. Population assessment of white perch in Maryland with special emphasis on Choptank River stocks. Maryland Department of Natural Resources, Federal Aid Report F-61-R, Annapolis, Maryland.

<sup>3</sup> Piavis, P.G. and E. Webb III. 2015. Population vital rates of resident finfish in selected tidal areas of Maryland's Chesapeake Bay. Maryland Department of Natural Resources, Fisheries Service Report F-61-R-9. Annapolis, Maryland.

**Draft 1990 White Perch Fishery Management Plan Implementation Table** (updated 8/16)

<b>Problem Area</b>	<b>Action</b>	<b>Date</b>	<b>Comments</b>
Mixed Fishery 1.1. Coordinate management with striped bass actions.	1.1. The white perch fishery will abide by striped bass restrictions. Striped bass bycatch will be minimized.	1990 Continue	Commercial gear restrictions and area restrictions and closures apply. White perch are primarily caught with gill nets and fyke nets, both of which have mesh size and location restrictions that, in some cases, vary seasonally.
Optimum Harvest 2.1. White perch populations exhibit growth differences.	2.1. Consider eliminating minimum size limits.	1990 Continue	Minimum size limits for commercial and non-H&L recreational are 8"; no size limit for recreational H&L.
Stock Assessment 3.1. Basic stock information is lacking, including commercial and recreational harvest size and age-composition.	3.1. Stock assessments will be performed periodically.	Periodic	<p>White perch stock assessments are performed every three to four years. A stock assessment survey was conducted in 2011 and 2015 and employed a catch survey analysis. This type of analysis has been better than surplus production models for assessing stock size. Young-of year surveys produced high CPUE values from 1994-2001 and 2003-2004. However, fishery independent indices often conflicted and differed between areas examined.</p> <p>Fishing mortality rates have decreased since 1997. Fishing mortality rates have been under <math>F=0.60</math> since 2000 and the population has increased. Total upper Bay population abundance has been variable from 11 million fish (2001) to 4.4 million (2007).<sup>4</sup> The 2013 total population estimate for the upper Bay was approximately 10 million fish. .</p> <p>Overfishing is not occurring, based on the suggested <math>F_{target} = 0.60</math>. However, formal BRPs have not been adopted.</p>
Habitat Issues 4.1. Water quality impacts distribution and abundance of finfish species in Chesapeake Bay.	4.1. MD will develop objectives for finfish water quality standards under the latest Bay agreements, including, nutrient and toxics reduction strategies on a watershed approach.	Ongoing	<p>Watershed indicators for aquatic systems include water quality as well as components of aquatic systems, biological diversity, hydrologic, and terrestrial system.</p> <p><a href="http://www.dnr.state.md.us/watersheds/surf/indic/md/md_indic.html">http://www.dnr.state.md.us/watersheds/surf/indic/md/md_indic.html</a></p> <p>This Maryland Integrated Watershed Data and Information System is a cooperative effort between the DNR and Dept. of Environment and provides a comprehensive database of natural resources and biological information for watershed indicators, profiles, bibliography, planning &amp; strategies, and organizations.</p> <p>The Chesapeake Bay Program tools to track water quality improvement can be found at: <a href="http://www.chesapeakebay.net/track/tools">http://www.chesapeakebay.net/track/tools</a></p>



**Acronyms:**

BRPs = Biological Reference Points

CPUE = Catch per Unit Effort

DNR = Department of Natural Resources

F = Fishing Mortality

H & L = Hook and Line

## 2015 Maryland FMP Report (August 2016)

### Section 22. Yellow Perch (*Perca flavescens*)

A commercial yellow perch pilot program began at the opening of the 2016 season with twenty eight participants. These commercial yellow perch fishermen were trained in the use of the Fishing Activity & Catch Tracking System (FACTS) (<http://dnr.maryland.gov/fisheries/Pages/e-reporting/index.aspx>) and procedures for hauling out, hauling in, and requirements for the use of box tags. The pilot program and the use of individual tags for fishermen who chose not to enroll in the program were in effect during 2016.

#### Maryland Fishery Management Plan (FMP)

The Maryland Tidewater Yellow Perch Fishery Management Plan (MDYP FMP), adopted in 2002, improved on the traditional FMP format by including guidelines for ecosystem-based management. Ecosystem-based surveys utilizing yellow perch data have been important in developing guidelines for habitat preservation and land use decisions.<sup>1</sup> Stakeholder meetings were conducted during 2008 to develop objectives for the commercial and recreational fisheries. Maryland's yellow perch fisheries have responded to management actions taken in 2009. The MDYP FMP was reviewed in 2006 and 2013. The 2013 FMP review recommended the development of an amendment that would include the new management strategies in place since 2009. An amendment was drafted in 2016 to address the recommendations and has been reviewed. A request to reconsider allocation between the commercial and recreational fishery is under consideration and will be discussed at the sport fisheries and tidal fisheries commission meetings in October 2016.

#### Stock Status

Based on the most recent yellow perch stock assessment update, overfishing is not occurring.<sup>2</sup> Yellow perch stock assessments have been conducted periodically with special emphasis on the upper Chesapeake Bay (tidewater areas north of the Bay Bridge and all tributaries except the Chester River). Stock assessment methodologies have changed over time and are refined with additional data as it becomes available. Yellow perch are currently assessed using a statistical catch-at-age (CCA) model and a spawning stock biomass per recruit (SSB/R) model. The CCA model estimates population abundance at age, annual fishing mortality, recruitment, catchability and selectivity of the fishery.<sup>3</sup> Since recreational harvest data are unavailable before 2008 and creel surveys have been limited in number and scope,

recreational removals have not been considered in the stock assessment models.

Management measures for yellow perch are based on achieving a fishing mortality (F) rate that produces a 35% maximum spawning potential (MSP). The MSP is the spawning stock biomass per recruit (SSB/R) when F is zero. The degree to which fishing reduces the SSB/R is expressed as a percentage of MSP. For yellow perch,  $F_{35\%}$  and  $F_{25\%}$  are the target and threshold reference points, respectively, and are consistent with the 2002 MDYP FMP. The selection of this target and threshold is considered a risk-averse strategy. Overfishing is deemed to occur when an annual F exceeds  $F_{35\% \text{ MSP}}$ . For the commercial fishery slot limit,  $F_{\text{target}} = F_{35\%} = 0.53$  and  $F_{\text{threshold (limit)}} = F_{25\%} = 0.85$ . For the recreational fishery 9" minimum size limit,  $F_{\text{target}} = F_{35\%} = 0.50$  and  $F_{\text{threshold (limit)}} = F_{25\%} = 0.80$ .

Since 1998, yellow perch abundance estimates (numbers of fish age 3 and older) in the upper Bay have varied between approximately 640,000 and 2.0 million fish. The upper Bay population abundance estimate for 2015 was 781,356 fish, a decrease from 1,009,899 in 2014 (Figure 1). Biomass reached a low in 2013 at 118,387 kg (261,000 lbs.) and has moderately increased since then (Figure 2). Instantaneous fishing mortality (F) has remained below the target level (0.53) since 2002 (Figure 3). Fishing mortality was calculated at 0.15 for 2013, 0.12 in 2014 and 0.24 in 2015. In contrast, F peaked in 2002 at 0.92 when overfishing was occurring. Estimated recruitment in 2013 was just above the long-term average while recruitment in 2014 and 2015 was well below the long-term average (Figure 4).

#### Current Management Measures

After considerable public input during 2008, yellow perch fisheries are managed under a Total Allowable Catch (TAC). The TAC has been allocated 50:50 between the commercial fishery and the recreational fishery since 2009. The TAC is calculated annually based upon the stock assessment to achieve the target fishing mortality rate ( $F=0.53$ ). The fishing mortality target is divided in half between the commercial and recreational fishing sectors. Three management areas have been established: the upper Bay, the Chester River and the Patuxent River. A management area's commercial season is closed early if the TAC is reached before the scheduled closing date. Any overages are subtracted from the following year's allocation. Commercial fishermen are required to have a special yellow perch permit. Daily reporting is required in the commercial fishery and every fish is tagged for accountability except for those fishermen in the 2016 pilot program. The pilot program has a provision for using tags on

boxes of fish with additional accountability requirements. The commercial fishery has a slot limit of 8.5 to 11 inches and closed areas. The recreational fishery is open year round, has no closed area, a minimum size limit of 9 inches, and a creel limit of 10.

## The Fisheries

The 2012 season was the first season in which the commercial quotas were not reached or exceeded for any management region (Figure 5). Final quotas for 2012 were 38,950 pounds for the upper Bay; 6,770 pounds for the Chester River; and 2,500 pounds for the Patuxent River. The upper Bay harvest was under its quota by 1,757 pounds; while the remaining quota for the Chester and Patuxent Rivers were 1,252 and 1,213 pounds, respectively.

In 2013, the yellow perch season was extended from March 10 to March 16 for the upper Bay and Patuxent River management units. The quotas of 29,800 pounds for the upper Bay; 5,175 pounds for the Chester River; and 2,500 pounds for the Patuxent River were not met. The TAC was not reached for any management unit (Figure 6). Overall harvest was 32% under the quota in 2013.

In 2014, the yellow perch season was extended from March 10 to March 20 for the upper Bay and Patuxent River management units. The quotas of 27,200 pounds for the Upper Bay and 4,725 pounds for the Chester River were the lowest quotas since 2009. Overall harvest was 27% under the quota in 2014 (Figure 7).

In 2015, the yellow perch season closure was extended to April 1 for the upper Bay, Chester, and Patuxent management units. Heavy ice in the Bay and tributaries prevented the majority of watermen from fishing their nets until March. The majority of the upper Bay quota of 30,489 pounds was harvested within eight days once the ice cleared. When the quota was predicted to be met the season was closed. However, harvest exceeded the quota in both the Chester River and upper Bay by 27 and 3,990 pounds, respectively (Figure 8). The Patuxent River quota of 2,500 pounds was under harvested by 1,389 pounds.

For 2016, the commercial season in the Chester River was closed on March 1 and in the upper Bay the season closed on March 5. The quotas for both regions were exceeded by 83 and 14,392 pounds, respectively. The overages will be subtracted from the quotas for the 2017 season once those numbers have been determined. The Patuxent River harvest of 330 pounds was well below the 2,500 quota (Figure 9). The 2017 TAC will be announced in the fall of 2016.

## Issues and Concerns

Some areas, such as the Severn River, continue to experience poor egg survivorship.<sup>4</sup> Recreational harvest is unknown but is believed to be within the recreational TAC. Efforts to monitor recreational fishing in Maryland's tidal tributaries are not adequate to provide reliable estimates. Few Maryland state recreational surveys have been conducted. A voluntary online creel survey was initiated by the MD DNR Fisheries Service in 2008 (<http://dnr.maryland.gov/fisheries/survey/yperch/2012.pdf>). These reports include information about catch, harvest, fish length, fishing success, perceptions of success and quality of a fishing trip. The last summary report (2016) noted a 73% drop in the number of anglers responding to the survey since 2008. Over the years, catch per angler hour has been between 1.5 (2008) and 6.2 fish (preliminary results, 2016). Increased participation in the on-line survey by recreational fishermen would be helpful.

## References:

<sup>1</sup> Uphoff, J.H., M. McGinty, R. Lukacovic, J. Mowrer and B. Pyle. 2009. Impervious surface target and reference points for Chesapeake Bay subestuaries based on summer dissolved oxygen and fish distribution. Fisheries Technical Report Series Number 55. Maryland Department of Natural Resources, Annapolis, MD 21401.

<sup>2</sup> Piavis, P.G. and E. Webb. 2015. Population assessment of yellow perch in Maryland with special emphasis on head-of-bay stocks. Maryland Department of Natural Resources, Federal Aid Annual Report, F-61-R-10, Annapolis, Maryland.

<sup>3</sup> Piavis, P. and E. Webb, III. 2011. Assessment of upper Chesapeake Bay yellow perch stocks with a statistical catch-at-age model. Fisheries Technical Report Series. Maryland Department of Natural Resources, Fisheries Service. Annapolis, Maryland.

<sup>4</sup> Blazer, V., A. Pinkney, J. Jenkins, L. Iwanowicz, S. Minkinen, R. Draugelis-Dale, and J. Uphoff. 2013. Reproductive health of yellow perch *Perca flavescens* in selected tributaries of the Chesapeake Bay. Science of the Total Environment. 447:198-209.

Figure 1. Yellow perch population abundance estimates from the Upper Bay, 1998-2015<sup>1</sup>

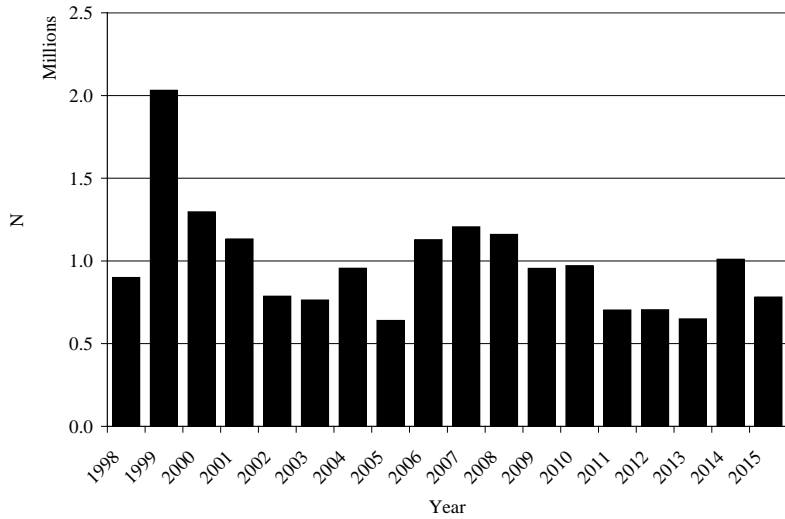


Figure 3. Instantaneous fishing mortality (F) estimates for Upper Chesapeake Bay yellow perch, 1998-2015.<sup>1</sup>

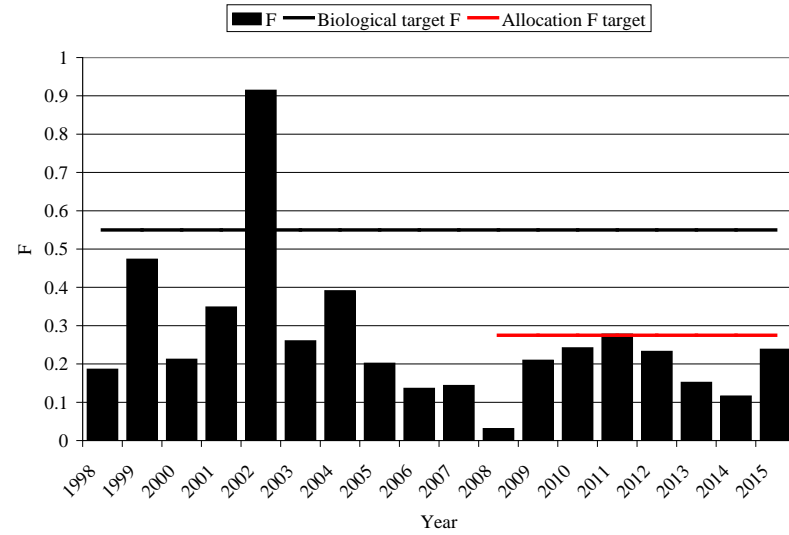


Figure 2. Estimated biomass of Upper Chesapeake Bay yellow perch, 1998-2015<sup>1</sup>

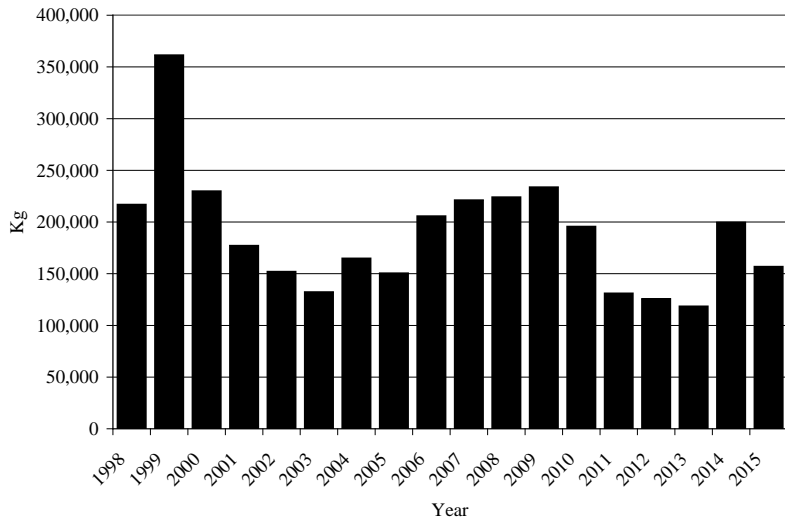


Figure 4. Estimated recruitment (numbers of age 2 fish) of yellow perch in the upper Chesapeake Bay, 1998-2015<sup>1</sup>.

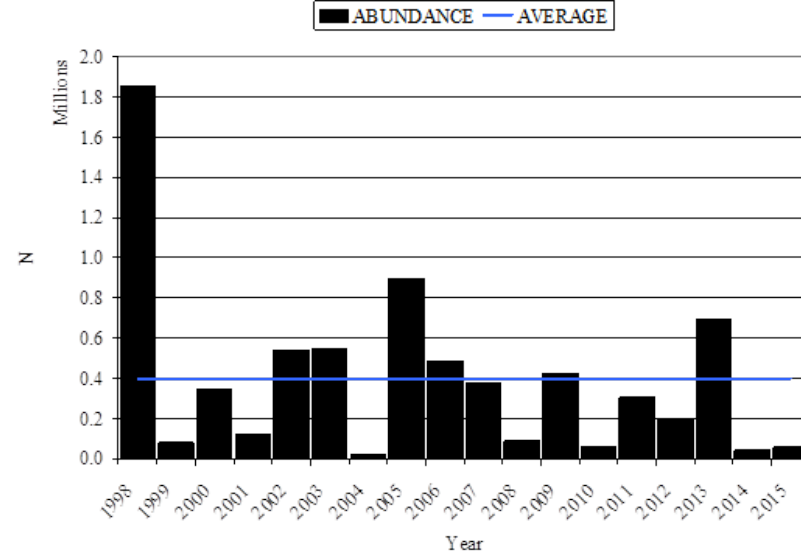


Figure 5. Maryland commercial yellow perch harvest by region, 2012

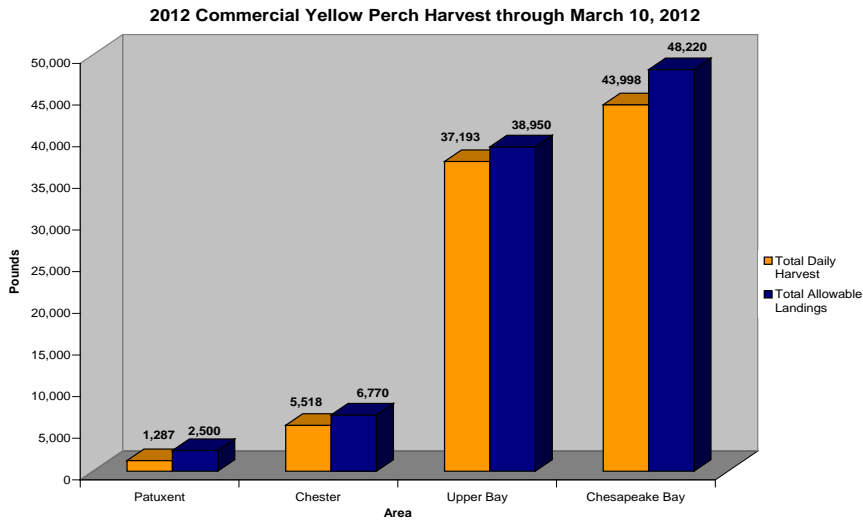


Figure 7. Maryland Commercial Yellow Perch Harvest by Region, 2014

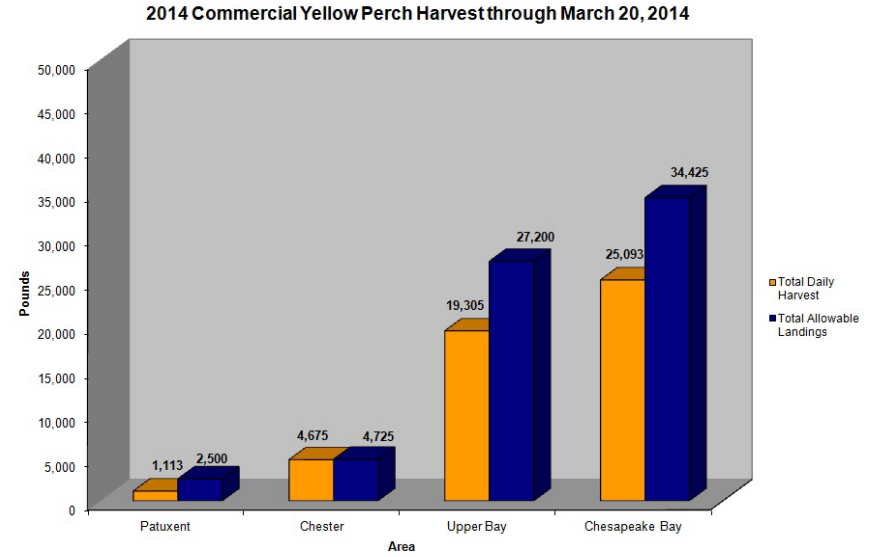


Figure 6. Maryland commercial yellow perch harvest by region, 2013

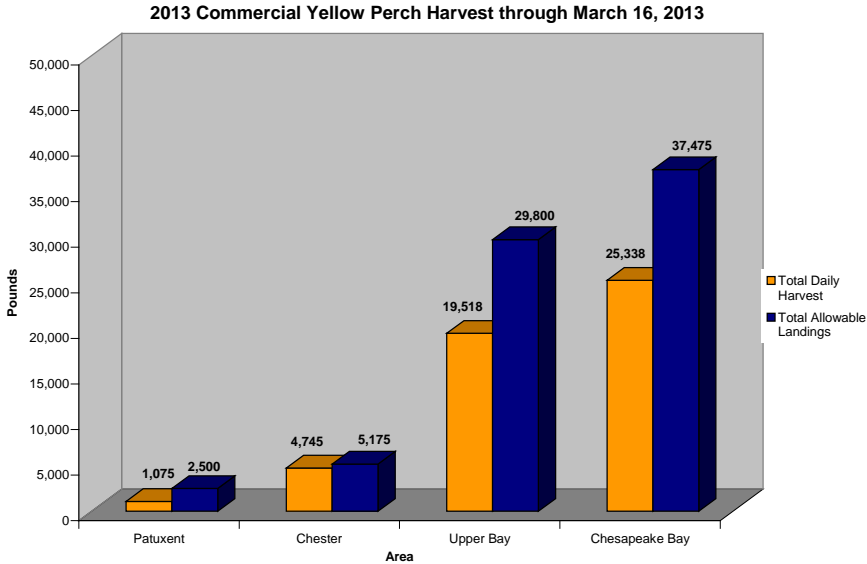


Figure 8. Maryland Commercial Yellow Perch Harvest by Region, 2015

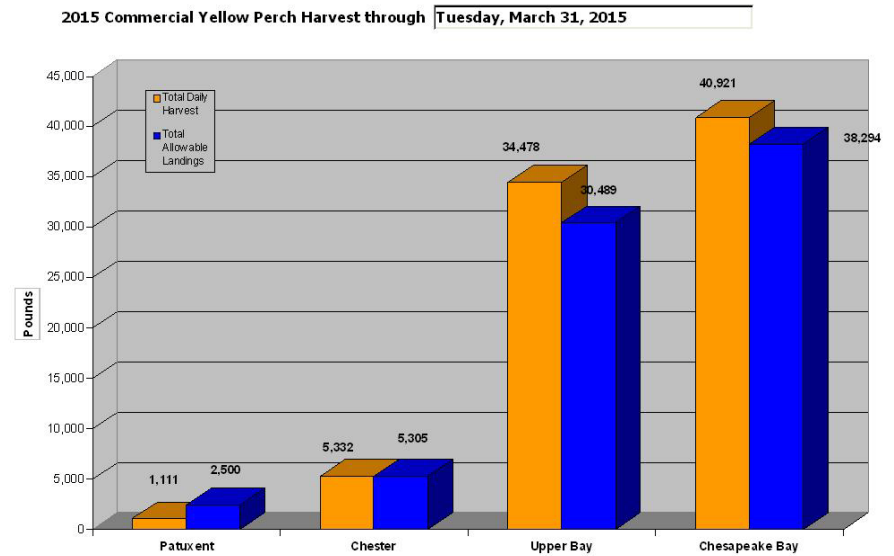
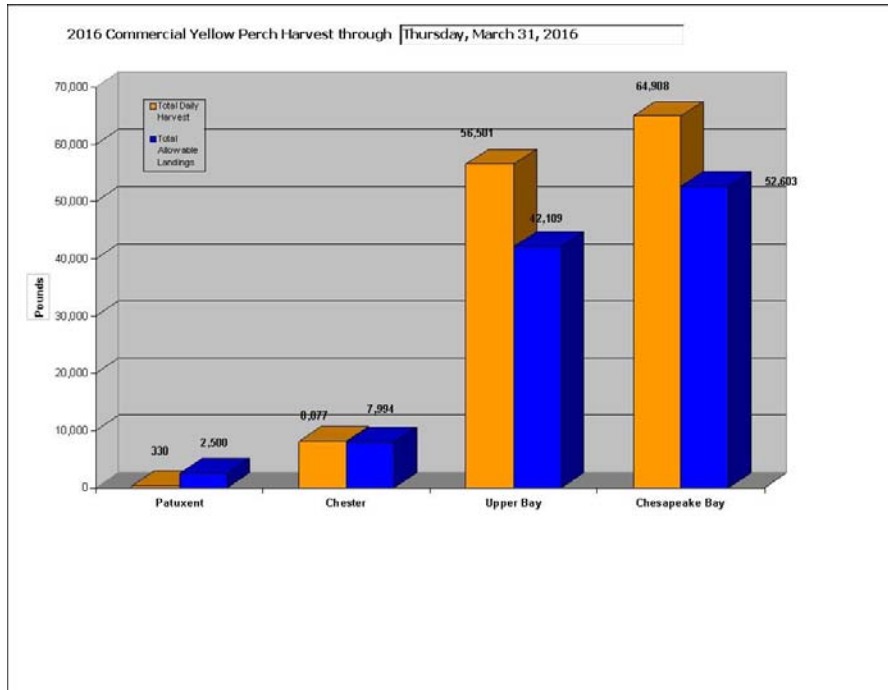


Figure 9. Maryland Commercial Yellow Perch Harvest by Region, 2016



<b>2002 Maryland Tidewater Yellow Perch Fishery Management Plan Implementation Table</b> (updated 08/2016)			
<b>Section</b>	<b>Action</b>	<b>Date</b>	<b>Comments</b>
Implement Ecosystem Considerations	1) Adopt the following ecosystem guidelines	2001	Refer to comments for each sub-action.
	1.1) Participate in forums, which develop federal or state water quality criteria.	Ongoing	Refer to Chesapeake Bay Program (CBP) website for current efforts. Groups addressing tributary strategies and prioritizing watersheds activities have been made aware of yellow perch. Yellow perch is a focal species for the Corsica River Targeted Watershed project.
	1.2) Cooperate with the MD Department of Natural Resource's (DNR) Chesapeake and Coastal Watershed Services in the development of watershed assessment surveys, watershed restoration plans and in the implementation of restoration and enhancement projects	Ongoing	Watershed & tributary groups use the Anadromous and Estuarine Finfish Spawning Locations in Maryland, Technical Rept. # 42 (Mowrer & McGinty 2002) during discussions of strategies and actions. To date, 25 watershed restoration action strategies (WRAS) have been developed. Each WRAS includes a watershed characterization report, a synoptic survey (water quality & biological) and a stream corridor assessment. Fisheries staff has been involved in reviewing proposals. Funding for developing additional WRAS ended in 2006. DNR, OOS developed the GIS based "blue infrastructure" to identify and prioritizes tidal aquatic habitat and connected watershed features. Yellow perch habitat has been included.
	1.3) Participate in the review of permits for projects, which have the potential for significant impact on fishery resources.	Ongoing	Coordinate with DNR Environmental Review Unit (ERU). The ERU typically reviews 2,500 to 3,000 projects per year. During FY'06 over 800 projects were considered for yellow perch impacts. The ERU has been restructured to include representatives from the major units with DNR. This new structure should aid in improving coordination on restoration and protection projects. As a result of the 2008 Fisheries Task Force recommendations, ERU includes FS staff and fisheries issues are considered in the process. Efforts to improve the ER process has continued.
	1.4) Cooperate with the CBP and the Atlantic States Marine Fisheries Commission (ASMFC) to develop models, collect and exchange data, and support research projects that explore multispecies management.	Ongoing	DNR has provided fishery data for the input parameters of the CBP Ecopath/EcoSim modeling efforts. To date, most of the multispecies initiatives have been focused on migratory species. Yellow perch has not been included in any modeling scenarios but has been recognized as a priority species from a tributary/watershed perspective. Fisheries Ecosystem Project has developed a model of Head-of-Bay yellow perch biomass dynamics that incorporates predation and nutrient management impacts. A cooperative DNR-NMFS CBP effort to develop a Head-of-Bay Ecopath/Ecosim model was initiated for the Yellow Perch Workgroup, but was discontinued.
	1.5) Develop funding sources for habitat restoration.		No new yellow perch habitat projects have been funded. The Corsica River Project provided some info on watershed management in relationship to yellow perch.
	1.6) Develop research proposals to examine habitat fish linkages.	Ongoing	Impervious surface and its impact on aquatic resources (especially fish) are currently under study. There appears to be a 10% IS threshold for fish that also relates to other habitat parameters. Letters of endorsement were supplied for proposals researching habitat and

**2002 Maryland Tidewater Yellow Perch Fishery Management Plan Implementation Table** (updated 08/2016)

Section	Action	Date	Comments
			development.
	2) Initiate a Severn River Ecosystem study that focuses on life history stage analysis to assess the effects of degraded habitat on stock abundance.	2001 2005	DNR completed field work in 2005. The field results indicated low juvenile survival, low DO and high salinity. Volunteers have been enlisted to monitor yellow perch larvae in the Severn River. These data are incorporated into impervious surface analyses. Severn River habitat has been monitored by the Riverkeeper program ( <a href="http://www.severnriverkeeper.org">http://www.severnriverkeeper.org</a> )
	3) Use the Yellow Perch FMP as a model for the application of ecosystem-based fishery management principles and develop new methods of application/implementation.	Ongoing	The Corsica River Project and Mattawoman Watershed Agreement both use the “best management practice” approach. They include a diverse partnership and strive to minimize development as much as possible. Although Smart Growth is charged with minimizing development, it only addresses infrastructure. Fisheries staff continues to work with citizens and county government on the importance of aquatic health and use the Severn River as an example. It is important to identify prime habitat and aquatic resources and encourage/implement good land management decisions for protection. Impervious surface reference points have been proposed that could directly apply to yellow perch management. Priority habitat areas for fish have been mapped.
Restore Yellow Perch Habitat and Enhance Yellow Perch Populations	4) Use the table on Stock Status and Exploitation and the watershed planning process, to designate yellow perch areas for restoration, maintenance or enhancement and develop specific habitat strategies for each area.	Ongoing Discontinued	The table was updated but a more general watershed management approach is necessary. There should be an emphasis on preserving habitat especially in more pristine areas. Blue infrastructure may aid in determining priority areas for preservation and restoration. The Fish Passage Program continues to collect ichthyoplankton in some historical yellow perch spawning streams. Results are compared with historical yellow perch ichthyoplankton data. The table is no longer used.
	5) Designate the currently closed rivers as yellow perch areas of particular concern, so if resources and funding become available, they can be directed to these areas.	2002	Before 2009, the Magothy, Nanticoke, Patapsco, Severn, South and West Rivers were identified as yellow perch spawning areas because these areas were already closed to harvest not because they were currently areas of high reproduction. It would be more appropriate to use impervious surface (IS) data and land development projections to identify potential habitat areas of particular concern (HAPC). Most of the identified areas above have high IS values and degraded habitat except the Nanticoke. Based on current knowledge, Mattawoman Creek should be designated a HAPC. Blue infrastructure may aid in determining priority areas for preservation and restoration. New management strategies for 2009 opened the previously closed areas to recreational fishing only. Migration of yellow perch from upper Bay areas into the mid-Western shore rivers is responsible for the yellow perch populations in those areas and removals by recreational fishermen will not reduce recruitment in these rivers.
	6) Form a MD DNR intra- and inter departmental team to implement habitat restoration strategies for yellow perch in prioritized tributaries of the Bay. Coordinate with the	2002 Continue	MD FS is working with Tidewater Ecosystem Assessment (TEA) and WRAS to develop habitat recommendations. A Wye Island Yellow Perch Research and Monitoring Coordination Meeting was held in 2003. The meeting resulted in increased participation with state and federal agencies. The USFWS conducts research on contaminants in yellow perch from different tributaries when funding is available. MDE is monitoring PCBs and mercury from



**2002 Maryland Tidewater Yellow Perch Fishery Management Plan Implementation Table** (updated 08/2016)

Section	Action	Date	Comments
	Watershed Restoration Action Plans and evaluate five watersheds annually.		fish samples and also evaluating disease. The Corsica River Project has been underway since 2005.
	7) Identify essential fish habitat (EFH) for utilizing progressively more detailed information.	On-going	Results from the Impervious Surface Project of the Bush River indicate that stream habitat in developed regions is no longer viable, but yellow perch larvae are abundant in the estuary. These results indicate that other spawning locations may be more critical. Maps have been updated to illustrate essential fish habitat at different life stages.
	8) Facilitate the implementation of habitat management and restoration practices identified as important to yellow perch.	On-going	Work with tributary teams and local riverkeepers when feasible and broaden the scope of work DNR will continue to coordinate habitat activities.
Control Fishing Mortality by establishing biological reference points (BRPs)	9) Adopt BRPs of $F_{35\%}$ and $F_{25\%}$ as a threshold for the yellow perch resource. As more data becomes available, the BRPs may be changed to reflect the most current status of the resource.	2002 Continue	Continuing analysis indicates current BRPs are appropriate. The Maryland Yellow Perch Stakeholder Committee (YPSC) presented recommendations (2007) to evaluate triggers for yellow perch based on stock biomass or age structure in addition to triggers based on fishing mortality. Triggers were evaluated in 2008. The target fishing mortality rate ( $F$ ) = 0.53.
that describe the targets and thresholds (limits) for yellow perch stocks.	10) Adopt the decision rules for managing the yellow perch resource based on the target and threshold mortality rates and utilize the decision rules to make recommendations regarding the yellow perch systems currently under assessment.	2002 Continue	Decision rules have been adopted. Based on a target fishing mortality rate ( $F=0.53$ ), a <b>2015</b> Chesapeake Bay TAC of <b>38,295</b> pounds was calculated. This was an <b>increase</b> from the <b>2014</b> TAC of <b>34,425</b> pounds. The calculated <b>2015 quota</b> for the upper Bay commercial fishery was <b>30,489</b> pounds. The Chester River quota was <b>5,306</b> pounds and the Patuxent River quota was 2,500 pounds. Improved catch reporting included daily call-ins, verified by tagging. These measures were implemented in 2009 to improve accountability and have continued.  <b>The 2017 TAC will be announced in fall, 2016.</b>
	11) Utilize Table 1 of MD Yellow Perch FMP to guide the development of management strategies and actions for selected river systems within the MD portion of the Bay.	On-going Evaluated/ Updated Periodically Discontinued	Management actions may include size limits, creel limits, closed seasons, area closures, and/or gear restrictions. The table was updated (2006) but needs to be reexamined for its usefulness in guiding management strategies. Starting with the 2009 season, the annual stock assessment will determine the strategies and actions for three management areas – upper Bay, Chester River, and Patuxent River for commercial fishing. The stock assessment, creel surveys, and public input will help determine strategies and actions for the recreational fishery.
	12) Continue the 8.5 -11 inch slot limit for the commercial fishery in all open areas and adjust fishing mortality ( $F$ ) depending on the most recent stock assessment.	2000 Assessed annually	Slot limit has not changed and is currently in place. Analysis was conducted and evaluated. Slot limit was selected to be the most robust approach. Fishing mortality was below targets in all years. No changes in management recommendations. During stakeholder meetings in 2008, the slot limit was widely supported.

**2002 Maryland Tidewater Yellow Perch Fishery Management Plan Implementation Table** (updated 08/2016)

<b>Section</b>	<b>Action</b>	<b>Date</b>	<b>Comments</b>
	13) Continue the uniform recreational minimum size limit of 9 inches in all open areas. Adjust size and/or creel limits depending on the most recent stock assessment.	2000 Assessed annually	The 9 inch size limit is still in effect. Fishing mortality was below targets in all years. No changes in management recommendations. Based upon recent stock assessments, the creel limit was increased from 5 to 10 yellow perch effective with the 2009 recreational season.

**2002 Maryland Tidewater Yellow Perch Fishery Management Plan Implementation Table** (updated 08/2016)

Section	Action	Date	Comments
User Conflicts	14) Establish an ad hoc yellow perch committee comprising stakeholders to provide input into the yellow perch management process.	2001	The ad hoc group will meet as necessary. The Sport Fisheries & Tidal Fisheries Advisory Commissions will also consider new recommendations. Ad hoc group was empanelled and met during 2006-2007. No progress was made on reducing conflicts. Stakeholder meetings held in 2008 produced compromises that allow both quality recreational fishing and a limited commercial fishery. A yellow perch FMP amendment was drafted and reviewed in 2016 by the commissions.
Examine the conflict between commercial and recreational uses of yellow perch.	15) Evaluate the utility of a web-based volunteer angler survey to collect data on the recreational fishery and implement the survey if feasible.	2002 Continue	A pilot program to utilize angler logbooks was implemented, but the anglers did not return any information. The program was discontinued. A web-based angler survey was implemented in 2008 and continues but participation has decreased. Catch per angler hour has been between 1.5 (2008) and 6.2 fish (preliminary results, 2016). The full results can be viewed at: <a href="http://dnr2.maryland.gov/Fisheries/Pages/survey/index.aspx">http://dnr2.maryland.gov/Fisheries/Pages/survey/index.aspx</a>
Identify any problems and recommend solutions.	16) MD DNR has implemented a system to track the use of pound nets in the Bay. Evaluate the pound net system. For tracking fyke nets and make recommendations for their use.	2003	Fixed gear restrictions are county specific. DNR has done unofficial counts of fyke nets and over the last few years the number of fyke nets has decreased. The number of nets is recorded on reporting forms but it is difficult to get effort data. Regulations to prohibit the use of fyke nets in tributaries upstream of the first 200 ft. channel width during the month of February were implemented for 2008. The width limit was changed in 2009 to a geographic and temporal restriction by area. Fyke nets were legally defined in 2009.
	17) If fishing mortality is too high in relation to the adopted targets, strategies to reduce fishing effort will be explored. Topics to be considered include but are not limited to: capping the number of fyke nets per fishermen, the placement of fyke nets in river systems (i.e., total number per river system; distance between nets); daily harvest restrictions; and seasonal quotas.	As necessary	When targets have been exceeded, these types of management strategies to reduce fishing effort will be evaluated. Total Allowable Catch (TAC) is calculated based on the latest stock assessment. Allocation of the TAC between commercial fishing and recreational fishing is determined after considering input from stakeholders. The public notice required to close the commercial fishery has been reduced from 48 hours to 24 hours.
	18) Evaluate the need for increased enforcement of yellow perch regulations, develop strategies to meet the needs and implement actions accordingly.	To be determined 2001 Continue	NRP makes a special effort to enforce yellow perch regulations during spring spawning run. They also conduct a yellow perch creel survey based on random stops and interviews, mostly at road crossings.

**2002 Maryland Tidewater Yellow Perch Fishery Management Plan Implementation Table** (updated 08/2016)

Section	Action	Date	Comments
<p>Stock Status</p> <p>MD DNR will monitor yellow perch stocks in representative areas of the</p>	<p>19) Continue to sample commercial and recreational harvest of yellow perch and collect basic biological data. Additional biological data may indicate changes in the status of the stocks and require additional management measures.</p>	<p>On-going</p>	<p>Chesapeake Finfish Program (previously FS Multispecies Project) collects yellow perch data from commercial and experimental fyke nets, seine and trawl surveys and uses data to periodically assess stocks. Since 1998, yellow perch abundance estimates (numbers of fish age 3 and older) in the upper Bay have varied between approximately 640,000 and 2.0 million fish. <b>The upper Bay population abundance estimate for 2015 was 781,356 fish, a decrease from 1,009,899 in 2014. Estimated recruitment in 2013 was just above the long-term average while recruitment in 2014 and 2015 was well below the long term average</b></p>
<p>Chesapeake Bay in order to assess yellow perch stock status. Assessment and</p>	<p>20) Develop a method for evaluating yellow perch recruitment and utilize it as one of the parameters for assessing stock status and consequent management actions.</p>	<p>2003</p>	<p>Yellow perch recruitment has been monitored on the Severn River but is no longer a priority. DNR utilizes the EJFS in the upper Bay for information on recruitment. Larval survey methods are being evaluated for use in tributaries. The Nanticoke, Bush, Corsica and Severn rivers were sampled in 2006.</p>
<p>management efforts will be focused on areas already under special management measures, i.e., closed areas.</p>	<p>21) Yellow perch egg strands are easy to collect and important for hatchery and/or aquaculture endeavors. Maryland will prohibit the removal or selling of egg chains that have been stripped by artificial methods, unless a scientific collection permit has been issued.</p>	<p>2001 2005</p>	<p>A person needs a Scientific Collection Permit as described in Natural Resources Article, §08-02.12.02, of the Annotated Code of Maryland, to collect yellow perch eggs. Effective Feb. 2005, a person may not catch or possess yellow perch eggs from any state waters (08.02.05.07F).</p>
	<p>22) Evaluate additional fishery-independent indicators of stock status, such as the trawl survey in the upper Bay.</p>	<p>On going</p>	<p>Current estimates of stock status are based on data from the upper Bay and Choptank.</p>
	<p>23) Review and evaluate yellow perch monitoring efforts biannually. Recommend changes in monitoring and protocol necessary to implement the yellow perch FMP.</p>	<p>2002 and even years thereafter</p>	<p>Evaluated annually. Added Marshyhope River to fyke net sampling schedule. Contracted with CBL to do a 2008 yellow perch creel survey in Bush River, Mattawoman Creek, Wicomico River (western shore), and Chester River. Additional rivers were surveyed in 2009 – Chester, Bush, Northeast, Patuxent, South, Magothy and 3 tributaries of the Potomac (Mattawoman Ck., Nanjemoy Ck., Wicomico R.). Funding for this creel survey was cut for 2010. DNR Fisheries Service studies fisheries independent and dependent surveys. Fisheries independent efforts include the upper Bay Winter Bottom Trawl Survey (Sassafras River, Elk River, Upper Bay, Mid-Bay, in 2011) and Choptank River Fishery Independent Sampling. Fishery dependent efforts include upper Chesapeake Bay fyke net surveys (Gunpowder River, Back River and Middle River vicinities) and Nanticoke River fyke and pound net surveys.</p>
<p>Yellow Perch Outreach</p> <p>MD will continue</p>	<p>24) Utilize volunteers from the recreational fishing sector, such as the Coastal Conservation Association or watershed community associations, to</p>	<p>On-going</p>	<p>Dependent on volunteer recruitment. The volunteer angler survey did not generate any response and was discontinued. A web-based angler survey has been produced and was implemented in 2008. CCA and MSSA will be asked to promote angler participation. The access to the survey and the summary of the 2008-2012 volunteer yellow perch survey can be</p>

**2002 Maryland Tidewater Yellow Perch Fishery Management Plan Implementation Table** (updated 08/2016)

Section	Action	Date	Comments
<p>outreach efforts to engage fishing and non-fishing communities in stewardship of the yellow perch resource in tributary basins.</p>	<p>obtain recreational data in areas not sampled by the MD DNR Multispecies Project. Explore the use of volunteer recreational survey using the web similar to the recreational survey implemented for striped bass.                      25) Add yellow perch egg strand sampling in the early spring to river basins with volunteer monitoring programs to obtain data on yellow perch spawning locations.                      26) MD DNR will continue to partner with the Yellow Perch Hatch, Raise and Release Project by providing assistance and advice in the collecting, raising, releasing, and stocking of yellow perch in all facets of the project.                      27) MD DNR Fisheries Outreach will explore new avenues to involve the public in yellow perch projects, such as a new exhibit on identifying yellow perch egg strands and collecting information on their occurrence and distribution: cooperative efforts with the Team program; and volunteer monitoring opportunities.</p>	<p>On-going</p> <p>2004</p> <p>On-going</p>	<p>viewed at:  <a href="http://dnr2.maryland.gov/Fisheries/Pages/survey/index.aspx">http://dnr2.maryland.gov/Fisheries/Pages/survey/index.aspx</a></p> <p>CCA conducts stream walks utilizing citizen volunteers. The information is used to indicate spawning presence, although zero egg sightings does not mean there is no spawning in a particular system. Shifts away from “traditional” spawning locations may be indicative of habitat degradation and subsequent shifts by spawning yellow perch to more suitable spawning habitats.</p> <p>Arlington Echo Outdoor Education Center reported poor viability of Severn River yellow perch eggs preventing such a program. Focus has changed to bluegill and hybrid sunfish as educational tools.</p> <p>Volunteer monitoring has occurred in the Bush, Severn and Corsica to monitor eggs, larvae and juveniles and to assess aquatic health (water quality). Fisheries staff has continued to give presentations to fishing clubs, environmental organizations, etc. upon request.</p>

Acronyms:

ASMFC = Atlantic States Marine Fisheries Commission  
 BRPs = Biological Reference Points  
 CBL = Chesapeake Biological Laboratory  
 CBP = Chesapeake Bay Program  
 CCA = Coastal Conservation Association  
 CPAH = Catch Per Angler Hour  
 DNR = Department of Natural Resources  
 DO = Dissolved Oxygen  
 EFH = Essential Fish Habitat  
 EJFS = Estuarine Juvenile Finfish Survey  
 ERU = Environmental Review Unit  
 F = instantaneous fishing mortality

FACTS = Fishing Activity & Catch Tracking System  
 FMP = Fishery Management Plan  
 FS = Fisheries Service  
 FY = Fiscal Year  
 GIS = Geographic Information System  
 HAPC = Habitat Areas of Particular Concern  
 IS = Impervious Surface  
 MDE = Maryland Department of the Environment  
 MSSA = Maryland Saltwater Sportfishermen’s Association  
 NMFS = National Marine Fisheries Service  
 NRP = Natural Resources Police  
 OOS = Office of Sustainability

PCB = Polychlorinated Biphenyl  
TAC = Total Allowable Catch  
TEA = Tidewater Ecosystem Assessment  
WRAS = Watershed Restoration Action Strategies  
YPSC = Yellow Perch Stakeholder Committee

**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 ( $\geq 0.79$ ) 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](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>).

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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.

<b>River Basin</b>	<b># Streams Sampled 2014</b>
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).

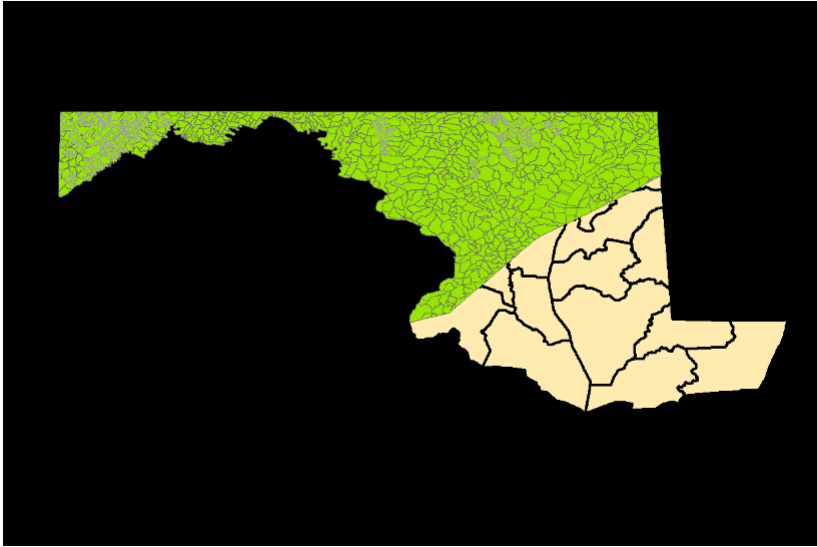
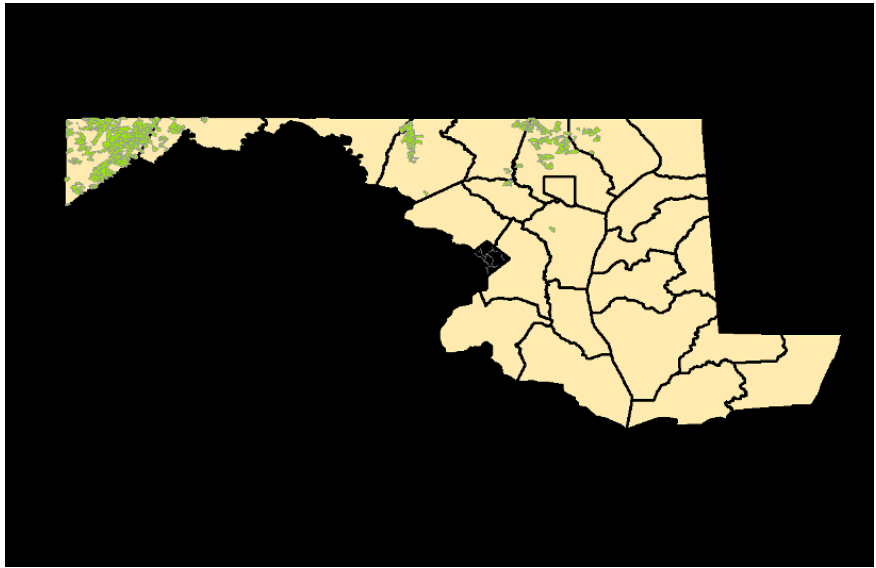


Figure 2. Current (2015) Distribution of Brook Trout in Maryland, by Subwatersheds (green is currently occupied).



**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.

<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  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.
<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.	2012-2013  <b>Statewide Pending, possible initiation in 2017-2018</b>	<b>This is the number 1 priority for 2016-2019.</b>  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. <b>Earliest a statewide creel survey would be initiated is 2018.</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 Completed	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		2009	No action was formulated in the BTFMP.  <b>GEP index and report (Action 2.1.1) will be</b>

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.		<b>On-going</b>	<b>used to identify populations at risk by watershed and guide conservation efforts. Priority list will be developed during 2018 – 2019.</b>
<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 Projected completion 2019</b>	This was the number 2 priority action (along 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 factors. Additional resources are needed to continue project.</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.	Pending	Requires completion of 3.1.1.  The priority list will be generated when the GEP map has been developed.
<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	GIS project underway as a joint effort of MD DNR, Savage River Watershed Association, and the Izaak Walton League. <b>Final report is being drafted. GIS database has been completed, water budget work will be initiated in 2017.</b>

	<b>Action 4.1.2</b> 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.
	<b>Action 4.1.3</b> 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.
<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 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.
<b>Strategy 4.3</b> 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.  <b>Development of a GIS layer is being explored. Anticipated to begin in 2017.</b>
<b>Strategy 4.4</b> Identify adverse summer water temperature impact areas (impoundments, etc.) and develop strategies to alleviate the impacts.		2007 <b>On-going</b>	No action was formulated in the BTFMP. This is the number 4 priority action for 2016-2019.  <b>Action: Create a network of temperature</b>

			<p><b>loggers to monitor thermal impacts to streams.</b></p> <p><b>Obtain existing water temperature data and develop a GIS layer within the BT database.</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 necessary research; and it will demonstrate Maryland’s commitment to protecting and conserving this unique resource.</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>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 &gt;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><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.</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.
<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	No progress to date.
<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 populations is available. Developing an outreach	<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 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 <a href="http://easternbrooktrout.org/">http://easternbrooktrout.org/</a>

<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><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><b>Strategy 7.1</b> Develop statewide restoration guidelines for restoring extirpated brook trout populations.</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>Pending</p>	<p>Requires completion of 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>Pending</p>	<p>Requires completion of 6.1.1.</p>
	<p><b>Action 6.1.4</b> 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><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><b>Pending</b></p>	<p><b>This is the number 2 priority action for 2016-2019.</b></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
	<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.  Laboratory work and analysis was scheduled for winter 2014.
<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>Partially completed for the USR in 2014, if funding secured will be completed in 2016.</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	<b>This is the number 3 priority for 2016-2019.</b>  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  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.
<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 Completed	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	<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  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.  <b>This is the number 5 priority for 2016-2019.</b>  <b>Streams will be monitored on a five year rotation from 2014- 2018.</b>  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.
	<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 On-going	Inland Fisheries and MBSS have increased sampling coordination. Action will continue annually.
<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>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.	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	<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	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 <b>Continue as needed</b>	established and convenes as needed.
	<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.	Completed	Requires completion of Action 13.1.1.
	<b>Action 13.1.3</b> Develop a GIS database describing BT population boundaries, population information, habitat variable information, and water temperature data.	2009 <b>On-going</b>	Action 13.1.3 was the number 2 priority (along with Action 3.1.1) in 2010.  <b>GIS database was completed and functional in 2013. It will be updated annually.</b>

**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

## 2015 Maryland FMP Report (July 2016)

### Section 24. largemouth bass (*Micropterus salmoides*) in Maryland Tidewater

Largemouth bass populations occur throughout Maryland's tidal freshwater. The populations differ in size and size structure, as well as productivity because of differing habitat quality and fishing pressure. Fishing pressure is an important consideration for the largemouth bass fishery even though it is primarily a catch-and-release fishery. Harvest, catch-and-release mortality and a daily possession of bass during tournaments can affect survival of adults and contribute to fishing mortality. Aside from fishing mortality, natural mortality and reproduction are affected by habitat quality or conditions. These habitat conditions may be influenced by pollution, invasive species, and climate change. Because of the roles of both fishing pressure and habitat quality on structuring largemouth bass populations, strategies and actions were developed to manage this nationally important fishery.

Strategies and management actions are described in the Fishery Management Plan (MDLB FMP) for Largemouth Bass in Maryland Tidewater (January 2014). The goal of the MDLB FMP is to describe objective reference points and provide management targets for populations in tidal freshwater habitats of the Maryland portion of the Chesapeake Bay watershed. It has become necessary to take management actions in many cases. These actions are taken to help conserve the population by minimizing negative impacts of intense fishing pressure and poor habitat quality. They have also been taken to identify at risk populations so that resources may be effectively appropriated. At risk populations are identified using a suite of indices calculated, in part, from surveys described in the Standard Operating Procedure (SOP) for the Tidal Bass Program (TBP). Other indices are calculated from tournament reporting. The methodology within the SOP has undergone external peer-review for at least 3 cases and results are reported annually within the Federal Aid Report (for federal

and technical audiences) and Black Bass Annual Review (for general public). The FMP, SOP, short reports and fishery related data are posted on the TBP website:

<http://dmr2.maryland.gov/fisheries/Pages/bass/index.aspx>.

Largemouth bass have been widely introduced throughout the United States from beyond their initial Mississippi River drainage distribution. As populations thrived, commercial and recreational fisheries developed. Commercial sale of largemouth bass is illegal in Maryland and the recreational fishery includes pass-time fishing, live-release competitive sportfishing (or tournaments), and charter boat guiding. Year-class strength may depend on the number of offspring produced during spring, their survivorship throughout summer, and their survivorship during winter. In Maryland, the number of juveniles collected during fall is usually a good indicator of year-class strength. The oldest documented largemouth bass in Maryland tidal water of the Chesapeake Bay watershed was 13 years old; however, largemouth bass are known to reach 22 years so older individuals in the watershed are likely to exist.

#### Stock Status

Stock status for largemouth bass in the watershed in 2015 was determined using survey data from fishery independent and dependent surveys. Assessments were conducted for each riverine population, indices were compared with reference points (Table 1), and general conclusions were drawn based upon the suite of indices and their relationships to reference points. Catch in the upper Chesapeake Bay was below average, but reproduction and recruitment appear to have improved over previous years. While overall catch remains low in the Potomac River, the population has experienced greater annual survivorship, reproduction and recruitment in recent years. These improvements may lead to greater levels of catch in the next 3 - 5 years. The fishery in the Choptank River has poor natural sustainability. This may be a result of progressive changes in habitat suitability since 2000. Despite significant stocking of fish since 2009,

there has been little evidence of improving recruitment. Reproduction and recruitment appear to be significantly limited by habitat conditions so population growth rates will be highly sensitive to fishing mortality and should be minimized wherever possible.

The population in Wicomico River is small and capable of providing a small, sustainable fishery. While stocking conducted in 2012 may have helped to bolster young age classes in this population, natural reproduction was discernible and habitat conditions may be suitable to support both stocked fish and naturally reproduced fish. It is anticipated that older largemouth bass collected during this survey will spawn and contribute to natural reproduction. As habitat in Wicomico River becomes more suitable for largemouth bass in tidal freshwater areas near Salisbury (MD), it will be important to manage and monitor fishing mortality to ensure successful survival of adults.

The population from Marshyhope Creek does not appear to require any additional management actions. The population is actively fished and the population has not changed substantially since survey work began consistently in 2008. In general, survey results indicate a quality population in Marshyhope Creek with natural and effective reproduction, probably owed in part to quality, pristine habitat with minimally developed lands.

The Pocomoke River population survey yielded results that were similar to previous years, reflecting a small but sustainable population. Pristine forests of Pocomoke River help protect habitat for bass. Not as many fish were caught in 2015 as in 2014, which could simply reflect sampling bias. Many of the fish caught in 2014 were juveniles and subadults with good growth and condition. To provide a robust stock assessment for this population, a complete 10-year time series of data will be available in 2019 with population specific reference points available in 2020.

## **Current Management Measures/The Fishery**

The number of largemouth bass caught, weighed, and released by tournament anglers is reported by permitted tournament directors. Not all tournaments are permitted, particularly those without a staged weigh-in area or those with less than 10 boats. There are no protocols in place to measure the number of largemouth bass caught and released by pass-time anglers or charter boat guide clients. A creel survey is being developed to measure fishing effort statewide. Once that survey is developed, fishing effort and total catch data will be available for stocks in specific Maryland tidal rivers of the Chesapeake Bay watershed. These data will improve the Department's ability to objectively assess the quality of the fishery from the perspective of the angler.

There is a minimum size limit of 12-inches for largemouth bass between June 16 and the end of February (inclusive) in tidewater. This minimum size limit essentially prevents smaller or younger fish from being harvested (~ 1 % of anglers) or from being moved around and experiencing handling stress during competitive sportfishing tournaments. Currently, there are no reliable statistics that indicate the proportion of tournament anglers within the bass fishery. Nonetheless, tournament anglers are considered a large, important group of anglers within the fishery. There is a 15-inch minimum size limit for largemouth bass between March 1 and June 15 (inclusive) in tidewater. The larger size limit was implemented in 1989 to reduce the number of sexually mature largemouth bass moved from their nests to a weigh-in station during the spawning season. These size limits do not prevent catch-and-release fishing which can be harmful during the spawning season and can also lead to mortality from excessive handling. There is no reliable estimate of catch-and-release mortality for any tidewater largemouth bass fishery in Maryland.



## Focus Areas 2016-17

The TBP will focus on the following actions:

- 1) Continue Tidal Bass Survey so that at least a 10-year baseline of data is established for targeted tidewater areas populations and populations are monitored at least bi-annually. Continue surveys as specified in the Tidal Bass Program's Standard Operating Procedure (<http://dnr2.maryland.gov/fisheries/Pages/bass/reports.aspx>) during fall as funded with federal and state money.
- 2) Determine catch-and-release mortality for pass-time fishing using both long-term mark-recapture studies (at least 3 years) and short-term, hatchery pond experiments at Manning Hatchery using federal money.
- 3) Develop measures to determine angler satisfaction and relate those measures to fishery-independent and fishery-dependent indices. Angler satisfaction will be determined using statewide creel surveys and angler preference surveys conducted annually or semi-annually. These surveys are on-line surveys. Rewards are provided to a randomly selected subset of participants twice a year.
- 4) Determine economic impact of the fishery using statewide angler creel surveys and determine the economic impact of tournaments.
- 5) Proactively provide outreach information regarding handling bass, the use of additives, mechanisms to assure adequate live well maintenance, and factors that improve post-release survival of captured bass.

**Fishery Management Plan for largemouth bass in Maryland Tidewater Implementation Table (updated 6/16)**

Strategy	Actions	Dates	Comments
1.1 Annually conduct tidal bass surveys on targeted rivers, critically evaluate indices that are used to determine changes in the abundance, health, and life history of largemouth bass within tidewater areas of the Chesapeake Bay watershed, and develop new indices as necessary	1.1.1 Coordinate with regional managers to survey tidewater areas and collect data needed to develop indices	Sep - Oct 2015 On-going	Similar to 2014-2015 and previous years, <b>survey completed for 2015 (see Table 2 for survey results).</b>
1.1 Annually conduct tidal bass surveys on targeted rivers, critically evaluate indices that are used to determine changes in the abundance, health, and life history of largemouth bass within tidewater areas of the Chesapeake Bay watershed, and develop new indices as necessary	1.1.2 Share results with anglers, stakeholders, and the general public via a Federal Aid Report, one-page summary sheets, and annual information booklet, and other forms as requested	March 2016 On-going	Similar to 2014-2015 and previous years, <b>Black Bass Annual Review completed and online</b> ( <a href="http://dnr2.maryland.gov/fisheries/Pages/bass/reports.aspx">http://dnr2.maryland.gov/fisheries/Pages/bass/reports.aspx</a> ), Also disseminated among anglers and tournament directors. Federal Aid Report completed, but not provided on-line.
1.1 Annually conduct tidal bass surveys on targeted rivers, critically evaluate indices that are used to determine changes in the abundance, health, and life history of largemouth bass within tidewater areas of the Chesapeake Bay watershed, and develop new indices as necessary	1.1.3 Discuss indices with members of partner agencies, organizations, and universities to evaluate causes or consequences of changes in the indices	Feb 2016	Similar to 2014-2015, <b>presented data at Potomac River Fisheries Commission annual meeting on Potomac River bass population and conducted a black bass roundtable with partner agencies and stakeholders.</b>

Strategy	Actions	Dates	Comments
1.1 Annually conduct tidal bass surveys on targeted rivers, critically evaluate indices that are used to determine changes in the abundance, health, and life history of largemouth bass within tidewater areas of the Chesapeake Bay watershed, and develop new indices as necessary	1.1.5 Improve sharing of data with other Department biologists and programs, such as the Blue Infrastructure Initiative and GIFS	June 2015 - June 2016	In 2014-2015, reviewed and critiqued GIFS. <b>Contributed to meeting on GIFS, data sharing, and improvement of the existing database. Also, worked toward developing an Inland Fisheries website that will be linked to the Tidal Bass Program page and provide greater cross-referencing with other inland fisheries.</b>
1.2 Annually assess data quality and effective usefulness of data collection	1.2.1 Conduct general assessments of variance within catch and other indices and ensure variance is considerably lower than the average point estimate	April 2016 On-going	<b>Coefficients of variation (CV) for indices computed to assess evaluates and determine if any were too high to yield productive indices; CVs ranged between 2% to 65%, with the most variable for catch indices; none varied beyond reasonable expectations (i.e., greater than 100%).</b>

Strategy	Actions	Dates	Comments
1.2 Annually assess data quality and effective usefulness of data collection	1.2.3 Allow internal and external peer-review of data collection and analysis to refine methods based on expert opinions	June 2015 - June 2016	Two papers were published in 2014-2015, <b>and one publication was externally reviewed and it contained details of the problems with the Potomac River bass fishery, as well as possible solutions.</b> The publication contained information on tidal bass survey collection methods, indices and interpretation, and analysis of catch data. Use of indices are appropriate for meeting objectives of this FMP.
1.2 Annually assess data quality and effective usefulness of data collection	1.2.4 Deliver technical reports to regional managers, other internal reviewers, and reviewers of refereed journals for review of methods and data analysis	Feb - May 2016 On-Going	<b>Federal Aid Report and the Black Bass Annual Review were provided to regional managers and senior staff for internal review. Two manuscripts, one regarding the Potomac River fishery and one regarding the age-at-length key, were internally reviewed by the Manager of Statewide Operations.</b>
1.2 Annually assess data quality and effective usefulness of data collection	1.2.5 Assess and/or improve sampling equipment for efficiency	August 2015, March 2016	QA/QC checks were performed on dataset after they were entered into the GIFS database. <b>Regional managers and Tidal Bass Program discussed and decided upon a routine maintenance schedule for boat electrofishers. Additionally, an oscilloscope was used to detect power output for eastern region vessels,</b> which was also done in southern region in 2014-2015, to ensure there was sufficient power output.

Strategy	Actions	Dates	Comments
2.1 Establish biological reference points for populations of tidewater largemouth bass and use them to assess population status	2.1.1 Compute 25th and 75th percentiles for each index from the reference dataset, which will be annual averages computed across a minimum of 10 years of data	2014	Reference points were re-evaluated and readjusted in the 2014 Tidal Bass FMP and <b>no work was done on this between June 2015 and June 2016.</b>
2.1 Establish biological reference points for populations of tidewater largemouth bass and use them to assess population status	2.1.2 Obtain additional data for populations surveyed less than 10 years and develop reference points	Sept - Oct 2015 On-going	Data were collected from Patuxent River to complete a base-line, 10 year dataset in 2014-2015. <b>Populations in Marshyhope Creek, Wicomico River, Pocomoke River, and Gunpowder River were surveyed to obtain data for populations with less than 10 years of data.</b>
2.1 Establish biological reference points for populations of tidewater largemouth bass and use them to assess population status	2.1.3 Use reference points from the peer reviewed literature, when possible, as comparisons to reference points, particularly for populations that do not have a reference dataset of at least 10 years	Feb 2015	Similar to that for 2014-2015, <b>reference points from the peer reviewed literature were used to assess populations without a 10 year reference dataset.</b>
2.1 Establish biological reference points for populations of tidewater largemouth bass and use them to assess population status	2.1.4 Adjust reference points as additional data are required for inter-correlations and importance in reflecting the status of populations	2014	No work was done on this action between June 2014 and June 2016.

Strategy	Actions	Dates	Comments
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2.2 Compare current indices to the reference points and assess significant differences between current indices and historical reference points	2.2.1 Evaluate indices relative to all available reference points and historical data to determine which reference points describe a problem with the fishery	Nov-Dec 2015 On-going	Similar to 2014, <b>indices were compared to assess significant differences between current indices and historical reference points</b>
2.2 Compare current indices to the reference points and assess significant differences between current indices and historical reference points	2.2.2 Develop a management strategy for imperiled populations by constructing a framework of management actions for improving indices	June 2015- June 2016 On-going	Management actions were evaluated to help improve the Potomac River fishery and protect the upper Chesapeake Bay fishery. <b>Public input was received on various action options.</b> Spatial modeling was conducted in 2014 to determine the influence of catch-and-return areas. <b>Additional strategies such as targeting black bass anglers with conservation materials and developing reef habitat in the Potomac River occurred, but are not complete.</b>
2.2 Compare current indices to the reference points and assess significant differences between current indices and historical reference points	2.2.3 Conduct population modeling to determine if and how management actions will influence indices and the population	Dec 2015 - June 2016 On-going	Spatial modeling was conducted in 2014 to determine how catch-and-return areas would influence populations of largemouth bass in the Potomac River and upper Chesapeake Bay. <b>Assessments were conducted to evaluate existing spring-time regulations in tidal and non-tidal water and the expectations on their expansion to improve the fishery.</b>

Strategy	Actions	Dates	Comments
2.3 Establish reference points for angler exploitation of largemouth bass populations in tidewater	2.3.1 Coordinate with directors of competitive events to obtain information on catch and initial mortality of largemouth bass	Dec 2015 - Feb 2016	Most directors of tournaments are routinely required to provide catch data and data on initial mortality of largemouth bass via an on-line reporting system, as required by the permit they receive for staging a tournament. <b>Emails and phone calls were directed to directors who did not report findings so that we obtained a 100% reporting rate.</b>
2.3 Establish reference points for angler exploitation of largemouth bass populations in tidewater	2.3.2 Promote registration and activity reporting of tournament directors, for communication and compliance of permit restrictions	Feb 2016	<b>A letter was issued to past and current tournament directors that reminded them of the obligation to get a free permit and the requirements of the permit (i.e., reporting requirements, no leaking bags).</b>
2.3 Establish reference points for angler exploitation of largemouth bass populations in tidewater	2.3.3 Report results during an annual or semi-annual bass roundtable meeting that includes participants from tournaments and the recreational angling community	Feb - June 2016 On-going	A stakeholder roundtable meeting was held at the at DNR. The agenda and minutes from the meeting are provided on-line at, <a href="http://dnr2.maryland.gov/fisheries/Pages/bass/reports.aspx">http://dnr2.maryland.gov/fisheries/Pages/bass/reports.aspx</a> . <b>This meeting has been formalized into a Black Bass Advisory Subcommittee that provides input to the Sport Fisheries Advisory Commission, which in turn advises the Department.</b>



Strategy	Actions	Dates	Comments
2.3 Establish reference points for angler exploitation of largemouth bass populations in tidewater	2.3.4 Perform angler creel surveys, as necessary, to determine angler satisfaction, catch, and harvest rates by recreational anglers	June 2015 - June 2016 On-going	A statewide creel survey was developed as an on-line Volunteer Angler Survey; <b>anglers who take this survey may win a raffle; licensed anglers are sent an email encouraging them to take the survey and every angler who submits to the DNR Angler's Log is encouraged to take the survey;</b> additional datasets were evaluated for their utility (USFWS; Chesapeake Catch, Angler's Log, MRFS), but most of these cannot be used for tidal freshwater habitats; <b>an intercept survey was developed to provide angler creel data that is comparable to past survey data from the 1980's and 1990's;</b> angler exploitation indices and reference points have not yet been fully developed.
2.3 Establish reference points for angler exploitation of largemouth bass populations in tidewater	2.3.5 Produce studies and provide guidance on live well operating procedures to reduce mortality of largemouth bass	Aug 2015 - June 2016	Reviewed and updated guidelines on live release and handling tips in the Maryland Fishing Guide 2015. <b>Additional work was done to obtain information from B.A.S.S. and begin developing videos that will be put on-line and provide short video clips of information to the larger black bass community - these clips are currently being considered by DNR's Office of Communications.</b> Provided funding and in-kind support for research on keeping adult largemouth bass alive in livewells at Mississippi State University. In December, clarified requirements on existing permits for tournament directors that help reduce handling stress on adults.

3.1 Identify valuable habitat and habitat conditions for largemouth bass and promote their protection	3.1.1 Refine the habitat suitability index using important habitat variables for identifying and prioritizing suitable habitat for largemouth bass	Mar - May 2016	<b>Spatial data on watershed quality were obtained from MD DNR Fisheries Habitat and Ecosystem Program. These data were loaded to an on-line spatial database of suitable areas for largemouth bass. This database is accessed at: <a href="http://dnr2.maryland.gov/fisheries/Pages/bass/recreational.aspx">http://dnr2.maryland.gov/fisheries/Pages/bass/recreational.aspx</a>.</b>
3.1 Identify valuable habitat and habitat conditions for largemouth bass and promote their protection	3.1.2 Ensure that the most informative variables are being measured during the Tidal Bass Survey by conferring with MD DNR Fisheries Habitat and Ecosystem Program		No work was done on this action between June 2015 and June 2016.
3.1 Identify valuable habitat and habitat conditions for largemouth bass and promote their protection	3.1.3 Use a habitat suitability index and consult anglers and regional managers to identify habitats important for the spawning success and growth of largemouth bass	2015	Suitability of spawning coves were identified for several tidal rivers; an ArcGIS shapefile was created to illustrate the coves; the work was written up and will be published in fall 2015 by American Midland Naturalist. It conveys how coves were ranked according to their ability to support largemouth bass reproduction. No work was done on this between June 2015 and June 2016.

Strategy	Actions	Dates	Comments
3.1 Identify valuable habitat and habitat conditions for largemouth bass and promote their protection	3.1.4 Consult published literature and experts to help identify valuable habitat for spawning success and growth of largemouth bass	Nov 2015 - May 2016	Published literature on spawning habitat for largemouth bass was summarized for stakeholders who are evaluating whether catch-and-return areas are viable options for promoting reproduction.
3.1 Identify valuable habitat and habitat conditions for largemouth bass and promote their protection	3.1.5 Generate and submit to GreenPrint spatial data reflecting valuable habitats for largemouth bass and anglers		No work was done on this action between June 2014 and June 2015.
3.1 Identify valuable habitat and habitat conditions for largemouth bass and promote their protection	3.1.6 Consider the effects of climate change on largemouth bass habitat and develop adaptive management to address possible changes	June 2015 - Dec 2016	The impacts of sea level rise on nursery habitats of largemouth bass was investigated and will be published in American Midland Naturalist in fall 2015. While some nursery habitats in Potomac River and the upper Chesapeake Bay will be negatively affected by sea level rise, the fisheries may be robust to changes because the species is likely to expand its range as water temperatures warm. <b>A spatial layer of spawning coves and potential impact by sea level rise was added to the Tidal Bass Program's website.</b>

Strategy	Actions	Dates	Comments
3.1 Identify valuable habitat and habitat conditions for largemouth bass and promote their protection	3.1.7 Utilize the proposed Climate Sensitive Areas for use in land-use planning and increased protection of vulnerable habitats especially in regards to largemouth bass habitat		No work was done on this action between June 2014 and June 2015.
3.1 Identify valuable habitat and habitat conditions for largemouth bass and promote their protection	3.1.8 Provide comments during permit review via MD DNR Environmental Review to help minimize ecological impacts on populations from tidewater of the Chesapeake Bay watershed and largemouth bass habitat	June 2015 - March 2016 On-going	Tidal Bass Program worked with Environmental Review to review consequences and draft a letter regarding the Department's position on coal ash discharge to Potomac River from a Virginia business, Dominion Power; Provided comments regarding construction projects proposed or conducted in upper Choptank, Pocomoke and Wicomico Rivers.
3.1 Identify valuable habitat and habitat conditions for largemouth bass and promote their protection	3.1.9 Write letters on official letterhead to stakeholders or on behalf of stakeholders to acknowledge and promote the significance of the fishery	Feb 2016, June 2016	<b>Official letters were written to tournament directors, those who target black bass in Maryland, and owners of Anchor Marina to thank stakeholders for participating in the fishery and to promote the bass fishery</b>

Strategy	Actions	Dates	Comments
3.1 Identify valuable habitat and habitat conditions for largemouth bass and promote their protection	3.1.10 Promote a level of imperviousness that is lower than 10% of the drainage	May 2016	<b>A map indicating watershed health, in part based on imperviousness levels, was added to an on-line spatial database of important bass habitats.</b>
3.1 Identify valuable habitat and habitat conditions for largemouth bass and promote their protection	3.1.11 Ensure that natural variability in stream discharge is maintained by encouraging "smart growth" and limiting channelization		No work was done on this action between June 2015 and June 2016.
3.1 Identify valuable habitat and habitat conditions for largemouth bass and promote their protection	3.1.12 Encourage lower levels of nitrogen and phosphorus waste from entering waterways via non-point and point sources	June 2015-2016 On-going	Letters were written in 2014 regarding eutrophication of Wicomico Rivers. <b>In 2015-2016, reviewed grant proposals for nutrient and sediment reduction from public and private lands. Provided comments on removal of nutrients from storm water for 2 State Highway projects on Route 40 at the Gunpowder/Little Gunpowder.</b>
3.1 Identify valuable habitat and habitat conditions for largemouth bass and promote their protection	3.1.13 Proactively work through a comprehensive plan renewal process to identify and protect important habitat features	June 2015-2016	Reviewed and commented on the proposed Mallows Bay National Marine Sanctuary. The main focus was to ensure that angler access to Mallows Bay would not be negatively impacted by the "Sanctuary" classification. We were ensured that anglers would retain full access to the water.

Strategy	Actions	Dates	Comments
3.1 Identify valuable habitat and habitat conditions for largemouth bass and promote their protection	3.1.14 Collect data on invasive species as habitat data is collected in order to better monitor changes in habitat conditions over time and evaluate how those changes would affect the largemouth bass fishery	June 2015 - June 2016 On-going	Data for invasive snakeheads were collected as part of the Tidal Bass Survey, which is on-going; <b>these monitoring data were presented at a USFWS interagency taskforce to discuss impacts of snakeheads in January.</b> Blue and flathead catfish are also considered invasive species and monitoring will begin on the Patuxent River in 2016. The commercial harvest of blue catfish is currently monitored on the Potomac River. <b>Data regarding expansion and impacts of invasive species on largemouth bass have been examined with stakeholder groups and during taskforce meetings.</b>
3.2 Improve habitat conditions for largemouth bass and species on which largemouth bass depend	3.2.1 Identify and determine the need for protected areas that are completely or temporarily closed to largemouth bass fishing either year-round or during the spawning season to prevent displacement or high levels of catch-and-release mortality	Nov 2015 - June 2016	<b>Public awareness on the importance of SAV for productivity of largemouth bass was discussed at the Potomac River Fishery Commission's inter-agency meeting in November 2015. A comprehensive review of existing spring-time and year-round possession restrictions was conducted and that information was used to generate several internal reports. One such report will be presented to the Black Bass Advisory Subcommittee, after its formation in June and during its first convened meeting in July.</b>

Strategy	Actions	Dates	Comments
3.2 Improve habitat conditions for largemouth bass and species on which largemouth bass depend	3.2.2 Use ecosystem-based management to provide management options that protect growth or survival of largemouth bass and accounts for competition or predation by invasive species		No work was done on this action between June 2014 and June 2015.
3.2 Improve habitat conditions for largemouth bass and species on which largemouth bass depend	3.2.3 Tidal Bass Program staff may work with Artificial Reef Program staff (MARI) as needed to develop reefs and other artificial habitat for largemouth bass	Jun 2015 - Jun 2016	An artificial reef ball project is proposed, <b>fully funded</b> , and may be permitted for Smoots Bay (National Harbor). <b>Permits from Maryland have been obtained and should be obtained from Army Corps of Engineers.</b> This project should be completed in 2016. It will compensate for grass lost from the area in the last decade. <b>The collaboration with MARI will help ensure that future projects have a framework that details the process of artificial reef placement from design to implementation.</b>

Strategy	Actions	Dates	Comments
3.2 Improve habitat conditions for largemouth bass and species on which largemouth bass depend	3.2.4 Develop innovative storm water management techniques, promote storm water management retrofits where applicable, creation of wet marshy conditions throughout watersheds, and reconnect streams to riparian areas		No work was done on this action between June 2015 and June 2016.
3.2 Improve habitat conditions for largemouth bass and species on which largemouth bass depend	3.2.5 Upgrade and improve semi-natural landscape elements, such as man-made wetlands, ponds, and recreated natural lands		No work was done on this action between June 2016 and June 2016.



Strategy	Actions	Dates	Comments
3.2 Improve habitat conditions for largemouth bass and species on which largemouth bass depend	3.2.6 Promote low sedimentation of streams	June 2015 - June 2016	<p><b>Reviewed and commented on the following projects: Zekiah Swamp State Highway Administration (SHA) project designed to repair degraded shoreline stabilization materials; Rt 210 over upper Piscataway Creek, SHA project to repair rip-rap and storm gutters; Stoney Run – just upstream from the tidal lagoons in Patapsco River, SHA project to repair roadside drains and sediment traps.</b></p> <p><b>Our comments emphasized the importance of functional sediment controls and continuous monitoring of those put in place. Flash flooding occurs frequently in all these places and heavy sediment loads, even temporary ones, negatively impact black bass young of year and their forage.</b></p> <p><b>Provided comments on 2 State Highway projects on Route 40 at Gunpowder/Little Gunpowder to limit sedimentation and maintain fish passage in order to protect the popular tidal largemouth bass fishery.</b></p>

Strategy	Actions	Dates	Comments
4.1 Generate a decision making process to resolve identified problems with the population and fishery as they relate to significant departures of indices from reference points	4.1.1 Hold public meetings to determine angler behavior and perceptions on the quality of the fishery	Nov 2015 - Jun 2016	Similar to that in 2014, <b>public meetings were held with Potomac River Fisheries Commission.</b> A public meeting was also held local town hall style in North East (MD). Similar to 2014, <b>meetings also included a black bass roundtable in Annapolis and with tournament organizations during their registration meeting.</b>
4.1 Generate a decision making process to resolve identified problems with the population and fishery as they relate to significant departures of indices from reference points	4.1.2 Evaluate the adequacy of current regulations in supporting the sustainability and quality of the fishery	Nov 2015 - Jun 2016	Catch and return areas were evaluated in 2014 and early 2015. <b>Current possession regulations were also evaluated by MDDNR staff to determine what changes may be made to improve the sustainability of the Potomac River and upper Chesapeake Bay fisheries. Additionally, past regulations such as a 15" limit during spring was evaluated for its effectiveness.</b>
4.1 Generate a decision making process to resolve identified problems with the population and fishery as they relate to significant departures of indices from reference points	4.1.3 Establish relationships between fishery independent data, angler catch, and angler satisfaction		No work was done on this action between June 2015 and June 2016. Data regarding angler satisfaction will be collected in 2016.

Strategy	Actions	Dates	Comments
4.2 Enhance fish populations by releasing hatchery raised largemouth bass, when natural reproduction or recruitment is deemed insufficient for sustaining a fishery	4.2.1 Target tidewater areas that require stocking of largemouth bass that are determined to be at risk and would be expected to suffer a decline in the quality of the fishery without stocking efforts	June 2016 On-going	Stocking is a routine annual event. <b>In June, largemouth bass were released to the Potomac River, where populations have suffered recruitment declines.</b>
4.2 Enhance fish populations by releasing hatchery raised largemouth bass, when natural reproduction or recruitment is deemed insufficient for sustaining a fishery	4.2.2 Generate a stocking strategy with an objective to either support or improve the fishery	Feb 2016	In accordance with the stocking policy (2015), key areas were identified for stocking and include Potomac River, Middle River, and the upper Chesapeake Bay; <b>money was requested from federal aid to purchase largemouth bass juveniles when stocking to an environment from which brood stock are not obtained.</b>

Strategy	Actions	Dates	Comments
4.3 Promote the survival and abundance of older, larger fish	4.3.1 Adjust creel limits or size limits for promoting survival of older fish when: 1) there are few adults in the population for enabling sufficient recruitment that sustains the population; or b) catch rates for adults are too low to provide a quality fishery		No work was done on this between June 2015 and June 2016.
4.3 Promote the survival and abundance of older, larger fish	4.3.2 Improve and promote angler awareness that increases survivorship of largemouth bass during catch-and-release fishing	June 2015 - June 2016	Provided funding and in-kind support for research on keeping adult largemouth bass alive in live-wells at Mississippi State University. Black bass anglers were targeted with current information on reducing handling stress of bass that anglers intend to keep alive in February and June. Catch-and-release areas are also being considered to help promote the survivorship of older, larger fish.

Strategy	Actions	Dates	Comments
4.3 Promote the survival and abundance of older, larger fish	4.3.3 Engage in meaningful studies that benefit the angling community by informing them on methods to improve survivorship		No work was done on this action between June 2015 and June 2016.
4.3 Promote the survival and abundance of older, larger fish	4.3.4 Enforce restrictions on holding more than 5 bass/angler/day by specially permitted release boat captains	June 2015 - June 2016	<b>Tournaments with release boats were attended by staff.</b> Oxygen and temperature conditions required in the permit were measured by MDDNR staff. When problems occurred, they were solved by the release boat crew and MDDNR staff. <b>Staff developed a datasheet to record oxygen and temperature routinely throughout the day; the max and min are provided the tournament director at the end of the day to aid in their data reporting.</b>
4.3 Promote the survival and abundance of older, larger fish	4.3.5 When necessary, discourage the transportation of largemouth bass among river systems or to an uninterrupted area greater than 30 km from its area of capture	October 2016	Initially discouraged at meetings with stakeholders, <b>limiting redistribution of fish from distant streams was encouraged as a best management practice in the permitting system for most black bass tournaments in Maryland.</b>

Strategy	Actions	Dates	Comments
4.4 Protect, enhance and improve important angler access points to the tidewater largemouth bass fishery	4.4.1 As part of the Chesapeake Bay Watershed Access Plan, 300 public access sites will be developed in the watershed and important angler access points to the tidewater largemouth bass fishery should be provided	June 2015 - June 2016	An angler access map describes fishing spots for anglers in Maryland. <b>It was referenced in phone calls and conversations with stakeholders throughout the year.</b> No work was done on this action between June 2015 and June 2016. <b>Mallows Bay is considered as a national marine sanctuary and if approved, will be advertised as a valuable access point to the tidewater largemouth bass fishery on Potomac River. Hallowing Point, Cedar Point, and a new free fishing area in Federalsburg (see Action 4.4.4) will be added or edited in the angler access map.</b>
4.4 Protect, enhance and improve important angler access points to the tidewater largemouth bass fishery	4.4.2 Determine crowding of angler access points and mitigate, when possible		No work was done on this action between June 2015 and June 2016.
4.4 Protect, enhance and improve important angler access points to the tidewater largemouth bass fishery	4.4.3 Encourage public or DNR Fisheries to identify potentially new access areas for motor boats		No work was done on this action between June 2015 and June 2016.

Strategy	Actions	Dates	Comments
4.4 Protect, enhance and improve important angler access points to the tidewater largemouth bass fishery	4.4.4 Create and/or advertise new angler access points to the tidewater largemouth bass fishery	June 2015 - June 2016	<p>The Angler Access map, which is available on-line, was noted in correspondence with several anglers who were interested in fishing in Maryland; also, a map of approved release sites for tournaments is available on-line, advertised to directors, and is used to highlight access points for competitive sport fishing.</p> <p><b>Reviewed and commented on two Project Open Space (POS) projects with the potential to increase angler access to tidal bass waters. Hallowing Point on the Calvert County side of the Benedict Bridge is being expanded to include additional boat launches, shoreline fishing and, possibly, a fishing pier. Cedar Point Wildlife Management Area will expand waterfowl access to hunter in southern Charles County, but there will be ample shoreline access for anglers as well.</b></p>
4.4 Protect, enhance and improve important angler access points to the tidewater largemouth bass fishery	4.4.5 Promote small craft and shore based angler access		<p><b>Worked with the Town of Federalsburg to create a new "free fishing area" along Marshyhope Creek.</b></p> <p><b>See Section 4.4.4. for additional boat access at Hallowing Point. Additionally, all POS submissions that are received in the Southern Region office are reviewed with additional angler and boat access being the primary point of interest.</b></p>

Strategy	Actions	Dates	Comments
5.1 Improve habitat for largemouth bass	5.1.1 Control and manage invasive species that threaten the health or sustainability of largemouth bass populations	June 2015 - June 2016	Incentive programs, such as the statewide invasive species record, were promoted to help control and manage invasive species (Northern snakehead). <b>A fishing derby aimed at raising awareness of northern snakehead was held in partnership with National Park Service and U.S. Fish and Wildlife Service in C&amp;O Historical Park.</b>
5.1 Improve habitat for largemouth bass	5.1.2 Monitor, protect or enhance the availability of prey for largemouth bass by partnering with other agencies or other programs within MD DNR	March 2015	A monitoring strategy was implemented within the Tidal Bass Program for documenting the availability of prey. <b>Availability of forage was investigated for Middle River by developing a fish forage index, which will be computed from Tidal Bass Program data in select streams and spatially referenced on-line using ArcGIS.</b>
5.1 Improve habitat for largemouth bass	5.1.3 Control or limit pollution sources to impaired waterways in order to improve the sustainability of largemouth bass populations		<b>Reviewed new power plant proposal (the 3<sup>rd</sup> in the greater Waldorf area). The smokestacks of this plant appear to be relatively short, causing additional concern over chemical compounds that would be precipitated from the smokestack.</b>



Strategy	Actions	Dates	Comments
5.2 Maintain important aspects of ecosystem function to maintain habitat for largemouth bass	5.2.1 Identify components of ecosystem function essential for the sustainability of largemouth bass populations	June 2015 - June 2016.	<b>A macroinvertebrate index of biotic integrity was developed and compared between Vallisneria dominated habitats and Hydrilla dominated habitats. This index reflects the diversity of the macroinvertebrate community and is being related to bass health and body condition.</b>
5.2 Maintain important aspects of ecosystem function to maintain habitat for largemouth bass	5.2.2 Identify possible threats to the maintenance and function essential for the sustainability of largemouth bass		Ecosystem threats to the fishery in the Potomac River and upper Chesapeake Bay were largely identified as ones related to loss of SAV in 2014. No work was done on this action between June 2015 and June 2016.
5.2 Maintain important aspects of ecosystem function to maintain habitat for largemouth bass	5.2.3 Preserve ecosystem components that are essential and potentially threatened		No work was done on this action between June 2015 and June 2016.

Acronyms: GIFS = Geographic Inland Fisheries Survey System MDDNR = Maryland Department of Natural Resources QA/QC = quality assurance/quality control SAV = Submerged Aquatic Vegetation

Table 1. Stock assessment of largemouth bass populations in 2015 for targeted drainages of the Chesapeake Bay watershed using indices and metrics reflecting changes in population biology. When a metric falls below the 25<sup>th</sup> percentile computed for available data for that river, the ▼ symbol is given. When a metric falls above the 75<sup>th</sup> percentile computed for available data for that river, then the ▲ symbol is given. nc = value falls within the 25<sup>th</sup> and 75<sup>th</sup> percentiles. For tidal rivers where 25<sup>th</sup> and 75<sup>th</sup> percentiles for populations were not available, values were compared to general, reference point-estimates established for non-Maryland populations; ☺ = values similar to reference point-estimate and ☹ = values much different than reference point. Abbreviations for indices are in text. NA = Not Available

River	N	CPUE	Cor-CPUE	CPUE, 1+	PSD <sub>305</sub>	PSD <sub>381</sub>	-Z	GR-EXPrise	GR-VBGF	LW-Slope	W <sub>r</sub>	K <sub>n</sub>	JuvCPUE	JUVPSD	JUV%OCC (N)
Upper Bay	28	38.07 ▼	4.77 ▼	19.31 ▼	0.63	0.58 ▲	NA	57.61 ▼	57.80 ▼	3.18	1.07 ▲	1.05 ▲	26.90 ▼	0.58	0.74 (19)
Potomac	53	35.10 ▼	3.77 ▼	9.41 ▼	0.65	0.36 ▲	0.56 ▼	66.48	66.72	3.24	1.09 ▲	1.07 ▲	26.38 ▲	0.71	0.79 (34)
Patuxent <sup>1</sup>	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Choptank	37	5.70 ▼	2.94 ▼	7.09 ▼	0.83 ▲	0.57 ▲	NA	60.06 ▼	60.26 ▼	3.25	1.04 ▲	1.03 ▲	11.87 ▼	0.12	0.10 (30) ▼
Wicomico	24	16.32	4.98	12.49	0.65	0.31 ☺	0.47 ☹	62.18 ☹	62.44 ☹	3.31 ☺	1.03 ☺	1.00	12.13	0.31	0.41 (17)
Marshyhope	24	36.53	8.60	32.93	0.65	0.28	0.56	65.83	62.24 ☹	3.15 ☺	0.99	1.03 ☺	25.79	0.19	0.12 (16)
Pocomoke	30	13.55	3.71	11.23	0.47 ☹	0.21	0.63 ☺	60.42 ☹	60.58 ☹	3.21 ☺	0.99	0.96 ☹	11.83	0.24	0.20 (20)
Gunpowder	19	8.39	8.25	3.25	0.86 ☺	0.64 ☺	NA	NA	NA	2.92	1.03 ☺	0.93 ☹	0.00	0.00	0.00 (15)

<sup>1</sup>Patuxent River was not sampled (NS) in 2015.

## 2015 Maryland FMP Report (July 2016)

### Section 3. Atlantic croaker (*Micropogonias undulatus*) and Spot (*Leiostomus xanthurus*)

The ASMFC 2015 traffic light analysis (a method to evaluate fishery and abundance trends) for both Atlantic croaker and spot indicated declining trends in almost all indices for both species. Thresholds representing moderate and significant concern were established in 2014. Although there were declining trends, they were low to moderate and did not trigger any management action. Both species have a coast wide benchmark stock assessment in progress with peer reviews scheduled in late 2016. Maryland juvenile indices have declined to very low level for both species over the past few years. Croaker and spot are important commercial, recreational and forage species.

#### Fishery Management Plans (FMPs)

The Chesapeake Bay Atlantic Croaker and Spot Fishery Management Plan (CBCS FMP) was adopted in 1991. The FMP's goal is to: "Protect the Atlantic croaker and spot resource in the Chesapeake Bay, its tributaries, and coastal waters, while providing the greatest long term ecological, economic, and social benefits from their usage over time." To accomplish this goal, management strategies were developed to prohibit the harvest of small fish (age 1 and younger) of both species and to recommend monitoring and research programs for stock assessments and habitat needs. The CBCS FMP was reviewed in 2014 by the Maryland Plan Review Team. It was determined that the plan is an appropriate framework for managing the croaker and spot resources. The team recommended that the plan be reviewed again in 2017 after the completion of coastal stock assessments and the development of new management triggers.

The Atlantic States Marine Fisheries Commission (ASMFC) adopted coastal FMPs for each species in 1987. The main purpose of the plans was to decrease the number of small fish caught as bycatch in the coastal shrimp trawl fishery. Bycatch reduction devices were required in the offshore coastal areas and have reduced the number of small fish caught in the trawl fishery. Amendment 1 to the croaker FMP was adopted in November 2005, which replaced the original FMP, and established spawning stock biomass target and threshold.<sup>1</sup> Addendum I (2010) to Amendment I modified the management area and biological reference points. Addendum II to Amendment I for croaker (2014) established a precautionary management framework using the Traffic Light Approach.

An Omnibus Amendment to the Interstate Fishery Management Plans for Spanish Mackerel, Spot, and Spotted Seatrout was adopted in 2011 to allow these species to be managed under the authority of the Atlantic Coastal Fisheries Cooperative Management Act<sup>2</sup>. Addendum I to the Fishery Management Plan for Spot (2014) established a similar precautionary management approach using the Traffic Light

Approach for spot. There have been no interstate management requirements for either Atlantic croaker or spot.

**Atlantic croaker** - Biological reference points (BRPs) were established for croaker in the mid-Atlantic region in 2005. The BRPs were revised in 2011 (Addendum I) following the 2010 ASMFC stock assessment and now apply to the entire Atlantic coastal stock.<sup>3</sup> The BRPs set targets for fishing mortality (F) and spawning stock biomass (SSB), and are ratio-based. For the threshold, if  $F/F_{MSY}=1$ , overfishing is occurring. If  $SSB/(SSB_{MSY}(1-M))=1$ , the coastal stock is overfished. The 2011 ASMFC Atlantic Stock Assessment Technical Committee evaluated the stock assessment triggers in 2014 and found no evidence to alter management.<sup>1</sup> The 2013 ASMFC Action Plan called for the development of an addendum to consider alternate croaker trigger mechanisms. Existing management triggers were not considered an effective method to respond to changes in the fisheries. The Atlantic Croaker technical committee supported a new approach – a traffic light analysis, to evaluate the fishery.<sup>4</sup> The traffic light approach (TLA) was approved in Addendum II to Amendment 1 of the Atlantic Croaker FMP (August 2014).<sup>5</sup> The TLA incorporates multiple data sources into a single metric to provide management guidance. The TLA is useful for data-poor species management and replaces past assessment triggers. The development of state specific harvest reductions will occur if the harvest and abundance indices thresholds are exceeded for three consecutive years.

Maryland is required to submit an annual ASMFC Atlantic croaker compliance report. This report describes the fishery management program for Atlantic croaker, including fishery dependent and independent monitoring, regulations, commercial harvest reports and recreational catch estimates.<sup>3</sup> Juvenile indices (seine and trawl) for the Maryland portion of the Chesapeake Bay have been calculated for every year since 1959. Maryland started a new gill net survey in the Choptank River to sample adult Atlantic croaker and spot in 2013.

**Atlantic croaker Stock Status** – Atlantic croaker is considered a single stock along the Atlantic Coast. Based on the 2010 ASMFC benchmark stock assessment, overfishing is not occurring but whether the stock is overfished could not be determined due to data limitations.<sup>7</sup> The 2010 stock assessment indicated that biomass was increasing and the age-structure of the population was expanding from the late 1980's through 2008. A new benchmark stock assessment is currently being developed, and is slated for peer review in late 2016. MD DNR staff participated in the data workshop in September 2015 and will participate in both assessment workshops in 2016. Analysis of TLA for 2014 showed that the population characteristic (commercial and recreational landings) tripped for the second year in a row. The abundance characteristic also declined in 2014 but the proportion of metrics was below the 30% threshold. No management action was required but the declining values in all adult indices is concerning. The benchmark stock assessment should provide a better indication of current stock status and whether any

management action is warranted. Atlantic croaker ages were determined from fish captured in Maryland pound nets and 2015 was the first year in which no fish older than age seven were present.

**Atlantic Croaker Fisheries** – Commercial landings from Maryland and Virginia followed a similar trend (Figures 1 and 2) with periods of high harvest in the 1950s, late 1970s and late 1990s through the 2000s.<sup>8</sup> Commercial landings have declined to more moderate levels in recent years. Maryland’s 2014 landings were 552,000 pounds and Virginia landings were 4.8 million pounds: both, a decrease from 2013 (NMFS data). Recreational harvest and release estimates from the Marine Recreational Information Program (MRIP) are higher for Virginia than Maryland for the majority of years and decreased in both states in 2015 (Figures 3 and 4).<sup>9</sup>

Figure 1. Maryland commercial landings of Atlantic croaker from 1950-2014.<sup>8</sup>

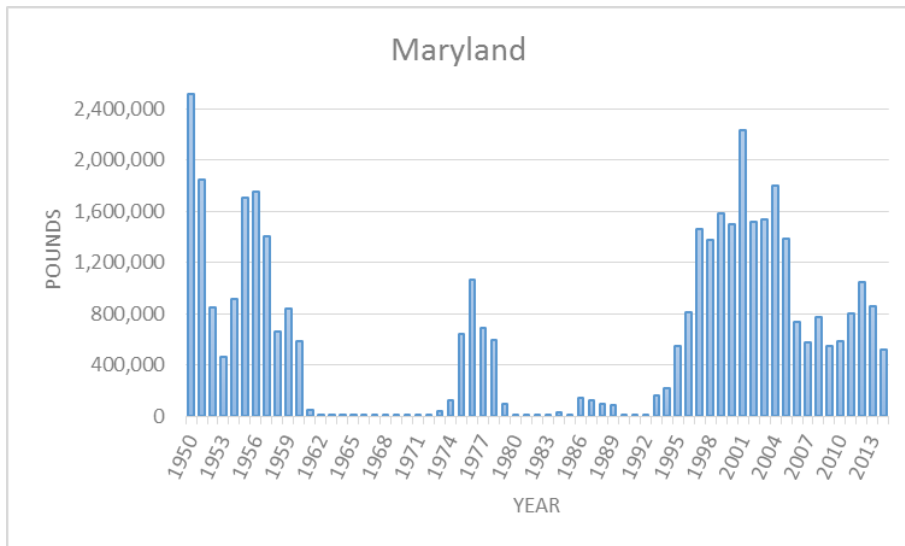


Figure 2. Virginia commercial landings of Atlantic croaker: 1950-2014.<sup>8</sup>

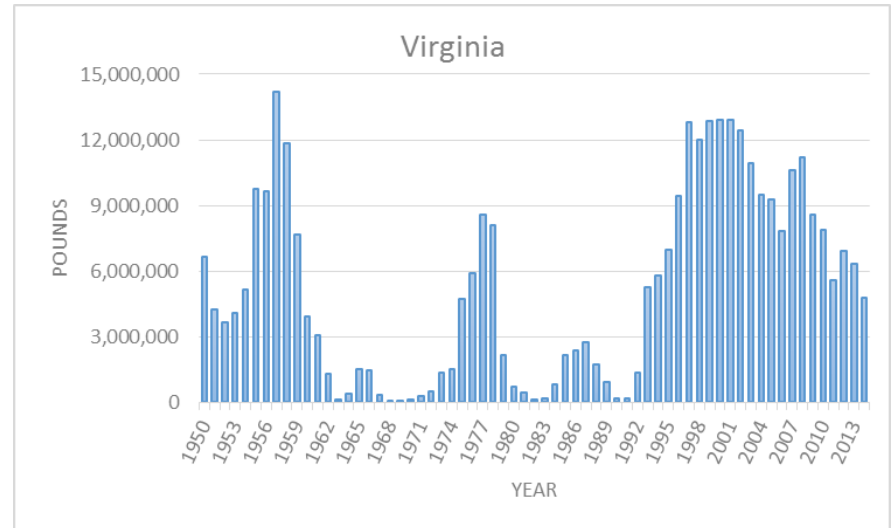


Figure 3. Maryland estimated recreational harvest and release for Atlantic croaker: 1981-2015.<sup>9</sup>

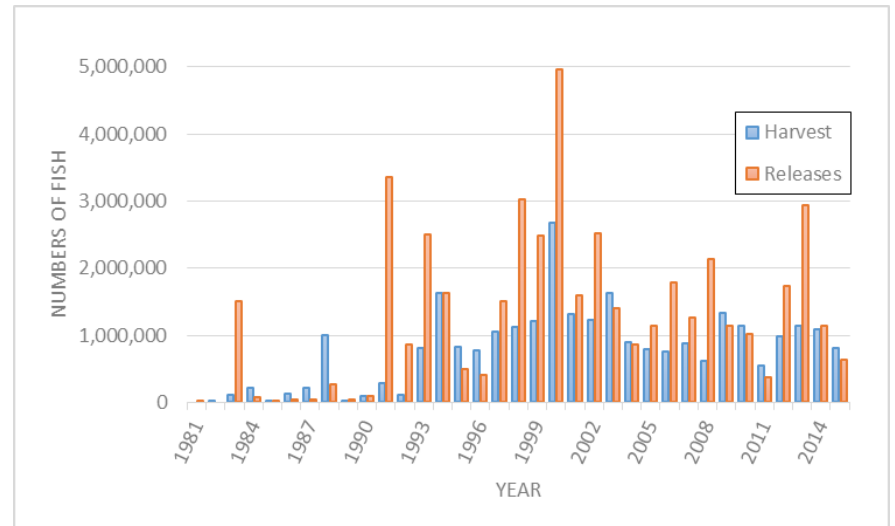
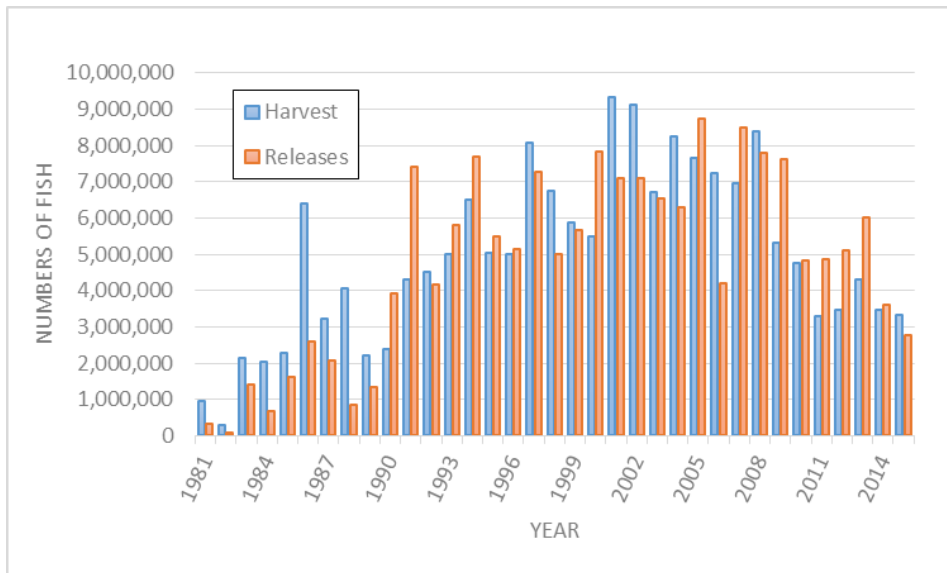


Figure 4. Virginia estimated recreational Atlantic croaker harvest and release, 1981-2015.<sup>9</sup>



**Spot** - The 2013 ASMFC Action Plan called for the evaluation of spot management triggers. As described above for Atlantic croaker, a similar TLA was approved for spot at the 2014 summer meeting of the ASMFC through an addendum to the Omnibus Amendment for Spanish Mackerel, Spot and Spotted Seatrout.<sup>2, 11</sup> The TLA will provide management guidance until a stock assessment is completed in 2016. The TLA incorporates multiple data sources into a single metric and includes both population abundance and harvest data. If the threshold of 30% is triggered for two consecutive years, then state-specific management actions will be developed.<sup>5</sup> The ASMFC Spot Plan Review Team met in 2015 to review the trigger indices<sup>10</sup>. The review team found that the harvest composite index (recreational and commercial harvest) was above the threshold in 2012 and 2013 but was below the threshold in 2014. The abundance composite index (SEAMAP and NNFS surveys) was triggered in 2014 since it was above the 30% threshold but both harvest and abundance indices need to be over the threshold before management action is triggered. Although the PRT did not recommend any management actions at this time, there was concern over declining harvest trends and low fishery independent index values.<sup>10</sup>

**Spot Stock Status**— Overfishing and overfished status remain unknown. The first benchmark stock assessment for spot is currently being developed and is slated for peer review in late 2016. MD DNR staff participated in the data workshop in

September 2015 and will participate in both assessment workshops in 2016. Two juvenile indices (JI) are calculated to evaluate recruitment of spot in Maryland’s portion of Chesapeake Bay. A JI is calculated for spot from the MD DNR Blue Crab Trawl Survey (BCS) and another from the Maryland Estuarine Juvenile Finfish Survey (EJFS). These indices are highly variable. Chesapeake Bay juvenile indices were near their time series means in 2012, but have declined steadily to a level near the time series low for both surveys.

### Spot Fisheries

There is an order of magnitude difference in the commercial harvest of spot in Virginia and Maryland (Figures 5 & 6). However, commercial landings from both states indicate similar fluctuations across the years. Landings were higher in the 1950s, decreased in the 1960s and 1970s, and rebounded in the 1990s. Variability in spot landings is expected since it is a short-lived species. Year-class strength is impacted by annual environmental conditions. Recreational landings have been variable with additional fish caught but released (Figures 7 & 8). Compared to the other coastal states, Virginia recreational anglers have caught between 30% and 50% of the total coastal catch and Maryland recreational anglers have caught between 12% and 35% of the coastal catch based on the last ten years of estimated harvest data.

Figure 5. Maryland commercial landings of spot: 1950-2015.<sup>8</sup>

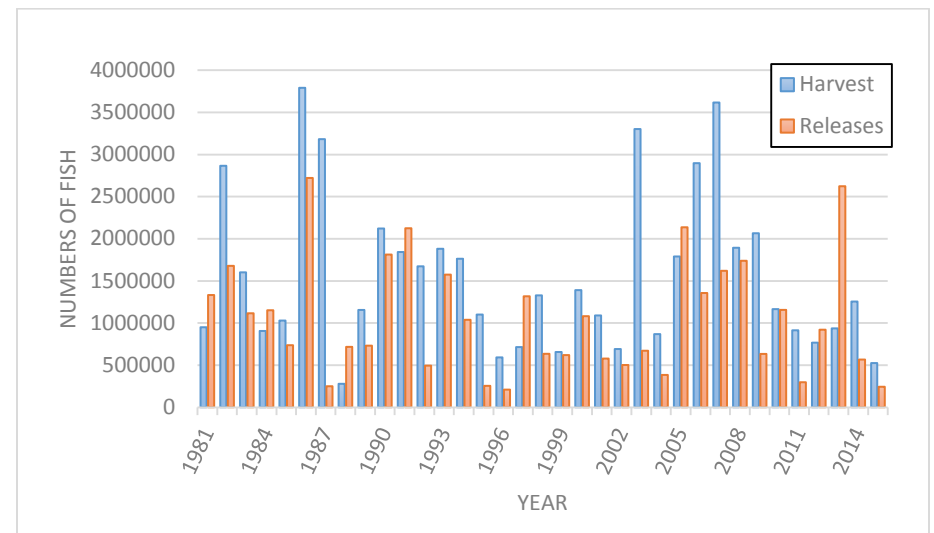


Figure 6. Virginia commercial landings of spot: 1950-2015.<sup>8</sup>

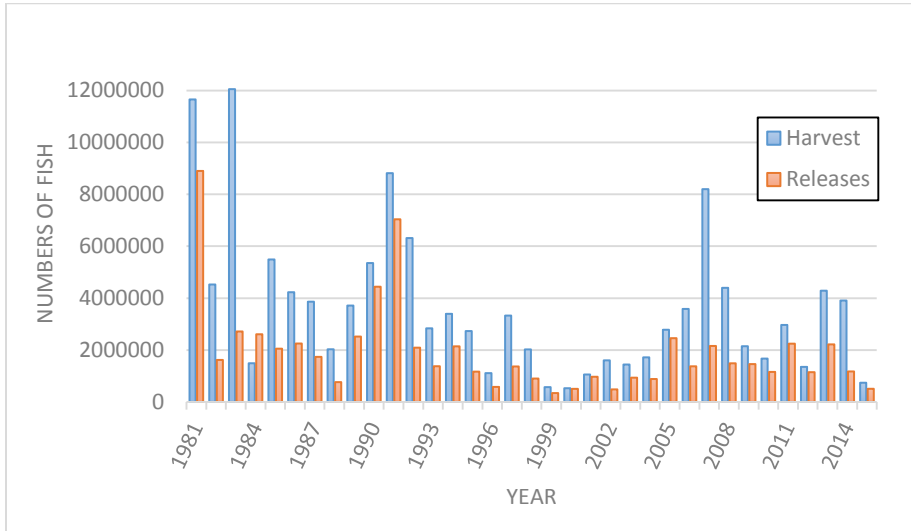


Figure 8. Virginia estimated recreational spot harvest and releases: 1983-2014.<sup>8</sup>

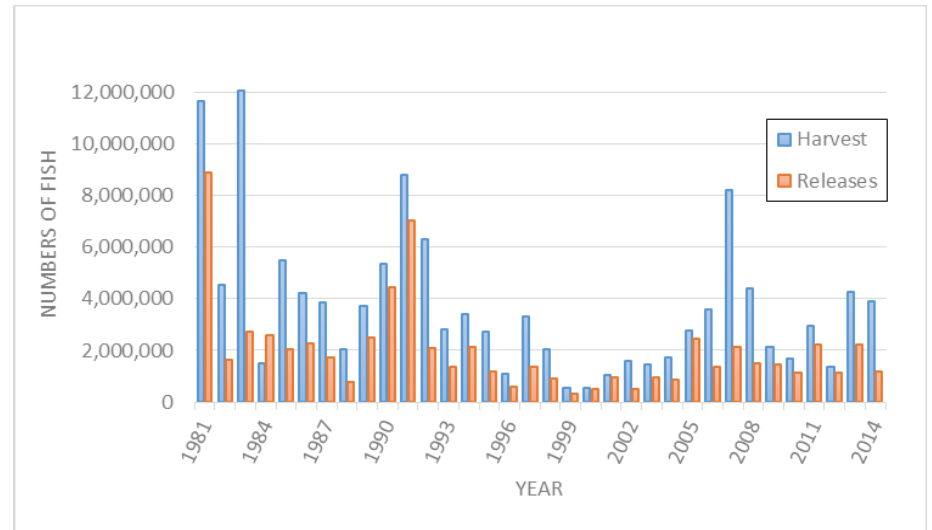
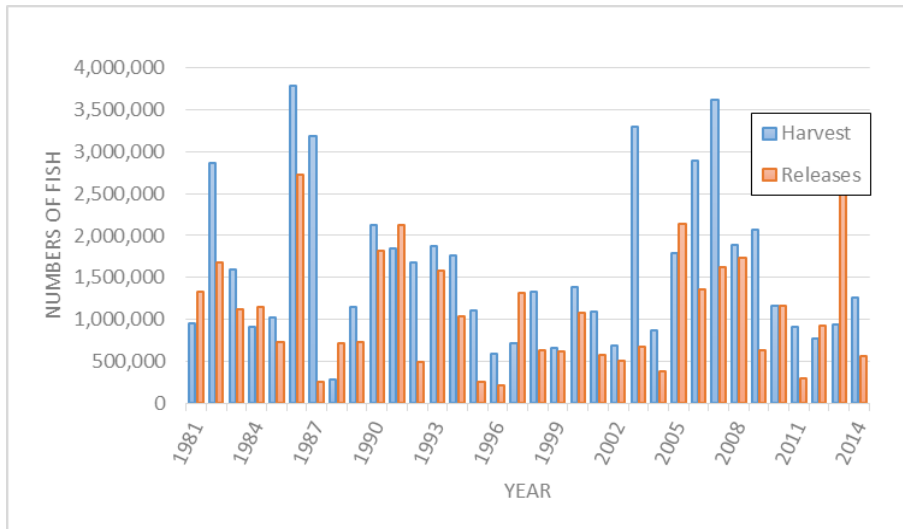


Figure 7. Maryland estimated recreational spot harvest and releases: 1983-2014.<sup>8</sup>



### Management Measures

There are no management measures required by ASMFC to restrict the commercial or recreational fisheries for either croaker or spot. The adoption of the TLA is a precautionary management framework for both species. The coastal states are required to compile commercial and recreational harvest statistics and monitoring data. Annual spot and Atlantic croaker compliance reports have been required since 2012 and 2006, respectively.<sup>6,12</sup> Maryland and PRFC have a recreational minimum size limit of 9 inches for croaker and a creel limit of 25 fish per person per day. Maryland has a commercial season from March through December and a 9 inch minimum size limit. There are no harvest restrictions for Atlantic croaker in Virginia or for spot in any of the Chesapeake Bay jurisdictions.

### Issues/Concerns

Continued monitoring of the commercial and recreational harvest of both croaker and spot is important in order to obtain data for conducting stock assessments and evaluating the status of the stocks. There is some concern about the overall decreasing trend in commercial landings of spot along the coast. The ASMFC Spot Plan Review Team will continue to monitor the trend and make management recommendations if necessary. The use of circle hooks to reduce recreational discard mortality is encouraged. Both species are caught indirectly and together during other fishing activities; bycatch mortality is a continued concern. Small spot, for example,

could account for as much as 80% of the shrimp trawl catch by weight and 60% by number, depending on area.<sup>13</sup> States are encouraged to use bycatch reduction devices to reduce bycatch.

Spot are used as live bait in both the commercial hook and line fishery and the recreational striped bass fishery in the Chesapeake Bay. Gear restrictions and/or harvest and size restrictions on spot could significantly impact these striped bass fisheries. The consequences of using small spot as bait are unknown. Spot used for the live bait fishery are harvested in fish pots or by hook and line.

A winter kill in Chesapeake Bay estimated at two million juvenile spot occurred in late December 2010 and was associated with a sudden cold snap. The consequences of this winter kill are unknown but illustrate the vulnerability of this species to sudden cold snaps.

#### References:

<sup>1</sup> ASMFC 2005. Amendment 1 to the Interstate Fishery Management Plan for Atlantic Croaker. Fishery Management Report No. 44 of the Atlantic States Marine Fisheries Commission. Arlington, VA. 92p.

<sup>2</sup> ASMFC 2011a. Omnibus Amendment to the Interstate Fishery Management Plans for Spanish Mackerel, Spot, and Spotted Seatrout. Fishery Management Report of the Atlantic States Marine Fisheries Commission. Arlington VA 161p.

<sup>3</sup> ASMFC 2011b. Addendum I to Amendment 1 to the Atlantic Croaker Fishery Management Plan. Arlington, VA 7p.

<sup>4</sup> ASMFC 2015a. 2015 Review of the Atlantic States Marine Fisheries Commission Fishery Management Plan for Atlantic Croaker (*Micropogonias undulatus*) 2014 Fishing Year. Accepted August 2015. 20P.

<sup>5</sup> ASMFC 2014a. Addendum II to Amendment I to the Interstate Fisheries Management Plan for Atlantic Croaker. Arlington, VA 7p.

<sup>6</sup> Rickabaugh, H., Jr. 2016. Maryland Atlantic Croaker (*Micropogonias undulatus*) Compliance Report to the Atlantic States Marine Fisheries Commission – 2015. Maryland Department of Natural Resources Fisheries Service June 17, 2016.

<sup>7</sup> ASMFC. 2010. Atlantic Croaker 2010 Benchmark Stock Assessment. Washington DC.

<sup>8</sup> Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division, June 29, 2015.

<sup>9</sup> Personal communication from the National Marine Fisheries Service, Recreational Fisheries Statistics Division, Marine Recreational Information Program, June 29, 2016.

<sup>10</sup> ASMFC 2015b. 2015 Review of the Atlantic States Marine Fisheries Commission Fishery Management Plan for Spot (*Leiostomus xanthurus*) – 2014 Fishing Year, Arlington, VA 17p.

<sup>11</sup> ASMFC 2014d. Addendum I to the Omnibus Amendment to the Interstate Fishery management Plans for Spanish Mackerel, Spot, and Spotted Seatrout, management of the Spot Fishery using the Traffic Light Approach. Arlington, VA. 7p.

<sup>12</sup> Rickabaugh, H., Jr. 2015. Maryland Spot (*Leiostomus xanthurus*) Compliance Report to the Atlantic States Marine Fisheries Commission – 2014. Maryland Department of Natural Resources Fisheries Service October, 2015.

<sup>13</sup> Peuser, R (editor). 1996. Estimates of finfish bycatch in the south Atlantic shrimp fishery. Final Report of the SEAMAP-South Atlantic Committee: Shrimp Bycatch Work Group. Washington DC: Atlantic States Marine Fisheries Commission.

<b>1991 Chesapeake Bay Program Atlantic Croaker and Spot Fishery Management Plan Implementation</b> (updated 07/16)			
<b>Problem Area</b>	<b>Action</b>	<b>Date</b>	<b>Comments</b>
<b>Stock Status</b> Annual abundance of Atlantic croaker and spot is highly variable from year-to-year. Little information is available on the causes of stock fluctuations.	Action 1.1 CBP jurisdictions will continue to participate in scientific and technical meetings for managing Atlantic croaker and spot along the Atlantic coast and in estuarine waters.	2005  2009  Continue	CBP jurisdictions will continue to monitor Atlantic croaker and spot stocks and cooperate with the ASMFC to manage stocks through inter-jurisdictional management measures. BRPs were adopted for the coastal croaker stock in 2005 and updated in 2010. Current estimates of F and SSB indicate that the croaker stock is healthy and overfishing is not occurring (ASMFC 2010). The status of the coastal spot stock is undeterminable. No stock assessment has been completed. The ASMFC Spot PRT has been monitoring stock status through reports to the South Atlantic Management Board. Annual spot and Atlantic croaker compliance reports to ASMFC are required. <b>A coast wide stock assessment for both species was initiated in 2015 and is scheduled for peer review in 2016.</b>
	Action 1.2.1 A) MD and the PRFC have a minimum size limit for Atlantic croaker. B) VA does not have a minimum size limit for Atlantic croaker.	Continue  1993	CBP jurisdictions will promote the increase in yield per recruit for the Atlantic Croaker and spot fisheries. MD and PRFC have a 9” minimum size limit and a 25 fish/person/day creel limit for croaker recreational fisheries. MD has an open commercial season from March 16 through December with a 9” minimum size limit. VA does not have any restrictions for Atlantic croaker.
	Action 1.2.2 CBP jurisdictions will evaluate the need to implement a minimum size limit for spot.	1992 2009  Continue	No recommendations have been made for spot. There is some concern over declining juvenile abundance. The ASMFC omnibus amendment, approved in 2011, did not require additional management criteria. With the adoption of addendums to the ASMFC amendments (August 2014), both croaker and spot are managed using the traffic light approach (see text for explanation).



**1991 Chesapeake Bay Program Atlantic Croaker and Spot Fishery Management Plan Implementation** (updated 07/16)

<b>Problem Area</b>	<b>Action</b>	<b>Date</b>	<b>Comments</b>
<b>Harvest of Small Croaker and Spot</b> Incidental bycatch and discard mortality of small croaker and spot in non-directed fisheries is substantial and has the potential to significantly impact croaker and spot stocks.	Action 2.1 A) Through the ASMFC, the jurisdictions will promote the development and use of trawl efficiency devices (TEDs) in the southern shrimp fishery and promote the use bycatch reduction devices (BRDs) in the finfish trawl fishery. B) Virginia will continue its prohibition on trawling in state waters. Virginia will maintain its 2 <sup>7</sup> / <sub>8</sub> inch minimum mesh size for gill nets C) Maryland will continue its 4-6 inch gill net restriction during June 15 through September 30 and implement a 3 inch minimum mesh size along the coast. D) PRFC will continue its prohibition on gill net fishing in the summer.	Continue  Continue  1992  Continue	Commercial trawling is prohibited within the Chesapeake Bay in both MD and VA. The 2004 Croaker Stock Assessment indicated that the coastal states were successful at reducing mortality on age 1 fish. The commercial & recreational catch-at-age data showed an increasing age distribution with a few croaker at age 12. The stock assessment analyses indicated that the shrimp bycatch estimates are important to consider in the calculations but there needs a more comprehensive evaluation. ASMFC encourages states to use bycatch reduction devices (BRDs). MD currently allows attended gill nets with a stretched mesh size of 3 1/8 to 3 1/2 inches from January 1 through March 15 and 2 1/2 to 3 1/2 inches between March 16 and December 31 in the Chesapeake Bay and tributaries, with location restrictions during striped bass spawning seasons. The minimum stretched gill net mesh size in MD waters is 2 1/2 inches. Virginia has a minimum gill net stretched mesh of 2 7/8".
	Action 2.1.2 CBP jurisdictions will investigate the magnitude of the bycatch problem and consider implementing bycatch restrictions for the non-directed fisheries in the Bay	1992  On-going	
<b>Research and Monitoring Needs</b> There is a lack of stock assessment data for both Atlantic croaker and spot stocks in the Chesapeake Bay.	Action 3.1 VMRC stock assessment program will continue to analyze size and sex data from Atlantic croaker and spot collected from the VA commercial fishery.	Continue	The amount of data available for croaker has increased since the 2003/2004 coastal stock assessment. The 2010 ASMFC coastal stock benchmark assessment concluded that the coastal Atlantic croaker population is a single stock. Addendum 1 to the ASMFC FMP changed the management unit to a single stock and modified the BRPs. Stock assessment data for Atlantic croaker and spot is collected by the MD Estuarine Juvenile Finfish Survey, and VIMS Juvenile Abundance Surveys (formerly known as the VIMS Trawl Survey and the VIMS Juvenile Seine Survey), NEAMAP and ChesMMAP. Both Maryland and Virginia collect age, length, weight and sex data from commercially harvested spot and croaker.

**1991 Chesapeake Bay Program Atlantic Croaker and Spot Fishery Management Plan Implementation** (updated 07/16)

Problem Area	Action	Date	Comments
	<p>Action 3.2                      A) MD and PRFC will encourage research to collect data on croaker and spot biology, especially estimates of population abundance, recruitment, and reproductive biology.                      B) VA will continue to fund its stock assessment research conducted by the conducted by VIMS and ODU, specifically designed to provide the estimates of population abundance, recruitment, and reproductive biology.</p>	<p>Continue  Continue</p>	<p>An Atlantic Croaker Ageing Workshop was held in October 2008 and resulted in a standardized ageing procedure. High priority research &amp; monitoring recommendations included: determining migratory patterns; collecting life history information; evaluating bycatch and discard practices; and examining reproductive strategies. Spot up to age 3 are regularly represented in the commercial fishery. Commercial catch-at-age data has contracted the last several years. Length-at-age and weight-at-age have decreased for ages 1-3. Spot age 4 to 6 years are not seen every year and when present, account for a small percentage of harvest. Recommendations for spot in the 2011 omnibus amendment include: monitoring data and gear studies on discards from the shrimp, recreational and commercial fisheries; expanding sampling; assessing BRDs; continuing development of fishery-dependent and fishery-independent size and sex specific relative abundance estimates; evaluating juvenile indices to predict year class strength; improving catch and effort statistics; and developing stock assessment analyses such as a yield-per-recruit analysis and determining the inshore vs offshore components of the fishery.</p> <p><b>Commercial pound net sampling in Maryland’s portion of the Chesapeake Bay was conducted from late May through early September, 2015. Atlantic croaker mean length from the onboard pound net survey was 265 mm total length in 2014, below the 23 year time series mean. Ages ranged from 1 to 7 years old, with age 3 fish accounting for the majority of the catch. Atlantic croaker over age 6 have become less abundant since the mid-2000s. Spot mean length from the onboard sampling decreased slightly in 2014 to 194 mm total length, where it remained in 2015, and was below the mean value of 204 mm for the 23 year time series. Atlantic croaker juvenile abundance from the Maryland Chesapeake Bay Blue Crab Trawl Survey was high in 2012 but declined through 2015 to the 2<sup>nd</sup> lowest value of the 27 year time series. The spot Chesapeake Bay juvenile trawl index declined from 2013 to 2015. The 2015 value was the lowest of the 27 year time series.</b></p>

**1991 Chesapeake Bay Program Atlantic Croaker and Spot Fishery Management Plan Implementation** (updated 07/16)

Problem Area	Action	Date	Comments
<p><b>Habitat and Water Quality Issues</b> Habitat alteration and water quality impact the distribution of finfish species in the Chesapeake Bay</p>	<p>Action 4.1 CBP jurisdictions will continue to set specific objectives for water quality goals and review management programs established under the 1987 Chesapeake Bay Agreement. The Agreement and documents developed pursuant to the Agreement call for: A) Developing habitat requirements and water quality goals for various finfish species. B) Developing and adopting basinwide nutrient reduction strategies. C) Developing and Adopting basinwide plans for the reduction and control of toxic substances. D) Developing and adopting basinwide management measures for conventional pollutants entering the Bay from point source and non-point sources. E) Quantifying the impacts and identifying the sources of atmospheric inputs on the Bay system. F) Developing management strategies to protect and restore wetlands and submerged aquatic vegetation (SAV). G) Managing population growth to minimize adverse impacts to the Bay environment</p>	<p>Continue 2000 on-going</p> <p>2014 On-going</p> <p>2016-2017</p>	<p>Water quality and living resource commitments were updated and renewed in the Chesapeake Bay 2000 Agreement. These activities include the discharge of toxic pollutants or excessive nutrients into the Chesapeake Bay and its tributaries, interruption or changes in water discharge patterns, deposition of solid waste, sewage sludge or industrial waste into the Bay (which may lead to anoxic conditions), rapid coastal development, unregulated agricultural practices, net coastal wetland loss or the dredging of contaminated sub-aqueous soils. Based on the most recent available data, scientists project that 58% of the pollution reduction efforts needed to achieve the Bay restoration goals have been implemented since 1985. Excess nitrogen, phosphorus and sediment are the major pollutants. The greatest challenge to achieving restoration is population growth and development which destroys forests, wetlands and other natural areas. Habitat and water quality objectives and actions were delineated in the President’s Executive Order and provide more current strategies for managing resources in the Chesapeake Bay. Estuaries are designated as Habitat Areas of Particular Concern (HAPC) for spot.</p> <p>The CBP developed a new Watershed Agreement in 2014 with outcomes and strategies that address sustainable fisheries, vital habitats, water quality, toxic contaminants, healthy watersheds, stewardship, land conservation, public access, environmental literacy and climate resiliency. For more information see: <a href="http://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignatures-Hires.pdf">http://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignatures-Hires.pdf</a></p> <p><b>Of particular interest for croaker and spot is the evaluation of forage in the Chesapeake Bay as part of the sustainable fisheries outcomes. A two-year work plan (2016-2017) was developed to address forage in the Bay and a STAC workshop was held in 2014. Both small spot and croaker were important forage for several of the key predator species.</b> For more details, go to the workshop report at <a href="http://www.chesapeake.org/pubs/346_Ihde2015.pdf">http://www.chesapeake.org/pubs/346_Ihde2015.pdf</a></p>

**Acronyms:**

ASMFC = Atlantic States Marine Fisheries Commission;  
BRPs = Biological Reference Points  
CHESFIMS = Chesapeake Bay Fishery Independent Multispecies Fisheries Survey  
ChesMMAP = Chesapeake Bay Multispecies Monitoring and Assessment Program;  
CBP = Chesapeake Bay Program  
FMP = Fishery Management Plan  
NMFS = National Marine Fisheries Service

ODU = Old Dominion University  
PRFC = Potomac River Fisheries Commission  
PRT = Plan Review Team  
SEAMAP = Southeast Area Monitoring and Assessment Program  
STAC = Scientific and Technical Advisory Committee  
TLA = Traffic Light Approach VIMS = Virginia Institute of Marine Science

## 2015 Maryland FMP Report (July 2016)

### Section 4. Atlantic Menhaden (*Brevoortia tyrannus*)

Management measures were implemented by the Atlantic States Marine Fisheries Commission (ASMFC) in 2013 in response to the 2012 stock assessment results that indicated the menhaden stock was overfished and overfishing was occurring.<sup>1</sup> Amendment 2 to the ASMFC Interstate FMP established a total allowable catch (TAC) and individual state quotas. The updated 2014 benchmark stock assessment concluded that the menhaden stock is not overfished and overfishing is not occurring.<sup>2</sup> As a result, ASMFC increased the TAC by 10% in 2016 and will consider increasing the TAC again in 2017 until a new amendment is completed and approved for management use (slated for 2018). A socioeconomic study is also being conducted in 2016 for the menhaden bait and reduction fisheries to better understand the economic impacts of management changes. Addendum 1 to Amendment 2 was released for public comment and, if adopted, will provide operational flexibility to Chesapeake Bay pound netters during the 2016 bycatch fishery. The ASMFC has also initiated the development of Amendment 3. The new amendment will focus on evaluating state allocations and will develop new reference points that take into account the ecological importance of menhaden.

#### ASMFC Fishery Management

A coastal Atlantic menhaden fishery management plan (FMP) was developed by the ASMFC in 1981. The plan was revised in 1992, replaced by Amendment 1 (2001: including 5 addenda; 2004, 2005, 2006, 2009 2011) and currently managed under Amendment 2 (2012). The coastal stock has been assessed several times since 1999. The update and revision in 2010 resulted in Addendum V to Amendment 1 (2011) with new biological reference points. The goal of Addendum V was to increase abundance, to increase spawning stock biomass, and to increase menhaden availability as forage. The 2011 threshold and target for biomass was based on a maximum spawning potential (MSP) of 15% and 30%, respectively. Amendment 2 was developed to reduce fishing mortality, to reduce the risk of recruitment failure, to reduce the impacts to other species that are dependent on menhaden as prey, and to minimize adverse effects on the fishery. ASMFC is developing Addendum I (draft for public comment approved in May, 2016) to allow two qualifying commercial fisherman utilizing stationary multispecies gear to harvest two bycatch limits from the same vessel on the same day. This provision was requested by MD DNR and PRFC to accommodate the standard working practices of Chesapeake Bay pound net fishermen. ASMFC continues to place a high priority on developing ecosystem based reference points to address the forage needs of predator species. Menhaden are important prey for many fish, bird and marine mammal species. A workshop on menhaden ecosystem management objectives was conducted by ASMFC in 2014, and another workshop on ecological reference points was conducted in 2015. The

outcome of these workshops will be used to guide the development of ecosystem-based reference points. The ASMFC initiated the development of Amendment 3 in May, 2015, with a projected completion date in 2019. Drafting of the public information document is scheduled to begin in mid- to late 2016 to reevaluate the state by state allocation and to complete a socioeconomic study of the Atlantic menhaden commercial fishery. This study began in March, 2016, with an objective to understand the impacts of potential regulation changes on the fishing industry.

There is no Chesapeake Bay fishery management plan (FMP) for Atlantic menhaden. Menhaden was one of the species slated for the development of an ecosystem based fishery management plan (EBFMP). Maryland Sea Grant facilitated the EBFM process and developed biological briefs on key ecosystem topics for menhaden in Chesapeake Bay. More information on the EBFM process and the completed menhaden briefs can be found at the following website: <http://www.mdsg.umd.edu/programs/policy/ebfm>.

#### Stock Status

Biological reference points (BRPs) were established in ASMFC Amendment 1 and updated in 2004. A benchmark assessment was conducted during 2009, peer reviewed, and released in 2010. The assessment included two new components: a factor for aging error and natural mortality rates that varied with age and time. The assessment was updated in 2012 with data from 2009 through 2011 and indicated that fishing mortality rates were above the overfishing reference point and overfishing was occurring.<sup>1</sup> Results of the 2012 update were inconclusive to determine if the stock was overfished. The 2010 BRPs were considered interim benchmarks until the 2014 coastal assessment was completed. The BRPs were intended to protect the spawning stock and to take into account the needs of top predators. Stock assessment workshops were conducted in 2014 and the assessment was peer reviewed by the Southeast Data, Assessment and Review (SEDAR) process.<sup>2</sup> The 2014 assessment addressed several issues from the previous assessments. The age at maturity was corrected and selectivity in the fishery was considered and resulted in a higher estimated proportion of age 1, 2, and 3 year old fish in the population. Most significantly, the new assessment used nine new fishery-independent indices rather than the single Chesapeake Bay pound net index that was used in the 2010 assessment. The 2014 benchmark assessment concluded that the Atlantic menhaden resource is not overfished. Total instantaneous fishing mortality was estimated at 0.27, well under the threshold of 2.98 and the target of 1.03. As a result, overfishing is not occurring. Details of the 2014 assessment can be found on the ASMFC webpage ([www.asmfc.org](http://www.asmfc.org)) under the Atlantic Menhaden fishery page.

Coastal recruitment indices have been generally low since the 1980s. In Maryland, juvenile menhaden are sampled annually through the Estuarine Juvenile Finfish Survey. The index of juvenile menhaden has been low since 1992 (Figure 1). The

development of new management actions and reduced harvest could contribute to higher recruitment but environmental conditions seem to be a major factor driving recruitment.

### **Management Measures**

The coastal overfishing designation in 2013 resulted in management measures to reduce harvest by 20% compared to the 2009 to 2011 average harvest. Based on the 2010 BRPs, a total allowable catch (TAC) of 170,800 MT (376,549,574 lbs.) was calculated for the Atlantic states for 2013. The coastal TAC was allocated state-by-state based on average state landings (2009-2011). Maryland's quota was 1.37% of the TAC or 2,320 MT (5,185,729 lbs.). Maryland's 2014 quota was 5,116,874 lbs. and the 2015 quota was set at 5,628,568 lbs. The Potomac River and Virginia portion of the TAC was 0.62% and 85.32%, respectively. The Virginia quota for 2014 was set at 318,066,790lbs. and 349,873,884 lbs. for 2015. Since Maryland did not have any regulations for menhaden other than a prohibition on purse seining, new regulations were required to implement the ASMFC management measures. Following the 2014 coastal stock assessment, ASMFC increased the TAC by 10% to 187,880 MT for 2015 and 2016 as an interim measure until new reference points and possible allocation changes are addressed in Amendment 3. The increased TAC is to be divided by the allocation set in Amendment 2.

The coastwide commercial menhaden fishery is composed of two different components: the reduction fishery (fish caught by purse seines and processed for fish oil/fish meal) and the bait fishery (fish for other commercial and recreational fisheries such as the blue crab fishery). Purse seining, the predominant gear type for harvesting menhaden, is not allowed in the Maryland portion of the Chesapeake Bay. However, menhaden are harvested from pound nets for the bait fishery. Virginia allows purse seining in the lower bay. Omega Protein has a menhaden reduction plant in Reedville, Virginia, which is the only active menhaden reduction factory on the Atlantic coast. ASMFC Addendum II to Amendment I (2006) established a harvest cap (109,020 MT) for the reduction fishery in Chesapeake Bay. With the adoption of ASMFC Amendment 2, there was a 20% reduction in the harvest cap based on average landings from 2001-2005. The new harvest cap for the Chesapeake Bay reduction fishery is 87,216 MT (192,278,382 lbs.).

### **The Fishery**

The 2015 Maryland open fishery was closed on August 30, 2015 at 12:01am, and landed 5,601,853 lbs.<sup>3</sup> The fishery was then capped at a 6,000 lb. per day bycatch limit for pound net fishermen who held bycatch landing permits and a 1,500 lb. per day limit for all other fisheries. The bycatch fishery landed an additional 1,949,577 lbs. for a total 2015 Maryland harvest of 7,551,430<sup>4</sup> lbs. (Figure 2). The bait fishery in Maryland is primarily a pound net fishery. This single gear type accounted for

90.3% of the 2015 total reported harvest. Virginia's total Atlantic menhaden harvest for 2014 was 326,592,125 lbs.<sup>5</sup> (Figure 3) and includes the reduction and bait fishery from both Chesapeake Bay and Atlantic Ocean. None of the Bay jurisdictions exceeded their open fishery quota since the quotas were enacted in 2013.

Biological monitoring from the Maryland pound net (bait) fishery indicated that the majority of harvested menhaden were age 1 through age 3 fish (97%). Menhaden ages 1 through 5 were present in the samples. Maryland DNR will continue to collect biological data on fish sampled from commercial pound nets.

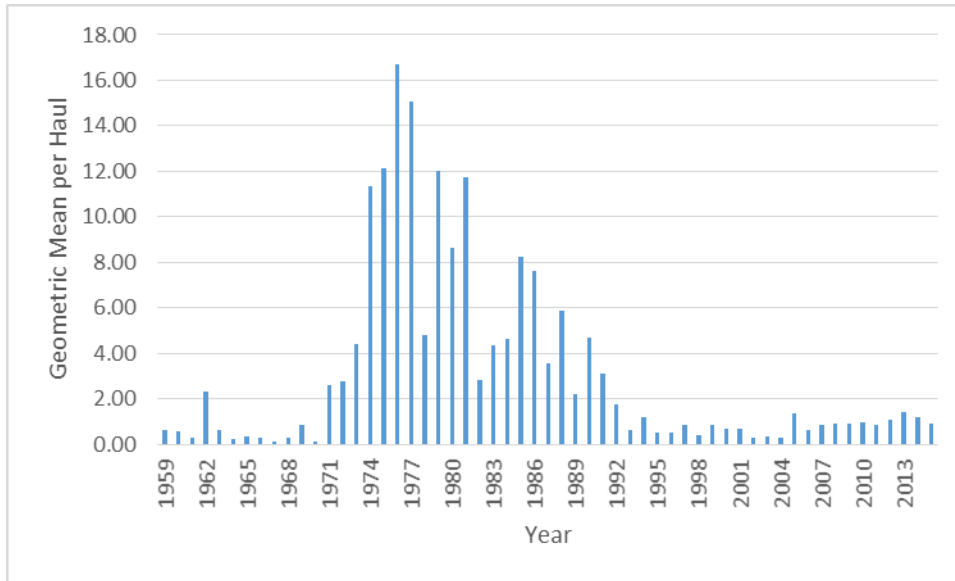
### **Issues/Concerns**

Significant changes in management were put in place in Maryland on June 29, 2013 to meet the state-specific quotas set forth by ASMFC compliance requirements. The commercial fishery continues to be managed under a coastal TAC with subsequent state quotas. All watermen harvesting menhaden from pound nets are required to obtain a bycatch permit and to report their catch on a daily basis. Once the fishery is closed a bycatch limit of 6,000 lbs. per day is allowed for permit holders. Non-permit holders are restricted to a 1,500 lb. bycatch limit.

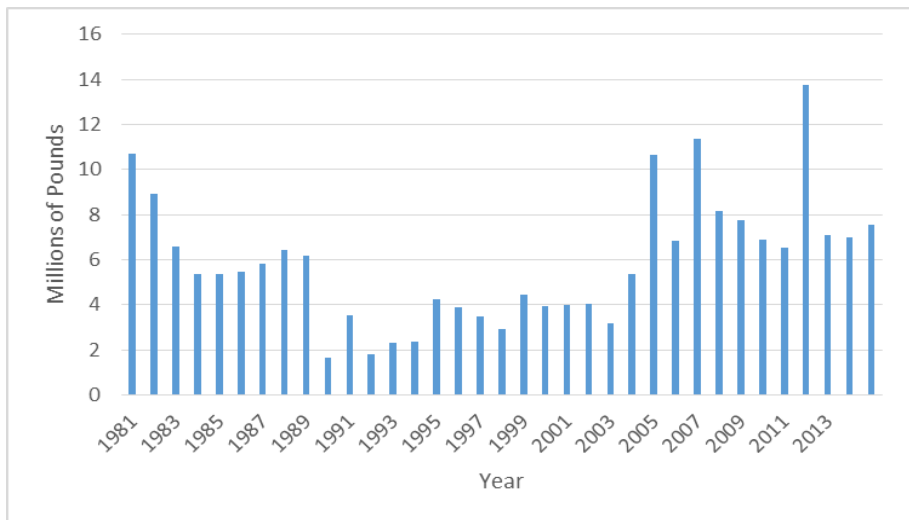
Menhaden have a unique role in the Chesapeake Bay ecosystem as both a primary filter-feeder and an important forage species for top predators (striped bass, bluefish, osprey, etc.). The development of ecosystem based biological reference points would be useful for managing the stock. Menhaden support a major commercial fishery and are the Bay's largest fishery by weight. Consequently, they are an economically important species.

Two ways to improve the menhaden stock assessments (and recommended by ASMFC) are the development of a coastwide fishery-independent survey to assess adult abundance at age and better estimates of natural mortality by age class.

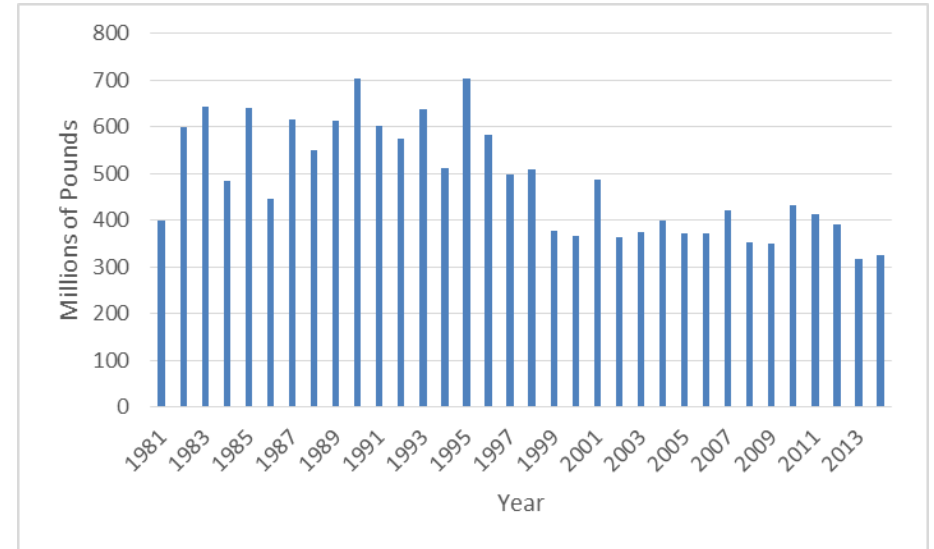
**Figure 1.** Geometric mean catch per haul of menhaden juveniles in the Maryland portion of the Chesapeake Bay, 1959-2015.<sup>6</sup>



**Figure 2.** Maryland Atlantic menhaden commercial landings, 1981-2015.



**Figure 3.** Virginia Atlantic menhaden commercial landings, 1981-2014.



**References**

<sup>1</sup>ASMFC 2012. 2012 Atlantic Menhaden Stock Assessment Update. A publication of the Atlantic States Marine Fisheries Commission. Arlington, VA. 213pp.

<sup>2</sup>SEDAR. 2015. SEDAR 40 - Atlantic Menhaden Stock Assessment Report. SEDAR, North Charleston SC, 643 pp. available online at: [http://www.sefsc.noaa.gov/sedar/Sedar\\_Workshops.jsp?WorkshopNum=40](http://www.sefsc.noaa.gov/sedar/Sedar_Workshops.jsp?WorkshopNum=40).

<sup>3</sup>Rickabaugh, H.W. 2016. Maryland Atlantic Menhaden (*Brevoortia tyrannus*) Compliance Report to the Atlantic State Marine Fisheries Commission – 2015

<sup>4</sup>From Maryland’s mandatory commercial reporting system. Personnel communication march 2016.

<sup>5</sup>Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division, November 12, 2015.

<sup>6</sup>Durell, E.Q., and Weedon, C. 2015. Striped Bass Seine Survey Juvenile Index Web Page. <http://dnr2.maryland.gov/fisheries/Pages/juvenile-index/index.aspx>. Maryland Department of Natural Resources, Fisheries Service.

## 2015 Maryland FMP Report (April 2016)

### Section 5. Black Drum (*Pogonias cromis*)

The first coastwide stock assessment of black drum was approved for management use in February, 2015. The assessment determined the stock was not overfished and overfishing was not occurring, therefore, no changes to the coastwide FMP were recommended by the Atlantic States Marine Fisheries Commission (ASMFC). Commercial and recreational harvests have been stable the past few years.

#### Chesapeake Bay FMP

The Chesapeake Bay Black Drum Fishery Management Plan (CBBDD FMP) was adopted in 1993 to address concerns about potential overfishing. The objectives of the plan include: 1) promoting coastwide coordination where possible; 2) promoting the protection of the resource through conservation goals and allocation; 3) maintaining the spawning stock to minimize recruitment failure; 4) promoting the collection of data; 5) promoting fair allocation; and 6) promoting water quality and habitat protection. Maryland's Fisheries Service conducted a review of the 1993 CBBDD FMP in 2010 and determined that the plan is still an appropriate framework for managing the black drum stock.

The Atlantic States Marine Fisheries Commission Interstate Fishery Management Plan for Black Drum<sup>2</sup> (June 2013) (ASMFC FMP) was initiated because of increased recreational and commercial harvest, inconsistent coastwide regulations, unknown condition of the stock and concerns about harvesting immature and breeding black drum. All states are required to maintain their current level of restrictions on the black drum fishery and establish a maximum possession limit (January 1, 2014) and a minimum size limit of 14 inches (January 1, 2016). The Chesapeake Bay jurisdictions have implemented a more conservative minimum size of 16" since the mid-1990s.

#### Stock Status

The first coastwide benchmark stock assessment for black drum was conducted in 2014 and approved for management use in 2015.<sup>1</sup> The 2015 benchmark stock assessment used a Depletion Based – Stock Reduction Analysis and determined that the stock is not overfished and not experiencing overfishing.<sup>1</sup> The assessment indicated biomass was slowly decreasing, but remained well above the level needed to sustain maximum sustainable yield. Tagging data, life history data and nuclear microsatellite markers indicate black drum along the US Atlantic coast are from a single stock. If there are no changes in harvest and fishing mortality, the next benchmark stock assessment is scheduled for 2020.

#### Current Management Measures

Maryland closed its Chesapeake Bay commercial black drum fishery in 1999, but retains a limited Atlantic coastal commercial fishery with a 1,500 pound annual limit. Virginia manages its commercial fishery through limited entry and a total allowable catch of 120,000 pounds. Both states have a 16 inch minimum size limit and require mandatory commercial harvest reporting. Virginia established a special management zone in the southeast portion of the Chesapeake Bay for black drum, further restricting some commercial gear. The Potomac River Fisheries Commission also has a 16" minimum size limit and allows commercial fishermen 1 black drum per licensee per day. The harvest of black drum is primarily a recreational fishery. Both states and the Potomac River limit recreational harvest to 1 fish over 16".

#### Issues/Concerns

There are occasional requests from the Maryland commercial fishery to consider re-opening the commercial harvest of black drum in Chesapeake Bay. In addition, the 16" minimum size limit does not protect all immature black drum. Females reach 100 % maturity at 6 years of age and a length of 28".

Delaware and New Jersey have discussed the development of a joint DE-NJ black drum FMP as well as an increase in the minimum size limit to 32", but the minimum size limit remains 16" with a creel limit of 3 in both states. There is concern that the fisheries along the coast target both juvenile and adult black drum, and that the coastal fisheries are expanding. The 2015 coastwide stock assessment indicated a declining trend in biomass, but the stock is not currently experiencing overfishing. Continuing to monitor the stock through periodic assessment updates is recommended to insure expanding fisheries do not negatively impact stock status.

#### The Fisheries

Virginia has a spring gill net fishery that targets adult black drum. The remaining commercial harvest is primarily the bycatch of fisheries targeting other species (Figure 1). Recreational anglers occasionally target black drum in the spring of the year and harvest is sporadic especially in Maryland (Figure 2).

Figure 1. Reported Chesapeake Bay commercial harvest of black drum in pounds from Maryland and Virginia, 1981 - 2014.<sup>3</sup> PRFC landings are divided between the states by NMFS based on the state in which the fish are sold.

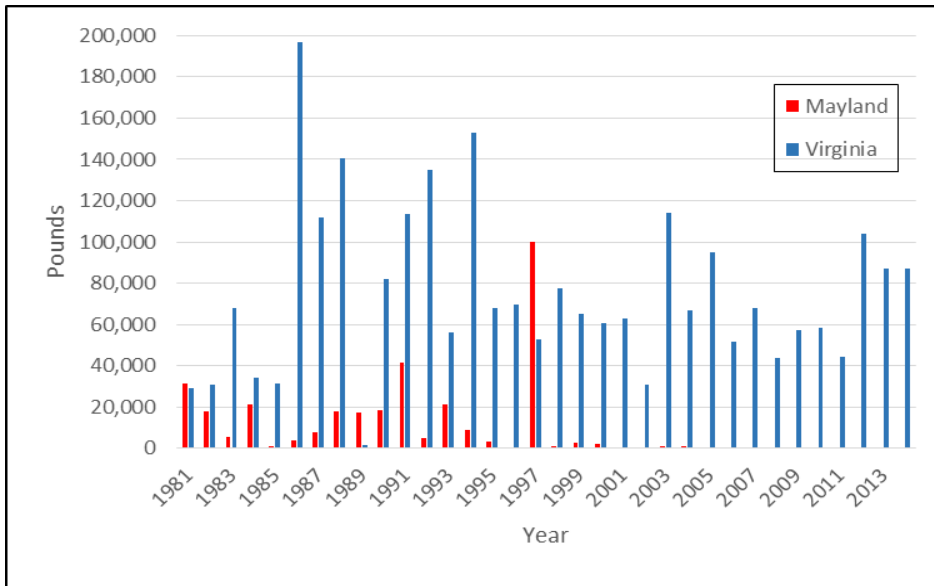
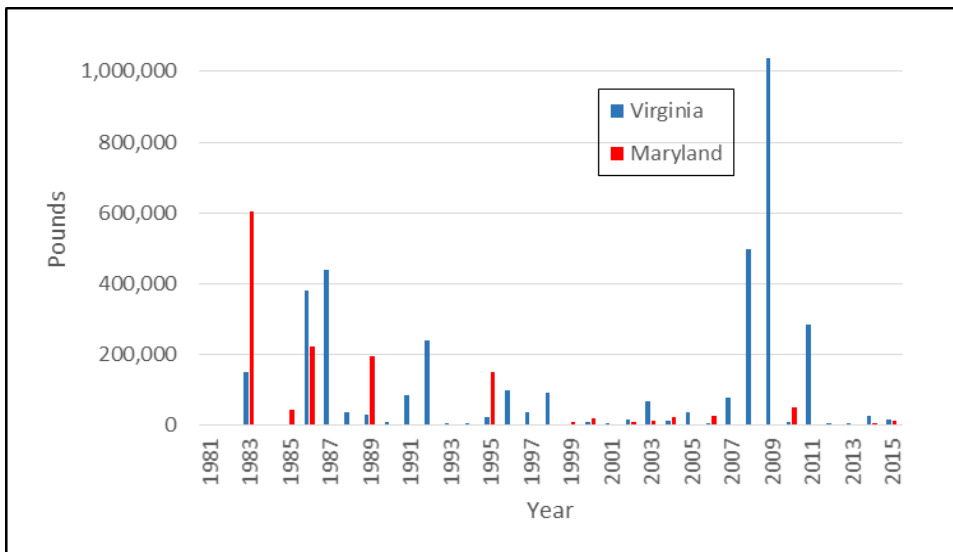


Figure 2. Recreational harvest estimate (MRIP) of black drum in pounds from inland waters for Maryland and Virginia, 1981 - 2015.<sup>4</sup> 2015 data is preliminary.



**References**

- <sup>1</sup> Atlantic States Marine Fisheries Commission, February 2015. Black Drum Stock Assessment and Peer Review Reports. Arlington, VA. 351pp.
- <sup>2</sup> Atlantic States Marine Fisheries Commission, June 2013. Interstate Fishery Management Plan for Black Drum. Arlington, VA. 72pp.
- <sup>3</sup> Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division. April 14, 2016. <http://www.st.nmfs.noaa.gov/st1/commercial/>.
- <sup>4</sup> Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division. April 14, 2016. <http://www.st.nmfs.noaa.gov/st1/recreational/index.html>.



**1993 Chesapeake Bay Program Black Drum Implementation** (updated 5/16)

<b>Problem Area</b>	<b>Action</b>	<b>Date</b>	<b>Comments</b>
1. Status of Stock	1. Virginia (VA) will continue tagging black drum to determine coastal movements of the Chesapeake Bay Stock, fund research to determine age, fecundity, and spawning periodicity, and sample the commercial and recreational catch to determine length, weight, and sex. Maryland (MD) will continue to support the Old Dominion University (ODU) drum tagging study	Continue Completed  2014	VA's tagging program is opportunistic and the ODU tagging study is complete. ODU has an ongoing otolith aging study for black drum. Forty-eight black drum were collected in 2007 with an average age of 33.8 years (range 0- 64 years). MD conducted an adult tagging program from commercial pound nets in 1998 and 1999. ASMFC conducted a peer reviewed coastwide stock assessment in 2014/2015. <sup>1</sup> The assessment determined black drum were not overfished and overfishing was not occurring. Priority research recommendations include increased age and length samples from commercial and recreational fisheries, better bycatch information including lengths of discarded fish, continued fishery independent surveys and the development of an adult fishery independent survey.
2. Fishing Mortality	2a VA will limit entry into the commercial black drum fishery & continue to require commercial black drum fisherman & buyer to obtain a permit and report weekly. VA will continue a 16-inch minimum size limit, 120,000 pound commercial quota, a 1 fish/person/day recreational creel limit, and continue monitoring commercial and recreational landings.	1992; 1994; Continue	Fully implemented. VA will emphasize the need for timely reporting.
	2b MD will adopt a 16 inch minimum size limit and a 1 fish/person/day recreational creel limit	1994 Continue	MD REG: COMAR 08.02.05.15 The minimum size limit (16") with a creel limit of 1 fish/person/day and a maximum of 6 fish/boat.
	2c Potomac River Fisheries Commission (PFRC) will consider similar size and bag limits once VA and MD regulations are established	1994 Continue	PFRC adopted a 16-inch minimum size limit and 1 fish/person/day creel limit for recreational and commercial fisheries
	2d MD and PFRC will assess the need for commercial black drum harvest restrictions as data becomes available	1994 Continue	MD- Beginning in 1998, the commercial catch of black drum from the coastal bays and tributaries, and the Chesapeake Bay and its tidal tributaries is prohibited except for scientific investigation. Total allowable landings from the Atlantic Ocean are 1,500 pounds.

**1993 Chesapeake Bay Program Black Drum Implementation** (updated 5/16)

<b>Problem Area</b>	<b>Action</b>	<b>Date</b>	<b>Comments</b>
3. Gear Conflicts	3. VA has established a Special Black Drum Management Zone, for “high use” areas such as the Cabbage Patch and Latimer Shoals. During May 1 through June 7, no gill net or trot line may be in established zone from 7:00 AM to 8:30 PM.	1992; Continue	Established to address commercial and recreational area and time conflicts.
4. Habitat Issues	4.1-7 Bay jurisdictions will continue to set water quality goals and review management programs under the 1987 Chesapeake Bay Agreement	Continue	The CBP completed a Chesapeake Bay Watershed Agreement in 2014, which set new goals and outcomes for restoration and protection of the Chesapeake Bay and its watershed. A copy of the 2014 agreement can be found on the CBP website at <a href="http://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement_withsignatures-Hires.pdf">http://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement_withsignatures-Hires.pdf</a> The Agreement has fish habitat, blue crab, oyster, SAV and water quality outcomes that when reached will enhance habitat and prey availability for juvenile and adult black drum.

**Acronyms**

ASMFC – Atlantic States Marine Fisheries Commission  
 COMAR – Code of Maryland Regulations  
 MRIP – Marine Recreational Information Program  
 ODU – Old Dominion University

## 2015 Maryland FMP Report (July 2016)

### Section 6. Black Sea Bass (*Centropristis striata*)

Recreational management of black sea bass is confused by a stock that is at a high abundance in the northern part of its range and at low abundance in the southern part of its range. At the same time, the scientific and statistical committee (SSC) that informs the Mid-Atlantic Fishery Management Council (MAFMC) on quotas has not recommended any management changes in response to an overall increase in abundance. The result has been restrictive recreational fishing measures in the northern states and dissatisfied head boat captains up and down the coast. There remains a controversy about how to effectively manage a data-poor species.

A species usually associated with structure, black sea bass favor complex habitats such as cold water corals in federal waters, oyster reefs in Chesapeake Bay, and natural hard bottom. The movements of black sea bass determined by tagging studies are more regional than coast-wide migrations. As a result, regional management has been implemented and the coastal management framework is evaluated on a yearly basis.

#### Chesapeake Bay FMP

The Chesapeake Bay and Atlantic Coast Black Sea Bass Fishery Management Plan (BSB FMP) was adopted in 1996. At that time, the black sea bass stock was overfished. The BSB FMP was developed to reduce fishing mortality particularly on juvenile black sea bass. The Chesapeake Bay and Coastal Bays provide nursery areas for juvenile black sea bass which utilize reef structures and submerged aquatic vegetation (SAV). Protecting these two habitats is part of the Chesapeake Bay Program's habitat goals.

Black sea bass were incorporated as one component of the Atlantic States Marine Fisheries Commission (ASMFC) and Mid-Atlantic Fishery Management Council (MAFMC) joint management framework for summer flounder and scup in 1996 with a Black Sea

Bass Fishery Management Plan (ASMFC/MAFMC BSB FMP). The ASMFC/MAFMC FMP implemented permit requirements for charter boats, commercial fishermen, and seafood dealers; specifications for fishing gear; and criteria to designate special management zones around artificial reefs. A progressive implementation schedule was instituted to increase minimum length, reduce landings, modify gear, and introduce a commercial quota system. Several addenda (ASMFC), frameworks (MAFMC), and amendments have been implemented to modify the overfishing mortality threshold and target exploitation rates and quota management.

Addenda IV (2001), VI (2002), XVI (2005) improved upon the timeliness of developing and implementing management requirements. Framework 1 (2001) established a research set-aside quota. The ASMFC/MAFMC Amendment 13 (2002, 2003) was developed to reduce fishing mortality, improve yield, align and minimize jurisdictional regulations; and revised the commercial quota system. Addendum XII (2004) instituted state-by-state quota shares for the commercial fishery; Maryland's share is 11%. Addendum XIII (2004) and Framework 5 (2004) established that a commercial quota can be specified for up to three years at a time. Addendum XIX (2007) continued state-by-state commercial quota management which began in 2003. Framework 7 (2007) improved the efficiency of implementing management actions as stock status changed. Amendment 16 (2007) standardized requirements for bycatch reporting. Addendum XX (2009) streamlined the procedures for commercial quota transfer among states. Addenda XXI (2011), XXIII (2013), and XXV (2014) provided flexibility for regional management measures. Addendum XXVII (February 2016) continues the use of adaptive regional management measures for the recreational fishery in 2016.

#### Stock Status

Black sea bass are protogynous hermaphrodites which means they begin life as a female but change sex to male. For black sea bass, this change typically occurs between ages 2 to 5 (9" to 13"). Protogyny increases the uncertainty associated with stock assessments.

Black sea bass from Cape Hatteras, North Carolina to the United States-Canadian border are managed as a single northern stock. The northern black sea bass stock is not overfished and overfishing is not occurring.<sup>1</sup> Revised biological reference points (BRP) presented in the Northeast Fisheries Science Center's 2012 stock assessment were rejected by the review committee due to model uncertainties.<sup>1</sup> The target fishing mortality (F) is 0.42, F threshold is  $F_{40\%} = 0.44$ , target spawning stock biomass (SSB) is 12,537 metric tons (27.6 million pounds), and threshold  $SSB_{40\%}$  is 10,886 metric tons (24.0 million pounds).<sup>2,3</sup> Current F is 0.21 and SSB is 24.6 million pounds.<sup>3</sup> Reference points and stock status should be viewed with caution.<sup>4</sup> A new stock assessment is scheduled for 2016 and the working group has already met to begin the process.

Maryland monitors black sea bass juvenile abundance using trawl and beach seine surveys in the Coastal Bays. In Maryland, the geometric mean catch per unit effort (CPUE) for juveniles has varied annually since the surveys were standardized in 1989. There is no CPUE trend for either the trawl or beach seine surveys. Maryland does not collect fishery-dependent black sea bass data.

### **Current Management Measures**

Coastwide, the commercial fishery is allocated 49% of the total allowable catch and the recreational sector is allocated the remaining 51%.<sup>3</sup> The 2016 and 2017 coastwide commercial quotas are 2.7 million pounds for each year.<sup>5</sup> Among the coastal states, Maryland receives 11% of the commercial quota. In a given fishing season excess quota in one state can be transferred to another state which has exceeded its quota.

The Maryland commercial black sea bass fishery is managed through limited entry. A permit transfer from a licensed fisherman is required to enter the fishery and individual fishing quotas are assigned to each black sea bass permit holder. Quota reserved for permit holders who do not enter the fishery is reallocated among declared permit holders.

However, an individual is not allowed to have >20% of the quota. Overages are deducted from the following year's quota allocation. Quota is allocated among four commercial sectors: 87% pots, 11% trawl, 1% hook and line, and 1% for all other fishing gear. Licensed commercial fishermen without a commercial black sea bass permit card are limited to landing 50 lbs. per day. The commercial fishery has an 11" minimum size limit.<sup>7</sup>

Maryland's recreational fishery (including federal waters) in 2015 was managed with a 12½" minimum size, 15 fish per person per day creel, and was open May 15 – September 21 and October 22 – December 31.<sup>7,8</sup> In Maryland, almost all of the recreational black sea bass fishery occurs in federal waters.<sup>9</sup> A recreational quota is not allocated among the states but a coastwide total allowable landings (TAL) is determined. Since 2012, states have worked together to establish regional regulations to comply with ASMFC requirements (conservation equivalency). There are no changes in recreational fishing measures for 2016.

### **The Fisheries**

Maryland's 2015 commercial quota was 239,000 pounds<sup>11</sup> with a reported harvest of 230,018 pounds (Figure 1). Maryland's quota for 2016 is 298,289 pounds.

States do not get individual recreational quotas. The north and mid-Atlantic recreational harvest limit for 2013 and 2014 was 2.26 million pounds. For 2016 and 2017, the coastal recreational quota was increased to 2.82 million pounds. Maryland's recreational harvest estimate was 87,000 pounds (68,500 fish) in 2014 and 78,000 pounds (57,600 fish) in 2015 (Figure 2).<sup>12</sup> Limits for 2017 may be adjusted as necessary based on additional data from previous years and recommendations from the next stock assessment scheduled in 2016.

## Issues/Concerns

The 2012 black sea bass stock assessment peer review rejected the use of an age-based assessment model due to the limited amount of age data for the assessment. The ASMFC convened an ageing workshop for northern stock black sea bass in 2013 to establish standardized methodology to determine ages from otoliths and scales.<sup>13</sup> Standardization of methods was hoped to increase the number of data sets that could be incorporated into the assessment models. However, age in black sea bass is extremely variable. The nature of the tail and the propensity to break off the filament confound management based on age at length.

Tagging results indicate that black sea bass migration is limited to regional areas. Addenda XXI, XXII, XXIII, XXV and now XXVII have been implemented to facilitate regional management including regional management. This management framework is being proposed on an annual basis.

The scientific and statistical committee (SSC) from the Mid-Atlantic Fishery Management Council (MAFMC) continues to use a cautionary approach to setting harvest quotas because they consider the stock assessment data poor. This has led to restrictive recreational management measures especially in the northern states where there has been an increase in abundance. Since data for the species is lacking, the SSC has maintained a conservative approach and has not changed the quota. There remain many questions about how to effectively manage a data poor species.

Figure 1. Black sea bass harvested by the commercial fishery in Maryland: 1990 – 2015.<sup>12</sup>

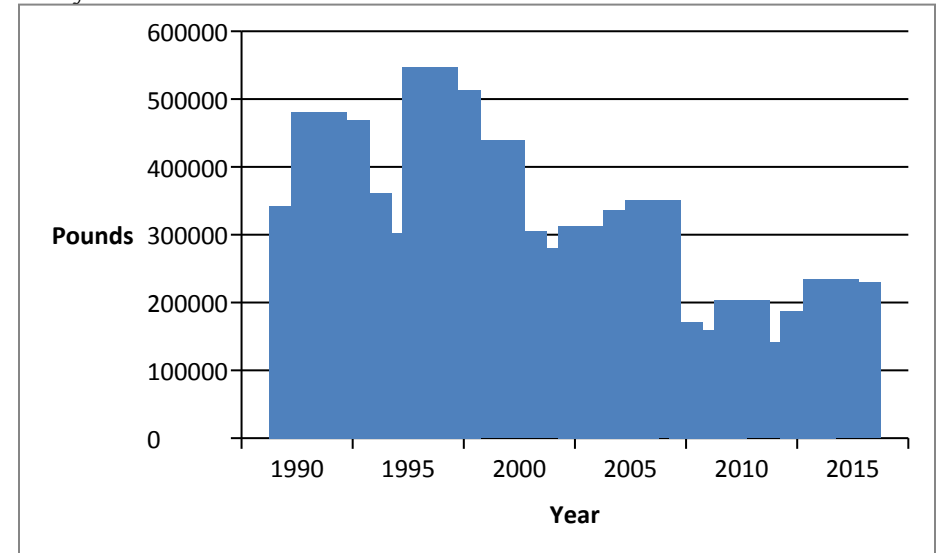
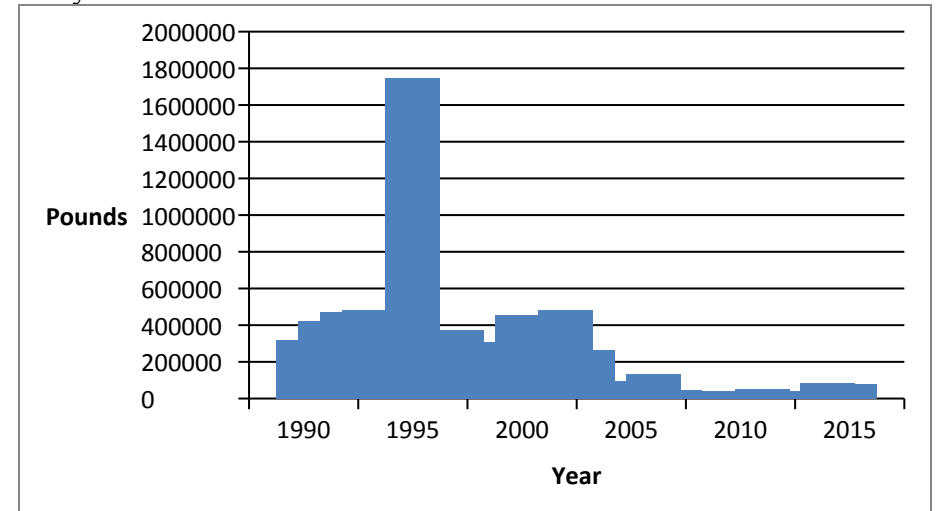


Figure 2. Estimated recreational harvest of black sea bass from Maryland: 1990-2015.<sup>10</sup>



## References

- <sup>1</sup> Northeast Fisheries Science Center. 2012. 53rd northeast regional stock assessment workshop (53rd SAW) assessment report. US Dept. Commerce, Northeast Fisheries Science Center Ref Doc. 12-05; 559 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026
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- <sup>3</sup> Atlantic States Marine Fisheries Commission. 2013. 2013 review of the Atlantic States Marine Fisheries Commission fishery management plan for the 2012 black sea bass fishery: Black sea bass (*Centropristis striata*). Atlantic States Marine Fisheries Commission, Alexandria, VA.
- <sup>4</sup> Shepherd GR. 2009. Black sea bass 2009 stock assessment update. US Dept. Commer, Northeast Fish Sci Cent Ref Doc. 09-16; 30 p.
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<http://www.gpo.gov/fdsys/pkg/FR-2014-07-07/pdf/2014-15799.pdf>
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[http://www.nero.noaa.gov/ro/fso/reports/reports\\_frame.htm](http://www.nero.noaa.gov/ro/fso/reports/reports_frame.htm).
- <sup>11</sup> Federal Register / Vol. 79, No. 99 / Thursday, May, 22, 2014 / Rules and Regulations.
- <sup>12</sup> Personal communication from the National Marine Fisheries Service, Fisheries Statistics. Accessed on August 18, 2016. Division.  
<http://www.st.nmfs.noaa.gov/st1/commercial/>.
- <sup>13</sup> Atlantic States Marine Fisheries Commission. 2013. Proceedings of the 2013 black sea bass ageing workshop. Atlantic States Marine Fisheries Commission. Alexandria, VA.

<b>1996 Chesapeake Bay and Atlantic Coast Black Sea Bass Fishery Management Plan Implementation Table (updated 7/2016)</b>			
<b>Strategy</b>	<b>Action</b>	<b>Date</b>	<b>Comments</b>
1.1) Reduce fishing mortality, increase YPR and provide more escape opportunities for small BSB to the spawning stock. A maximum spawning potential level of 22-30% should be achieved.	1.1a) The Bay jurisdictions will implement a 9" minimum size limit for commercial and recreational BSB fisheries in year 1 (1996) and year 2 (1997) of the plan. Beginning in year 3 (1998), the minimum size will be determined by MAFMC on an annual basis. Regulations will be written so that they are applicable to all fish landed in a state, whether caught in state or federal waters.	1996	BSB have exceeded the survey index since 2003 and are not considered overexploited. The minimum size limit for the commercial fishery was 11 inches and for the recreational fishery was 11.5 inches with a 25 fish/day /person creel limit.  In MD, individual commercial BSB quota and limit are identified on a BSB permit card. Non permitted individuals are limited to landing ≤50 lbs. MD & VA with an 11" minimum size limit for the commercial fishery.  MD recreational minimum BSB size limit increased to 12.5" with a creel limit of 25/person/day  VA recreational minimum BSB size limit increased to 12.5" with a creel limit of 25/person/day.  MD & VA reduced their recreational creel to 15 fish/person/day and maintained the 12.5" size limit.
		1997	
		Continue	
		2003	
		2004	
	1.1b) Based on the MAFMC Monitoring Committee's evaluation of the success of the FMP relative to the overfishing reduction goal, additional restrictions such as seasonal closures, creel limits, quotas, and limited entry, may be established.	Continue	Amendment 13 of the MAFMC and ASMFC's Summer Flounder, Scup and BSB FMP changed the management of the commercial fishery from coastal quarterly quotas to state by state allocations.  MD is allotted 11% of coastwide landings and VA is allotted 20%. The BSB fishery is open year round in MD & VA until quota is met.  MD & VA implemented recreational closures from January 1 to May 21 and October 12 to October 31. Closure was revised to January 1-May 18 and September 19-October 17. Closure adjusted to January
		2000	
		2002	
		2003	
		2010 2013	

		2015-2016	1 to May 14 and September 22 to October 21.
		2010	Stock was assessed in 2010.
		2012	The black sea bass coastal stock is not overfished and overfishing is not occurring based on 2012 revised BRPs.
1.2) Management agencies will require the use of escape panels, trawl efficiency devices, selective mesh sizes, culling devices and/or other methods to promote gear efficiency and reduce bycatch.	1.2a) VA, MD, and PRFC will investigate the potential for innovative devices designed to reduce the bycatch of juvenile finfish in non-selective fisheries. Continued testing of these bycatch reduction devices will be encouraged.	2000 Continue	PRFC tested plastic escape panels for pound nets. The device can provide escapement provide escapement for up to 80% of undersized fish.
	1.2b) VA and MD will work with MAFMC/ASMFC to develop and require the use of more efficient gear consistent with policies designed to reduce bycatch and/or discards.	As specified	No specific gear alterations have been recommended.
	1.2c) VA and MD will implement a mesh size of 4.0 inch diamond mesh for trawl vessels harvesting more than 100 pounds of BSB per trip. Changes in minimum mesh size will be implemented based on MAFMC/ASMFC recommendations. VA will continue its ban on trawling in state waters. PRFC will continue its ban on Potomac River.	1996	Mesh size requirements for the commercial fishery are appropriate for the minimum size requirements.
		1980 1981 1992 2004 On-going	MD COMAR 08.02.05.21: Minimum mesh: larger nets are required to possess a minimum of 75 meshes of 4 ½” diamond mesh in the cod-end or the entire net must have a minimum mesh size of 4 ½” throughout; smaller nets must have 4.5" mesh or larger throughout. Maximum roller rig trawl roller diameter ≤ 18”
Continue		Chesapeake Bay Program (CBP) jurisdictions are in compliance with vent requirements in pots and traps.	
1.2 d) VA and MD will require escape vents in BSB pots, based on the recommendations of MAFMC/ASMFC. The minimum size requirements will be considered after the MAFMC completes its study on escape vents.	1996	MD COMAR: Unobstructed escape vent in holding chamber of at least 2 ½” diameter, if circular, or 2 ½” stretched mesh size if square.  4VAC20-950-40: Two escape vents of 2 ½” circular	



		1996	dimension, 2" square dimension, or 1 3/8" by 5 3/4" rectangular dimension.
		1996	MD & VA require hinges or fasteners on one side panel or door made of the following materials: a) Untreated hemp, jute, or cotton string of 3/16" or less diameter; b) Magnesium alloy, timed float releases (pop-up devices), or similar magnesium alloy fasteners; or c) ungalvanized or uncoated iron wire of 0.094" or less in diameter.
	1.2e) The jurisdictions will define a BSB pot for enforcement requirements as recommended by the MAFMC.	2002	Was not defined because CBP jurisdictional commercial fishermen use lobster pots and fish traps to catch both lobster and black sea bass.
		2008	MD COMAR 08.02.05.02: (9) "Fish pot" means a single, finfish entrapment net device, without associated wings or leads, consisting of: (a) An enclosure of various shapes covered with wire, fabric, or nylon mesh webbing of not less than 1 1/2" stretched mesh size; (b) One or more conical entrance funnels; (c) One or more unobstructed escape vents, in the holding chamber, of at least 2 1/2" in diameter, if circular, or 2 1/2" stretched mesh size if square.  VA does not have a fish pot definition.
	1.2f) VA and MD will require that BSB pots and traps have biodegradable hinges and fasteners on one panel or door.	1996 Completed 2002	MD & VA require hinges or fasteners on one side panel or door made of the following materials: a) Untreated hemp, jute, or cotton string of 3/16" or less diameter; b) Magnesium alloy, timed float releases (pop-up devices), or similar magnesium alloy fasteners; or c) ungalvanized or uncoated iron wire of 0.094" or less in diameter. Pots and traps having wooden slats will remove one set of parlor slats so it is 1 1/8" apart.
2.1) VA and MD will work with	2.1a) Research on effects of hermaphroditism	Continue	Although the stock has been rebuilt, management

the Institute of Marine Science, Old Dominion, and University of Maryland to promote research concerning the effects of sex-reversal. The stock assessment departments of VMRC, MDNR, and PRFC will continue to collect information on size composition in commercial catches as part of a coastwide effort to monitor the effects of minimum sizes on BSB stocks.	on yield, spawning stock and other parameters will be encouraged. VMRC's stock assessment department, in cooperation with VIMS, will attempt to determine the appropriate size at which sex reversal takes place for BSB in this region.	2009	measures have been kept conservative because of unknown population dynamics due to hermaphroditism.  Increased uncertainty in the stock assessment model was incorporated because black sea bass are protogynous hermaphrodites.
	2.1b) VA will continue its annual VIMS Trawl Survey, of estuarine finfish species and crabs found in VA Bay waters, to measure size, age, sex, distribution, abundance, and catch-per-unit-effort (CPUE).	1997 2002 Continue	BSB were sporadically caught during the 2002-2006 trawl surveys. The majority of BSB abundance and biomass exist in Virginia waters of the Chesapeake Bay. Typically, BSB are first observed during the summer and peak during the fall portions of the survey. BSB may be observed during spring trawls.
2.2) The jurisdictions will promote research to define movements and mortality of BSB between state and federal waters.	2.2a) VMRC's Stock Assessment Program will continue to collect biological data (age, size, sex) from commercial catches of BSB.	Continue	Biological data is used for the coastal stock assessment.
	2.2b) Research on migration of BSB between inshore and offshore areas will be encouraged. Tagging experiments to provide data on BSB migration may be funded from sales of VA saltwater fishing licenses.	Continue	In VA, black sea bass is 1 of 10 species currently being tagged in the Virginia Volunteer Angler Gamefish Tagging Program.
	2.2c) PRFC will collect information on BSB harvested and discarded in the Potomac River pound net fishery as part of a two year pound net study funded by the Atlantic Coastal Fisheries Cooperative Management Act (ACFCMA).	Continue	PRFC continues to collect BSB harvest data.
2.3) MD, VA and PRFC will continue to support interjurisdictional efforts to maintain a comprehensive database on a baywide scale.	2.3a) The jurisdictions will collect information on commercial landings.	2008	MD does not have a fishery-dependent monitoring program. Data is occasionally collected from the recreational for-hire fishery. Northeast Data Poor Stocks Working Group determined that BSB are undergoing overfishing, but the stock is not overfished.  ASMFC Technical Committee declared stock rebuilt.

		2010	Revised BRPs are $F_{40\%} = 0.42$ and $SSB_{40\%} = 27.6$ million pounds. Overfished threshold is $SSB_{\text{threshold}} = 24.0$ million pounds.
		2015	Maryland commercial landings were 230,018 lbs. in 2015.
	2.3b) VA will continue to supplement MRFSS data with more detailed catch statistics at the state level.	1996-1997 2012	MRFSS is used to collect recreational catch data. MRFSS replaced with the MRIP survey.
		2015	Maryland recreational estimate was 78,000 lbs. (57,600 fish) for 2015.
	2.3c) MD will require mandatory reporting for all black sea bass landed in Maryland, wherever harvested.	Continue	Data is included in commercial fishery statistics.
3.1a) Restoration of aquatic reefs would lead to increased habitat for black sea bass. Jurisdictions will continue to expand and improve their current oyster restoration programs with periodic program evaluations to ensure maximum success. Specific attention should be focused on aquatic reefs in the salinity range of the black sea bass.	3.1aA) MD and VA will continue implementation of the 1994 Oyster FMP which combines the recommendations of both the VA Holton Plan and the MD Roundtable Action Plan.	Continue	CBP jurisdictions developed a 2004 Oyster Management Plan (2005) which combines the FMP and habitat objectives. It includes reef development using reclaimed and fresh oyster shell, oyster repletion and oyster sanctuary and harvest reserve areas. Maryland is currently managing oyster restoration under the Maryland 10-point Action Plan.
		2008	<i>Crassostrea virginica</i> (native oyster) and not <i>Crassostrea ariakensis</i> (Asian oyster) will be used for reef development following the Environmental Impact Statement for Oyster Restoration in Chesapeake Bay Including the Use of a Native and/or Nonnative Oyster.
		2010	Maryland is implementing a 10-point Oyster Restoration and Aquaculture Development Plan. The plan increases the network of oyster sanctuaries from 9% of available habitat to 25%. The priority targeted restoration areas are Harris Creek, Tred Avon and Little Choptank.

		<b>2015</b>	<b>The management of oyster sanctuary areas is under review and a final report is scheduled for completion in July 2016.</b>
	3.1aB) MD and VA will continue the implementation of the Aquatic Reef Habitat Plan.	Continued 2007	Artificial Reef Committee, Maryland Artificial Reef Initiative, and Maryland's Artificial Reef Management Plan were developed and several reefs have been created in Bay and the Atlantic Ocean.
		Continue	Reefs are qualitatively monitored with underwater video.
		2010 On-going	ARC and MARI have begun support for shallow water (<20 ft.) reef projects. For a complete list of reef sites go to <a href="http://dnr2.maryland.gov/fisheries/Pages/reefs/index.aspx">http://dnr2.maryland.gov/fisheries/Pages/reefs/index.aspx</a>
3.1b) The creation of new artificial reefs and the expansion and improvement of preexisting reefs will provide additional habitat for the BSB population.	3.1bA) Jurisdictions will continue to maintain, expand, and improve their artificial reef programs.	Continuing	In VA, artificial reefs are being funded through Recreational Advisory Board. All artificial reefs created by funds from recreational license revenues adhere to the gear type prohibition.
		1996-2006	MD terminated its program in 1996. Artificial reef development was administered in the Chesapeake Bay by MD Environmental Service and in the Atlantic Ocean by the Ocean City Reef Foundation (OCRF).
		2007	MD Artificial Reef Committee and the MD Artificial Reef Initiative (MARI) were established to develop reefs in cooperation with OCRF. Both MARI and OCRF accept private donations while MD contributes funds when available for reef development projects.
		2008	44 NY subway cars were deployed off Ocean City. USN Destroyer <i>Radford</i> is being prepared for reefing.

		Continue	Ship continues to be tested for contaminants. Additional funding is required. Permits are pending. OCRC continues to deploy small steel hulled vessels and concrete material for reef development.
		2011	USN Destroyer <i>Radford</i> was reefered on August 10, 2011. The vessel has since broken into 3 pieces but remains upright.
	3.1bB) VA recently prohibited use of all gear except recreational rod and reel, hand-line, spear, or gig on four artificial reefs in state waters.	Continuing 1998	MD and VA adopted legislation that prohibits hydraulic clamming (and crab dredging in VA) in or near SAV beds.
3.2) Jurisdictions will continue efforts to “achieve a net gain in submerged aquatic vegetation distribution, abundance, and species diversity in the Chesapeake Bay and its tributaries over current populations	<p>3.2a) Protect existing SAV beds from further losses due to degradation of water quality, physical damage to plants, or disruption to the local sedimentary environment as recommended by Chesapeake Bay SAV Policy Implementation Plan.</p> <ul style="list-style-type: none"> <li>• Protect SAV and potential SAV habitat from physical disruption. Implement a tiered approach to SAV protection, giving highest priority to protecting Tier I and II areas but also protecting Tier III areas from physical disruption.</li> <li>• Avoid dredging, filling or construction activities that create turbidity sufficient to impact nearby SAV beds during the SAV growing season.</li> <li>• Establish an appropriate undisturbed buffer around SAV beds to minimize the direct and indirect impacts on SAV from activities that significantly increase turbidity.</li> <li>• Preserve natural shorelines. Stabilize</li> </ul>	Continue	<p>MD implemented a living shorelines program in 1970 to encourage vegetative shoreline stabilization.</p> <p>Regulations are in place to prohibit dredging through SAV beds. Tiered designation and prioritization of SAV beds has not been implemented.</p> <p>Avoidance of dredging, filling and construction impacts to SAV is strictly enforced by MDE and USACE with input from DNR, USFWS, and NMFS.</p> <p>MD has not established undisturbed buffers. VA has established buffer criteria.</p> <p>The revised SAV goal adopted by Chesapeake Bay Program is restoration of 185,000 acres of SAV by 2010 and planting 1,000 acres of SAV by 2008. Only 15% of restoration target was met by 2008. There’s been very little long-term survival from SAV plantings.</p> <p>STAC reviewed the SAV restoration projects during 2011 and concluded that the projects were operationally successful but functionally unsuccessful.</p>
		2003	
		2011	

	<p>shorelines, when needed, with marsh plantings as a first alternative. Use structures that cause the smallest increase in local wave energy where planting vegetation is not feasible.</p> <ul style="list-style-type: none"> <li>Educate the public about the potential negative effects of recreational and commercial boating on SAV and how to avoid or reduce them.</li> </ul>	<p>2014</p> <p>2008</p>	<p>The restoration planting goal was revised to 20 acres per year.</p> <p>A new Chesapeake Watershed Agreement was adopted (June 2014) to achieve the ultimate goal of 185,000 acres of SAV baywide with a target of 90,000 acres by 2017 and 130,000 acres by 2025.</p> <p>MD legislated that shoreline stabilization projects must use living shoreline techniques unless demonstrated to be infeasible.</p>
	<p>3.2b) Set and achieve regional water and habitat quality objectives that will result in restoration of SAV through natural revegetation as recommended by the Chesapeake Bay SAV Policy Implementation Plan.</p>	<p>Continuing</p>	<p>Water quality criteria have been adopted <a href="http://www.chesapeakebay.net/issues/issue/nutrients">http://www.chesapeakebay.net/issues/issue/nutrients</a>.</p>
	<p>3.2c) Set regional SAV restoration goals in terms of acreage, abundance, and species diversity considering historical distribution records and estimates of potential habitat as recommended by the Chesapeake Bay SAV Policy Implementation Plan.</p>	<p>2003</p> <p>2011</p> <p>On-going</p> <p>2014</p> <p>2015</p>	<p>Bay wide SAV restoration goal was 1,000 acres planted by 2008. In 2012, the restoration planting goal was revised to 20 acres per year. Little progress has been made since 2010 and a SAV restoration goal was not included in the new Chesapeake Watershed Agreement. One acre was planted in 2013. Tracking of this indicator was discontinued in 2014 with a programmatic focus on restoring water clarity and protecting existing Bay grass beds.</p> <p>SAV covered 59,927 acres in 2013. SAV increased 27% to 75,835 acres in 2014. This increase is attributed to a rapid expansion of widgeongrass and a modest recovery of eelgrass.</p> <p>Between 2014 and 2015, SAVs increased by 21% for a total of 91,621 acres. This marks 3 years of consecutive growth. See Chesapeake Bay Program website for</p>

			updates on SAV restoration. <a href="http://www.chesapeakebay.net/issues/issue/bay_grasses">http://www.chesapeakebay.net/issues/issue/bay_grasses</a>
3.3) Establish a goal of no net loss of wetlands and a long term goal of a net resource gain for tidal and nontidal wetlands as recommended in the Chesapeake Bay Wetlands Policy.	3.3) Jurisdictions should strive towards achieving the following, especially in the salinity range of BSB. <ul style="list-style-type: none"> <li>• Define the resource through inventory and mapping activities.</li> <li>• Protect existing wetlands.</li> <li>• Rehabilitation, restoring and creating wetlands.</li> <li>• Improving education.</li> <li>• Further research.</li> </ul>	Continuing  2006 Continuing   2006 Continue  2009 Continue  2012   2014	Programs have been expanded to the tributaries.  GIS mapping activities are underway to target protection and restoration efforts habitat resources, but habitats are not targeted for a single, specific species' benefit. MD developed a Blue Infrastructure that includes mapping of BSB habitats such as structural habitat and SAV.  MD developed a Blue Infrastructure that includes mapping structural habitat and SAV.  Wetland mosquito ditches from the 1930s-1940s are being plugged to reduce tidal flow and restore wetland hydrology and function. Wetland enhancement and restoration is tracked cumulatively among tidal and non-tidal wetlands and salinity regimes. Between 2010 and 2012, wetland acres established or re-established in MD = 1,646 and in VA = 16,853. Wetland acres enhanced or rehabilitated from 2010-2012 in Chesapeake Bay watershed was 5,503.  See Chesapeake Bay Program website for updates on wetland rehabilitation and restoration. <a href="http://www.chesapeakebay.net/indicators/indicator/tidal_wetlands_abundance">http://www.chesapeakebay.net/indicators/indicator/tidal_wetlands_abundance</a>  <a href="http://www.chesapeakebay.net/indicators/indicator/restoring_wetlands">http://www.chesapeakebay.net/indicators/indicator/restoring_wetlands</a>
3.4) Jurisdictions will continue efforts to improve baywide water quality through the efforts of	3.4a) Based on the 1992 baywide nutrient reduction plan reevaluation, the jurisdictions will:	Continue	Maps that indicate regions of concerns for living resources have been developed.

<p>programs established under the 1987 Chesapeake Bay Agreement. In addition, the jurisdictions will implement new strategies, based on recent program reevaluations, to strengthen deficient areas.</p>	<ul style="list-style-type: none"> <li>• Expand program efforts to include tributaries.</li> <li>• Intensify efforts to control nonpoint sources of pollution from agriculture and developed area.</li> <li>• Improve on current point and nonpoint source control technologies.</li> </ul>	<p>2009</p> <p>2012/2014</p>	<p>President Obama executive order recommitting federal agencies to Bay restoration and regulatory enforcement.</p> <p>The Chesapeake Bay Program and Chesapeake Bay jurisdictions signed a new Watershed Agreement with 2 year milestones for nutrient reduction and water quality improvement. See Chesapeake Bay Program website for updates on nutrient reduction.  <a href="http://www.chesapeakebay.net/track/restoration">http://www.chesapeakebay.net/track/restoration</a></p>
	<p>3.4b) Based on the 1994 Chesapeake Bay Toxics Reduction Strategy Reevaluation Report, the jurisdictions will emphasize the following four areas:</p> <ul style="list-style-type: none"> <li>• Pollution Prevention: Target “Regions of Concern” and “Areas of Emphasis.</li> <li>• Regulatory Program Implementation: Insure that revised strategies are consistent with and supplement pre-existing regulatory mandates.</li> <li>• Regional focus: Identify and classify regions according to the level of contaminants.</li> <li>• Directed Toxics Assessment: Identify areas of low level contamination, improve tracking and control of non-point sources.</li> </ul>	<p>Continue</p>	<p>See Chesapeake Bay Program website for updates on nutrient reduction.  <a href="http://www.chesapeakebay.net/track/health/factors">http://www.chesapeakebay.net/track/health/factors</a></p> <p>Chesapeake Bay Program is monitoring levels of mercury, PCBs, PAHs, organophosphate and organochloride pesticides.</p>
	<p>3.4c) The jurisdictions will continue to develop, implement and monitor their tributary strategies to improve bay water quality.</p>	<p>Continuing</p> <p>2010</p> <p>2013</p>	<p>Ambient water quality criteria of DO, water clarity, and chlorophyll-a have been adopted for the Chesapeake Bay (April 2003). EPA’s Phase I TMDL requirements (WIP development) completed. Phase II requirements have been initiated. Targets and progress will be evaluated in 2017 and Phase III WIPs will be developed.</p>

**Acronyms**

ARC – Artificial Reef Committee



ASMFC – Atlantic Marine Fisheries Commission  
BSB – Black Sea Bass  
CB – Chesapeake Bay  
COMAR – Code of Maryland  
CPUE – Catch per Unit Effort  
DO – Dissolved Oxygen  
EPA – Environmental Protection Agency  
F – Fishing Mortality  
FMP – Fisheries Management Plan  
GIS – Geographic Information System  
MAFMC – Mid-Atlantic Fisheries Management Council  
MARI – Maryland Artificial Reef Initiative  
MDE – Maryland Department of the Environment  
MDNR – Maryland Department of Natural Resources  
MRFSS – Marine Recreational Fisheries Statistics Survey  
NMFS – National Marine Fisheries Service  
PAH – Polycyclic Aromatic Hydrocarbon  
PCB – Polychlorinated Biphenyl  
PRFC – Potomac River Fisheries Commission  
RHL – Recreational Harvest Limit  
SAV – Submerged Aquatic Vegetation  
SSB – Spawning Stock Biomass  
STAC – Scientific and Technical Advisory Committee  
TAL – Total Allowable Catch  
TMDL – Total Maximum Daily Load  
USACE – U.S. Army Corps of Engineers  
USFWS – U.S. Fish and Wildlife Service  
VAC – Code of Virginia  
VIMS – Virginia Institute of Marine Science  
VMRC – Virginia Marine Resource Commission  
WIP – Watershed Implementation Plan  
YPR – Yield per Recruit

## 2015 Maryland FMP Report (July 2016)

### Section 7. Blue Crab (*Callinectes sapidus*)

The overall blue crab population showed another year of growth based on the results from the 2015-2016 winter dredge survey (WDS). The estimated abundance of spawning age females increased for the second year in a row, nearly doubling to 194 million. Mature female harvest remained at a sustainable level for the eighth consecutive year. Based on the female-specific biological reference points adopted in 2011 the Chesapeake Bay blue crab population is not depleted and overfishing is not occurring. Even with continued population growth conservative management efforts have been continued because the abundance of spawning age females is below the recommended target abundance of 215 million crabs.

#### Status of Chesapeake Bay Blue Crab Management

The Chesapeake Bay Program (CBP) adopted a Blue Crab Fishery Management Plan (CBBC FMP) in 1989. The plan was revised in 1997 with the following objectives: provide long-term protection for the blue crab stock and maintain a stable stock; establish quantitative targets (such as abundance, biomass, or other indices) and biological reference points. In 2003, Amendment 1 to the 1997 CBP Blue Crab FMP was adopted. The purpose of Amendment 1 was to formally adopt biological reference points for managing the resource; to reaffirm strategies for reducing fishing effort; and to recognize the importance of biological monitoring, habitat protection and ecosystem processes. Amendment 2 was developed in 2011 to formally adopt the new female-specific reference points and to recognize the importance of fishery-independent and fishery-dependent monitoring. Amendment 2 was incorporated by reference into Maryland regulation in September 2012. The CBBC FMP and amendments are scheduled for an in-depth review once the next stock assessment is completed (2017).

#### Stock Status

The Chesapeake Bay blue crab stock is currently not overfished and overfishing is not occurring. A full stock assessment was completed and peer reviewed in 2011. The 2011 stock assessment used an integrated estimate of management reference points and stock status. Previous stock assessments did not directly link the two parameters. The female-specific biological reference points (BRPs) are based on estimates of age 0+ female crabs (the exploitable stock) and the abundance of age 1+ female crabs (an index of the spawning stock). Recruitment (the estimated number of age 0 crabs – crabs that are less than 60mm or 2.4 inches) increased from 269 million in 2015 to 271 million crabs in 2016. The estimated abundance of spawning age female crabs was 194 million, an increase from 2015. The exploitation fraction was 15% in 2016, below the target (25.5%). The status of the stock from 2011-2016

based on the female-specific target and threshold is found on Table 1. A stock assessment update is scheduled for 2017.

In order to ensure that male abundance does not drop below a critical level relative to female abundance, the Bay jurisdictions developed conservation points of reference for male crabs. The points of reference were updated in 2014 to include a scaling factor that is consistent with the way female BRPs are calculated. The Chesapeake Bay Stock Assessment Committee (CBSAC) recommended the following conservation triggers for male crabs. If the male exploitation rate exceeds 33% or if the female exploitation rate is below 34% and the combined male/female rate exceeds 53%, the Bay jurisdictions should consider conservation measures for male crabs. The male conservation triggers are based on the second highest exploitation value in the time series of data and does not represent a biologically significant parameter. The 2015 estimate of male exploitation was 22% and no management action is recommended for male crabs at this time.<sup>1</sup> Estimates of male exploitation for 2016 cannot be calculated until the completion of the 2016 fishery (December).

The Baywide winter dredge survey (WDS) is the primary indicator of blue crab stock status in Chesapeake Bay. The WDS provides an annual estimate of over-wintering blue crab abundance by age and gender. The abundance of female spawning age crabs (age 1+) is used to determine if the population is overfished. The number of spawning age female crabs increased by 92% in 2016.

#### Management Measures

A control rule for the blue crab stock has been used to assess the status of the stock since 2001. Control rules describe a variable as a function of another variable that management can influence or have some control over.<sup>2</sup> Determining the variables depends on the characteristics of the stock and the fishery. These variables are then used to develop definitions of biological reference points, i.e., targets and thresholds. In developing a control rule, the selection of a target is risk-averse even though it is expected that the target may be exceeded because of natural annual variability. Currently, the control rule for blue crabs is based on female spawning stock biomass and exploitation.

In Maryland, catch limits and closed periods are implemented to maintain an allowable female harvest that is associated with the 25.5% exploitation target. The allowable female harvest changes with estimated annual abundance. Maryland DNR determines the allowable harvest and then develops a suite of limits designed to achieve but not exceed the allowable harvest. The crabbing industry provides input on which combinations of limits work best for the industry via the Blue Crab Industry Advisory Committee.

New regulations for recreational crabbing that went into effect in 2013 are still in place. Waterfront property owners must register their crab pots in order to use them from their piers. Anyone using collapsible traps or net rings must obtain a recreational license. A person can use a hand-line or dip net to catch crabs without a license. Refer to the Maryland DNR webpage for more details <http://dnr2.maryland.gov/fisheries/Pages/regulations/blue-crab.aspx>

In 2015 the estimated abundance of spawning females increased and was above the minimum safe threshold of 70 million crabs. The additional vessel bushel limits implemented in 2014 to provide additional protection for spawning-age females were effective through April 2015. The increase in the size limit for female peelers was effective until July 14 making the minimum size 3½ inches for the entire 2015 season. With an increase in estimated abundance of spawning age females and harvest below the recommended target, the daily mature female bushel limits were increased starting July 2015.

### **The Fishery**

As population levels change, maintaining the exploitation target may result in either an increase or a decrease in harvest. The 2015 baywide (Maryland, Virginia and Potomac River) commercial harvest was approximately 49.6 million pounds (Figure 2). The percentage of females removed by harvest in 2015 was approximately 15% which was below the recommended target (25.5%) and threshold (34%) (Table 1). Prior to 2008, recreational harvest was assumed to be approximately 8% of the total harvest. Since recreational crabbers can no longer harvest female crabs in Maryland the estimated harvest is now based on 8% of the bay wide male harvest plus 8% of Virginia female harvest for a total of 3.5 million pounds baywide in 2015. Adding up the harvest from each fraction of the harvesting sectors and across the entire Chesapeake Bay, the 2015 total harvest was approximately 53.1 million pounds.<sup>1</sup>

### **Issues/Concerns**

Although management measures have successfully kept the exploitation of female crabs below the target and kept abundance above the threshold, conservation measures need to remain in place to ensure that the population continues to increase. The blue crab population is subject to high natural variability from year to year due to overwintering mortality, recruitment (the number of juveniles >60mm), and other unknown variables. These factors emphasize the need to determine an appropriate margin of conservation to account for environmental variability.

Since 2012 a pilot study led by an industry-based group has been testing a new way to accurately report commercial harvest data in a more timely fashion using electronic technology. This is a co-management approach between the crab harvesters and MDNR. The electronic reporting program includes a “hail-in, hail

out” protocol and random catch verification which should provide improved and timely commercial harvest data. A report on the results of the pilot study can be found after the implementation table.

Maryland has continued with a text messaging system to help watermen stay abreast of blue crab regulations and any seasonal changes that may occur. Watermen can subscribe to receive text message reminders a day or two before a regulation change goes into effect.

Latent effort refers to the number of people holding fishing licenses that have not been actively harvesting crabs but could return to the fishery at any time. This part of the fishery continues to be a management concern. Maryland and Virginia have been successful at reducing the number of people holding crabbing licenses through a federally funded license buy-back program in 2009 and 2010. The number of inactive licenses needs to be monitored and additional recommendations formulated. New methods for calculating recreational catch and effort is also needed to fully characterize total removals by the fishery.

As part of the Sustainable Fisheries goals in the Chesapeake Watershed Agreement (June 2014), a blue crab abundance and management outcome was developed. It states: “Maintain a sustainable blue crab population based on the current 2012 target of 215 million adult females. Refine population targets through 2025 based on best available science.” The bay jurisdictions developed a management strategy to achieve the outcome and recently developed a work plan for 2016 and 2017. [http://www.chesapeakebay.net/managementstrategies/strategy/blue\\_crab\\_abundance\\_and\\_management](http://www.chesapeakebay.net/managementstrategies/strategy/blue_crab_abundance_and_management)

### **Enforcement**

The enforcement of commercial and recreational fishing regulations is critical to management success. There has been an initiative towards improving enforcement of blue crab conservation/management measures. In Maryland, the Natural Resource Police (NRP) hired additional officers to provide a dedicated enforcement effort for crab management. The NRP has successfully increased the total number of enforcement hours and initiated a targeted enforcement protocol through a program called “Don’t Get Pinched.” In addition, there have been increased penalties for offenses and improved judicial action.

### **Conclusion**

The Bay jurisdictions will continue to investigate alternative strategies to improve management of the blue crab resource in 2016. In preparation for the stock assessment update the jurisdictions have determined terms of reference. The state jurisdictions will take the lead on addressing topics for the stock assessment update.

Although steps have been made to improve harvest accountability and reporting for both the commercial and recreational fisheries, more improvements are needed. Since female abundance is not at target levels, the jurisdictions need to maintain conservative management measures and make adjustments to ensure that harvest levels are commensurate with abundance indices.

**References**

<sup>1</sup> Chesapeake Bay Stock Assessment Committee (CBSAC). 2016 Chesapeake Bay Blue Crab Advisory Report, June 2016.

<sup>2</sup> Miller, T., Wilberg, M., Davis, G., Sharov, A., Colton, A., Lipcius, R., Ralph, G., Johnson, E., and Kaufman, A. 2011. Stock Assessment of the Blue Crab in Chesapeake Bay. Tech. Rept. Series No. TS-614-11 of the University of Maryland Center for Environmental Science

<sup>3</sup> Restrepo, V. and J. Powers. 1999. Precautionary control rules in US fisheries management: specification and performance. ICES Journal of Marine Science, 56:846-852

Table 1. Female-specific biological reference points and status of the blue crab stock, 2011-2016

Reference Points			Stock Status					
	Target	Threshold	2011	2012	2013	2014	2015	2016
<b>Female-specific Exploitation Fraction</b>	25.5%	34% (max)	24%	10%	23%	17%	15%	TBD*
<b>Abundance (millions of female crabs)</b>	215	70 (min)	190	97	147	68.5	101	194

(2016 Chesapeake Bay Blue Crab Advisory Report)

\*Exploitation fraction cannot be calculated until the 2016 harvest data is complete

**Figure 1. Estimated abundance of spawning age female crabs (age 1+) in Chesapeake Bay, 1990-2016**

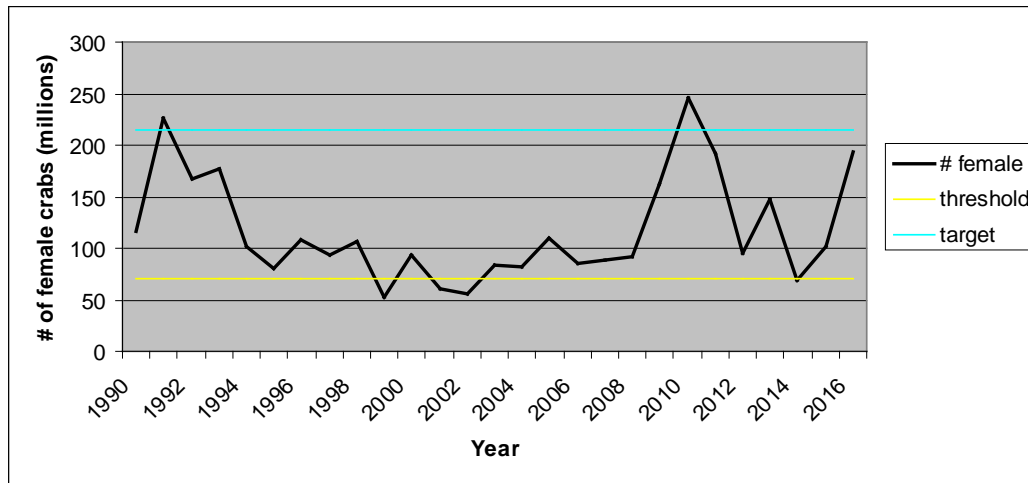
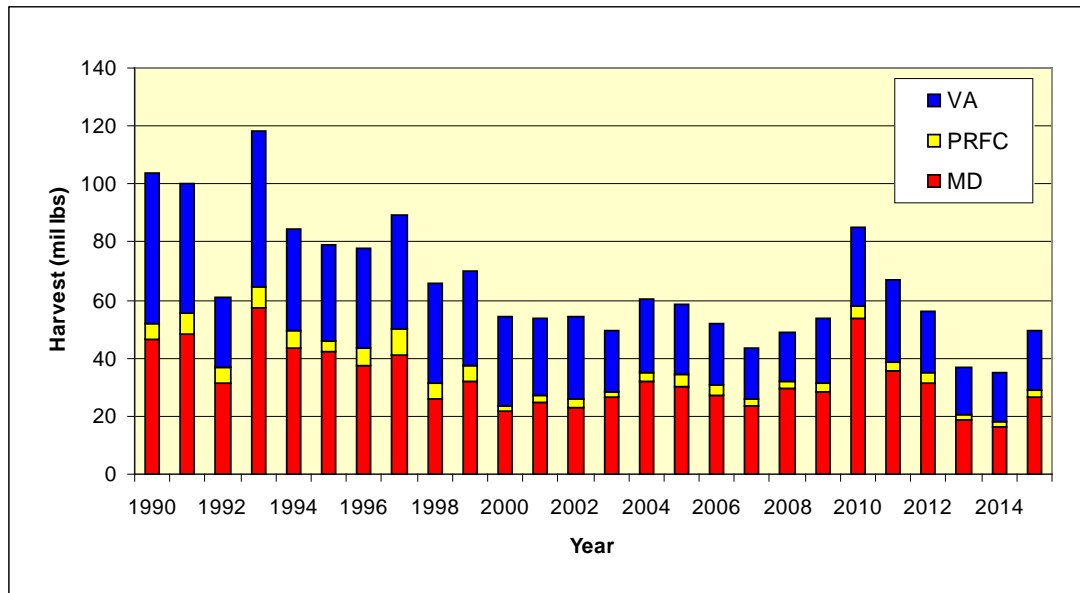


Figure 2. Chesapeake Bay Commercial Blue Crab Harvest, 1980-2015



<b>2003 Chesapeake Bay Program Blue Crab Fishery Management Plan Amendment 1</b> (updated 07/2016)			
<b>Problem Area</b>	<b>Action</b>	<b>Date</b>	<b>Comments</b>
Stock Status Strategy Chesapeake Bay stock has stabilized at historically low levels but continues to be at risk for recruitment failure.	Action 1 CBP jurisdictions will adopt a threshold fishing mortality rate that preserves 10% of the blue crab spawning potential, relative to an unfished stock, and a minimum stock size threshold.	Began in 2001; formally adopted in 2003 2011 Continue   <b>2016</b>	The 2005 Stock Assessment recommended using the exploitation fraction (the proportion of the vulnerable population that is harvested each year) instead of F for evaluating BRPs. The 2010 exploitation estimate was below the threshold and has been below the threshold since 2008. As a result of the 2011 stock assessment, new female-specific targets and thresholds were adopted. The new female target and threshold are 215 million female crabs and 70 million female crabs, respectively. <b>Female abundance (194 million crabs) is currently above the threshold level but below the target level. A stock assessment update is scheduled in 2017.</b>
	Action 2 CBP jurisdictions will adopt a target fishing mortality of $F_{20}$ , which if achieved, will increase the blue crab spawning potential from 10% to 20% relative to that of an unfished stock.	Began in 2001; formally adopted in 2003 Continue <b>2015</b>	The target fishing mortality (F) was replaced by the exploitation target of 46%. As a result of the 2011 stock assessment results, the female-specific exploitation target and threshold are 25.5% and 34%, respectively. <b>The 2015 female-specific exploitation was 15%, below the target level. An exploitation fraction for 2016 cannot be calculated until the completion of the 2016 fishery (December 2016).</b>
	Action 3 CBP jurisdictions will develop control rules based on the biological reference points (BRPs) for managing the blue crab resource. (The control rule was adopted in 2001 and updated in the 2005 stock assessment. It represents the relationship between adult crab abundance, exploitation and management reference points. <b>The 2011 control rule is a major improvement over the previous model because it integrated the calculation of reference points within the model rather than using two separate processes as in the 2005 assessment.</b> )	2003 2005 2006 2008 2011 On-going	In 2006 the overfishing limit was defined as 86 million age 1+ crabs (threshold value). An interim target of 200 million age 1+ crabs was established in 2008. The blue crab stock was not overfished in 2010. <b>In 2016, based on the female-specific BRPs adopted in 2011, the blue crab stock is not overfished and overfishing is not occurring.</b>



**2003 Chesapeake Bay Program Blue Crab Fishery Management Plan Amendment 1** (updated 07/2016)

Problem Area	Action	Date	Comments
			record but declined by almost 50% the following year (2012-2013). <b>WDS results indicate that recruitment increased from 269 million age 0 crabs in 2015 to 271 million crabs in 2016.</b>
Habitat Strategy CBP jurisdictions will identify and protect critical blue crab habitat.	Action 7 MD and VA will consider designating additional sanctuary areas to protect blue crab habitat based on new research data.	Continue	Closure of the VA blue crab spawning sanctuary (928 square miles) was extended an additional month (May-Sept) to protect female crabs. The EBFM life history brief indicates that blue crabs occupy a wide range of estuarine habitats and utilize a series of habitats sequentially along a salinity gradient.
	Action 8 CBP jurisdictions will continue to protect SAV in potential, post-larval settlement areas.	Continue	Sav beds in near shore habitats provide essential habitat for blue crabs, especially during their post larval and juvenile stages. SAVs provide critical shelter for many key species besides crabs. SAVs help improve water clarity, add oxygen to the water, and reduce shoreline erosion.





**2003 Chesapeake Bay Program Blue Crab Fishery Management Plan Amendment 1** (updated 07/2016)

Problem Area	Action	Date	Comments
<p>Ecosystem strategy                      CBP jurisdictions will incorporate information on ecosystem processes relating to blue crabs as it becomes available and utilize the information to determine management actions as necessary</p>	<p>Action 11                      Utilize the guidelines from the Fisheries Ecosystem Plan (FEP) to incorporate multi-species and ecosystem considerations into existing CBP fishery management plans.</p>	<p>Began                      2005                      Continue</p> <p>2014                      On-going</p>	<p>A new EBFM operational structure was facilitated through MSG. An EBFM blue crab species team was formed in late 2008. The team completed biological briefs on important blue crab issues. This information is available at <a href="http://www.mdsg.umd.edu/programs/policy/ebfm/">http://www.mdsg.umd.edu/programs/policy/ebfm/</a>                      The recommendation from the group is to use the briefs when the Blue Crab FMP is revised. In 2014, the Chesapeake Bay Program developed the Chesapeake Watershed Agreement. The document includes two outcomes for blue crabs. <b>A biannual work plan was developed for 2016/2017 to address the outcomes.</b></p>
	<p>Action 12                      As data becomes available on food web dynamics, adjust fishing mortality rates on the blue crab population to include predator and prey needs.</p>	<p>On-going</p>	<p>Blue crabs play an important role in the food web of the bay. They are prey for important species of finfish and are predators on other species such as mollusks. Blue crabs play a key role in the trophic dynamics of the Bay &amp; are considered the foremost benthic consumer in the Bay foodweb.</p>
	<p>Action 13                      Evaluate the impact of non-native crab introductions on the blue crab population and develop recommendations accordingly.</p>	<p>On-going</p>	<p>There is concern over the interaction of blue crabs with non-native species of crabs, which include the green, mitten and Japanese shore crab. In 2006 MD adopted regulations that prohibit the transport of green or Japanese crabs. MD also adopted regulations to prohibit the import, transport, purchase, possession, sale or release of mitten crabs. The states have implemented education and outreach programs to highlight the problems associated with invasive species.</p>

Acronyms:

BRP= biological reference points  
 CBSAC= Chesapeake Bay Stock Assessment Committee  
 CBP= Chesapeake Bay Program  
 EBFM = Ecosystem based fisheries management

FMP = Fishery Management Plan  
 MSG = Maryland Sea Grant  
 QET = Quantitative Ecosystem Team

**Final Report**

# **Aspects of Commercial Crabbing Activity and Harvest Reported Electronically by the Maryland Blue Crab Industry**

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## **EXECUTIVE SUMMARY**

In 2012, Maryland blue crab managers, fishing industry representatives and other stakeholders implemented a pilot project with a goal to evaluate if daily reporting using an electronic reporting system could improve the reliability of harvest information reported by the blue crab fishery. The pilot project was the outcome of discussions between Maryland fisheries managers and the Blue Crab Design Team that focused on identifying opportunities where industry and management could work together to improve industry accountability and enhance overall blue crab management (Slacum et al. 2013). To achieve the goal of the pilot project, two specific objectives had to be met: (1) provide industry with access to an electronic reporting system and evaluate if industry had the capability to report fishery information daily using mobile phone or personal computing technology; and (2) develop and implement methods to verify (i.e. dealer, dockside, and system monitoring) reported fishery information and use those methods to evaluate the accuracy of reported fishing activity. The results of the 2012 Pilot Project demonstrated that industry had the capability to use an electronic reporting system daily, and reported fishing activity could be successfully verified for accuracy. Based on these results, the Blue Crab Industry Design Team and Department of Natural Resources endorsed the final project recommendations which included some system and reporting modifications and the continuation of the Pilot Project through the 2013 crabbing season.

The 2013 Pilot Project was conducted for an entire crabbing season with a goal of recruiting more fishermen who would use their own mobile devices for reporting in order to evaluate the system on a scale and scenario similar to the entire fishery. The Project also evaluated the ability for participant's to choose their day off from fishing and the effectiveness of multiple harvest verification techniques. The outcome of the 2013 Pilot Project showed that industry had the ability to use their own mobile devices to report using the electronic system, the system could effectively monitor the participants' choice of day taken off and harvest monitoring techniques worked at near optimal levels with a few possible improvements. Based on these results, it was recommended that the system continue during the 2014 crabbing season with the exception of limiting the level of effort placed on monitoring and evaluating the system due to reduced financial resources to maintain these services.

The goals of the 2014 Pilot Project were to maintain the system's availability to allow for the entire blue crab industry's use on a voluntary basis while increasing watermen participation using various outreach methods. This year monitoring efforts were also limited and targeted to gather additional specific industry information. Three components of electronic harvest reporting were monitored and assessed during the 2014 Pilot Project:

- (1) Industry Participation
- (2) System Use by Participants
- (3) Harvest Monitoring Techniques

## INDUSTRY PARTICIPATION

Various outreach techniques were used to increase watermen use in the electronic reporting system including advertisement from previous and current Pilot Project participants and Design Team members to express the availability of the system to other commercial crabbers, an informational booth set up at the 2014 Watermen's Expo in Ocean City, MD to further advertise availability of the system and train interested watermen and posted information on the Maryland DNR commercial fishing webpage where watermen could also submit a request to use the system through a web form. Any new 2014 recruits were trained through one-on one in person training sessions, over the phone, or by watermen who had participated in the Pilot Project during the past two years.

Over 150 watermen expressed interest in participating in the 2014 Pilot Project and the majority of these were trained to report hails and harvest electronically, however, several watermen who were trained to use the system did not report their harvest electronically, leaving a total of 98 watermen that continued to use and evaluate the system during the 2014 Pilot year. Reasons for watermen who were trained not reporting their harvest electronically include their harvest being reported by other watermen who they were working with or deciding to drop out of the Pilot Project for reasons such as selling or transferring a license.

Participants of the 2014 Pilot Project crabbed throughout the Maryland tributaries and main stem regions of the Maryland portion of the Chesapeake Bay. In order to enforce the harvest verification component of the program, watermen were grouped into seven large geographic regions encompassing several coastal counties and parts of counties based on the number of offload locations in each region. Watermen participating in the 2014 Pilot Project used nearly all types of commonly deployed gear in the State of Maryland including crab pots, trotlines, peeler pots, dip nets, collapsible traps and scrapes/dredges with the majority of participants using crab pots or trotlines. A few watermen used multiple gear types throughout the project to harvest crabs.

Watermen participating in the Pilot Project had an option to report using one of four reporting platforms or a combination of multiple of the following reporting platforms: texting, mobile website, portal website or a call center. The call center platform was used for to report harvest throughout all seven reporting regions. The remaining platforms were used in the majority of the regions with each platform not being used in only one or two of the regions.

### ***PARTICIPANT USE AND PERSPECTIVES ON THE CALL CENTER***

Two series of calls were made to watermen using the call center during the 2014 Pilot Project. The first series of calls was made in order to establish if a connectivity issue had been resolved after numerous complaints to the help line were made stating that the call center not answering was preventing them from reporting. The second series helped to gather the watermen's perspectives of the call center,

### **Industry Participation and System Use Highlights**

#### **2014 Participation:**

- 98 watermen reported harvest
- Crab Pots and Trotline were the most frequently used gear types

#### **System Use:**

- 3,603 crabbing trips reported
- Watermen used full system functionality
- 36% of watermen revised hails and 22% revised harvest information showing they used the flexibility of the system

#### **Conclusions:**

- Industry has the ability to access and report daily fishing activity and harvest using industry owned mobile devices
- Watermen using the system effectively participated in a dockside and dealer monitoring system
- Interested participants required little training and had few problems over the course of the Pilot

why they chose to use the call center and whether any provided incentives would persuade them to switch to another reporting platform. The connectivity issue was able to be identified and resolved after numerous calls between Pilot Project staff, participating watermen using the call center and the call center representative and it was established that participants could successfully reach the call center to report. The feedback collected from the second series of calls established that the majority of watermen felt this reporting platform was sufficient for their reporting needs, they chose to use the call center because they felt they were not very tech savvy and it was all they could use, they had phones with other capabilities (i.e. texting), and they felt there was nothing that could be done to persuade them to switch reporting devices.

## SYSTEM USE BY PARTICIPANTS

The Maryland 2014 crabbing season extended from April 1, 2014 to December 15, 2014. The first electronic crabbing trip was submitted on April 3, 2014 and there were a total of 3,603 crabbing trips reported by all participating watermen through September 28, 2014. The peak week of operation throughout the season was the week of August 3, 2014.

Reporting by watermen was compared by month, gear type, and day of week. July and August had the highest percentage of participant use with nearly all watermen trained to use the system, reporting hails and harvest. April had the least number of watermen reporting harvest and hail information. Watermen using crab pots had the highest number of trips reported, however, the number of watermen reporting harvest using trotlines was higher than those reporting harvest with crab pots. The highest amount of trips occurred during weekdays, however, the number of watermen reporting on weekends was similar to that on weekdays.

After submitting a start hail, end hail or harvest report the watermen had the option and ability to

revise that hail or report in order to verify their data entry or correct a previously made estimate. About a third of watermen made a revision to one of their hails throughout the 2014 Pilot Project and less than a quarter of the participants revised their harvest information, totaling to an even smaller percentage of the total trips that had revisions. Over the course of the program, almost half of the watermen forgot to submit at least one end hail and over half forgot to submit at least one harvest report.

### Harvest Verification Highlights

#### Operations:

- 151 crabbing trips were targeted for dockside monitoring (Spot Checks) by roving monitors
- 1 dealer submitted 152 dealer reports from harvest purchased from 3 watermen
- 111 successful spot checks had the potential for harvest report comparisons

#### Performance:

- 75% of all attempted spot checks were successful
- 28% of harvest comparisons had discrepancies
- Dockside monitoring performed optimally when watermen adhered to recommended “Best Reporting Practices”
- Dockside monitoring and dealer reporting were effective at providing critical information to develop approaches for identifying potential typographical errors associated with electronic reporting and for verifying harvest report accuracy

## HARVEST VERIFICATION

The 2014 harvest verification program followed the basic design that was implemented during 2012 and 2013 Pilot Projects. Roving monitors were hired to perform “spot checks” of individual watermen’s harvest when it was offloaded from their vessels between August 10 and September 28, 2014. Two different methods were used to conduct “spot checks”. One method was used to target watermen of higher priority or those who crabbed less than 40 days throughout the season. These “Priority List” days were scheduled randomly on weekends within each region based on monitoring 10% of trips made by high priority watermen as reported in July. The second method





“Targeted Monitoring” focused on scheduling monitoring at as many different offload locations as possible when monitoring occurred. Targeted spot checks were also scheduled randomly but during the week days and within each region based on monitoring 5% of the trips made by all watermen except high priority watermen as reported in July. All watermen landing within a roving monitors region on a “Target” day had the potential to be monitored.

### ***EFFECTIVENESS OF DOCKSIDE MONITORING***

A total of 1,394 trips occurred between August 10 and September 28, 2014, when spot checks were conducted, therefore having the potential to be monitored. Spot checks were only attempted on 11% of all scheduled trips and were successful on 75% of those attempted. A spot check was defined as successful when a roving monitor was able to intercept a waterman and document the entire harvest offloaded from the vessel. The main reason for unsuccessful spot checks was due to offloads not occurring when scheduled (37 attempted spot checks, 97%).

### ***ROVING MONITOR AND WATERMEN REPORT COMPARISONS***

Harvest information reported by watermen was compared to roving monitor reports (spot checks) to evaluate the accuracy of reported harvest (Table 4-2). Discrepancies between reports were identified by comparing the six reported crab harvest grades (#1’s, #2’s mixed males, females, peelers, and soft crabs) between watermen and roving monitor reports. The accuracy of a waterman’s harvest was determined using a two-step process. The first step determined the accuracy of roving monitor reports and the second step involved screening discrepancies identified between reports and evaluating the source of the discrepancy to determine if the discrepancy was a legitimate difference between monitoring data and the harvest report. Harvest report accuracy was then quantified as the percentage of differences between reports. There were a total of 31 trips with roving monitor reports that could be compared to watermen harvest reports where data entry discrepancies occurred (28% out of the 111 trips with successful roving monitor spot checks) resulting in 56 harvest grade discrepancies. In 2014, harvest reported in bushels was limited to reporting in increments of quarter bushels which resulted in a 5% decrease in the number of discrepancies caused by rounding from 2013 to 2014.

### ***EFFECTIVENESS OF DEALER REPORTING AND DEALER AND WATERMEN REPORT COMPARISONS***

A total of 152 dealer reports were submitted into the electronic reporting system concurrent with harvest reports from these three watermen from May 14 to September 27, 2014 during which dealer reporting was conducted. These dealer reports were also used to determine data discrepancies for reported harvest. Only four grades of the harvest could be compared (#1’s, #2’s mixed males, and females) between watermen and dealer reports because the participating dealer did not purchase peelers or soft crabs.

Harvest accuracy was determined by screening discrepancies identified between dealer and watermen harvest reports and evaluating the source of the discrepancy to determine if there was a difference between the harvest reports. Harvest report accuracy was then quantified as the percentage of differences between reports. There were 134 trips out of a total of 146 trips with report comparison discrepancies and a total of 442 harvest grade comparisons with discrepancies. Two common groups of

discrepancies were identified as harvest reporting with different units and data entry error. The majority of the discrepancies were due to a harvest reporting unit difference whereas the watermen and the dealer reported harvest each with different units (either bushels or pounds).

## SYSTEM MONITORING

Currently the reporting system has no option for watermen to acknowledge when they do not intend to actively crab during specific time periods. The system assumes that a waterman is not fishing when no trip reports are submitted by watermen. However, since the use of the system was voluntary, some effort was required to contact watermen during the season that had been trained to use the system, but for whom no trips had been reported.

### System Monitoring Highlights

#### System Monitoring:

- Multiple system reports and other monitoring tools were implemented during 2014 to monitor and assess information submitted to the electronic reporting system

#### Performance:

- Few issues were encountered with the system's ability to process trip data which were minimal and quickly resolved
- Harvest information was immediately available to managers
- System reports identified data outliers
- System reports identified instances when reporting did not follow "Best Reporting Practices"
- System reports identified occasions when harvest was not reported allowing managers the opportunity to immediately follow-up and retrieve the missing harvest
- Harvest information obtained through follow-up was less accurate than harvest reported on the day of the crabbing trip
- Some areas of poor cellular service were documented, but watermen still found ways to report in those areas
- System effectively monitored watermen's choice of day off

Two series of calls were made during the crabbing season. The first series of calls were conducted mid-season to determine if watermen who had not reported for an extended period of time were either not crabbing or were not intending to use the electronic system to report. The second series of calls were made near the end of the season to follow-up with watermen who intended to use the system, but had not reported for the entire season, and determine when individual watermen expected to stop crabbing for the year.

The first series of calls was directed towards 31 watermen that were considered to be inactive in the electronic reporting system (had not reported any trips throughout the crabbing season) to determine whether or not they had been crabbing for the year. If they had been crabbing, it then had to be determined if they were still reporting using the paper method or if they were using the electronic system and therefore needed their harvest reports to be back-entered into the FACTS system. Out of the 31 participants that were called, 20 were reached leaving 11 who were unable to be contacted. Eighteen out of the 20 crabbers that were contacted indicated that they had not yet been crabbing or did not plan on going crabbing for the entire season. The remaining 2 participants did report that they had been crabbing; one who had been reporting using the paper reports and the other who was only using his recreational license to crab.

The second series of calls were conducted in the month of October, to determine if watermen who had been inactive in the system for an extended period of time (meaning they had not reported since August, if not earlier in the year) were still crabbing or intended to crab before the season was over. Previously, participants were given a check box that they were able to check during their reporting process when they determined that it would be their last day of crabbing for the season. This function was later removed from the reporting system so that it then had to be assumed that when no trip reports were submitted



for an extended period of time, the waterman was no longer crabbing. The follow up calls were made to confirm these assumptions and establish whether or not the watermen had been crabbing since their last crabbing trip or determine if they were finished crabbing for the season. There were 20 watermen that were identified for these calls, of which only 12 were reached. All 12 watermen who were reached reported that they had not been crabbing since their last date reported and the majority of these watermen also claimed that they were finished or most likely finished crabbing for the season.

### ***SYSTEM MONITORING OF BEST PRACTICES***

System reports and other monitoring tools were implemented during 2014 to assess information submitted to the electronic reporting system. Assessing system performance was based on the ability of the system to remain operational for reporting during the season and being able to identify and track reporting inconsistencies along with sources of error. Reporting inconsistencies were considered to be deviations from the established reporting “Best Reporting Practices” that were established based on recommendations from the 2012 and 2013 Assessment and have the potential to increase the amount of effort required to verify reported harvest as well as undermine the ability of the system to acquire timely and accurate harvest information. Additional monitoring of system performance, such as feedback through the help line and cellular service problems, were conducted manually by Pilot Project staff.

The ability of participants to follow the “Best Reporting Practices” was evaluated by comparing the submission times of hails and harvest logs and through monitoring of other reporting process behaviors. If a waterman submitted an end hail prior to 8 A.M., it was flagged as atypical due to the majority of watermen typically finishing crabbing after 10 A.M. Instances such as this suggest the end hail was not submitted at the end of a crabbing trip. Seven percent of watermen submitted trip end hails before 8 A.M. for a total of 17 trips. The second type of atypical behavior was based on the interval of time between start and end hails. If a trip had a start and end hail submitted within 15 minutes, it could be assumed that either the start hail was not submitted at the beginning of a crabbing trip or the end hail was not submitted at the end of a crabbing trip due a typical crabbing trip lasting longer than 15 minutes. Forty-eight percent of watermen submitted at least one start and end hail within a 15 minute interval which generated a total of 575 flagged trips. The last atypical trip identifier focuses on watermen sending harvest reports after 5 P.M. If a harvest report was submitted after 5 P.M., it was assumed to be an instance where harvest was not reported while the waterman was still on the water at the end of their crabbing day. Harvest reports submitted after 5 P.M. occurred on 516 trips by 63% of the watermen.

### ***SYSTEM MONITORING OF MISSING HARVEST REPORTS***

A total of 3,603 harvest reports were submitted by watermen from all reporting platforms. A total of 185 (5%) crabbing trips had missing harvest reports. The trips missing harvest reports submitted to the electronic reporting system had a hail but no harvest report, suggesting occasions when a waterman forgot to submit harvest after a crabbing trip. These instances were noted during the Pilot Project and either the watermen contacted the Maryland DNR to provide them with the harvest or the Maryland DNR followed up with the watermen.



Starting the week of August 3, 2013, the system was modified to include an automated text message which was sent to watermen that hailed in the morning and had not sent a harvest report by 5 P.M. Three additional text message reminders were sent at 6 P.M., 7 P.M., and 8 P.M. if harvest was still not received by those times. The text message reminders made a marked improvement in harvest log reporting with a decrease in missing harvest reporting from 11% to 2%

The majority of watermen using the electronic reporting system always reported harvest. When missing harvest did occur, it accounted for only a small fraction of a waterman's total trips but required nearly three phone calls to recover the harvest. A trend showed that those watermen who reported more trips throughout the season also had more missing harvest reports.

### ***ELECTRONIC REPORTING SYSTEM AND MOBILE DEVICE SUPPORT***

Over the course of the 2014 Pilot Project, a toll-free help line was available to the watermen 24-hours a day to assist in troubleshooting any technical issues with the mobile device or reporting system and to provide an outlet for watermen to submit feedback on the 2014 Pilot Project. A log recorded the description of each call, date, and type of device the caller was using to report. Nineteen calls were logged from watermen throughout the 2014 Pilot Project. The most common call to the help line was watermen reporting that they could not get through to the call center and/or that there were long wait times to speak to a call center operator. Some of these calls pertain to the June 19<sup>th</sup> call center issue (Appendix A) which was quickly resolved. The next most common call type made to the help line was watermen calling to report harvest when they had forgotten to submit it using the system.

The Pilot Project was continued in 2014 with a goal to maintain the system and expand its use by the blue crab industry. Although participation increased from previous Pilot years, the number of watermen using the system is still a fraction of the total number of active license holders. Watermen who have decided to use the system have required limited training and have had few problems over the course of the Pilot Project. In addition, watermen using the system have also effectively participated in a dockside and dealer monitoring system. These techniques have been successful at verifying harvest and identifying important variables required to assess accuracy of reported information. As in 2013, the results from system monitoring during the 2014 Pilot Project demonstrated that the FACTS™ system can meet the Maryland DNR commercial harvest reporting standards of timeliness, accuracy and data verifiability with the exception that the level of effort required to recover missing harvest will need further assessment.



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## 1.0 INTRODUCTION

In 2012, Maryland blue crab managers, fishing industry representatives and other stakeholders implemented a pilot project with a goal to evaluate if daily reporting using an electronic reporting system could improve the reliability of harvest information reported by the blue crab fishery. The pilot project was the outcome of discussions between Maryland fisheries managers and the Blue Crab Design Team that focused on identifying opportunities where industry and management could work together to improve industry accountability and enhance overall blue crab management (Slacum et al. 2013). To achieve the goal of the pilot project, two specific objectives had to be met: (1) provide industry with access to an electronic reporting system and evaluate if industry had the capability to report fishery information daily using mobile phone or personal computing technology; and (2) develop and implement methods to verify (i.e. dealer, dockside, and system monitoring) reported fishery information. These methods would then be used to evaluate the accuracy of reported fishing activity. The results of the 2012 Pilot Project demonstrated that industry had the capability to use an electronic reporting system daily, and reported fishing activity could be successfully verified for accuracy. Based on these results, the Blue Crab Design Team and Department of Natural Resources endorsed the final project recommendations which included some system and reporting modifications and the continuation of the Pilot Project through the 2013 crabbing season.

The 2013 Pilot Project was conducted for an entire crabbing season with a goal of recruiting more fishermen who would use their own mobile devices for reporting in order to evaluate the system on a scale similar to the entire fishery while also evaluating a variety of reporting devices.. In addition, the system's ability to allow participants to take any day of the week off from fishing was evaluated along with harvest verification techniques. The outcome of the 2013 Pilot Project showed that industry had the ability to use their own mobile devices to report using the electronic system, the system could effectively monitor the participants choice of day taken off and harvest monitoring techniques worked at near optimal levels with a few possible improvements. Based on these results it was recommended that the system continue during the 2014 crabbing season. However, the level of effort for monitoring and evaluating system components needed to be limited due to reduced financial resources to maintain these services.

The goals of the 2014 Pilot Project were to:

- Maintain the systems availability for the entire blue crab industry to use;
- Increase watermen participation through various outreach methods;
- Conduct targeted harvest monitoring techniques to gather additional industry specific information;
- Conduct limited system monitoring.

Information gathered during the 2014 Pilot Project is presented in this final report under three main project components, (1) Industry Participation, (2) System Use by Participants, and (3) Harvest Monitoring Techniques.

## 2.0 INDUSTRY PARTICIPATION

Recruiting waterman to use the electronic reporting system and participate in the 2014 Pilot Project was accomplished using various outreach techniques. Watermen who previously participated in the Pilot Project and Design Team members were also encouraged to advertise the availability of the system to other commercial crabbers. An informational booth was also set up at the 2014 Watermen's Expo in Ocean City, MD (January 17 to January 19, 2014) to advertise availability of the system and train interested watermen. Information was posted on the Maryland DNR commercial fishing webpage where watermen could submit a request to use the system through a web form. New watermen who had not previously used the system were trained through one-on-one in person training sessions, over the phone, or by watermen who had participated in the Pilot Project during the past two years.

Of the 168 watermen who expressed interest in participating in the 2014 Pilot Project, a total of 142 were trained to report hails and harvest electronically. Forty-one watermen who were trained to use the system did not report their harvest electronically. Three watermen that were trained to use the system did not report electronically because their harvest was reported by other watermen they were working with. Six watermen were trained to use the system but decided to drop out of the 2014 Pilot Project for reasons including selling or transferring their license (three watermen), never sending in the Pilot permit (two watermen), or becoming frustrated with the call center and their mobile device (one waterman). Two of these six watermen that dropped, out did report electronically while they were participating in the project. All results in this section are based on the participation and activities of the 98 watermen that reported using the electronic reporting system.

Watermen participating in the 2014 Pilot Project crabbed throughout the Maryland portion of the Chesapeake Bay, in tributaries and in the mainstem (Table 2-1; Figure 2-1). For planning purposes related to the harvest verification program component, watermen were grouped into seven large geographic regions encompassing several coastal counties and parts of counties based on the number of offload locations occurring in each region. Nearly all types of commonly deployed gear in the State of Maryland were used by Pilot Project participants (Table 2-1). Watermen used hard crab pots, trotlines, peeler pots, dip nets, collapsible traps, and scrapes/dredges. The majority (88%) of watermen used crab pots or trotlines to harvest blue crabs. A small number of watermen (seven) used multiple gear types to harvest crabs. Crab pots are the only gear type that were used in all seven regions.

Participating watermen used one of four reporting platforms or a combination of multiple reporting platforms to hail and report harvest throughout the 2014 Pilot Project (Table 2-2). All reporting regions had participating watermen who reported using the call center platform. The mobile website was used for reporting in all regions except region seven, and no watermen used the texting platform in regions one or seven. Reporting through the website on a personal computer did not occur in regions one and five.

Table 2-1. Numbers of watermen, harvest offload regions, types of commercial gear used and areas fished for the 2014 Pilot Project. Regions encompassing several coastal counties were based on a waterman's harvest offload locations. Each waterman was assigned to a region based on their primary offload location.

Region #	Maryland Counties	Total # Watermen*	Number of Watermen by Gear Type**					Crabbing Area**	
			Crab Pot	Trotline	Scrape/ Dredge	Peeler Pot	Dip-net	Mainstem	Tributary
1	Somerset, C. and S. Dorchester, Wicomico, Worcester	12	9	3	0	0	0	9	3
2	N. Dorchester, Talbot	17	2	15	0	0	0	2	15
3	Kent, Queen Anne, S. Cecil	20	9	10	0	0	0	9	10
4	Baltimore, N. and C. Cecil, Harford	13	7	4	0	0	0	6	5
5	Anne Arundel, N. Calvert	19	12	9	0	0	0	11	10
6	C. and S. Calvert, Charles, Prince George's, St Mary's	28	4	21	1	2	2	7	23
7	Smith Island	7	2	0	6	1	0	9	3
Total		98	41	51	7	3	2	49	55

\*Multiple watermen indicated that they fished in multiple areas.

\*\*Multiple watermen indicated that they used multiple gear types and fished in multiple areas.

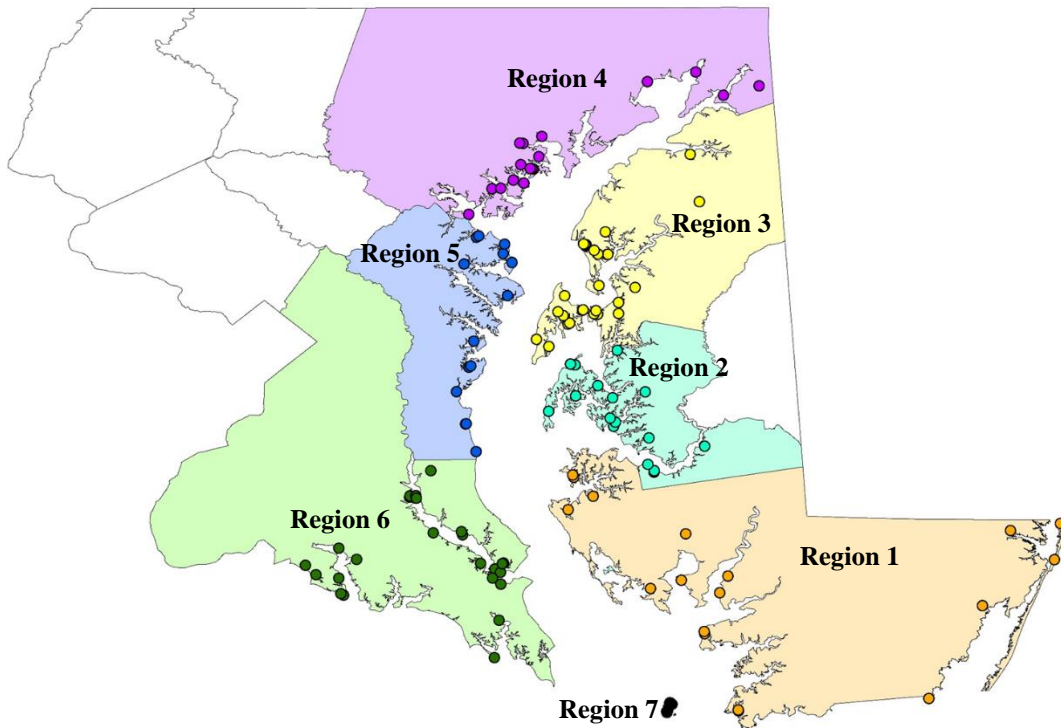


Figure 2-1. Map of Maryland Coastal Counties showing the harvest offload locations for commercial watermen participating in the 2014 Pilot Project.

Table 2-2. The number of watermen in each 2014 Pilot Project region, reporting group, and the distribution of mobile devices among regions and reporting groups.

Region #	Total # Watermen	Mobile Platform Used								
		Mobile Website	Call Center	PC Website	Texting	Mobile Web & Call Center	Mobile Web & PC Web	Call Center & PC Web	Call Center & Texting	PC Website & Texting
1	12	7	4	0	0	1	0	0	0	0
2	17	9	5	0	1	1	1	0	1	0
3	20	5	10	2	0	2	0	1	0	0
4	13	7	2	0	2	0	1	0	0	1
5	18	11	6	0	1	0	0	0	0	0
6	27	11	11	3	1	0	2	1	0	0
7	7	0	6	0	0	0	1	0	0	0
<b>Total</b>	<b>98</b>	<b>37</b>	<b>38</b>	<b>5</b>	<b>5</b>	<b>4</b>	<b>5</b>	<b>2</b>	<b>1</b>	<b>1</b>

Multiple watermen used multiple platforms and reported from multiple regions throughout the Pilot Project.

## 2.1 PARTICIPANT USE OF AND PERSPECTIVES ON THE CALL CENTER

Watermen using the call center were contacted by phone twice during the 2014 Pilot Project. The first series of phone calls were made after an issue with connectivity to the call center was identified by watermen. On June 19, 2014 watermen using the call center began calling the help line stating that they were unable to report using the call center because the calls were never answered. After numerous calls between the Pilot Project staff, participating watermen using the call center, and the call center representative, the problem was identified and resolved. The complete case study of this connectivity issue is provided in the Appendix A.

The second series of calls was conducted to gather information about the watermen's perspectives of the call center, and to determine why they chose to use the call center for reporting, and to determine what incentives might cause them to switch to another reporting platform (e.g. text messaging or web-based reporting). This effort was initiated on September 3, 2014 and phone calls were made over a three week period. Of the 43 watermen who were contacted, only 27 provided feedback to the survey; reasons for watermen not providing feedback included disconnected phone lines, not returning messages, and declining to answer any questions.

Twenty-one (78%) watermen indicated that the call center was sufficient for their reporting needs. When asked if there was a specific reason why they chose to use the call center, the most common response was that they were not very tech savvy and felt that the call center was all they could use (11 waterman, 41%); 9 watermen (33%) indicated that it was more convenient, 2 watermen (7%) indicated that they used it before and liked it, 1 waterman (4%) indicated that they did not know there were other options, and 4 (15%) gave other responses. Twenty-one (78%) watermen indicated that they owned cell phones capable of sending and receiving text messages, but only 10 (37%) indicated that their phones had the capability to access the internet. Lastly, the watermen were asked if potential incentives such as provided training would persuade them to switch reporting devices and therefore increase the use of web-based and text-message reporting. Thirteen watermen (48%) said that there was nothing that could be done, 4 (15%) answered that better training needs to be provided, 4 (15%) answered that hardware and/or service plans need to be provided, and 6 (22%) gave other responses, such as having already switched to the other reporting platforms.



### 3.0 SYSTEM USE BY PARTICIPANTS

The Maryland 2014 crabbing season began April 1, 2014 and the first electronic crabbing trip was submitted on April 3, 2014. Data presented in this report consists of trips submitted until September 28, 2014 although the crabbing season continues until December 15, 2014. The total number of trips reported by all participating watermen was 3,603 (Table 3-1; Figure 3-1). After the first full week of operation the number of reports increased steadily and peaked during the week of August 3, 2014.

Reporting by watermen was compared by month, gear type, and day of week. Nearly all the watermen trained to use the electronic reporting system reported hails and harvest in July and August (Table 3-1; Figure 3-2). April had the least number of watermen reporting harvest and hail information. Watermen using crab pots had the highest number of trips reported and those crabbing with trotlines had the second highest number of trips reported; however, the number of watermen reporting harvest using trotlines was higher than crab pots. The number of watermen reporting on both weekends and weekdays was similar; however there were substantially more trips during the weekday.

Table 3-1. The total number of watermen and trips by month, gear type, and day of the week for the 2014 Pilot Project.

		Total # watermen	Total # Trips
Month	April	5	20
	May	44	262
	June	73	744
	July	83	879
	August	81	994
	September	74	704
Gear Type	Crab Pot	41	1895
	Dip Net	2	32
	Peeler Pot	3	10
	Scrape/Dredge	7	500
	Trotline	51	1153
Day of the Week	Weekday	91	2711
	Weekend	89	891

Multiple watermen used multiple gear types throughout the Pilot Project.

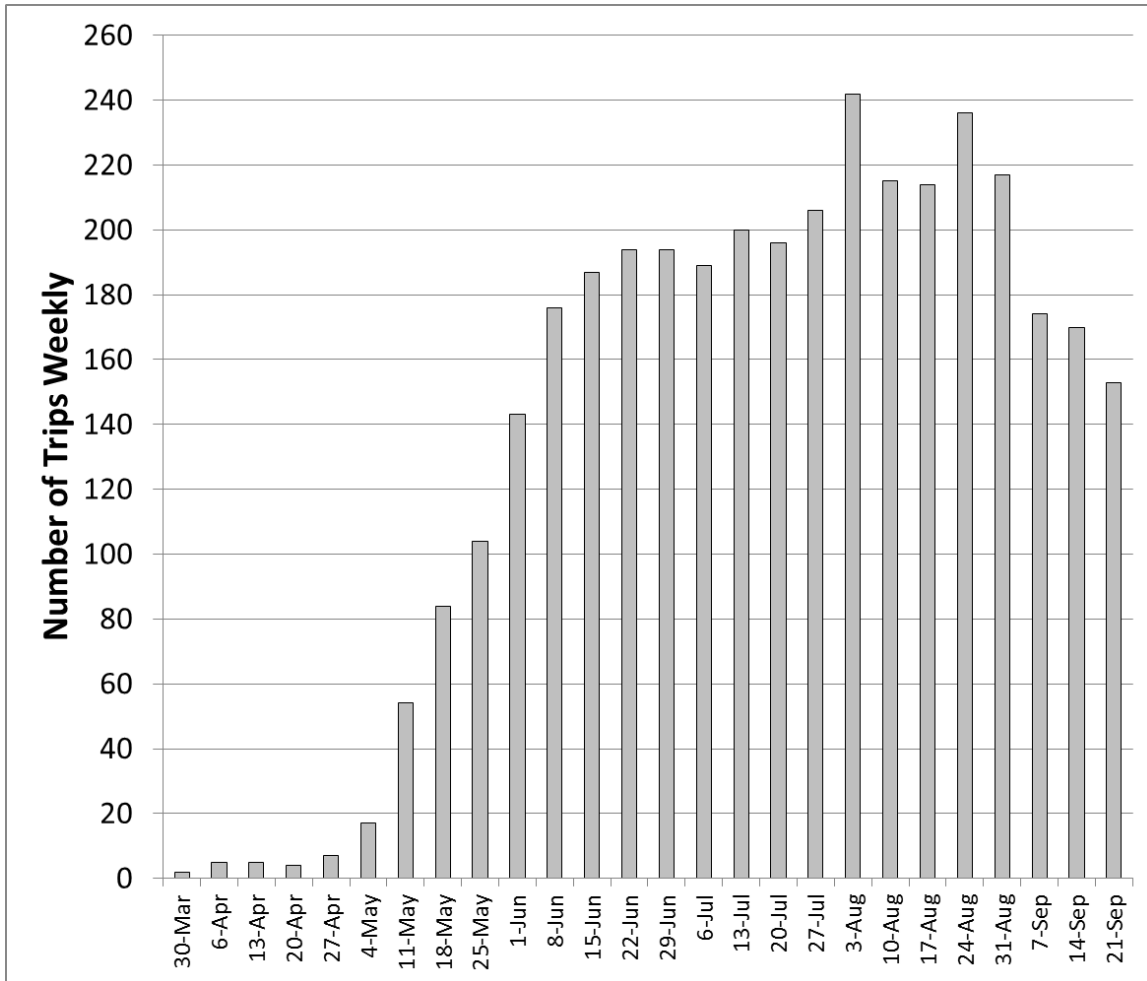


Figure 3-1. The number of crabbing trips reported weekly during the 2014 crabbing season in Maryland.

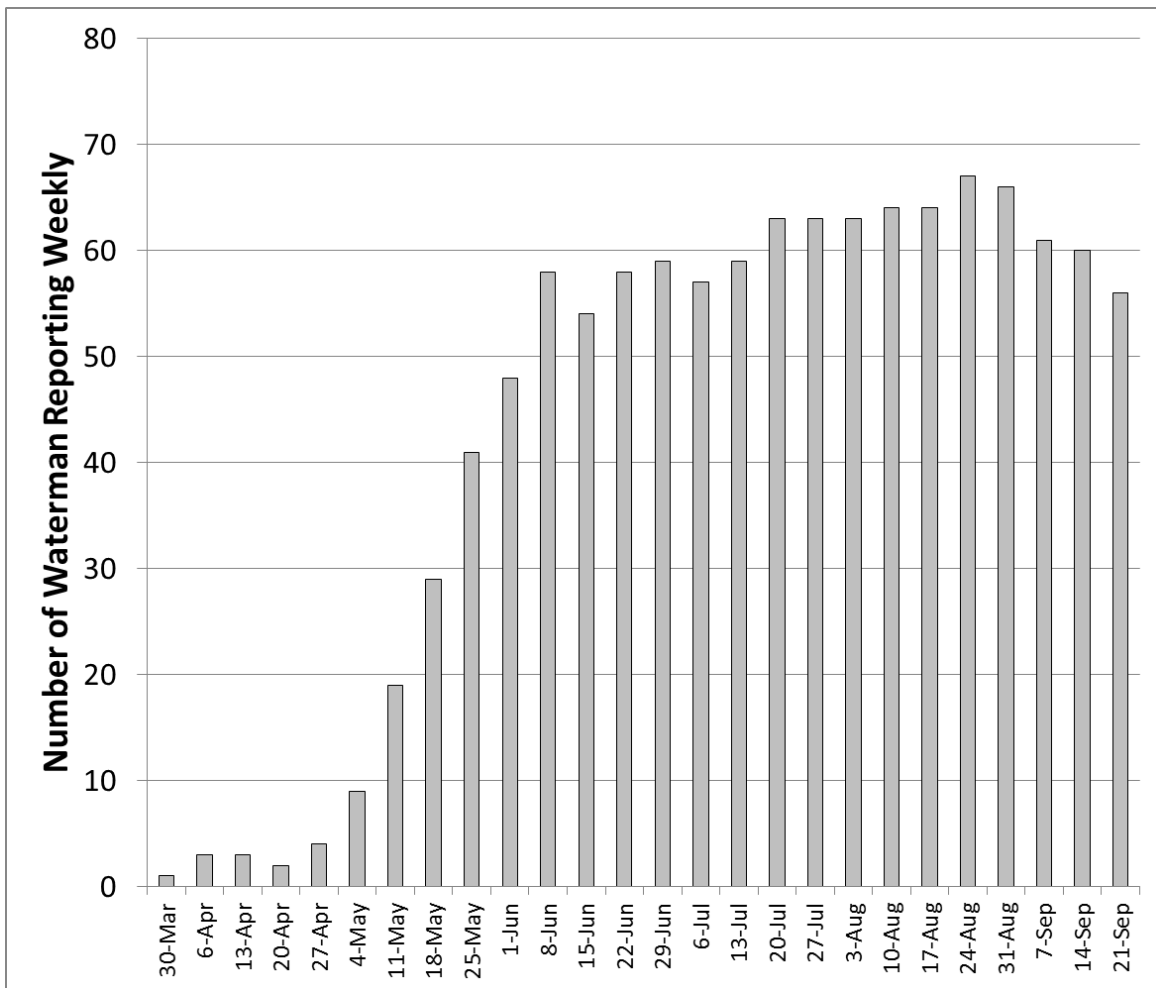


Figure 3-2. The number of waterman reporting crabbing trips weekly during the 2014 crabbing season in Maryland.

Three percent of trips had revisions to the start hail and 1% of the trips had revised end hails and harvest reports (Table 3-2). Reasons for watermen submitting a revised harvest report without actually changing harvest information include instances when a waterman wanted to verify their data entry or if they estimated the number of peelers while on the water and then revised harvest after actually counting the number of peelers. Thirty-six percent of watermen revised their hails and 22% revised harvest information (Table 3-3). Over the course of the program, 40% of watermen forgot to submit at least one end hail and 52% forgot to submit at least one harvest report.



Table 3-2. The total number of hails and harvest reports submitted, revised, and cancelled by region during the 2014 Pilot Project.

Region #	Total # Watermen	Type of Electronic Report							
		# Start Hails Submitted	# Start Hail Revised	# End Hails Submitted	# End Hail Revised	# Harvest Report Submitted	# Harvest Report Revised	# End Hail Not Submitted	# Harvest Report Not Submitted
1	12	551	4	527	5	524	8	24	27
2	17	439	5	402	3	382	6	37	57
3	20	597	14	589	7	589	3	8	8
4	13	176	10	171	7	169	2	5	7
5	19	733	11	678	10	672	5	55	60
6	28	536	65	527	4	521	3	9	15
7	7	571	5	562	10	560	5	9	11
Total	98	3,603	114	3,456	46	3,417	32	186	185

Multiple watermen reported from multiple regions throughout the Pilot Project.

Table 3-3. The total number of watermen that revised and cancelled hails and harvest reports by region during the 2014 Pilot Project.

Region #	Total # Watermen	Type of Electronic Report				
		# Start Hail Revised	# End Hail Revised	# Harvest Report Revised	# End Hail Not Submitted	# Harvest Report Not Submitted
1	12	3	3	3	6	7
2	17	2	3	3	5	8
3	20	6	4	2	4	5
4	13	4	2	2	4	9
5	19	7	9	5	9	6
6	28	12	4	3	5	10
7	7	4	6	4	5	6
Total	98	35	30	22	39	50

Multiple watermen reported from multiple regions throughout the Pilot Project.

## 4.0 HARVEST VERIFICATION

The 2014 harvest verification program followed the basic design that was implemented during 2012 and 2013 Pilot Projects (Slacum et al. 2014; Slacum et al. 2013). Harvest was verified by roving monitors that conducted “spot checks” of individual watermen’s harvest when it was offloaded from their vessels. Monitoring occurred between August 10 and September 28, 2014 using these two scheduling approaches:

- Method 1 (Priority List) – All Pilot Project participants were ranked based on previous levels of crabbing activity (provided by DNR). Two categories were used: high priority watermen crabbed between 0-40 days and low priority watermen crabbed more than 41 days. Watermen with low levels of crabbing activity were considered the highest priority for monitoring and higher levels of activity were lower priority.
- Method 2 (Targeted Monitoring) – The goal of targeted monitoring was to schedule monitoring at as many different offload locations as possible when monitoring occurred.

Priority list spot checks were scheduled randomly, and the number of days scheduled in each region was based on monitoring 10% of trips made by high priority watermen as reported in July. These “Priority” days were conducted on Saturdays and Sundays, and focused only on the high priority watermen. Targeted spot checks were also scheduled randomly, and the number of days scheduled in each region was based on monitoring 5% of the trips made by all watermen except high priority watermen as reported in July. These “Targeted” days were conducted on week days (Monday through Friday), and focused on all watermen landing in a roving monitor region.

### 4.1 EFFECTIVENESS OF DOCKSIDE MONITORING

Spot checks were conducted between August 10 and September 28, 2014, over which time a total of 1,394 trips that could be monitored were reported by watermen. Spot checks were attempted on 151, or 11%, of all scheduled trips (Table 4-1). A spot check was defined as successful when a roving monitor was able to intercept a waterman and document the entire harvest offloaded from the vessel. Of the 151 spot checks, 75% were conducted successfully (Figure 4-1). The main reason for unsuccessful spot checks was due to offloads not occurring when scheduled (37 attempted spot checks, 97%). Other reasons for unsuccessful spot checks included roving monitors being unable to find the vessel (1 attempted spot check, 3%).

Table 4-1. The total number of crabbing trips that coincided with dockside monitoring in each region and the number of spot checks attempted and successfully completed in each region during the 2014 Pilot Project.

Region #	Total # Crabbing Trips	# of Trips a Spot Check was Attempted	% of Trips a Spot Check was Attempted	# of Successful Spot Checks	% Successful Spot Checks
1	150	21	14%	18	86%
2	189	17	9%	11	65%
3	276	32	12%	23	72%
4	86	11	13%	10	91%
5	282	37	13%	27	73%
6	189	18	10%	9	50%
7	222	15	7%	15	100%
Total	1,394	151	11%	113	75%

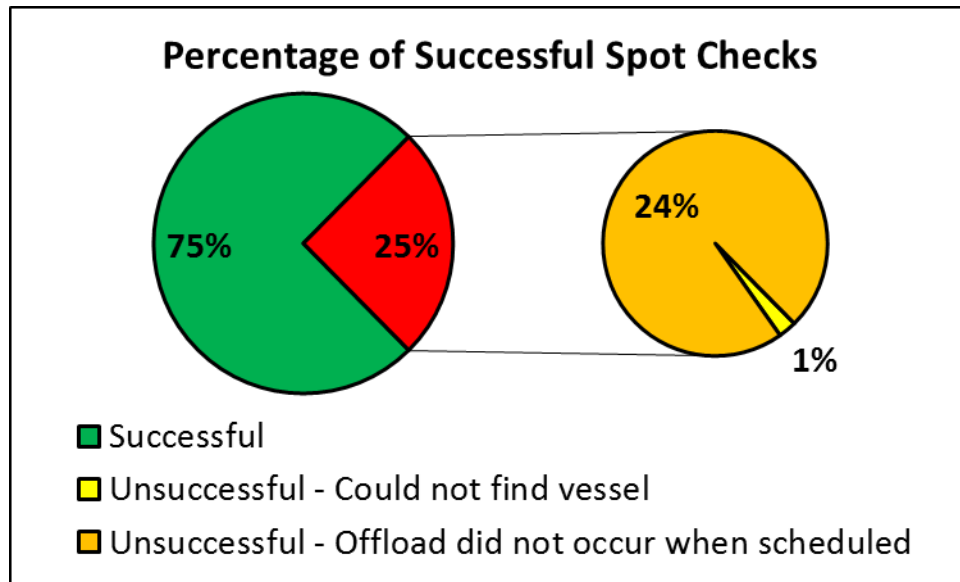


Figure 4-1. Percentage of all successful and unsuccessful spot checks conducted in the 2014 Pilot Project on Maryland commercial blue crab harvest.

During the 2014 monitoring period there was one waterman who was not spot checked after multiple attempts. After the third consecutive unsuccessful monitoring attempt the watermen was contacted to determine if the waterman was reporting landing locations correctly. Upon talking with the waterman, it was determined that the problem was that the waterman was entering the wrong landing location code in the text message string when hailing. This incorrect code would then direct the roving monitor to the wrong offload location. In reviewing the original preference sheet of the watermen, his primary landing location was coded as “LL1” however the locations were reordered in FACTS, resulting in his primary landing location re-assigned as “LL2.” The correct codes were given to the waterman and the problem was resolved.

#### 4.2 ROVING MONITOR AND WATERMEN REPORT COMPARISONS

Harvest information reported by watermen was compared to roving monitor reports (spot checks) to evaluate the accuracy of reported harvest (Table 4-2). Discrepancies between reports were identified by comparing the six reported crab harvest grades (#1’s, #2’s mixed males, females, peelers, and soft crabs) between watermen and roving monitor reports.

	#
Total number of trips with report comparisons	111
Total # of trips with report comparisons with discrepancies	44
Total # of harvest grade comparisons	666
Total # of harvest grade comparisons with discrepancies	89

2 trips were missing watermen harvest information but had roving monitor harvest information.

Harvest accuracy was determined using a two-step process. The first step determined the accuracy of roving monitor reports and the second step involved screening discrepancies identified between reports and evaluating the source of the discrepancy to determine if the discrepancy was a legitimate difference between monitoring data and the harvest report. Harvest report accuracy was then quantified as the percentage of differences between reports. This process only quantified the amount of discrepancies between roving monitor and watermen reports and was not applied to reported harvest to determine overall reporting error. Additional methods must be developed in order to apply the error to overall harvest.

Harvest unit discrepancies occurred a total of 10 times, rounding differences occurred 4 times, and 19 discrepancies from revising harvest grade counts were identified (Table 4-3). There were a total of 31 trips with roving monitor reports that could be compared to watermen



harvest reports where data entry discrepancies occurred (28% out of the 111 trips with successful roving monitor spot checks) resulting in 56 harvest grade discrepancies. In 2014, harvest reported in bushels was limited to reporting in increments of quarter bushels. This data validation rule contributed to decreasing the number of discrepancies caused by rounding as compared to 2013. In 2013, 12% (20 out of 168) of the discrepancies were caused by rounding compared to 7% in 2014.

Table 4-3. Causes of data discrepancies between watermen and roving monitor reports during the 2014 Pilot Project.

Discrepancy Type	# Trips	# Harvest Grade Reports						
		Total	#1s	#2s	Female	Mixed Male	Peeler	Soft Shell
Harvest reporting unit difference	4	10	2	2	4	2	0	0
Rounding difference	2	4	3	1	0	0	0	0
Revising harvest grade counts difference	15	19	0	0	0	0	8	11
Data entry error	31	56	13	6	9	13	6	9

The number of crabs reported by watermen versus those reported by roving monitors was plotted per trip to visually compare the relationship between reports (Figure 4-2). The r-square regressions of watermen reports compared to roving monitor reports ranged from 93 to 98% in reporting for male crabs, female crabs, and peelers. The relationship of watermen reports compared to roving monitor reports of soft crabs was weaker at 57% due mostly to 5 large discrepancies between reports.

#### **4.3 EFFECTIVENESS OF DEALER REPORTING AND DEALER AND WATERMEN REPORT COMPARISONS**

Dealer reporting was conducted between May 14, 2014 and September, 27, 2014, over which time a total of 152 dealer reports were submitted into the electronic reporting system concurrent with the harvest reports from these three watermen. The dealer reports were used to determine data discrepancies for reported harvest.

Harvest information reported by watermen was also compared to dealer reports to evaluate if the accuracy of reported harvest was quantifiable (Table 4-4). Only four grades could be compared (#1's, #2's mixed males, and females) between watermen and dealer reports because the participating dealer did not purchase peelers or soft crabs.

Harvest accuracy was determined by screening discrepancies identified between dealer and watermen harvest reports and evaluating the source of the discrepancy to determine if there was a difference between the harvest reports. Harvest report accuracy was then quantified as the percentage of differences between reports. This process only quantified the amount of discrepancies between dealer and watermen reports and was not applied to reported harvest to determine overall reporting error. Additional methods must be developed in order to apply the error to overall harvest.

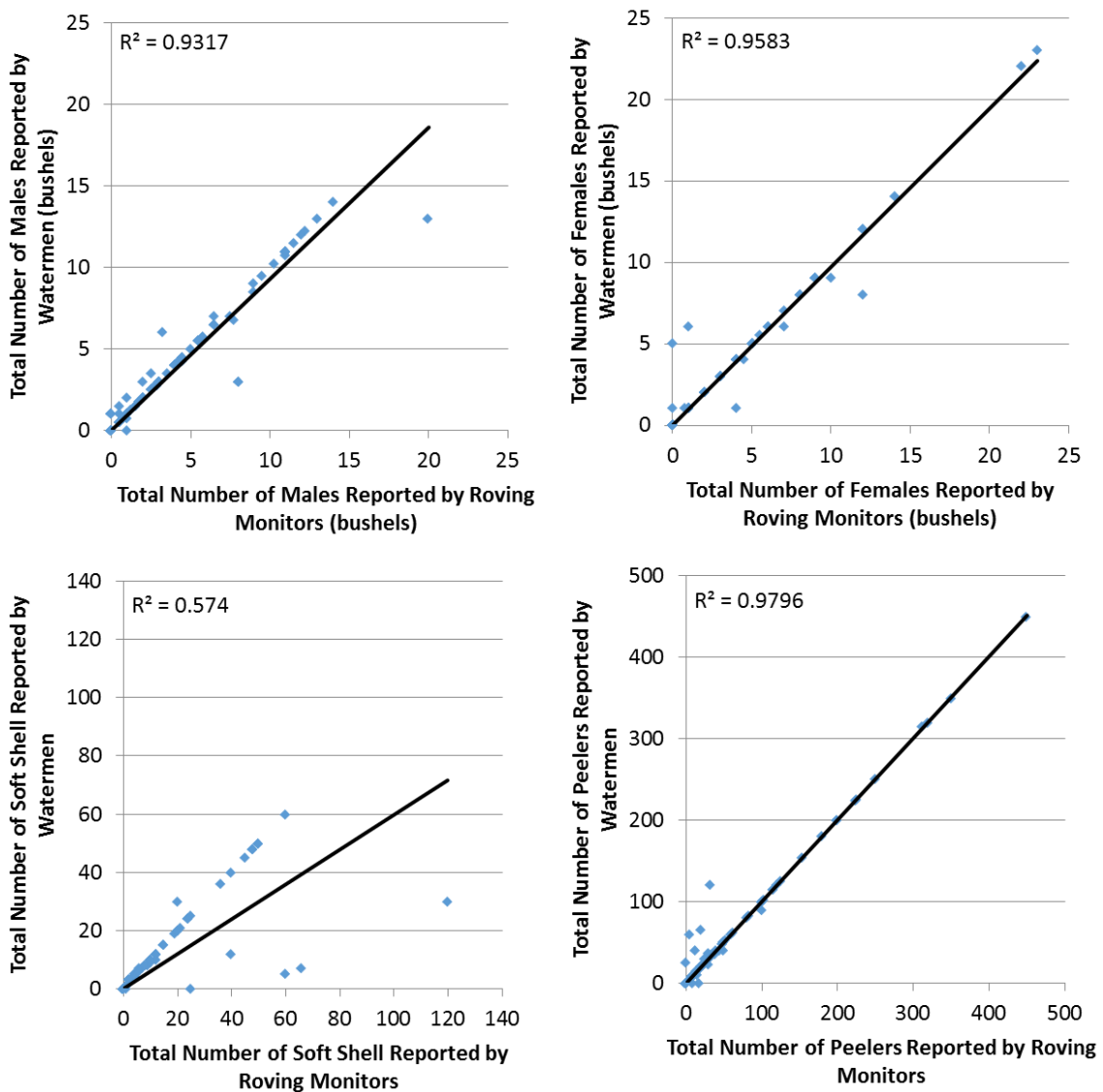


Figure 4-2. Number of crabs by grade reported by watermen and roving monitors per crabbing trip in the 2014 Pilot Project on Maryland commercial blue crab harvest.



Table 4-4. Number of comparisons conducted by dealers with corresponding waterman harvest report during the 2014 Pilot Project.	
	#
Total number of trips with report comparisons	146
Total # of trips with report comparisons with discrepancies	134
Total # of harvest grade comparisons	584
Total # of harvest grade comparisons with discrepancies	442
6 trips were missing watermen harvest information but had dealer harvest information	

Reports identified with discrepancies were tagged and reviewed to determine the source of each discrepancy. Two common groups of discrepancies were identified as harvest reporting with different units and data entry error. Three trips had data entry error discrepancies occurring in one harvest grade each. Ninety-four percent of the trips had a harvest reporting unit difference whereas the watermen and the dealer reported harvest each with different units (either bushels or pounds).

## 5.0 SYSTEM MONITORING

### 5.1 SYSTEM MONITORING OF WATERMEN NOT REPORTING

Currently the reporting system has no option for watermen to acknowledge when they do not intend to actively crab during specific time periods. The system assumes that a watermen is not fishing when no trip reports are submitted by watermen. However, since the use of the system was voluntary, some effort was required to contact watermen during the season who had been trained to use the system, but for whom no trips had been reported.

Two series of calls were made during the crabbing season. The first series of calls were conducted mid-season to determine if watermen who had not reported for an extended period of time were either not crabbing or were not intending to use the electronic system to report. The second series of calls were made near the end of the season to follow-up with watermen who intended to use the system, but had not reported for the entire season, and determine when individual watermen expected to stop crabbing for the year.

For the first series of calls, the system was monitored to establish which pilot participants were inactive and therefore had not reported any trips. This included a total of 31 watermen. These watermen were called to determine if they were or were not crabbing and if they were, whether they were still reporting using the paper reporting method or if they were using the electronic system to report and therefore needed their harvest reports back-entered into the FACTS system. Out of the 31 participants that were called, 20 were reached leaving 11 who were unable to be contacted. In three of these cases the line was disconnected and in the remaining 8 cases, voicemails were left and not returned. Eighteen out of the 20 crabbers that were contacted indicated that they had not yet been crabbing or did not plan on going crabbing for the entire season. There were 2 participants that did report that they had been crabbing; one who was still using the paper method of reporting due to not realizing that he was signed up for the program and the other who was only crabbing using his recreational license because of the status of the blue crab population during the past season.

The second series of calls were conducted in the month of October, to determine if watermen who had been inactive in the system for an extended period of time (meaning they had not reported since August, if not earlier in the year) were still crabbing or intended to crab before the season was over. Previously, participants were given a check box that they were able to check during their reporting process when they determined that it would be their last day of crabbing for the season. This function was later removed from the reporting system so that it then had to be assumed that when no trip reports were submitted for an extended period of time, the waterman was no longer crabbing. Follow up calls were then made to confirm these assumptions.. These follow up calls established whether or not the watermen had been crabbing since their last crabbing trip and verified whether or not they were finished crabbing for the season. Twenty watermen were identified for these calls and 12 were reached, and 8 were left messages or could not be reached. All 12 watermen who were reached reported that they had not been

crabbing since their last date reported and the majority of these watermen also claimed that they were finished or most likely finished crabbing for the season.

## **5.2 SYSTEM MONITORING OF BEST PRACTICES**

System reports and other monitoring tools were implemented during 2014 to assess information submitted to the electronic reporting system. Assessing system performance was based on the ability of the system to remain operational for reporting during the season and being able to identify and track reporting inconsistencies along with sources of error. Reporting inconsistencies were considered to be deviations from the established reporting “Best Reporting Practices” that were established based on recommendations from the 2012 and 2013 Assessment. Reporting inconsistencies have the potential to increase the amount of effort required to verify reported harvest and to undermine the ability of the system to acquire timely and accurate harvest information. Sources of error were identified as discrepancies and data outliers observed in reported data. Additional monitoring of system performance, such as feedback through the help line and cellular service problems, were conducted manually by Pilot Project staff.

The ability of participants to follow the “Best Reporting Practices” was evaluated by comparing the submission times of hails and harvest logs and through monitoring of other reporting process behaviors (Table 5-1). If a waterman submitted an end hail prior to 8 A.M., it was flagged as atypical due to the majority of watermen typically finishing crabbing after 10 A.M. Instances such as this suggest the end hail was not submitted at the end of a crabbing trip. Seven percent of watermen submitted trip end hails before 8 A.M. for a total of 17 trips. The majority of end hails submitted before 8 A.M. occurred from April to June (11 of the 17 trips). Follow up phone calls made by Pilot Project staff to reiterate the reporting process contributed to the decrease in these types of instances over time. The second type of atypical behavior was based on the interval of time between start and end hails. If a trip had a start and end hail submitted within 15 minutes, it could be assumed that either the start hail was not submitted at the beginning of a crabbing trip or the end hail was not submitted at the end of a crabbing trip due a typical crabbing trip lasting longer than 15 minutes. Forty-eight percent of watermen submitted at least one start and end hail within a 15 minute interval which generated a total of 575 flagged trips. Further review found 327 of these trips (57%) occurred by Smith Island watermen that had trouble with cell signal strength. The last atypical trip identifier focuses on watermen sending harvest reports after 5 P.M. If a harvest report was submitted after 5 P.M., it was assumed to be an instance where harvest was not reported while the waterman was still on the water at the end of their crabbing day. Harvest reports submitted after 5 P.M. occurred on 516 trips by 63% of the watermen.

Table 5-1. The total number of watermen and reported trips that did not follow the recommended “Best Reporting Practices.”

	<b>Total # Watermen</b>	<b>Total # Trips</b>
<b>Submitted an End Hail Before 8 A.M.</b> Majority of watermen do not finish crabbing until after 10 A.M. thus this could be assumed to be an instance where an end hail was not submitted at the end of a crabbing trip	7	17
<b>Submitted a Start and End Hail within 15 minutes</b> Majority of watermen crab longer than 15 minutes thus this could be assumed to be an instance when either a start hail was not submitted in the morning before crabbing begins or at the end of the day when crabbing is finished	47	575
<b>Harvest Submitted After 5 P.M.</b> Majority of watermen have finished crabbing before 5 P.M. thus this could be assumed to be an instance where a waterman did not report harvest at the end of the crabbing day while still on the water	62	516

### 5.3 SYSTEM MONITORING OF MISSING HARVEST REPORTS

A total of 3,603 harvest reports were submitted by watermen from all reporting platforms. A total of 185 (5%) crabbing trips were missing harvest reports. The trips missing harvest reports submitted to the electronic reporting system had a hail but no harvest report, suggesting occasions when a waterman forgot to submit harvest after a crabbing trip. These instances were noted during the Pilot Project and either the watermen by the Maryland DNR to provide them with the harvest or the Maryland DNR followed up with the watermen.

Starting the week of August 3, 2013, the system was modified to include an automated text message which was sent to watermen that hailed in the morning and had not sent a harvest report by 5 P.M. If the system had not received a waterman’s harvest log by 5 P.M., a text message was sent to them at that time. Three additional text message reminders were sent at 6 P.M., 7 P.M., and 8 P.M. if harvest was still not received by those times. The text message reminders made a marked improvement in harvest log reporting with a decrease in missing harvest reporting from 11% to 2% (Figure 5-1). After August 3<sup>rd</sup>, the percentage of trips with missing harvest reports decreased to 2%.

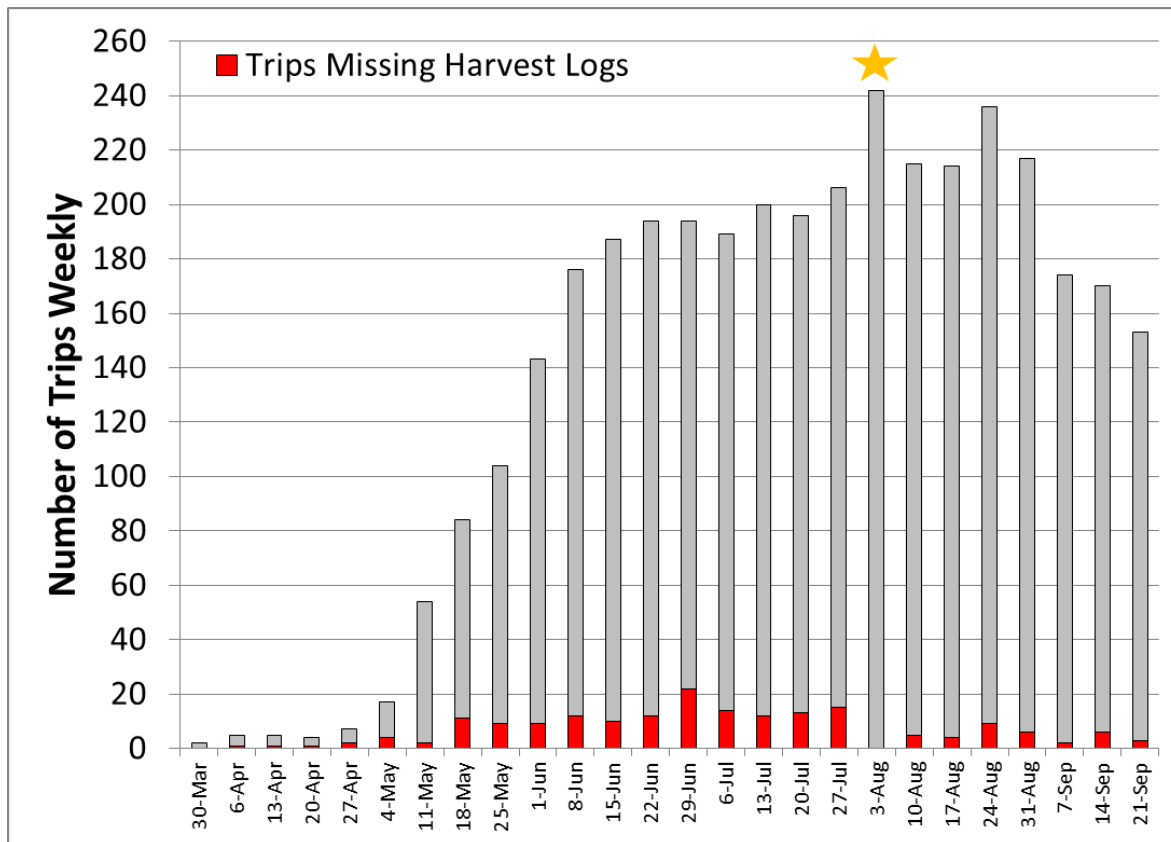


Figure 5-1. Number of weekly trips and trips with missing harvest logs (as shown in red) by watermen during the 2014 Maryland blue crab commercial harvest season. A text message reminder to submit harvest was implemented on August 3<sup>th</sup> (yellow star).

#### 5.4 EFFORT TO RECOVER MISSING HARVEST REPORTS

When a missing harvest report was identified, the specific trip was flagged and the Maryland DNR was required to follow-up with the watermen to recover the missing harvest. Watermen were immediately called to recover the information and if the waterman could not be reached on the first call, a voice message was left and if a return call was not received, the waterman received an additional call the following week. This process was continued until the missing harvest report was retrieved or the season ended.

During the time period of August through November, 90 watermen forgot to submit a harvest report on at least one crabbing trip. Some watermen forgot to submit harvest reports for multiple trips causing there to be a total of 113 trips with missing harvest reports throughout the season (Table 5-2). A total of 83 watermen were able to be contacted and 96 missing harvest reports were recovered. It required ninety-eight phone calls to recover missing harvest reports that were able to be retrieved. However, missing harvest could not be recovered for 17 trips reported by 7 watermen because those watermen were unable to be contacted, although 22 calls were attempted (Table 5.2).



Table 5-2 The number of missing harvest reports that were unable to be retrieved in comparison to those that were and the effort (shown in cumulative number of calls) that it took to retrieve these reports.

	<b>Number of Watermen</b>	<b>Number of Reports</b>	<b>Cumulative Number of Calls Made</b>
<b>Reports Retrieved</b>	83	96	98
<b>Reports Not Retrieved</b>	7	17	22
<b>Total</b>	<b>90</b>	<b>113</b>	<b>120</b>

Most of the watermen using the reporting system always reported harvest (Table 5-3). When missing harvest did occur, it accounted for only a small fraction of a waterman’s total trips, but required nearly three phone calls to recover the harvest. There was however an increasing trend of more missing harvest reports for watermen with large numbers of trips reported during the season (Figure 5-2).

Table 5-3 Percent of Watermen’s total crabbing trips with missing harvest reports and the effort required (number of calls on average) to collect these missing reports per watermen.

<b>% of Watermen’s Total Crabbing Trips with Missing Harvest Reports</b>	<b>Number of Watermen</b>	<b>Effort Required to Collect Missing Reports (Average # of calls made)</b>	<b>Range of Calls Made to Individual Waterman</b>
0	47	0	0
1 - 10	21	2.6	1 - 6
11 - 20	5	2.5	1 - 4
21 -30	3	1.33	1 - 2
31 - 40	2	4	3 - 5
41 - 50	1	2	2
51 - 60	1	2	2
61 - 70	1	2	2
71 - 80	0	0	0
81 - 90	0	0	0
100	2	1	1
<b>Total</b>	<b>83</b>	<b>17.43</b>	

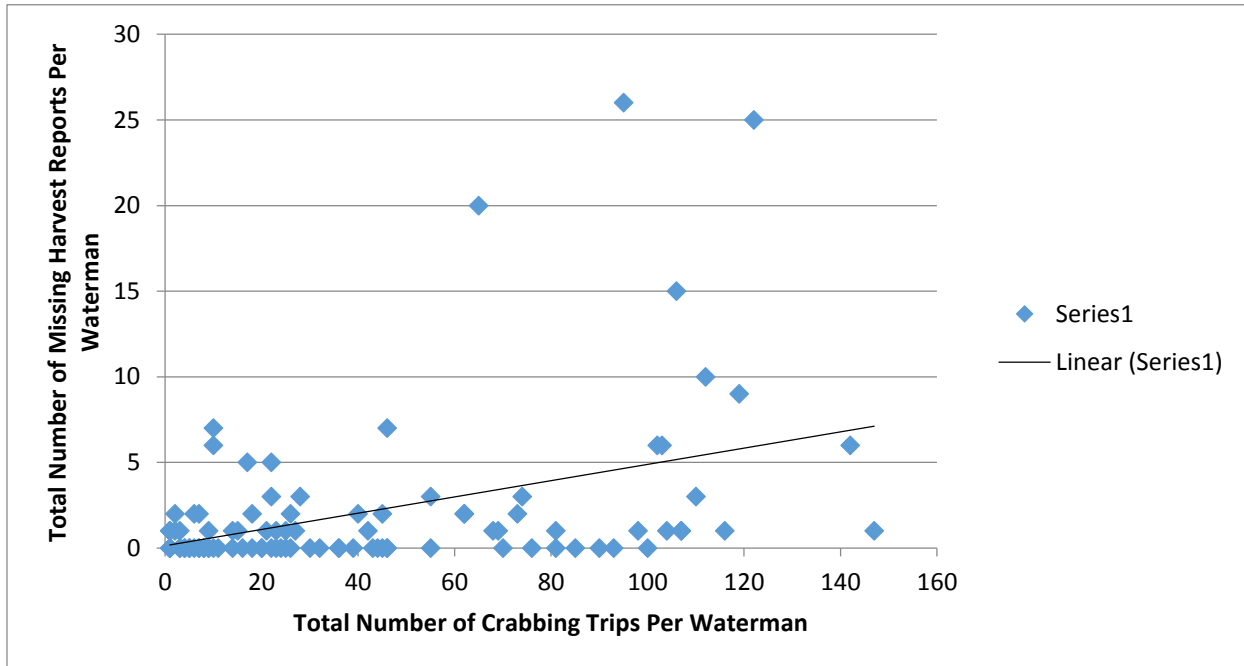


Figure 5-2 Total number of missing harvest reports per watermen in relation to their total number of crabbing trips.

## 5.5 ELECTRONIC REPORTING SYSTEM AND MOBILE DEVICE SUPPORT

Over the course of the 2014 Pilot Project, a toll-free help line was available to the watermen 24-hours a day to assist in troubleshooting any technical issues with the mobile device or reporting system and to provide an outlet for watermen to submit feedback on the 2014 Pilot Project. A log recorded the description of each call, date, and type of device the caller was using to report.

Nineteen calls were logged from watermen throughout the 2014 Pilot Project. The most common call to the help line was watermen reporting that they could not get through to the call center and/or that there were long wait times to speak to a call center operator (Table 5-4). Some of these calls pertain to the June 19<sup>th</sup> call center issue (Appendix A) which was quickly resolved. The next most common call type made to the help line was watermen calling to report harvest when they had forgotten to submit it using the system. Additional issues included a call pertaining to a waterman being unable to report female crab harvest. This issue arose from a change in the system coding and after immediately contacting Electric Edge Systems Group, the issue was resolved within 3 hours.

Table 5-4. Reasons for calls to the help line by watermen for troubleshooting questions based on 19 calls during the 2014 Pilot Project.

<b>Call Type</b>	<b>Overall</b>	<b>Call Center</b>	<b>Texting</b>	<b>Website</b>
Unable to get through to Call Center or long wait/hold times	7	7	0	0
Reporting harvest	5	3	0	2
Training on using system	2	0	0	2
Turned off data mode or cookies on mobile device	2	0	0	2
Changing preferences	2	0	0	2
Electronic system issue	1	0	0	1

## 6.0 CONCLUSIONS AND RECOMMENDATIONS

The Pilot Project was continued in 2014 with a goal to maintain the system and expand its use by the blue crab industry. Although participation increased from previous Pilot years, the number of watermen using the system is still a fraction of the total number of active license holders. Watermen who have decided to use the system have required limited training and have had few problems over the course of the Pilot Project. In addition, watermen using the system have also effectively participated in a dockside and dealer monitoring system. These techniques have been successful at verifying harvest and identifying important variables required to assess accuracy of reported information. One aspect of the reporting system that requires further assessment is the level of effort required to recover missing harvest reports, would has the potential to be extremely time consuming if the entire industry used the system to report harvest.

Based on the limited participation and system monitoring conducted during the 2014 Pilot Project, we make the following recommendation:

- Continue to maintain the system so that it is available for the entire blue crab industry;
- Increase outreach to publicize the systems availability for industry use;
- Increase training opportunities and tools to train watermen how to access and report following “Best Reporting Practices”;
- Educate industry on the benefits of using the system;
- Increase efforts to work with dealers to evaluate the effects of reporting on their business practices;
- Continue to evaluate harvest verification techniques;
- Evaluate and quantify the level of effort required to provide user support and recover trip level information not reported electronically.

## **APPENDIX A**

### **CASE STUDY TO RESOLVE CALL CENTER CONNECTIVITY ISSUE IN 2014 BLUE CRAB PILOT PROJECT**

Starting on Thursday, June 19, 2014, Versar staff began receiving phone calls from watermen participating in the Blue Crab Electronic Harvest Reporting Pilot Project who report using the call center. These watermen indicated that when calling the toll free number, 1-855-390-2722, they were unable to reach the call center to submit hail and harvest information. Various Versar staff tried calling the toll free number to confirm this issue however all attempts were successful in reaching the call center without problems. Without any definitive cause for this difficulty in reporting, Versar staff took two courses of action to try and rectify the problem.

First, Versar staff contacted the representative from the call center, Ryan Smith, on Monday, June 23, 2014 to determine if their system was properly functioning. The call center performed an analysis of their system, and the analysis did not return any issues, meaning that the call center was and is performing properly. Second, Versar staff made an attempt to contact all participants using the call center to determine the extent of the problem, and for how long the issue had been occurring. From the calls to participants, there seemed to be a 50/50 split between those having problems reporting and those who were able to report without flaw. Of those watermen who were not able to connect to the call center via the toll free number, they all indicated that the phone would either not ring at all or the ring would be a different sound than usual, with an end result from both scenarios of not being able to connect to the call center. Regardless of whether reporting difficulties were encountered by the participants using the call center, all were provided a direct line, 410-553-8979, to the call center to use as a back-up until the problem could be fixed. One waterman in particular called stating that he could not get through to the call center and had been trying for 3 hours until that point in time. After receiving the direct line, he called back indicating that he had no issues connecting to the call center and was able to report. The majority of watermen also indicated during these calls that the call center operators were proficient at recording hail and harvest information and that all the different operators were consistent in the way that they recorded the information.

From the calls to participants and the initial conversation with the call center, two problems became apparent. First, the issue of connecting to the call center appeared to possibly be linked to the toll free carrier service since the direct line worked when the toll free line did not. Ryan Smith contacted the carrier service to run an analysis to try and diagnose if the problem was occurring on the carriers end. After speaking with the toll free carrier service on July 3, 2014, Versar learned that the toll free carrier uses several carriers to route the calls from participating watermen to the call center for reporting. The toll free carrier stated that they had been having troubles with one of the routing services, and identified that this routing service was used for the one watermen Versar provided as an example. This routing service has been excluded from use by the toll free carrier for routing call center calls in an attempt to fix the connectivity issues.

Another issue regarding connectivity to the call center arose through watermen feedback, indicating that they were unable to get through to the call center or were put on hold for long periods of time when calling before 6:00 A.M. Regarding this complaint, Ryan Smith was

contacted and he stated that there was a lack of staff support during this time frame but that they would add more operators in the early morning to resolve this issue.

Of the watermen reporting using the call center who were surveyed in June, those who reported negative feedback were called back on July 21, 2014 for a follow-up. A total of 11 watermen were called and Versar staff was able to survey 8 of these watermen while messages were left for the remaining three. All 8 of the watermen who were contacted for the follow-up survey indicated that they had been able to reach the call center since the first survey, and that the connectivity issue had gotten much better. They also indicated that when calling before 6:00AM, they were now able to get through to the call center more frequently without being put on hold. Only 2 of the watermen indicated that they still received the hold message from the call center, but stated that these instances were infrequent and that overall they are happy with the way the call center is working. The call center connectivity problem seems to be remedied, and Versar staff will continue to monitor the situation to ensure that all participants can report with as few problems as possible.

## 2015 Maryland FMP Report (August 2016)

### Section 8. Bluefish (*Pomatomus saltatrix*)

As a top predator in the marine and estuarine food web, bluefish are likely to accumulate contaminants such as mercury and polychlorinated biphenyls (PCBs) in their body tissue. A recent report indicates that mercury levels in bluefish have steadily been dropping over the last four decades. The results indicate that regulations on mercury pollution are working. The Maryland Department of the Environment (MDE) monitors contaminants in fish. Based on their monitoring data, MDE recommends not consuming bluefish 15 inches and longer.

Bluefish are a coastal, pelagic species inhabiting inshore and offshore waters of the eastern coast of the United States. Their seasonal migration ranges from Maine to Florida along the Atlantic coast. Estuaries and other near shore habitats are used as nurseries by bluefish larvae and by juveniles. Bluefish are highly targeted by the recreational fishery due to their aggressive feeding behavior. High numbers of large bluefish in the recreational fishery have not been seen in the Chesapeake Bay since the early 1990's. Commercial harvest of bluefish occurs but their soft flesh make them a poor choice to freeze and this limits their market demand. In 2015, new biological reference points were developed during the benchmark stock assessment of the coastal stock because of the uncertainty in the stock recruitment relationship. Based on data through 2014, the bluefish stock is not overfished and overfishing is not occurring.

#### Chesapeake Bay FMP

The Chesapeake Bay Bluefish Fishery Management Plan (CBB FMP) was adopted in 1990 and amended in 2003. The CBB FMP Amendment 1 adopted the Mid-Atlantic Fisheries Management Council (MAFMC) and the Atlantic States Marine Fisheries Commission (ASMFC) coastal overfishing definition and rebuilding schedule. The 1989 ASMFC/MAFMC FMP was initially developed to address the concerns raised by recreational fishermen about harvest by the tuna purse seine fisheries.

The coastal bluefish FMP was the first FMP to be developed jointly by an interstate commission and regional fishery management council. The MAFMC/ASMFC FMP was amended by ASMFC in 1998 to prevent recruitment overfishing, reduce fishing waste, improve cooperative management among states, maximize availability, and improve biological understanding of the species. Addendum I to Amendment 1 (2012) mandated increased collection of length at age data by states responsible for 5% or more of the coastal harvest; MD is exempt from the mandate.<sup>1</sup> The MAFMC has amended the FMP five times (2000, 2007, 2011, 2014 and 2015). The 2015 omnibus amendment for all MAFMC species adds various measures to improve and expand on the Standardized Bycatch Reporting Methodology. It is unclear how this

amendment will affect bluefish fisheries because commercial discards are considered to be negligible in the stock assessment.

Maryland is required to submit an annual compliance report to ASMFC. The compliance report describes the fishery dependent and independent monitoring, current regulations, commercial and recreational landings, and planned management actions.<sup>3</sup>

#### Stock Status

Bluefish are managed as a single coastal stock. A benchmark stock assessment (SA) completed in 2015 projected stocks status through 2018.<sup>2</sup> The peer-reviewed assessment used new input data to improve upon the shortcomings of the previous model, which relied heavily on uncertain relationships between spawning stock biomass (SSB) and future recruitment. Catch estimates and juvenile recruitment indices were incorporated into the age-structured assessment program (ASAP) model to produce estimates of fishing mortality (F) and stock biomass.<sup>4</sup> The 2015 assessment resulted in lower biomass estimates and reference points than the previous model, and a 10% decrease in the acceptable biological catch (ABC) to 19.45 million pounds.<sup>2</sup>

Bluefish are not overfished, i.e. spawning stock biomass in 2014 (191 million pounds) was above the SSB threshold (112 million pounds). SSB was 50% of the target level of 223 million pounds. Overfishing is not occurring, i.e. fishing mortality (F) in 2014 (0.157) was below the threshold of 0.17. Fishing mortality has declined steadily since 2007.<sup>2</sup> Coastal recruitment has historically been variable, but a period of low recruitment persisted from 2008-2012. Coastal recruitment in 2013 and 2014 was above average. Total abundance increased in 2014 to 82 million fish, while total stock biomass decreased slightly from 214 million pounds in 2013 to 208 million pounds in 2014.<sup>2</sup>

#### Current Management Measures

Bluefish allocation among fisheries and coastal jurisdictions is based on historic landings data (1981-1989). Annual stock assessments are used to determine total allowable landings (TAL) for commercial and recreational fisheries. Seventeen percent of the TAL is allocated to the commercial fishery and the other 83% of the TAL is allocated to the recreational fishery. The commercial fishery is managed under state-by-state quotas and Maryland receives 3% of the coastwide quota.<sup>5</sup> For a brief overview of the Atlantic coast bluefish management and fishery performance for 2015 and 2016, go to: <http://www.mafmc.org/bluefish/> The 2016 Atlantic coast commercial quota is 4.88 million pounds and the recreational harvest limit for the coast is 11.58 million pounds.<sup>7</sup> The 2016 TAL is about a 10% decrease from the 2015 TAL. Maryland's 2016 commercial quota is 146,631 pounds, a slight decrease from 2015 (153,662 lbs.).<sup>3,7</sup>



## The Fisheries

Maryland's commercial and recreational bluefish fisheries are open year round with a minimum size limit of 8". The recreational fishery has a daily limit of 10 fish/person/day.

Maryland's commercial landings in 2015 were 91,105 pounds, a 15% increase from 2014 (Figure 1).<sup>3</sup> Approximately 54% of the commercial catch is harvested from the Atlantic Ocean with the remainder caught from the Chesapeake Bay.<sup>3</sup> The Marine Recreational Information Program (MRIP) preliminary harvest estimate (A+B1) for 2015 was 85,749 fish (118,344 lbs) in Maryland, a 42% decrease from 2014 (Figure 2).<sup>8</sup> Live discards (B2) increased from 142,034 in 2014 to 190,360 in 2015 (Figure 2).<sup>8</sup>

## Monitoring Programs

Bluefish data is collected by the Maryland DNR's Chesapeake Bay Finfish Program (CBFP) and Coastal Bays Program. Bluefish are sampled from pound nets (CBFP) to assess size structure of resident bluefish.<sup>3</sup> Seine surveys are conducted in the Chesapeake Bay and the Atlantic Coastal Bays to develop bluefish juvenile indices.<sup>3</sup> The 2015 Chesapeake Bay bluefish juvenile index was 0.02, below the time-series average of 0.22. The 2015 Coastal Bays bluefish juvenile index was 0.41, almost equal to the time-series average of 0.42.<sup>3</sup>

The Chesapeake Bay Multispecies Monitoring and Assessment Program (ChesMMAP) is designed to maximize the collection of biological and ecological data from important finfish species and is implemented by the Virginia Institute of Marine Science (VIMS). Bluefish stomachs have been collected from this survey to evaluate food habits. Bluefish are predominantly piscivorous and consume bay anchovy, spot, menhaden, silver perch, weakfish, and mysid shrimp.<sup>2</sup>

## Issues/Concerns

The 2015 benchmark SA included more robust age data from multiple east coast states as required by Addendum 1 to Amendment 1.<sup>1,2</sup> Age-0 bluefish have a bimodal (spring and summer) recruitment pattern. The contribution of recruits from each season to the adult population is uncertain, although it has been hypothesized that the spring cohort has a greater influence on adult abundance.<sup>4</sup>

The 2015 SA combined young of year indices from 6 states (NH, RI, NY, NJ, MD, VA) into a single composite index to reflect coastal recruitment patterns.<sup>2</sup> Recreational discard mortality is an important factor for bluefish stock assessments but data is limited. The bluefish Technical Committee conducted a thorough review of bluefish discard mortality literature for the latest stock assessment and approved

an estimate of 15% for use in modeling.<sup>2</sup> Commercial discard mortality is uncertain though commercial discards are considered negligible.<sup>2,6</sup>

## References

- <sup>1</sup> ASMFC. 2011. Addendum I to Amendment 1 to the bluefish fishery management plan. Atlantic States Marine Fisheries Commission. Alexandria, VA.
- <sup>2</sup> ASMFC. 2015. Bluefish Benchmark Stock Assessment for 2015. Atlantic States Marine Fisheries Commission. Alexandria, VA.
- <sup>3</sup> Durell, E.Q. 2016. Maryland 2015 Bluefish (*Pomatomus saltatrix*) Compliance Report to the Atlantic States Marine Fisheries Commission. Maryland Department of Natural Resources.
- <sup>4</sup> National Marine Fisheries Service. 2012. Bluefish 2012 stock assessment update. US Dept Commerce, Northeast Fishery Science Center.
- <sup>5</sup> Rootes-Murdy, K. nd. 2014 review of the Atlantic States Marine Fisheries Commission fishery management plan for the 2013 bluefish fishery: Bluefish (*Pomatomus saltatrix*). Atlantic States Marine Fisheries Commission. Alexandria, VA.
- <sup>6</sup> Waive, M. 2011. 2011 Review of the Atlantic States Marine Fisheries Commission fisheries management plan for bluefish (*Pomatomus saltatrix*). Atlantic States Marine Fisheries Commission. Alexandria, VA.
- <sup>7</sup> Fisheries of the Northeastern United States; Bluefish Fishery 2016-2018 Bluefish Specifications. FR Doc. 2016-07263.
- <sup>8</sup> Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division. June 2, 2016.
- <sup>9</sup> Personal communication from the Atlantic Coastal Cooperative Statistical Program, Joseph Myers. (2016).

Figure 1. Commercial bluefish landings in Maryland from 1950 to 2015.<sup>3,9</sup>

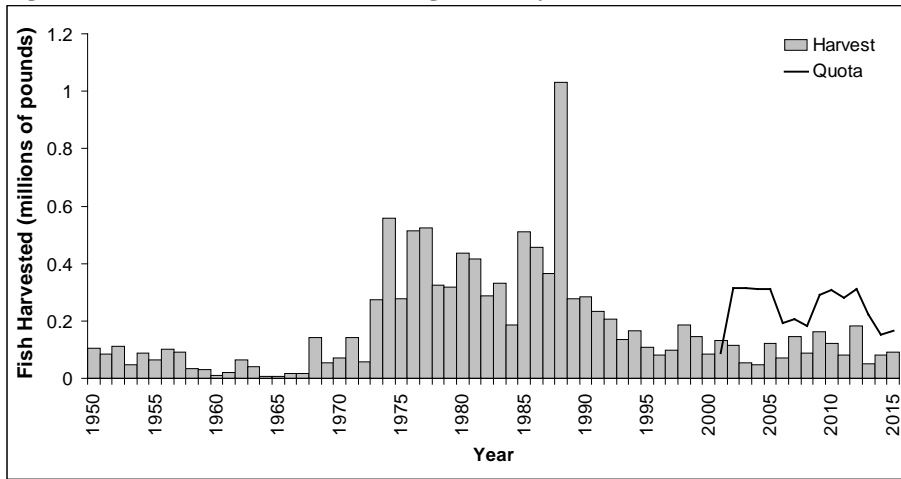
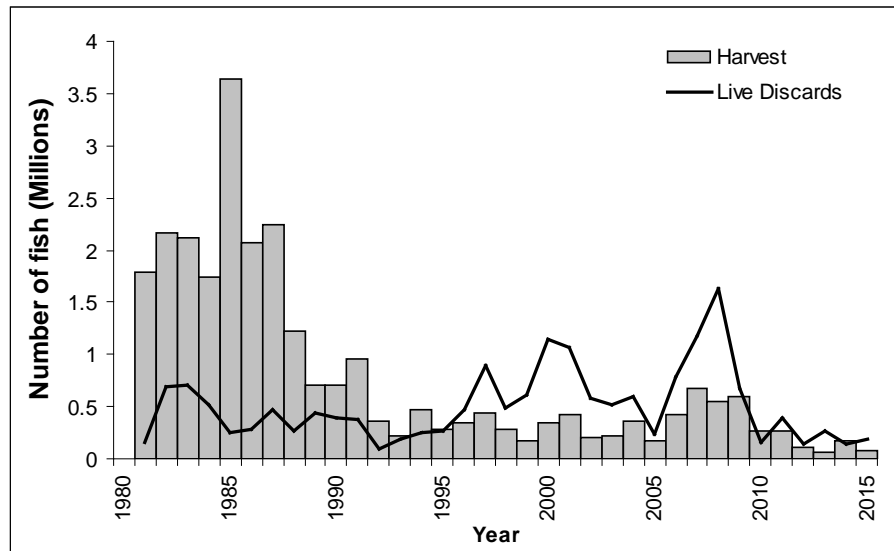


Figure 2. Estimated number of bluefish harvested and live discards by the recreational fishery in Maryland from 1981 to 2015.<sup>8</sup>



**2003 Amendment #1 to the 1990 Chesapeake Bay Bluefish Fishery Management Plan Implementation Table (updated 8/2016)**

<b>Problem Area</b>	<b>Action</b>	<b>Date</b>	<b>Comments</b>
<b>Stock Status</b> <b>Management Strategy</b> Management measures for the bluefish stock in the Chesapeake Bay will be based on the most recent coastal stock assessment. As stock assessment data, specific to the bluefish resources in the Bay, becomes available, additional measures will be developed. Management actions in Amendment #1 of the 1990 CBP Bluefish FMP will gradually rebuild the bluefish stock in the Chesapeake Bay and its tributaries over a 9-year period by reducing F and increasing SSB.	<b>Action 1.0</b> CBP jurisdictions will continue to participate in scientific and technical meetings for managing bluefish along the coast and estuarine waters.	1999 Continue	MD and VA staff participate on technical and advisory committees for both MAFMC and ASMFC.
	<b>Action 1.1</b> CBP jurisdictions will adopt the MAFMC/ASMFC overfishing definition, and adhere to the 9-year rebuilding schedule for the coast wide management of bluefish: F=0.51 (1999-2000) F=0.41 (2001-2003) F=0.31 (2004-2007).	1999 Continue  2008  2015	The 9-year rebuilding schedule reduced F: F=0.51(1999-2000) F=0.41(2001-2003) F=0.31(2004-2007) The bluefish stock is rebuilt, and overfishing is not occurring. <b>Fishing mortality target is <math>F_{MSY} = 0.170</math> and most recent F estimate is 0.157, below the target.</b>
<b>Fishery</b> <b>Management Strategy</b>	<b>Action 2.0</b> CBP jurisdictions will adhere to the commercial TAL established by the MAFM/ASMFC. Individual state-by-state TALs are based on historic landings from 1981-1989.	Continue	<b>TAL may vary annually. NMFS revised the 2016 TAL to 16.46 million lbs. The coastal commercial quota is 4.88 million lbs. and the recreational harvest limit is 11.58 million lbs. MD receives 3% of the commercial quota, 146,631 lbs. VA receives 11.87% or ~580,000 lbs. For 2016, the VA quota was adjusted to include a state quota transfer request to Rhode Island. VA final quota for 2016 is 500,287. TAL had no allocation for research set-aside quota for 2015.</b>
	<b>Action 2.1</b> CBP jurisdictions will continue to require licenses for harvest and sale of bluefish.	1991	Commercial licenses are required by each jurisdiction. VA requires an additional permit for commercial hook and line through a limited entry system. In VA, any species not managed under a coastal quota system is subject to the corresponding recreational creel limit for that species in the commercial hook and line fishery.
	<b>Action 2.2</b> CBP jurisdictions will adhere to the coastal recreational harvest level established by the MAFMC/ASMFC. Virginia and the Potomac River Fisheries Commission (PRFC) instituted a 10 fish recreational creel limit in 1990.	1990 1991 Continue	Historically, recreational landings have accounted for 80-90% of the total catch. MD has a 10 fish creel limit with an 8 inch minimum size limit. VA and PRFC have a 10 fish creel, but no minimum size limit. <b>The coastwide Recreational Harvest Level (RHL)</b>

<b>2003 Amendment #1 to the 1990 Chesapeake Bay Bluefish Fishery Management Plan Implementation Table (updated 8/2016)</b>			
<b>Problem Area</b>	<b>Action</b>	<b>Date</b>	<b>Comments</b>
	Maryland established a 10 fish recreational creel limit in 1991. Creel limits and minimum size limits may be modified, based on the annual TAL established for the Atlantic coast.		<b>for 2016 is 11.58 million lbs.</b>
<b>Research and Monitoring Strategy</b> CBP jurisdictions will monitor the commercial and recreational fisheries and improve catch and effort data. CBP jurisdictions will also pursue studies to evaluate the social and economic aspects of the bluefish fishery in the Chesapeake Bay.	<b>Action 3.0</b> CBP jurisdictions will continue to collect catch and effort data from the commercial fishery, and expand the economic data to include dollar value of the commercial fishery and the annual dockside value received for bluefish in CBP jurisdictions.	Continue	Mandatory reporting is in effect in all CBP jurisdictions. MAFMC created a RSA program which allows up to 3% of the TAC to be sold and the money used to fund research projects. Dockside value is available from NMFS. The RSA program is currently suspended pending thorough review of cost, benefit, and law enforcement concerns.
	<b>Action 3.1</b> CBP jurisdictions will assess methods for improving recreational and charter catch/effort data needed to evaluate biological and economic impacts.	Continue 2011 On-going	MD requires logbooks for charter boats. Beginning in 2004, coastal species managed by quota are electronically reported in real time. The MRIP implemented a Chesapeake Bay and Coastal sport fishing license to provide a more comprehensive assessment of recreational fishing statistics than the MRFSS.
	<b>Action 3.2</b> CBP jurisdictions will continue to collect fishery independent data on bluefish.	2001 On-going	The ChesFIMS and ChesMMAP surveys provided data used to help manage bluefish in Chesapeake Bay. The ChesFIMS survey ended in 2006. Bluefish are regularly sampled by the MDNR Fisheries Service to estimate recruitment and characterize size structure.
<b>Habitat Management Strategy</b> CBP jurisdictions will utilize the results from the new independent multifish surveys and research projects within the Chesapeake Bay to identify and develop specific strategies to protect bluefish habitat and important forage species.	<b>Action 4.0</b> CBP jurisdictions continue to set goals for water quality and habitat restoration and protection, to address commitments established under Chesapeake Bay 2000 Agreement.	2003	Bluefish habitat was identified in Amendment 1 to the Chesapeake Bay Bluefish FMP.
		2009	President Barack Obama's executive order recommitted federal agencies to Bay restoration and regulatory enforcement.
		2010	EPA established a Bay wide TMDL (aka: pollution diet). Each jurisdiction must establish 2 year milestones for progress towards meeting its TMDL.
		2012	Legislation has been passed for restrictions on

**2003 Amendment #1 to the 1990 Chesapeake Bay Bluefish Fishery Management Plan Implementation Table (updated 8/2016)**

Problem Area	Action	Date	Comments
		2013	<p>new developments using septic systems. Legislation for a stormwater fee based on impervious surface coverage was enacted.</p> <p>Chesapeake Bay Program monitors levels of mercury, PCBs, PAHs, organophosphate and organochloride pesticides. Ambient water quality criteria of DO, water clarity, and chlorophyll-a have been adopted for the Chesapeake Bay.</p> <p>See Chesapeake Bay Program website for updates on water quality criteria  <a href="http://www.chesapeakebay.net/issues/issue/chemical_contaminants">http://www.chesapeakebay.net/issues/issue/chemical_contaminants</a>  <a href="http://www.chesapeakebay.net/restoringwaterquality.aspx?menuitem=14728_nutrient_reduction">http://www.chesapeakebay.net/restoringwaterquality.aspx?menuitem=14728_nutrient_reduction</a></p>
	<p><b>Action 4.1</b>                      CBP jurisdictions will regulate land and water activities that may negatively impact essential water quality parameters for bluefish, such as temperature, dissolved oxygen and turbidity.</p>	Continue	<p>The CBP continues to implement strategies to reduce nutrients and improve water quality in the Bay. Planting forest buffers, controlling stormwater runoff and reducing agricultural and urban non-point nutrient inputs are part of the current action plan.</p> <p>MD developed curriculum “Where Do We Grow from Here?” about population growth and its impacts on the Bay.</p> <p>See Chesapeake Bay Program website for updates on land and water stewardship.  <a href="http://www.chesapeakebay.net/track/health">http://www.chesapeakebay.net/track/health</a></p>
	<p><b>Action 4.2</b>                      CBP jurisdictions will monitor activities that could negatively impact submerged aquatic vegetation in areas where bluefish have demonstrated a significant degree of association.</p>	2003 On-going  2012	<p>CBP monitors SAV in the Chesapeake Bay by annual aerial survey. The SAV goal adopted by Chesapeake Bay Program is planting 1,000 acres of SAV by 2008 and restoration of 185,000 acres of SAV by 2010. Planting goal revised to 20 acres per year. VIMS annually surveys SAV distribution in Chesapeake Bay.</p>

**2003 Amendment #1 to the 1990 Chesapeake Bay Bluefish Fishery Management Plan Implementation Table (updated 8/2016)**

Problem Area	Action	Date	Comments
		2014	<p>A Chesapeake Watershed Agreement was adopted in June 2014 with interim targets of 90,000 acres by 2017 and 130,000 acres by 2025. The <b>2015 SAV acreage was 91,621</b>. <a href="http://www.chesapeakebay.net/indicators/indicator/bay_grass_abundance_baywide">http://www.chesapeakebay.net/indicators/indicator/bay_grass_abundance_baywide</a></p> <p>MD developed a Blue Infrastructure that includes mapping structural habitat and SAV.</p> <p>Regulations are in place to prohibit dredging through SAV beds. Tiered designation and prioritization of SAV beds has not been implemented. Avoidance of dredging, filling and construction impacts to SAV is strictly enforced by MDE and USACE with input from DNR, USFWS, and NMFS. MD has not established undisturbed buffers. VA has established buffer criteria.</p>
	<p><b>Action 4.3</b>                      CBP jurisdictions will monitor important forage species, when identified by fishery independent surveys to insure that activities such as directed fisheries or incidental by-catch in non-directed fisheries, do not adversely affect forage species abundance. If fishing activities are contributing to higher fishing mortality (F) of important managed forage species such as Atlantic menhaden, Atlantic croaker, spot and/or blue crab, additional management measures may be necessary.</p>	<p>In progress</p> <p>2012</p> <p>2014</p>	<p>Fish collected from ChesFIMS &amp; ChesMAPP surveys provided stomachs for predator/prey analyses of juvenile and adult bluefish in the Chesapeake Bay. Variability of the abundance of forage fish in the Chesapeake Bay is also being examined by independent research project out of CBL. The ChesFIMS was discontinued after 2005 because of lack of funding.</p> <p>ASMFC determined that menhaden are overfished and that F needs to be reduced. The coastwide TAC is a 20% reduction from the average harvest during 2009-2011. Virginia is allocated 85% of the TAC while Maryland and PRFC are allocated 1.4% and 0.62%, respectively. Implementation began in 2013.</p> <p>Results of the most recent stock assessment for</p>

<b>2003 Amendment #1 to the 1990 Chesapeake Bay Bluefish Fishery Management Plan Implementation Table (updated 8/2016)</b>			
<b>Problem Area</b>	<b>Action</b>	<b>Date</b>	<b>Comments</b>
		<b>2015</b>	menhaden which considered new data, indicate that menhaden are not overfished and overfishing is not occurring.  The 2014 Chesapeake Watershed Agreement delineated a forage fish outcome and a forage workshop was held in Nov. 2014. <b>During 2015, a forage work plan was developed for 2016/2017</b> <a href="http://www.chesapeakebay.net/managementstrategies/strategy/forage_fish">http://www.chesapeakebay.net/managementstrategies/strategy/forage_fish</a>
	<b>Action 4.4</b> CBP jurisdictions will monitor the abundance of important bluefish forage species that are not managed under CBP FMPs, such as bay anchovies and Atlantic silversides	On-going	MD and VA juvenile seine surveys monitor the abundance of anchovies and silversides. Non-managed forage fish abundance is examined by an independent, CBL research project.
	<b>Action 4.5</b> CBP jurisdictions will continue to identify predator/prey interactions, both inter- and intra-species competition and other interactions that might effect the management of bluefish.	On-going  2012	Data from the ChesFIMS and the ChesMAP surveys will be utilized to identify and delineate ecological relationships. Development of multispecies fishery management plans may result from this data.  A multispecies predator/prey model is being developed by ASMFC that includes bluefish, menhaden, striped bass, and weakfish.

<b>1990 Chesapeake Bay Bluefish Fishery Management Plan Implementation Table (updated 6/2015)</b>			
<b>Strategy</b>	<b>Action</b>	<b>Date</b>	<b>Comments</b>
1 – Stock Status and Increased Fishing Pressure: In order to protect the bluefish resource in the Chesapeake Bay and along the Atlantic coast from overexploitation, stock levels and fishing rates need to be monitored. Appropriate management actions may be needed if stock levels continue to decline and harvest levels continue to increase.			

**1990 Chesapeake Bay Bluefish Fishery Management Plan Implementation Table (updated 6/2015)**

Strategy	Action	Date	Comments
<p>1.1.1) Since bluefish are a highly migratory species harvested along the Atlantic coast, Maryland, the Potomac River Fisheries Commission, and Virginia will cooperate with the Mid-Atlantic Fishery Management Council and the Atlantic States Marine Fisheries Commission to solve interjurisdictional problems in managing the bluefish stock</p>	<p>1.1.1) Maryland, the Potomac River Fisheries Commission, and Virginia will continue to participate in scientific and technical meetings for managing bluefish along the Atlantic coast and in estuarine waters.</p>	<p>Continue</p>	<p>Jurisdictions will work closely with the MAFMC, ASMFC, and other coastal states, especially to monitor the commercial catch.</p> <p>See Amendment #1 Action 1.0</p>
<p>1.1.2) Maryland, the Potomac River Fisheries Commission, and Virginia will monitor the bluefish fisheries in the Chesapeake Bay and in state coastal waters and implement conservation management measures for the fisheries as needed.</p>	<p>1.1.2.1) Maryland, the Potomac River Fisheries Commission, and Virginia will adhere to state allocations established by the MAFMC and ASMFC if the commercial harvest is projected to equal or exceed 20% of the total bluefish catch from the Atlantic coast. Commercial harvest controls will be coordinated among Bay jurisdictions and will be consistent with those established in federal waters. Options may include gear restrictions, areal closures, trip limits, and quotas.</p>	<p>Dependent on harvest trends</p>	<p>Bay jurisdictions will coordinate with each other and with federal government. May include gear, trip, area, catch, and/or other restrictions.</p> <p>See Amendment #1 Action 2.0</p>
	<p>1.1.2.2) A) Maryland, Potomac River Fisheries Commission, and Virginia will continue current licensing requirements for the commercial harvest and sale of bluefish. B) Virginia will institute a 10 fish creel limit for the commercial harvest of bluefish by hook and line and work towards establishing a commercial hook and line license.</p>	<p>1991</p>	<p>VA will require new regulation for commercial hook and line fishery.</p> <p>A) See Amendment #1 Action 2.1 B) See Amendment #1 Action 2.2</p>
	<p>1.1.2.3) Maryland will establish a 10 fish per person per day recreational creel limit at present minimum for the Chesapeake Bay and state coastal waters. Virginia and the Potomac River Fisheries Commission established a 10 fish per person per day recreational limit in summer 1990. Upon a recommendation from the MAFMC and ASMFC, or as otherwise determined to be appropriate, jurisdictions may</p>	<p>1991</p>	<p>Will require new regulations. Jurisdictions will coordinate creel limits and size limits.</p> <p>See Amendment #1 Action 2.2</p>



<b>1990 Chesapeake Bay Bluefish Fishery Management Plan Implementation Table (updated 6/2015)</b>			
<b>Strategy</b>	<b>Action</b>	<b>Date</b>	<b>Comments</b>
	modify the possession limit and/or minimum size limit.		
2 – Wasteful Harvest Practices: There will be a baywide effort to eliminate and/or minimize wasteful harvest practices in the bluefish commercial and recreational fisheries.			
2.1) Efforts will be made to reduce the discard of dead bluefish in the Chesapeake Bay.	2.1.1) Virginia and the Potomac River established a 10 fish per person per day recreational creel limit and Maryland will establish a 10 fish creel limit to minimize wastage (see Action 1.1.2.3).	1991	See Action 1.1.2.2  See Amendment #1 Action 2.2
	2.1.2) Maryland, the Potomac River Fisheries Commission, and Virginia will educate the general public, through the use of information brochures and other means, about the need to reduce the waste problem in the bluefish fishery. Hook and release will be promoted as one method for reducing waste in the fishery.	1991	MD has produced a video & fact sheet on hook & release; ASMFC has also developed hook & release brochure. Will explore other means to educate the public about reducing waste.
	2.1.3) Maryland, the Potomac River Fisheries Commission, and Virginia will begin assessing factors contributing to waste in the commercial bluefish fishery and identifying potential solutions. Issues to be considered include migratory patterns of bluefish, bycatch, the bait fishery, and market demand.	1991	Waste associated with the commercial fishery is no longer an issue.
3 – Research and Monitoring Needs: In order to increase the knowledge and understanding of the bluefish fishery in the Chesapeake Bay, the jurisdictions will monitor the commercial and recreational fishery and improve catch and effort data. The jurisdictions will also pursue studies to evaluate the economic aspects of the bluefish fishery.			
3.1) Maryland, the Potomac River Fisheries Commission, and Virginia will increase the knowledge and understanding of the bluefish	3.1.1) Maryland, the Potomac River Fisheries Commission, and Virginia will improve the catch and effort data collected from the bluefish	1991	Will be accomplished in conjunction with other fish species reporting. Need to assess licensing, reporting, and follow up systems. VA will

**1990 Chesapeake Bay Bluefish Fishery Management Plan Implementation Table (updated 6/2015)**

Strategy	Action	Date	Comments
fishery in the Chesapeake Bay.	commercial fishery in the Chesapeake Bay. Recommendations for improving the system include: 1) Coordinate finfish license requirements with the needs of finfish catch and effort reports. 2) Reevaluate the reporting form to include information on what types of gear a fisherman owns, how much they used on a particular day, and how much they caught. 3) Develop a check and balance system to validate the catch and effort records. 4) Continue the commercial reporting requirements in Maryland and establish a mandatory reporting system in Virginia. 5) Evaluate how the use of young bluefish in the bait fishery contributes to fishing mortality.		pursue mandatory reporting system.  See Amendment #1 Action 3.0
	3.1.2 Maryland, the Potomac River Fisheries Commission, and Virginia will assess methods for improving recreational/charter catch and effort data needed to evaluate the biological and economic impacts of these fisheries. Recommendations include: 1) Evaluate hook and line data collected from the Maryland charter boat industry, i.e., age and length frequency, to characterize the recreational catch in the Bay. 2) Obtain economic information for the recreational and charter fisheries to determine the factors important for sustaining these industries and determining their value to the region. 3) Institute a pilot survey of sportsfishermen. 4) Institute a pilot survey of sportsfishermen in Maryland to obtain catch and effort data for several species, including bluefish.	1991	The ASMFC is encouraging states to buy into MRFSS for bluefish; Bay jurisdictions will assess feasibility. Need staff to look at existing biological data and assess economic factors.  See Amendment #1 Action 3.1
	3.1.3) Maryland, the Potomac River Fisheries Commission, and Virginia will encourage research to collect data on bluefish biology,	1991	Will coordinate with CBSAC, universities, other agencies.

1990 Chesapeake Bay Bluefish Fishery Management Plan Implementation Table (updated 6/2015)			
Strategy	Action	Date	Comments
	especially estimates of population abundance, mortality, and recruitment in the Chesapeake Bay. Suggested research topics include: 1) Determine the factors that affect bluefish movements and distribution in the Bay. 2) Collect data on length frequency and age composition of both the commercial and recreational bluefish catch. 3) Investigate the environmental parameters that affect reproduction and growth of bluefish.		See Amendment #1 Action 3.2
4 – Habitat Issues) Adequate water quality is necessary to insure protection of living resources in Chesapeake Bay. The jurisdictions will continue their efforts to improve water quality and define habitat requirements for the living resources in Chesapeake Bay.			
4.1) The District of Columbia, Environmental Protection Agency, Maryland, Pennsylvania, the Potomac River Fisheries Commission, and Virginia will continue to promote the commitments of the 1987 Chesapeake Bay Agreement. The achievement of the Bay commitments will lead to improved water quality and enhanced biological production.	4.1) The District of Columbia, Environmental Protection Agency, Maryland, Pennsylvania, the Potomac River Fisheries Commission, and Virginia will continue to set specific objectives for water quality goals and review management programs established under the 1987 Chesapeake Bay Agreement. The Agreement and documents developed pursuant to the Agreement Call for: 1) Developing habitat requirements and water quality goals for various finfish species. 2) Developing and adopting basinwide nutrient reduction strategies. 3) Developing and adopting basinwide plans for the reduction and control of toxic substances. 4) Developing and adopting basinwide management measures for conventional pollutants entering the Bay from point and non-point sources. 5) Quantifying the impacts and identifying the sources of atmospheric inputs on the Bay	Continue	Agencies must coordinate closely; must continue work on habitat requirements for bluefish and other water quality issues in the Bay.  Chesapeake Bay Program (CBP) develops, revises, and monitors goals and strategies for agriculture, air pollution, bay grasses, chemical contaminants, climate change, development, education, forests, groundwater, nutrients, population growth, rivers and streams, sediment, stormwater runoff, wastewater, weather, and wetlands. For more information: <a href="http://www.chesapeakebay.net/issues">http://www.chesapeakebay.net/issues</a> <a href="http://www.chesapeakebay.net/issues/issue/nutrients">http://www.chesapeakebay.net/issues/issue/nutrients</a> <a href="http://www.chesapeakebay.net/issues/issue/chemical_contaminants">http://www.chesapeakebay.net/issues/issue/chemical_contaminants</a> <a href="http://www.chesapeakebay.net/issues/issue/sediment">http://www.chesapeakebay.net/issues/issue/sediment</a> <a href="http://www.chesapeakebay.net/issues/issue/was">http://www.chesapeakebay.net/issues/issue/was</a>

1990 Chesapeake Bay Bluefish Fishery Management Plan Implementation Table (updated 6/2015)			
Strategy	Action	Date	Comments
	system. 6) Developing management strategies to protect and restore wetlands and submerged aquatic vegetation. 7) Managing population growth to minimize adverse impacts to the Bay environment.		<a href="http://www.chesapeakebay.net/issues/issue/stor_mwater_runoff">tewater http://www.chesapeakebay.net/issues/issue/stor_mwater_runoff</a> <a href="http://www.chesapeakebay.net/issues/issue/air_pollution">http://www.chesapeakebay.net/issues/issue/air_pollution</a> <a href="http://www.chesapeakebay.net/issues/issue/wetlands">http://www.chesapeakebay.net/issues/issue/wetlands</a> <a href="http://www.chesapeakebay.net/issues/issue/bay_grasses">http://www.chesapeakebay.net/issues/issue/bay_grasses</a> <a href="http://www.chesapeakebay.net/issues/issue/development">http://www.chesapeakebay.net/issues/issue/development</a>  See Amendment #1 Actions 4.0, 4.1, 4.2

**Acronyms**

ABC – Allowable Biological Catch  
 ASMFC – Atlantic States Marine Fisheries Commission  
 $B_{msy}$  – Biomass maximum sustainable yield  
 BRP – Biological Reference Point  
 CBL – Chesapeake Biological Laboratory  
 CBP – Chesapeake Bay Program  
 CBSAC – Chesapeake Bay Stock Assessment Committee  
 CHESFIMS – Chesapeake Bay Fishery Independent Multispecies Survey  
 CHESMAP – Chesapeake Bay Multispecies Monitoring & Assessment Program  
 COMAR – Code of Maryland  
 EPA – Environmental Protection Agency  
 F – Fishing Mortality  
 FMP – Fishery Management Plan  
 $F_{msy}$  – Fishing mortality maximum sustainable yield (MSY).  
 MAFMC – Mid-Atlantic Fisheries Management Council  
 MDNR – Maryland Department of Natural Resources  
 MRFSS – Marine Recreational Fisheries Statistics Survey  
 MRIP – Marine Recreational Information Program  
 NMFS – National Marine Fisheries Service  
 PFC – Pennsylvania Fish Commission  
 PRFC – Potomac River Fisheries Commission  
 RHL – Recreational Harvest Limit

RSA – Research Set-Aside  
 SAV – Submerged Aquatic Vegetation  
 TAC – Total Allowable Catch  
 TAL – Total Allowable Landings  
 VMRC – Virginia Marine Resources Commission

## 2015 Maryland FMP Report (July 2016)

### Section 9. Maryland Catfish Species

#### Introduction

As both blue (*Ictalurus furcatus*) and flathead (*Pylodictis olivaris*) catfish populations continue to expand, the potential impacts these non-native species pose to fragile populations of American and hickory shad, river herring, and other native species becomes more of a concern. The Invasive Catfish Task Force has recommended that the Bay jurisdictions minimize the impact of the two invasive species. Consequently, more data is being collected on growth rates, relative abundance, and other population dynamics.

There are five catfish species harvested from the Chesapeake Bay. White catfish (*Ameiurus catus*) and brown bullheads (*A. nebulosus*) are native to the area. Channel catfish (*Ictalurus punctatus*) were introduced into the Potomac River around the end of the 19<sup>th</sup> century. The channel catfish spread throughout the Bay region, reaching Maryland's portion of the Chesapeake Bay in the late 1950's. They are now ubiquitous in the region and are considered naturalized. The non-native blue (*Ictalurus furcatus*) and flathead (*Pylodictis olivaris*) catfish populations have spread into nearly every major tributary of the Chesapeake Bay (Figure 1). Blue catfish were introduced to the Potomac River in the 1970s and have been found in high numbers from the 1990's to present. Flathead catfish were introduced to the James River in Virginia between 1965 and 1977. Additional introductions are believed to have occurred in the upper Chesapeake Bay within the last 10 years and flathead catfish are now commonly found there. Both non-native catfish species have increased in abundance and expanded their range beyond their usual salinity tolerance. Blue and flathead catfish are top apex predators in the ecosystem which raises concerns about their effects on native fish communities.

The Chesapeake Bay Program's Sustainable Fisheries Goal Implementation Team (SFGIT) has recognized invasive catfish as a problem. Blue and flathead catfishes are listed in Maryland regulations as "Nuisance and Prohibited Species" and are on the "No transport" list which prohibits anglers from moving them to other waters of the state. However, both non-native catfish species have been established in areas outside of what would be considered "normal" movement. It is likely that non-native species have been spread by angler transport. There are conflicting concerns between supporting recreational and commercial fishing opportunities for invasive catfish and implementing actions to control and reduce their numbers.

A Fishery Management Plan has not been written for catfish in Chesapeake Bay but a technical report was completed in 1998. The technical report summarized catfish

knowledge and recommended a survey of catfish populations to determine stock status in the Chesapeake Bay.

The Sustainable Fisheries Goal Implementation Team (GIT) of the Chesapeake Bay Program developed a policy on invasive catfish species in 2012. The policy agrees to develop and implement management strategies to reduce invasive catfish populations and mitigate their spread. An Invasive Catfish Task Force (ICTF) was established in 2012 to identify management options for addressing invasive catfish issues. The ICTF developed a report in 2014. The Invasive Species Action Plan recommends: slowing and reducing the spread of invasive catfishes populations in currently uninhabited waters; minimizing the ecological impacts of invasive catfishes on native species; promoting a commercial fishery to significantly reduce the abundance of invasive catfishes populations thus providing economic benefits to the region; and increasing outreach and education to improve public awareness that blue and flathead catfishes pose a risk to native species. The report was comprehensively reviewed by the Chesapeake Bay Program's Scientific and Technical Advisory Committee (STAC) in November, 2014.<sup>1</sup> While the review board expressed concerns that the recommendations contained in the ICTF report could be difficult to implement, they were supportive of further research efforts and suggested the Aquatic Nuisance Species Task Force (ANSTF) as a resource for the development of a comprehensive plan.

The ASMFC adopted a Resolution on Non-Native Invasive Catfish (2011) to recognize that blue and flathead catfish are invasive species. The policy identifies the need for more research and supports the development of management efforts to reduce/minimize the impacts of invasive catfish species. It also does not support the introduction or transport of non-native invasive species.

#### Stock Status

A population assessment of channel catfish was completed in 2010<sup>2</sup> and updated in 2013. A surplus production model for the Head of Bay (HOB), Choptank River, and the Potomac River was used to assess the stock. Fishery dependent and independent relative abundance indices were also calculated. In addition to indices from commercial landings, results from the spring drift gill net surveys in the HOB, Choptank and Potomac Rivers and the fyke net survey index for the Choptank River were used in the surplus production models. The Estuarine Juvenile Finfish Survey (EJFS) data were used to determine relative juvenile catfish abundance and used as qualitative supporting data. The HOB surplus production model showed a population biomass decline during the 1990's after a period of population growth in the 1980's. Relative stock density data from fyke nets sampled in the Choptank River indicate that channel and white catfish relative abundance was slightly above the average for the time series up to 2013 and was slightly below average in 2014. In 2015, white catfish relative abundance remained slightly below the time series average and channel catfish were well above the average, more than doubling that of 2014 (Figures 2 and 3).<sup>3</sup> Channel

catfish juvenile recruitment during 2012 was not detectable but was at or above 2011 levels during 2013, 2014, and 2015 (Figure 4).

## Management

There are no minimum size limits creel limits or closed seasons for any commercial or recreational catfish fisheries in tidal waters. Area and gear restrictions apply to commercial fishermen but are not catfish-specific. In non-tidal waters, there is a 5 fish/person/day creel limit with a 10 fish possession limit and no minimum size limit for channel catfish.

## Fishery Statistics

The catfish commercial fishery is important in the Chesapeake Bay region (Figure 5). When harvest peaked in 1996, catfish were the second highest landed species by weight. In 2008, catfish landings were third highest by weight. Since 2009, the catfish commercial landings are reported by species. Commercial catfish harvest for 2015, excluding non-natives, was over 2.2 million lbs. The 2015 commercial landings for blue and flathead catfish were 126,805 and 28,583 pounds, respectively, and landings for both were less than those reported in 2014. In the last few years, flathead and blue catfish have entered the commercial fishery and an active market exists for these invasive species. Catfish are caught in commercial fish pots, fyke nets, and pound nets. They are sold in both “dead” and “live” markets.

The recreational fishery for catfish is also important but there are no recent surveys of recreational catfish catch in Maryland. The Marine Recreational Information Program (MRIP) does not collect data on catfish. In some western shore tributaries of Chesapeake Bay, guided trophy fisheries exist and utilize catch-and-release activity especially for the larger, invasive blue catfish. Recreational catfish size records are frequently broken. The recreational catch of invasive catfish species is popular especially for large, trophy fish – which some anglers release with the belief that releasing them maintains or improves a trophy fishery. The DNR requests that anglers remove and kill any blue and flathead catfish they catch.

## Issues of Concern

Introduced non-native catfish are invasive species. Both blue and flathead catfish compete with native species for forage. Fishermen most likely have moved these invasive species to different areas within the Bay in misguided attempts to “improve” fishing conditions. Declines of channel catfish biomass have corresponded to the appearance of the blue catfish in Potomac River surveys.<sup>1</sup> Blue catfish inter-specific competition and predation may hinder channel catfish population recovery. Native white catfish have declined in many areas and circumstantial evidence suggests their decline may be correlated to the expansion of non-native, invasive catfish species. This

may also have consequences for the recovery of ospreys and eagles that rely upon native and naturalized fish species for high quality forage.<sup>4</sup>

Catfish do not undertake long migrations and can occur throughout the year in degraded habitats. They accumulate toxins, especially PCBs and pesticides, and MDE has posted consumption advisories for many areas such as Patapsco Harbor, Baltimore Harbor, Middle River and portions of the Elk River, Back River, Anacostia River and Potomac River. In addition to the human health advisories, catfish found in some habitats, such as the Anacostia River, exhibit high rates of skin and liver tumors, likely a result of exposure to polynuclear aromatic hydrocarbons (PAHs) in contaminated sediments.<sup>5</sup>

The Chesapeake Bay jurisdictions have engaged in a public outreach effort to inform people about invasive catfish species. Maryland developed an awareness campaign to help people identify and catch invasive catfish, understand the importance of prohibiting their transport, and encouraging anglers to keep and not release them. More than 150 educational signs have been posted at water access areas and there are increasing efforts to bring invasive catfish to market.

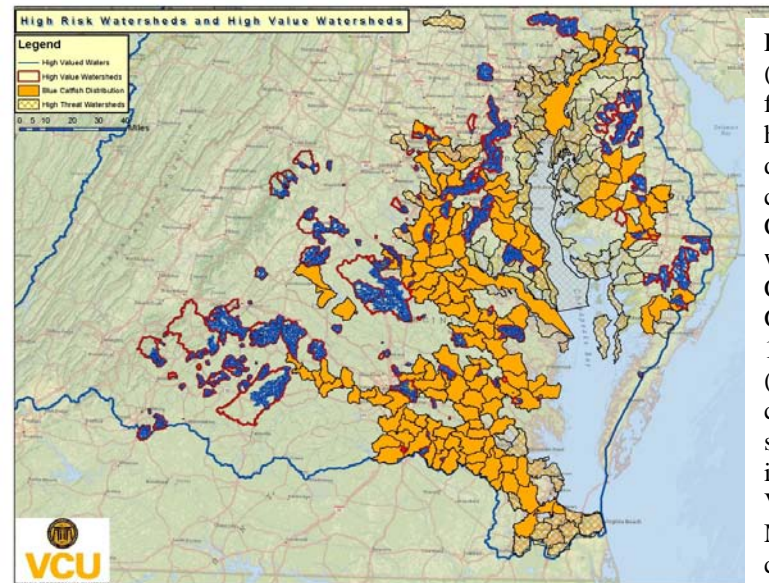


Figure 1. Current (solid polygons) and forecasted (cross-hatched polygons) distribution of blue catfish in Chesapeake Bay waters below Conowingo Dam. Geospatial units are 12-digit watersheds (HUCs). Data are compiled from several sources, including VCU, VIMS, VDGIF, and MdDNR; data were current as of 1 April, 2013.

**References:**

<sup>1</sup>Bilkovic, D.M. and T.F. Idhe. 2014. Review of the final report of the Sustainable Fisheries Goal Implementation Team Invasive Catfish Task Force. Chesapeake Bay Program Scientific and Technical Advisory Committee, No. 14-007, Edgewater, MD 46 pp.

<sup>2</sup>Piavis, P. and E. Webb III. 2010. Population assessment of channel catfish in Maryland with special emphasis on Head-of-Bay stocks. In Chesapeake Bay finfish and habitat investigations. Maryland Department of Natural Resources. Report F-61-R-5. Annapolis, Maryland.

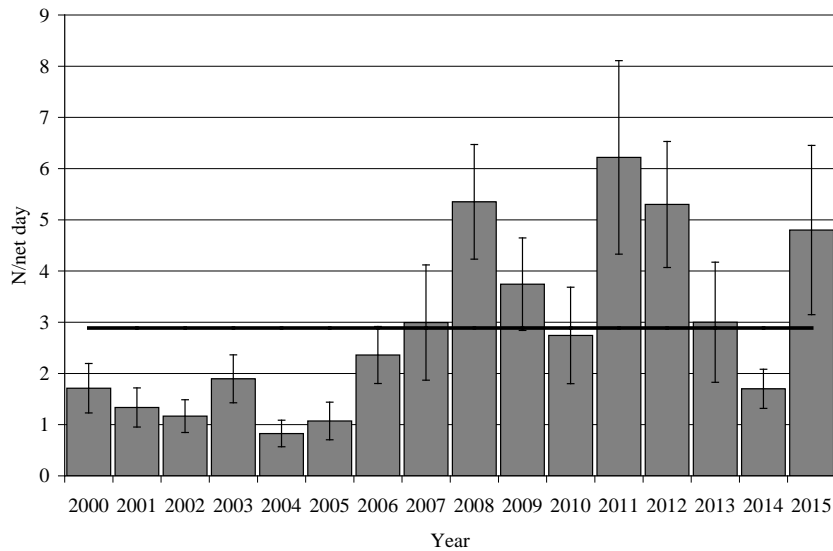
<sup>3</sup>Piavis, P. and E. Webb III. 2014. Population vital rates of resident finfish in selected tidal areas of Maryland’s Chesapeake Bay. Project No.1, Job No.1 *In* Chesapeake finfish and habitat investigations. Maryland Department of Natural Resources. Report F-61-R. Annapolis, Maryland.

<sup>4</sup>Viverette, C.A., G.C. Garman, S.P. McIninch, A. C. Markham, B.D. Macko. 2007. Finfish-waterbird trophic interactions in tidal freshwater tributaries of the Chesapeake Bay. *Waterbirds* 30 (Special Publications 1):50-62.

<sup>5</sup>Pinkney, A.E., J.C. Harshbarger, E.B. May, and W.L. Reichert. 2002. Tumor prevalence and biomarkers of exposure and response in brown bullheads (*Ameiurus nebulosus*) from the Anacostia River, Washington, D.C. and Tuckahoe River, Maryland. CBFO-C02-07.

<sup>6</sup>Durell, E.Q., and Weedon, C. 2013. Striped Bass Seine Survey Juvenile Index Web Page. <http://www.dnr.state.md.us/fisheries/juvindex/index.html>. Maryland Department of Natural Resources, Fisheries Service.

**Figure 2. Channel catfish relative abundance (N/net day) from the Choptank River fyke net survey, 2000 – 2015. Horizontal line indicates time series average relative abundance.**



**Figure 3. White catfish relative abundance (N/net day) from the Choptank River fyke net survey, 2000 – 2015. Horizontal line indicates time series average relative abundance.**

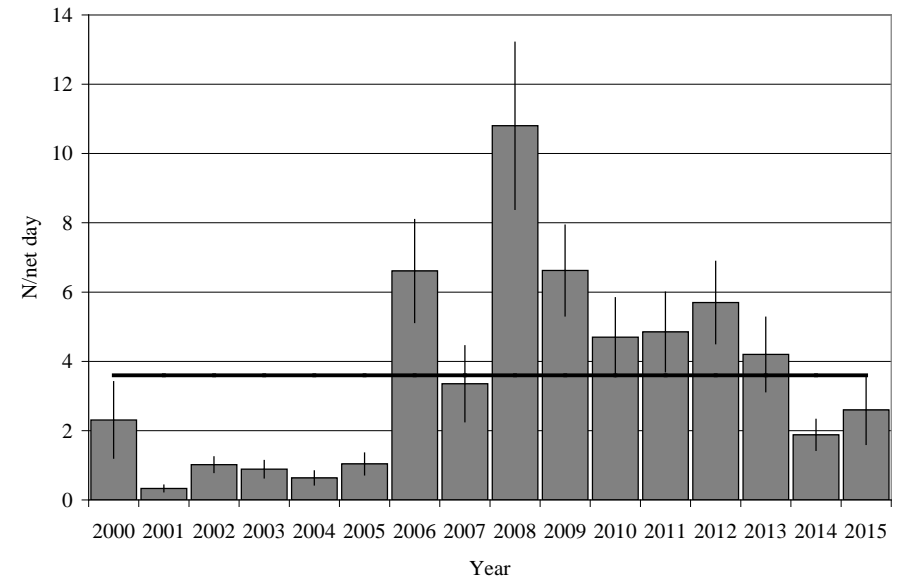


Figure 4. Maryland young-of-year (YOY) geometric mean catch per haul of channel catfish, 1975-2015.<sup>6</sup>

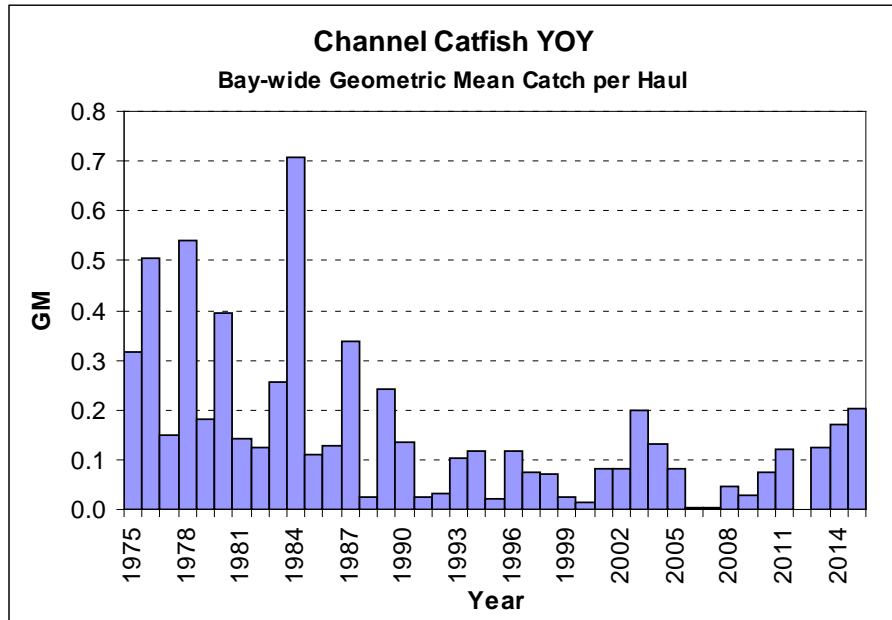


Figure 5. Maryland commercial catfish landings, 1950-2014 (MDDNR data)

