

# 2014 Fishery Management Plans Report to the Legislative Committees

Prepared by  
Maryland Department of Natural Resources  
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# **2014 Fishery Management Plans**

## **Report to the Legislative Committees**

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## **2014 Fishery Management Plan (FMP) Legislative Report (December 2015)**

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 introduction and fishery management plan (FMP) implementation table. The introduction 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 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, 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 for their input when developing management strategies and actions. Both brook trout and largemouth bass were not on the original species list for the development of FMPs. This is the first year that the status of these two FMPs have been included in the FMP report.

## **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 Shellfish, Brook Trout, Largemouth Bass, and a technical report for catfish. A Chesapeake Bay Clam FMP, an Amendment #1 to the Maryland Tidewater Yellow Perch FMP and an Amendment #1 to the Chesapeake Bay American Eel Fishery Management Plan are in progress.

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 includes considering the 2012 Fisheries Service Allocation Policy (Appendix A.).

During 2014, the Fisheries Service Plan Review Teams (FS PRT) completed reviews on the 1989 Chesapeake Bay Striped Bass Management Plan and 1998 Amendment #1, the 1991 Chesapeake Bay American Eel Fishery Management Plan, the 2006 Maryland Brook Trout Management Plan, the 1991 Chesapeake Bay Atlantic Croaker and Spot Fishery Management Plan, the 1994 Chesapeake Bay and Atlantic Coast King and Spanish Mackerel Fishery Management Plan, and the 1991 Chesapeake Bay Summer Flounder Fishery Management Plan.

## **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>

## **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 will continue 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. For more detailed information on MRIP, go to <http://www.countmyfish.noaa.gov/index.html>.

## 2014 Maryland FMP Report (October 2015)

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

Since the American eel stock was declared depleted after the results of the 2012 coastal stock assessment, management strategies have been developed to reduce mortality. In addition to increasing the minimum size limit from 6" to 9", a commercial catch cap on coastal fishing will be implemented in 2015.

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 the Atlantic coast. After approximately 2 months, the glass eels become pigmented and are referred to as elvers. The elvers either remain in the 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 the 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 (CBFMP) was adopted in 1991. The CBFMP 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 CBFMP was reviewed in 2014. The Plan Review Team concluded that the CBFMP management framework is still appropriate for managing the population in Chesapeake and Coastal bays but recommended the development of an amendment to adopt the ASMFC FMP guidelines for managing American eel.

The ASMFC adopted a coastal 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. The ASMFC approved both Addendum III (2013) and Addendum IV (2014) 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 coastwide 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> Climate change has the potential to alter ocean circulation patterns, however, the ramification of such a change is unknown. Although the American eel stock was declared depleted, biomass and fishing mortality reference points could not be determined with confidence.<sup>2</sup> The next stock assessment is scheduled for 2017.

Chesapeake Bay biological reference points for American eel have not been established, therefore stock status 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 as of 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 will be 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.

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 eel are subsampled for sex and age determination and the prevalence of the swimbladder parasite, *Anquillicolla crassus*<sup>4</sup>

The Maryland Department of Natural Resource Fish Passage Program added eels to its list of targeted species. 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.

### The Fishery

Ninety-nine percent of commercially harvested American eel were caught using eel pots.<sup>6</sup> Maryland's commercial fishery landed 610,585 pounds of American eel during 2014<sup>8</sup> (Figure 1). From 1989-2009 harvest averaged approximately 320,000 pounds with little variability. Since 2009, annual harvest has nearly doubled to 600,000 pounds.<sup>7, 8</sup> From 2009-2013, Maryland eel harvest has comprised 56% of the total coastwide harvest.<sup>1</sup> Commercial crabbers are allowed to harvest American eel for use as trotline bait. The 2014 reported harvest was 2,397 pounds. The 21 year average eel harvest from commercial crabbers is 24,517 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 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>10</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. Although prices dropped to \$400 - \$650 per pound in 2014, the economic value for glass eels makes them a prime target for poaching and illegal activities.<sup>1</sup>

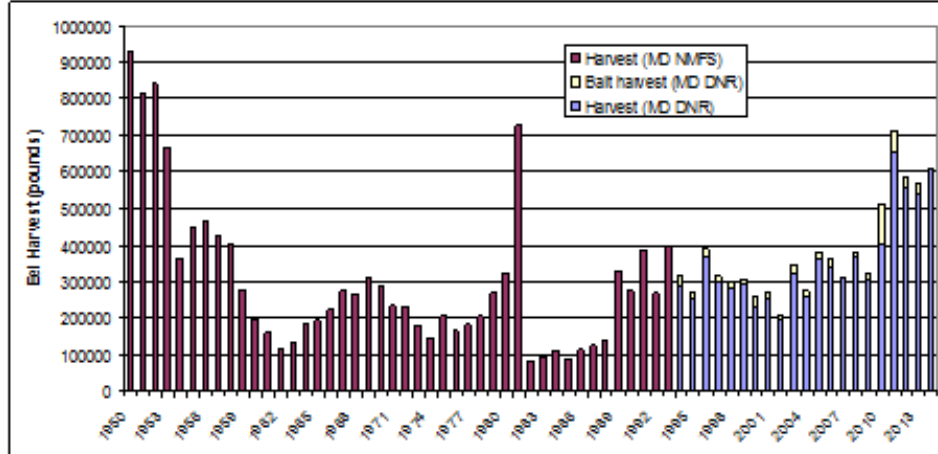
Stream and river blockages reduce American eel access to significant amounts of historic habitat. The Maryland Department of Natural Resource Fish Passage Program priority projects provide passage for diadromous species which includes American eel. The ASMFC published the Proceedings of a Workshop on American Eel Passage Technologies whereby the workshop participants determined that traditional fish passage structures (fishways and fish lifts) are ineffective at passing juvenile eels and that specialized eel passage structures are necessary. Downstream movement of yellow and silver eels is particularly problematic at hydropower structures where mortality can be as high as 100%. 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. 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.

Climate change has been implicated as a causative agent to alteration of leptocephali, prey availability, and temperature and circulation changes within the Sargasso Sea.<sup>11,12,13</sup> These changes have the potential to reduce survival and successful transport of leptocephali to estuarine habitats.

American eel are susceptible to the swim bladder parasite *Anguillicoloides crassus*. Average prevalence rate among Chesapeake Bay eels was 51% from 2004-2014.<sup>4</sup> The effect of the parasite on yellow and silver eel stages is not known.

**Figure 1. American eel commercial landings in Maryland, 1950-2013.**  
Data for the years 1950-1993 obtained from the National Marine Fisheries Service.<sup>7</sup> Data for years 1994-2014 was provided by Maryland Department of Natural Resources<sup>4</sup>



## References

- <sup>1</sup> Atlantic States Marine Fisheries Commission. 2014. Addendum IV to the Interstate Fishery Management Plan for American eel. Atlantic States Marine Fisheries Commission, Alexandria, VA.  
[http://www.asafc.org/uploads/file/55318062Addendum\\_IV\\_American\\_Eel\\_oct2014.pdf](http://www.asafc.org/uploads/file/55318062Addendum_IV_American_Eel_oct2014.pdf)
- <sup>2</sup> Atlantic States Marine Fisheries Commission. 2012. American eel benchmark stock assessment. Stock assessment report No. 12-01. Atlantic States Marine Fisheries Commission, Arlington, VA. Atlantic States Marine Fisheries Commission. May 9, 2014. Memorandum: American eel Board tasks to Technical Committee. Atlantic States Marine Fisheries Commission, Alexandria, VA.  
[http://www.asafc.org/uploads/file/53b32b2fMay\\_2014\\_Eel\\_TC\\_Memo\\_Stock\\_Status.pdf](http://www.asafc.org/uploads/file/53b32b2fMay_2014_Eel_TC_Memo_Stock_Status.pdf)
- <sup>4</sup> Whiteford, K. 2014. Maryland American Eel Population Study. Semi-annual reports. Project 3-ACA-125. Maryland Department of Natural Resources, Fisheries Division. Annapolis, Maryland.
- <sup>5</sup> Whiteford, K. and Matthew Rinehimer 2013. Maryland American Eel Population Study Completion Report. Project 3-ACA-125. Maryland Department of Natural Resources, Fisheries Division. Annapolis, Maryland.
- <sup>6</sup> Whiteford, K. 2014. 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>
- <sup>8</sup> Personal communication from Keith Whiteford, Maryland DNR Fisheries Division. Retrieved from Maryland DNR landings database.
- <sup>9</sup> Atlantic States Marine Fisheries Commission. 2013. 2013 Review of the Atlantic States Marine Fisheries Commission fishery management plan for American eel (*Anguilla rostrata*): 2012 fishing year. Atlantic States Marine Fisheries Commission, Arlington, VA.
- <sup>10</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>11</sup> Bonhommeau, S., E. Chassot, and E. Rivot. 2008. Fluctuations in European eel (*Anguilla anguilla*) recruitment resulting from environmental changes in the Sargasso Sea. Fisheries Oceanography. 17(1): 32-44. DOI: 10.1111/j.1365-2419.2007.00453.x
- <sup>12</sup> Bonhommeau, S., E. Chassot, B. Planque, E. Rivot, A. H. Knap, and O. Le Pape. 2008. Impact of climate on eel populations of the Northern Hemisphere. Marine Ecology Progress Series. 373: 71-80. DOI : 10.3354/meps07696
- <sup>13</sup> Friedland, K. D., M. J. Miller, and B. Knights. 2007. Oceanic changes in the Sargasso Sea and declines in recruitment of the European eel. ICES Journal of Marine Science. 64 (3): 519-530. DOI: 10.1093/icesjms/fsm022
- <sup>14</sup> 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>
- <sup>15</sup> 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.

1991 Chesapeake Bay American Eel Management Plan Implementation Table (updated 10/15)			
Strategy	Action	Date	Comments
1.1 The jurisdictions will adopt a conservative management approach until stock assessment analyses have been completed for American eels in the Bay.	1.1A) Maryland and the Potomac River Fisheries Commission will adopt a minimum size limit of 6 inches for American eels in the Bay.	1992 1993 Continue	Glass eel and elver fisheries are prohibited. 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.
	B) Virginia will continue its prohibition on the taking of elvers and will adjust its definition to correspond to a 6" minimum size limit.	2005/2006  2012  2013  2014  2015  2017	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.  A benchmark coastal stock assessment was completed in 2012 and concluded that eels are depleted along the coast.  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.  <b>Draft 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.</b>  <b>Maryland will need to develop an amendment to the Chesapeake Bay American Eel FMP and promulgate regulations in order to implement the management strategy in Addendum IV. 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>  A stock assessment is scheduled for 2017.
	1.2A) Maryland will implement a ½ x ½" minimum mesh size for eel pots.	1993 Continue	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 <½" require escape panels.
	B) Virginia and the Potomac River Fisheries Commission will continue to enforce a ½ x ½" minimum mesh size for eel pots. Virginia will	2013	Addendum III to the Interstate Eel FMP requires that by January 1, 2017

1991 Chesapeake Bay American Eel Management Plan Implementation Table (updated 10/15)			
Strategy	Action	Date	Comments
	continue to enforce the escape panel requirements in ½ x ½” mesh pots.	2017	the entire pot must be ½” x ½” mesh. Escape panels will no longer be allowed in small mesh pots (< ½” mesh).
	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.	On-going	Virginia requires a ½” x 1” escape panels in ½” x ½” mesh pots. CBP fish passage goal of 2,807 miles opened by 2014.
		2010 2013	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.srbrc.net/pubinfo/docs/SRAFRFC_American_Eel_Restoration_Plan_20140527_220124v1.pdf">http://www.srbrc.net/pubinfo/docs/SRAFRFC_American_Eel_Restoration_Plan_20140527_220124v1.pdf</a> There are no harvest regulations in PA.
2.1 Catch and effort statistics for the American eel crab bait fishery will be obtained.	2.1 Maryland will require the reporting of American eels used for the crab bait fishery on their mandatory finfish reporting forms.	1993  2007 Continue	Information gathered from the Crab Reporting Forms indicated that previous bait estimates were probably too high.  ASMFC required 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.
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 economic aspects affect the eel fishery.	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.	1997 2000 2006 Continue	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.
	B) PRFC will continue to collect catch and effort data from their commercial fishery.		
	3.2 Maryland, the Potomac River Fisheries Commission, and Virginia will encourage research to collect basic biological and socioeconomic information.	Continue 2000  2007 2010 2015  2006	The ASMFC coastal eel FMP required states/jurisdictions to conduct an annual young of year survey.  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. 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.  MD initiated an annual fishery independent eel pot survey and silver eel survey. Eel are also sampled for disease (swimbladder parasite <i>Anquillicolla crassus</i> ) prevalence. CB long term average (2004-2014) was 51%.
4.1 The District of Columbia, Environmental Protection	4.1 The jurisdictions will continue to provide for fish passage at dams, and to remove stream blockages	2005 2009	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.

1991 Chesapeake Bay American Eel Management Plan Implementation Table (updated 10/15)			
Strategy	Action	Date	Comments
<p>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.</p>	<p>wherever necessary.</p>	<p>2014</p>	<p>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.</p>
		<p>2008</p>	<p>ASMFC approved Addendum II to the Coastal eel FMP which placed an emphasis on improving upstream and downstream passage.</p>
		<p>2010</p>	<p>USFWS conducted a study to determine the timing &amp; cues for out-migrating eels in the Shenandoah River. Results of the study indicate that outmigration is variable and sometimes protracted.<sup>14</sup></p>
		<p>2012</p>	<p>Study of the Embury Dam removal on the Rappahannock River indicated that the restoration resulted in increased numbers of eels as far as 100 miles upstream.<sup>15</sup></p>
	<p>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:</p> <p>A) Developing habitat requirements and water quality goals for various finfish species.</p> <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</p>	<p>Continue</p> <p>2005</p> <p>2009</p> <p>On-going</p> <p>2014</p>	<p>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></p>

1991 Chesapeake Bay American Eel Management Plan Implementation Table (updated 10/15)			
Strategy	Action	Date	Comments
	impacts to the Bay environment.		

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  
 SRAFRC – Susquehanna River Anadromous Fish Restoration Cooperative  
 USFWS – United States Fish & Wildlife Service



## 2014 Maryland FMP Report (July 2015)

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

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

American shad abundance increased in 2014 in all monitored Chesapeake Bay tributaries, but still remains well below historic values. American shad abundance in the Potomac River continued to exceed the restoration target for the fourth consecutive year, and the Rappahannock River exceeded the restoration target for the first time in 2014. American shad restoration success in the Susquehanna River continues to be limited by access to prime spawning habitat. Wild hickory shad prevalence remains high in the Choptank and Patuxent rivers and in the upper Chesapeake Bay.

#### 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 (CBFMP) in 1989 to coordinate shad and river herring management among Chesapeake Bay jurisdictions. The CBFMP identified declining abundance, over-fishing, insufficient research and monitoring, and habitat loss as problems. The CBFMP 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 CBFMP Amendment #1 (1998) continued the shad moratorium, initiated review of criteria to reopen a shad fishery, and initiated development of measurable restoration targets.

ASMFC implemented Amendment I to the Interstate Fishery Management Plan for Shad & River Herring in 2000. The amendment mandated a 40% reduction in the American shad ocean intercept fishery by 2003 and 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, which did not affect Maryland's obligations. ASMFC 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. ASMFC has scheduled a stock assessment update for American shad for 2018.

The adequacy of the CBFMP, 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 CBFMP'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 CBFMP. However, if and when the stock has adequately recovered and a limited fishery 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.<sup>1</sup> The 2014 American shad population estimate for the Susquehanna River below Conowingo Dam was 118,883 fish<sup>1</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;<sup>3</sup> the lowest recorded passage since 1989.

American shad abundance in the Potomac River is measured using an index based on the number of shad pounds per pound net day. The Potomac River restoration target is 31.1 lbs of American shad per pound net day; 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 56% of American shad in the Conowingo Dam tailrace were of wild stock during 2014. Sixty-five percent of males and 84% of females were repeat spawners.<sup>1</sup> In the Nanticoke River, the proportion of wild spawners was 71% and repeat spawners were 79% male and 89% female.<sup>3</sup> Eighty-five percent of male and 77% of female American shad in the Potomac River were repeat spawners in 2014.<sup>3</sup> In the Choptank River, 92% of juveniles in 2014 were hatchery reared and adult American shad are not frequently encountered by monitoring surveys on this river.<sup>4</sup> Natural reproduction is occurring in the Choptank River but at low levels.

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> The proportion of wild, spawning adults in Marshyhope Creek (Nanticoke River) has not improved and stocking was discontinued in 2010.<sup>4</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 percent of male and 57% of female hickory shad in Deer Creek were repeat spawners during 2014.<sup>1</sup>

The Marine Recreational Information Program (formerly Marine Recreational Fisheries Statistics Survey, MRFSS) stopped collection of American shad and hickory shad recreational data in 2009.

### **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 two 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.

National Marine Fisheries Service (NMFS) enacted the New England Fishery Management Council's (NEFMC) Amendment 5 to the Atlantic Herring FMP in 2014.<sup>5</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) approved an incidental shad and river herring catch cap of 520,000 pounds for the Atlantic mackerel fishery for 2014.<sup>7</sup> The shad and river herring estimated incidental catch from the Atlantic mackerel fishery for 2014 was 14,154 pounds of shad and river herring, only 2.72% of the incidental catch cap.<sup>7</sup> The shad and river herring incidental catch cap was set at 196,211 pounds for 2015. If this cap is not reached and the mackerel fishery exceeds 10,000 mt of mackerel, then the incidental catch cap will be expanded to 341,717 pounds of shad and river herring.<sup>7</sup> MAFMC adopted Amendment 14 (2014) to the Atlantic Mackerel, Squid, and Butterfish FMP to improve monitoring of these fisheries and limit shad mortality in the Atlantic mackerel fishery. 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 New England Fisheries Management Council (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 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 two dead American shad for personal use per day.

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>3</sup> Data from American shad logbook and angler surveys indicate a decrease in catch rate since 2000 (Figure 3).<sup>1</sup> This trend mirrors the catch rate trend of the MD DNR tagging survey (Figure 3). An active catch and release recreational fishery for hickory shad also occurs in the Potomac, Patuxent, and Choptank rivers.<sup>4</sup>

Current shad release mortality in the recreational fishery is not known. 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

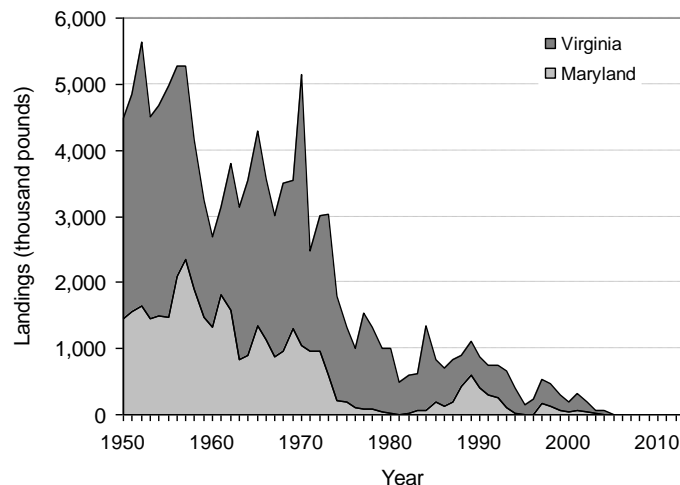
Conowingo Dam is the most significant remaining blockage to American shad migrating up the Susquehanna River in Maryland even though there is a fish lift. Relicensing for the Conowingo hydroelectric project continues to be reviewed by the Federal Energy Regulatory Commission.<sup>1</sup> Hickory shad are rarely encountered using the fish lift at the dam.<sup>1,3</sup>

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>

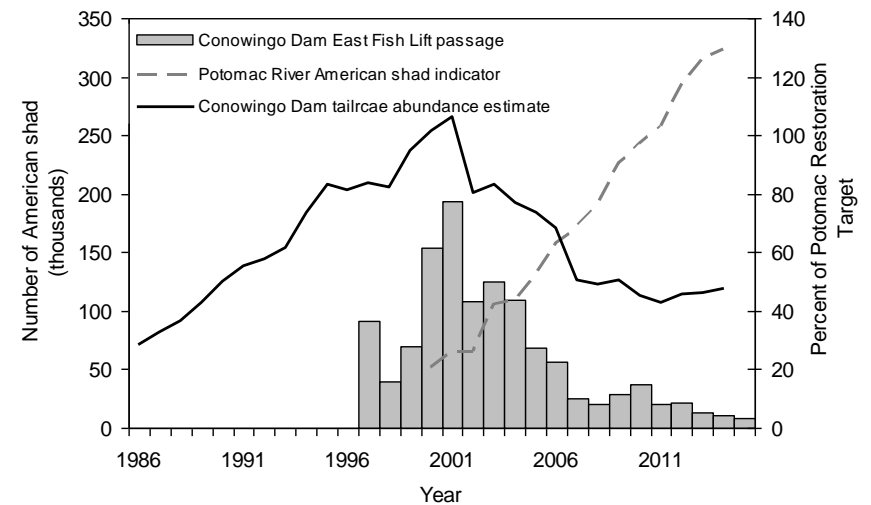
The effect of multiple mortality sources such as ocean bycatch, dam turbines, pollution, and predation on shad abundance is unknown. Additional data are required to estimate natural, anthropogenic, and fishery mortalities to develop appropriate biological benchmarks.

Currently, Maryland does not monitor commercial bycatch and discard of American shad as specified in Amendment 3. The current finfish reporting system is not designed for fishermen to report bycatch or discards.

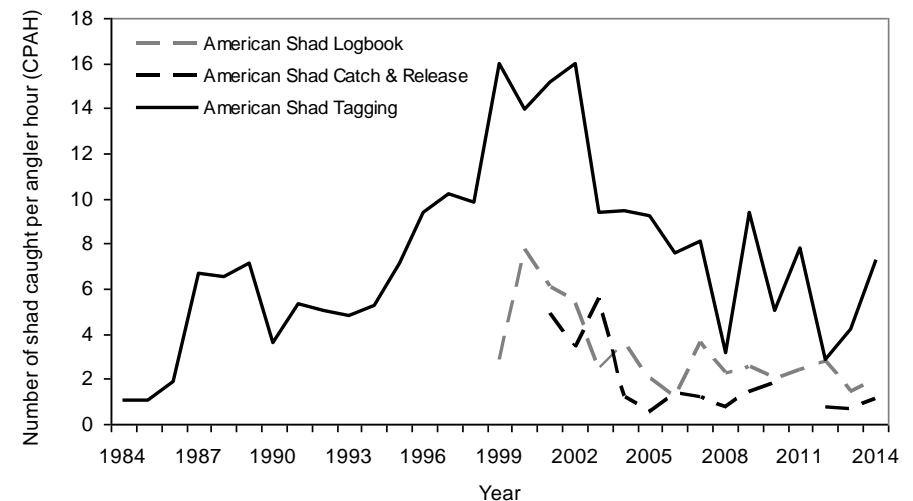
**Figure 1. Time series of commercial landings of American shad, 1950-2013 in Maryland and Virginia.**<sup>11</sup>



**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 (1986-2014).<sup>3</sup> and the status of American shad restoration in the Potomac River (2000-2014; E. Cosby, PRFC, pers. comm.).**



**Figure 3. Average catch per angler hour from the MD DNR tagging study (1984-2014), 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 2014 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> 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>3</sup> Maryland Department of Natural Resources. 2015. Chesapeake Bay Finfish Habitat Investigations. US FWS Federal Aid Project F-61-R-9 2012 – 2014. Maryland Department of Natural Resources, Annapolis, Maryland.
- <sup>4</sup> Stence, C. P., M. W. Baldwin, M. Bowermaster, and L. S. Barker. 2015. American shad restoration in three Maryland rivers. US FWS Federal Aid Project F-57-R Segment 14 Progress Report. Maryland Department of Natural Resources, Annapolis, Maryland.
- <sup>5</sup> Stence, C. P., M. W. Baldwin, M. Bowermaster, and L. S. Barker. 2015. Hickory shad restoration in three Maryland rivers. US FWS Federal Aid Project F-57-R Segment 14 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 were more abundant in 2013 and 2014, compared to recent years. Incidental catch avoidance of river herring in the Atlantic Ocean mixed fisheries continues to be addressed by the North East Fishery Management Council (NEFMC) and the Mid Atlantic Fishery Management Council (MAFMC) with the setting of catch caps and provisions for improving bycatch monitoring and reporting. In 2014, the National Marine Fisheries Service (NMFS) and the Atlantic States Marine Fisheries Commission (ASMFC) began development of a coastwide conservation plan for river herring with input from experts throughout these species' range.

### **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 (CBFMP) to coordinate shad and river herring management. The CBFMP identified declining abundance, over-fishing, insufficient research and monitoring, and habitat loss as problems. The CBFMP 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, to monitor 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. 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). For more

information on the ecosystem-based fisheries management process, go to <http://www.mdsg.umd.edu/programs/policy/ebfm>.

### **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. Total mortality (Z) of river herring in the Nanticoke River (Maryland) during 2014 was 1.32 for alewife herring and 1.37 for blueback herring.<sup>2</sup> These values are below the coastwide  $Z_{collapse}$  thresholds of 2.0 – 3.0 for alewife herring and 1.6 - 3.2 for blueback herring.<sup>1</sup>

Spawning adult river herring in the Nanticoke River were sampled from commercial fyke and pounds nets. Twenty-six percent of alewife and 35% of blueback herring were repeat spawners.<sup>2,3</sup> Maryland Department of Natural Resources (MD DNR) conducted the second year of a fishery independent river herring gill net survey in the North East River which sampled 722 river herring in 2014, an increase from the 209 encountered in 2013.<sup>3</sup> Forty-seven percent of alewife herring were repeat spawners and 58% of blueback herring were repeat spawners in 2014. The total instantaneous mortality was 1.0 for alewife and 0.98 for blueback.<sup>3</sup> Seine surveys are used to calculate juvenile abundance indices (JAI) which have varied without trend since 1980.<sup>2,3</sup>

Alewife and blueback herring recreational fishery data have not been available from the Marine Recreational Information Program since 2009. The next ASMFC river herring stock assessment update is scheduled for 2017.

### **Current Management Measures**

Maryland, Virginia, and the Potomac River Fisheries Commission instituted a recreational and commercial river herring moratorium as of 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 MAFMC approved an incidental shad and river herring catch cap of 520,000 pounds for the Atlantic mackerel fishery for 2014.<sup>4</sup> The estimated incidental catch of shad and river herring from the Atlantic mackerel fishery for 2014 was 14,154 pounds, only 2.72% of the incidental catch cap.<sup>5</sup> The shad and river herring incidental catch cap was set at 196,211 pounds for 2015. If this cap is not reached and the mackerel fishery exceeds 10,000 mt of mackerel, then the incidental catch cap will be expanded to 341,717 pounds of shad and river herring.<sup>5</sup> The MAFMC adopted Amendment 14 (2014) to the Atlantic Mackerel, Squid, and Butterfish FMP to improve monitoring of these fisheries and limit river herring mortality in the

Atlantic mackerel fishery. The NMFS did not approve all measures in Amendment 14; they did not approve increased observer coverage.<sup>6</sup> The MAFMC and the NEFMC hope to address the need for increased observer coverage in the Omnibus Industry-Funded Monitoring Amendment currently in development. The NMFS enacted the NEFMC's Amendment 5 to the Atlantic Herring FMP in 2014.<sup>7</sup> Amendment 5's objectives are to improve monitoring and minimize bycatch of river herring. Both amendments 5 and 14 include similar provisions such as: improved reporting and observer presence to monitor incidental take, reasonable and safe accommodations for on-board observers to subsample and monitor catch, industry compensation for the cost of the observer program, documentation of the weight of *Alosa* species in mixed landings, reduction of unsampled catch discards (slippage), area-based closures to reduce catch, and weekly vessel trip reporting for quota monitoring. The NMFS has the final decision on management recommendations adopted for fisheries in federal waters.

### The Fisheries

All commercial and recreational river herring fisheries in Maryland are under a moratorium. No river herring were reported landed by commercial harvesters in 2014.<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>8</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 accuracy of age estimates and 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 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.

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. The magnitude of identification errors within the offshore trawl fisheries has not been determined.

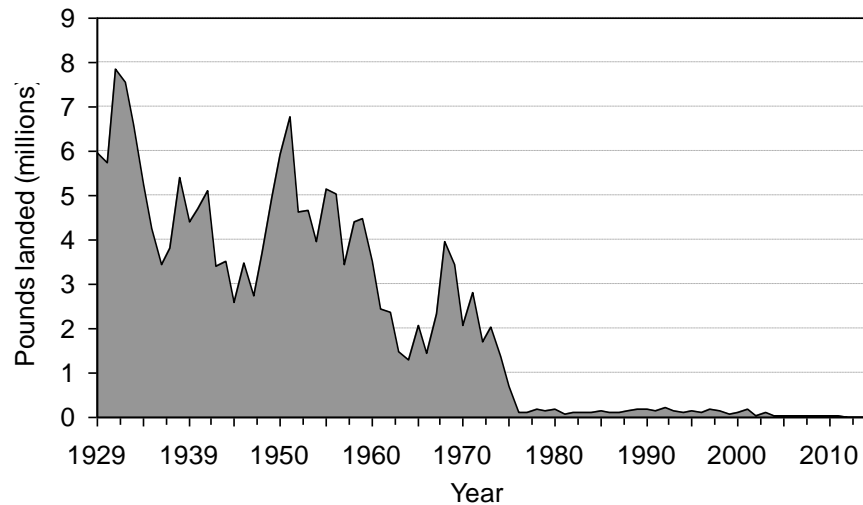
River herring mortality sources include harvest, bycatch, discard, pollution, and predation. In Maryland, mortality from hydroelectric turbines is considered insignificant because they are rarely encountered in Conowingo Dam's fish lifts and passed upstream.<sup>3</sup> Ocean trawl bycatch of juvenile river herring in the Atlantic mackerel and Atlantic herring fisheries is of particular concern.<sup>1</sup> Measures are being implemented to better document the extent of river herring in the bycatch and incentivize avoidance by fishermen. Additional 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 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. Recently, two large dams on the Patapsco River were removed (Union and Simkins - 2010) but two dams remain on the river's mainstem. Pre-removal data collection, engineering design, and permitting are underway for removal of Bloede Dam; the lower most dam in the river; removal is expected to begin in 2016.

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 a river herring Technical Expert Working Group (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 conservation plan, intended to be dynamic and easily updated as progress is made, was released on May 7, 2015 and can be found at <http://www.greateratlantic.fisheries.noaa.gov/protected/riverherring/conserv/index.html>.



**Figure 1. Time series of commercial landings of shad river herring (alewife and blueback, 1929-2014) 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. 2015. Chesapeake Bay finfish habitat investigations. US FWS Federal Aid Project F-61-R-9 2012 – 2014. Maryland Department of Natural Resources, Annapolis, Maryland.
- <sup>3</sup> Lipkey, G. K. 2015. Maryland's 2014 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> Mid-Atlantic Fishery Management Council. 2013. Council recommends first-ever cap on river herring and shad catch. Press Release. June 18, 2013. <http://www.mafmc.org/newsfeed/rh-s-cap>

- <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> Federal Register 79(30) February 13, 2014 Rules and Regulations. Final Rule. Fisheries of the Northeastern United States; Atlantic Herring Fishery; Amendment 5.
- <sup>8</sup> Atlantic States Marine Fisheries Commission. 2014. 2013 river herring ageing workshop report. Atlantic States Marine Fisheries Commission. Arlington, Virginia. [http://www.asmfmc.org/files/Science/RiverHerringAgeingWorkshopReport\\_August2014.pdf](http://www.asmfmc.org/files/Science/RiverHerringAgeingWorkshopReport_August2014.pdf)
- <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 7/2015)			
Strategy	Action	Date	Comments
1.1 The Bay jurisdictions will reevaluate the criteria for reopening a fishery in the Chesapeake Bay during the Alosid [sic] FMP revision process. Until new criteria are determined, the moratorium will remain in place for American and hickory shad in the Chesapeake Bay.	1.1 The Bay jurisdictions will continue the moratorium on American shad in Chesapeake Bay.	1989 On-going	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.
		2009 - 2011	MD Sea Grant coordinated development of a Chesapeake Bay Ecosystem-based FMP.
		On-going	Chesapeake Bay jurisdictions continue to follow ASMFC requirements. <a href="http://www.asmfc.org/shadriverherring.htm">http://www.asmfc.org/shadriverherring.htm</a>
		2012	PRFC developed an ASMFC approved sustainability plan for American shad.
		2014	MD, DC, & 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>
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 [sic] management plan.	1.2 The bay jurisdictions will incorporate the shad restoration targets into the revised Alosine FMP	1999	River specific targets were proposed in 1997, but no action was taken.
		2007	STAC held a 2007 workshop on Alosine targets. The white paper did not include targets.
		2008 On-going  2012	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 (55%) and Boshers Dam (45%) data. An index for the Rappahannock River was added. Indices for the York, Potomac, and Susquehanna rivers were not changed. For more information: <a href="http://www.chesapeakebay.net/indicators/indicator/">http://www.chesapeakebay.net/indicators/indicator/</a>

1998 Amendment 1 to the 1989 Chesapeake Bay Alosid [sic] Management Plan Implementation Table (updated 7/2015)			
Strategy	Action	Date	Comments
		2010	<a href="#">american shad abundance</a> 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.

1989 Chesapeake Bay Alosid [sic] Management Plan Implementation Table (updated 7/2015)			
Strategy	Action	Date	Comments
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.	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.	1980 On-going	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.
		1982 On-going	PRFC has had a moratorium on directed shad harvest in Potomac River since 1982.
		1992 On-going	DCFM implemented a moratorium on shad harvest within District of Columbia waters of the Potomac River in 1992.
		1998	CBAMP Amendment 1 supersedes Strategy 1.1.1 restoration criteria
		2013	No stock allocation for Alosa species has been developed due to the moratorium. Resource allocation will be revisited when Alosa stocks are deemed recovered.
1.1.2 Virginia will follow ASMFC recommendations for a 25% exploitation rate for alosids [sic].	1.1.2 Virginia will utilize the Virginia Marine Resources Commission's Stock Assessment Program and the fishery surveys of the Virginia Institute of Marine Science to assess current Alosid [sic] exploitation is above the 25% rate, Virginia	1994  Continue	VA implemented a moratorium on the harvest of American and hickory shad from the Bay in 1994.  ASMFC allows a limited American shad commercial bycatch harvest in the James, York, and

1989 Chesapeake Bay Alosid [ <i>sic</i> ] Management Plan Implementation Table (updated 7/2015)			
Strategy	Action	Date	Comments
	will take the appropriate steps to limit fishing effort.	2010 On-going	Rappahannock rivers for the anchored and staked gill net fisheries. VA has an allowable catch for Native American tribe(s).
		2012 On-going	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	On-going 2012	No harvest restrictions were implemented for river herring until 2012.
		2012 On-going	Commercial harvest of river herring declined due to low market demand and uncertain stock status.
		2012 On-going	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.
		2012	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	MD (1981) and DC (1992) and PRFC (1995) continue moratorium on hickory shad. Recent monitoring results suggest hickory shad are rebuilding in the Bay.
		1996 Continue	Larval and juvenile hickory shad have been stocked in the Patapsco, Patuxent, Chop tank, and Nanticoke rivers. Shad are no longer stocked in Marshyhope Creek (Nanticoke River). Stocking has been focused on the Choptank River.
		2010 Continue	Hickory shad are considered self-sustaining in the Patuxent and Choptank rivers.
		2014	
1.4 Pennsylvania will continue to prohibit the harvest of American shad in the Susquehanna River	1.4 As restoration of alosids [ <i>sic</i> ] progresses over dams in the Susquehanna River, additional	On-going	PA prohibits the harvest of American and hickory shad in the Susquehanna River watershed.

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and its tributaries, and American and hickory shad in the Conowingo Reservoir while restoration efforts are in progress.	regulations in Pennsylvania will be promulgated to protect these species until a degree of restoration is achieved	Continue	Insufficient recreational catch data are available post-2008.  The recreational catch and release fishery below Conowingo Dam will continue.
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 [sic].	2.1 Maryland, Pennsylvania and Virginia will participate in the ongoing ASMFC alosid [sic] 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	MD, VA, and PRFC participate in the ASMFC shad management board and technical committee.
		1997	ASMFC conducted a stock assessment in 1997.
		1999	Amendment 1 to the ASMFC shad plan adopted a strategy to keep fishing mortality below $F_{30}$ .
		2007	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.
		2012	The ASMFC Management Board approved the 2012 river herring stock assessment.
		2012-2013	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.
2.2 Virginia will follow ASMFC recommendations to reduce shad harvest to a 25% exploitation rate.	2.2 A) Implement a coastal shad tagging program to determine which stocks are being exploited in the intercept fishery	2014	<b>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.</b>
		1991 Continue	Tagging studies indicated that the coastal fishery is mixed and highly variable from year to year. Continuation of tagging programs is recommended.

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Strategy	Action	Date	Comments
		On-going	DNA data is currently 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    2012 Completed	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.  Action 2.3.1 was superseded 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.	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.
	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  2014	River herring bycatch is monitored by the MAFMC, NEFMC, NMFS, and NAFO.  <b>MAFMC approved a 196,211 pound incidental shad and river herring bycatch limit for the Atlantic mackerel fishery for 2015. The fishery will close early if the incidental bycatch limit is exceeded.</b>
	2.3.2 c) Intercept fisheries will be discouraged.	2012-2014	<b>MAFMC under Amendment 14, approved a 196,211 lb. Alosa bycatch limit to the Atlantic mackerel fishery for 2015. 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 databases.	3.1 A) Maryland will continue the alosid [ <i>sic</i> ] juvenile survey and develop an index of stock abundance. Virginia will continue to collect shad and herring juvenile abundance data with the objective of developing a baywide index of	Continue  2009	VIMS, MD DNR and DCFM have Alosine juvenile surveys and calculate indices for each species. - The last several years indicate an increase in juvenile Alosines.



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Strategy	Action	Date	Comments
	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.	Continue	ASMFC Amendment 2 requires river herring JAI surveys. VA & MD continue to provide data to coastal stock assessment
		2010 Discontinued	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	Adult shad tagging project on the Nanticoke River was ended due to a lack of tag returns.
		2009 Continue	ASMFC Amendment 2 requires adult river herring spawning/population assessment. The Nanticoke River commercial survey is the current data source for the river herring spawning population assessment. The Nanticoke River commercial survey will continue during the moratorium.
		2011	
	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)	2013 Continue	A fishery independent gill net survey was conducted in the Northeast River to monitor spawning river herring.
	3.1 D) The VMRC Stock Assessment Program will provide additional fishery dependent data collection for Virginia's shad fisheries (on-going)	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 E) Virginia will initiate an ocean intercept tagging program to determine stock composition in the coastal shad fishery (1990)	On-going	Required by the ASMFC.
		1991-1992 Completed	Tagging work completed in 1992. - Results indicated coastal catch is mixed and highly variable.

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		2005	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	Mortality rates are calculated for river herring in the Nanticoke River. Exploitation rate estimation has not been a priority.
		Continue	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	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.
		2009	CBSAC sponsored a workshop to evaluate different methodologies and recommended a multi-metric approach.
		2009 On-going	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)		MD striped bass juvenile seine and gill net surveys collect American shad data.
		1991 On-going	DCFM has been sampling the upper Potomac for shad and river herring since 1991.
		2011	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.
		2014	The PRFC American shad pound net survey indicates that CPUE in the Potomac River is 131% of the ASMFC restoration target.
4.1 The Chesapeake Bay Program's Fish Passage	4.1 The District of Columbia, Maryland,	Variable	Actions 4.1A - 4.1C, 4.1E, and 4.1G - 4.1I have been

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<p>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>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>Completed</p> <p>2010</p> <p>2011</p> <p>Continue</p> <p>2012</p> <p>2014</p> <p>2014</p>	<p>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><b>Fish passage and habitat studies conducted as part of the FERC relicensing process are available at:</b>  <a href="http://www.exeloncorp.com/powerplants/Conowingo/relicensing/documents.aspx">http://www.exeloncorp.com/powerplants/Conowingo/relicensing/documents.aspx</a></p> <p><b>FERC has not renewed the license for the Conowingo Project and 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.</b></p>
	<p>4.1 B) Design planning and implementation of fishways at Holtwood, Safe Harbor and York Haven dams on the Susquehanna River. (In progress)</p>	<p>1986 Completed</p> <p>2010 Continue</p>	<p>Fishways have been constructed. Fishway improvements are periodically implemented to boost fish passage efficiency.</p> <p>Holtwood Dam fishway is being renovated to improve upstream passage of Alosa. <b>All</b></p>

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Strategy	Action	Date	Comments
		2014	<p>improvements are complete with the exception of the installation of Obermeyer gates.</p> <p><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></p>
	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)	<p>1990</p> <p>2011/2012 Completed And On-going</p>	<p>Action completed.</p> <p>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.</p>
	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	1,838 miles of Chesapeake Bay stream habitat was reopened in PA, VA, and MD for anadromous fish from 1988 through 2005.
		1989-2007 Ongoing	VA has removed 6 dams, breached 3, and build passage structures at 9 as of 2012. 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>
		2009	Between 1989 and 2013, approximately 2,576 miles of habitat were reopened to anadromous and resident fish.
		<p>2010 Continue</p> <p>2011</p>	<p>From 1986 to 2003, &gt;340 million American shad fry and fingerlings were cultured and released in Susquehanna, James, Pamunky, Mattaponi, Rappahannock, Potomac &amp; Choptank rivers. Rappahannock River stocking began in 2003.</p> <p>Patuxent River hickory shad have been restored and stocking discontinued. Limited monitoring will continue. Marshyhope stocking was discontinued after 2011. Hickory shad stocking will continue in the Choptank River. American shad are only stocked</p>
		2011-2013 Completed	

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Strategy	Action	Date	Comments
		<p>2010 on-going</p> <p>2013 Continue</p> <p><b>2014 On-going</b></p>	<p>in the Choptank River as of 2011.</p> <p>Additional wells were drilled at Manning hatchery and liners added to existing ponds to accommodate increased river herring culture.</p> <p>Union Dam and Simkins Dam on Patapsco River were removed. Removal of Bloede Dam on the Patapsco River is scheduled for 2016 and in the final design phase.</p> <p>Experimental stocking of American shad, hickory shad, and river herring in the Patapsco River began in 2013. <b>795,000 alewife, 160,000 American shad, 679,500 blueback, and 538,500 hickory shad were stocked in 2014.</b> The project will stock for 3 years with 2 additional years of monitoring.</p> <p><b>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).</b></p>
	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)	<p>Completed</p> <p>2014</p>	<p>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.</p> <p>Town of Elkton created a bypass channel around the dam which increased from bank incision and erosion 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</p>

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Strategy	Action	Date	Comments
			sediment deposits are inhibiting fish from using the ladder. The town of Elkton is responsible for maintaining the ladder and will made provisions for improving access when their MDE permit is renewed in 2016.
	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	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.  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.
	4.1 G) Fish passage facilities on the James and Rappahannock Rivers will be established. (Currently being implemented )	1999 Completed  2005 Completed	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.  Embrey Dam was removed from the Rappahannock River reopening 106 miles of the Rappahannock and Rapidan rivers.
	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, 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:	Continue	Hatchery-rearing methods are standardized. MD, VA, and PA strip spawn. DE hatchery spawning is hormone free. Jurisdictional coordination is good.



1989 Chesapeake Bay Alosid [ <i>sic</i> ] Management Plan Implementation Table (updated 7/2015)			
Strategy	Action	Date	Comments
	J) Sources of adult fish used for restocking areas will be coordinated with other states and agencies. (1990)	Continue	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.
	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	Moratorium in place for American and hickory shad. Hickory shad data is insufficient for most tributaries to determine population status.
		2010	Juvenile downstream survival has to be improved at dams having Francis turbines: Holtwood and York Haven.
		2011	Normandeau studies at Safe Harbor (2008) and Conowingo (2012) indicate ~86% survival of adult American shad during downstream passage.
		2013	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	ASMFC Amendment 2 encourages assessment of fishway passage efficiency/inefficiency for river herring.
		Continue	Boshers Dam vertical slot fishway is monitored for passage each spring. American shad plus 23 other species are known to use the passage.
		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.
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	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.	Continue 2002 2010	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>

1989 Chesapeake Bay Alosid [sic] Management Plan Implementation Table (updated 7/2015)			
Strategy	Action	Date	Comments
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.		<b>2014</b>	<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>
	4.2.2 A) Maryland, Pennsylvania, and Virginia working within SRAFR, will promote using Susquehanna River brood stock for hatchery production.	Discontinued 2002 Continue	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.
	4.2.2 B) Virginia will expand funding to the recently constructed Pamunky/Mattaponi Indian Reservation shad hatcheries.	1993 Continue	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. Funding was from VMRC, but is now provided by VDGF.
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.	4.3.1 The following technical issues have been accepted.	Continue	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.
	A) Adoption of Maryland water quality standard for dissolved oxygen of 5.0 mg/liter in the Susquehanna River below Conowingo Dam (1989)		
	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

1989 Chesapeake Bay Alosid [sic] Management Plan Implementation Table (updated 7/2015)			
Strategy	Action	Date	Comments
			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	Maps delineating particular habitats of concern are used for developing water quality standards.
		2011	Revised habitat prioritization maps have been completed by CBP.
		<b>2014 On-going</b>	<b>Jurisdictions adopted the Chesapeake Watershed Agreement (2014) to set specific restoration goals and timeframes. For more information:</b> <a href="http://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignature-s-HIres.pdf">http://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignature-s-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 [sic] 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. 2) Reduce the discharge of untreated or inadequately treated sewage. 3) Establish and enforce nutrient and conventional pollutant limitations in regulated discharges. 4) Reduce levels of nutrients and other conventional pollutants in runoff from agricultural and forested lands. 5) Reduce levels of nutrients and other conventional pollutants in urban runoff.	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>
		2000	New commitments were established in the Chesapeake 2000 Agreement. For Alosines, priority populations will be identified and tributary-specific targets developed.
		2007	STAC sponsored a workshop during 2007 to develop restoration targets.  Executive Order 13508 by President Barack Obama required federal agencies to increase cooperation and

1989 Chesapeake Bay Alosid [sic] Management Plan Implementation Table (updated 7/2015)			
Strategy	Action	Date	Comments
		2009	leadership, coordinate with state and local government, and enforcement of Clean Water Act.
		2009	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
		2010 2012 On-going	<b>Jurisdictions adopted the Chesapeake Watershed Agreement (2014) to set specific restoration goals and timeframes. For more information:</b> <a href="http://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignature-s-Hires.pdf">http://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignature-s-Hires.pdf</a>
		<b>2014 On-going</b>	
	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. 1) Reduce discharge of metals and organic compounds from sewage treatment plants receiving industrial wastewater. 2) Reduce the discharge of metals and organic compounds from industrial sources. 3) Reduce levels of metals and organic compounds in urban and agriculture runoff. 4) Reduce chlorine discharges to critical finfish areas.	On-going  <b>2014 On-going</b>	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>  <b>Jurisdictions adopted the Chesapeake Watershed Agreement (2014) to set specific restoration goals and timeframes. For more information:</b> <a href="http://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignature-s-Hires.pdf">http://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignature-s-Hires.pdf</a>
	4.5 C) Develop and adopt a basinwide plan for the management of conventional pollutants entering the Chesapeake Bay from point and nonpoint sources. 1) Manage sewage sludge, dredge spoil and hazardous wastes. 2) Improve dissolved oxygen concentrations in the Chesapeake Bay through the reduction of nutrients from both point and nonpoint sources. 3) Continue study of the impacts of acidic	2011	Some Alosa spawning reaches appear to be sand and gravel deficient and may impair egg survival. MD DNR and USACE are studying sand and gravel transport at the Simkins Dam removal site (Patapsco River) as well as possible negative effects of accumulated sand and gravel behind blockages.
		2008	MD DNR Fisheries Service is studying spawning and hatching success with associated habitat and

1989 Chesapeake Bay Alosid [sic] Management Plan Implementation Table (updated 7/2015)			
Strategy	Action	Date	Comments
	conditions on water quality. 4) Manage groundwater to protect the water quality of the Chesapeake Bay. 5) Continue research to refine strategies to reduce point and nonpoint sources of nutrient, toxic and conventional pollutants in the Chesapeake Bay.	On-going	watershed conditions including land use. <b>Analyses indicate that urbanization is detrimental to Alosine spawning.</b>
		2011 Continue	Sediment accumulation behind Conowingo Dam is nearing capacity. At capacity, the Dam will no longer reduce sediment, nutrient and other pollutant inputs to Chesapeake Bay. Options being considered for sediment removal and disposal include sediment bypass, quarry infill, use as landfill material, construction material, and Blackwater Wildlife Refuge marsh restoration. High flow events (storms) scour significant quantities of the stored sediment.
		2014 On-going	<b>Jurisdictions adopted the Chesapeake Watershed Agreement (2014) to set specific restoration goals and timeframes. For more information:</b> <a href="http://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignature-s-Hires.pdf">http://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignature-s-Hires.pdf</a>
	4.5 D) Develop and adopt a plan for continued research and monitoring of the impacts and causes of acidic atmosphere deposition into the Chesapeake Bay. This plan is complimented 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). 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.	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>
		2014 On-going	<b>Jurisdictions adopted the Chesapeake Watershed Agreement (2014) to set specific restoration goals and timeframes. For more information:</b> <a href="http://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignature-s-Hires.pdf">http://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignature-s-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  
SRAFRFC – 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

## 2014 Maryland FMP Report (October 2015)

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

Atlantic croaker and spot are important components of both the commercial and recreational fisheries in Chesapeake Bay. In addition, spot are utilized as bait by the recreational sector. Spot and croaker are important prey items for predators such as spotted seatrout, red drum, striped bass, bluefish, marine mammals and many bird species. Their importance as prey and their dependence on coastal estuaries for juvenile habitat make them a consideration in ecosystem management.

#### Fishery Management Plans (FMPs)

The Chesapeake Bay Atlantic Croaker and Spot Fishery Management Plan (CaS 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 CaS 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 the Fishery Management Plan for Atlantic Croaker modified the management area and biological reference points. Addendum II 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 precautionary management approach using the Traffic Light Approach. 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. The next benchmark stock assessment is slated for completion in 2016. The ages of Atlantic croaker caught in Maryland pound nets in 2014 ranged from one to nine years old, with age two fish accounting for the majority of the catch. Atlantic croaker over age six have become less abundant since the mid-2000s, leading to a corresponding reduction in mean fish length.

**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 (Figures 3 and 4).<sup>9</sup>



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

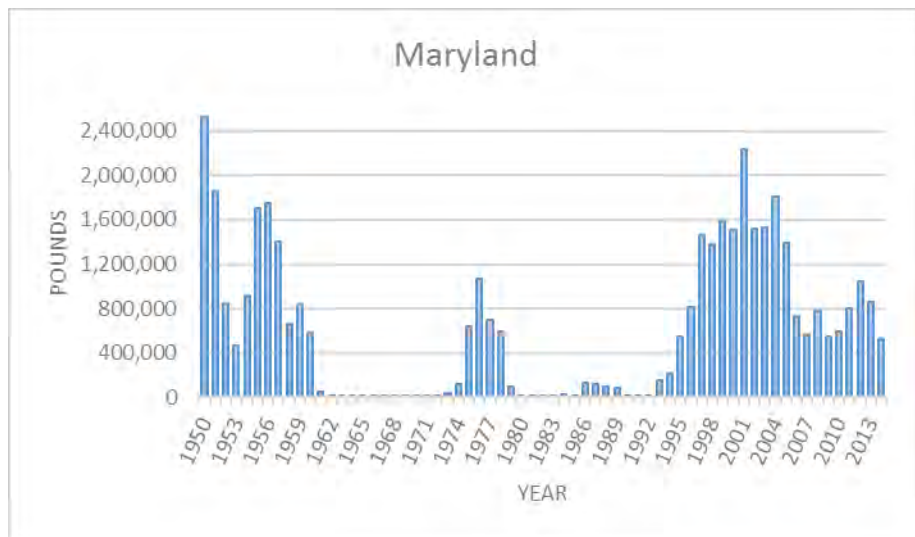


Figure 2. Virginia commercial landings of Atlantic croaker: 1950-2014.<sup>8</sup>

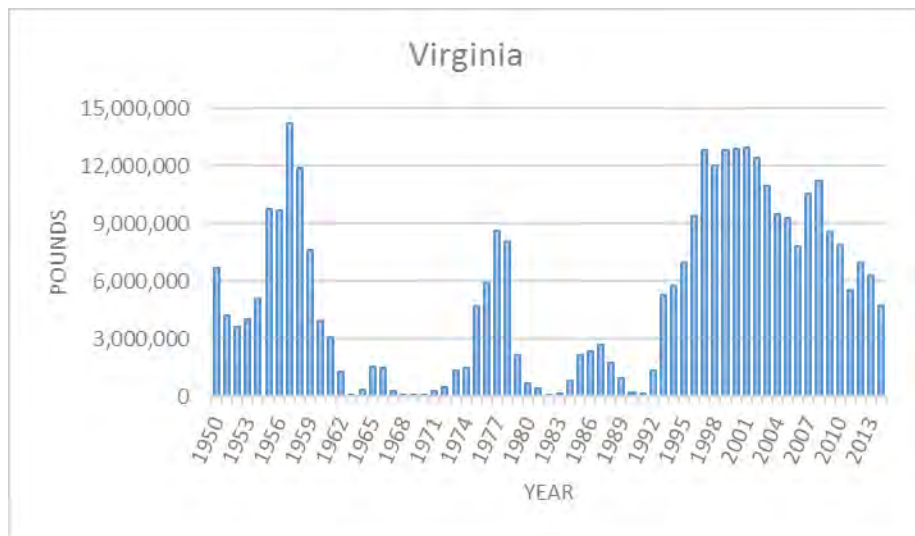


Figure 3. Maryland estimated recreational harvest and release for Atlantic croaker: 1981-2014.<sup>9</sup>

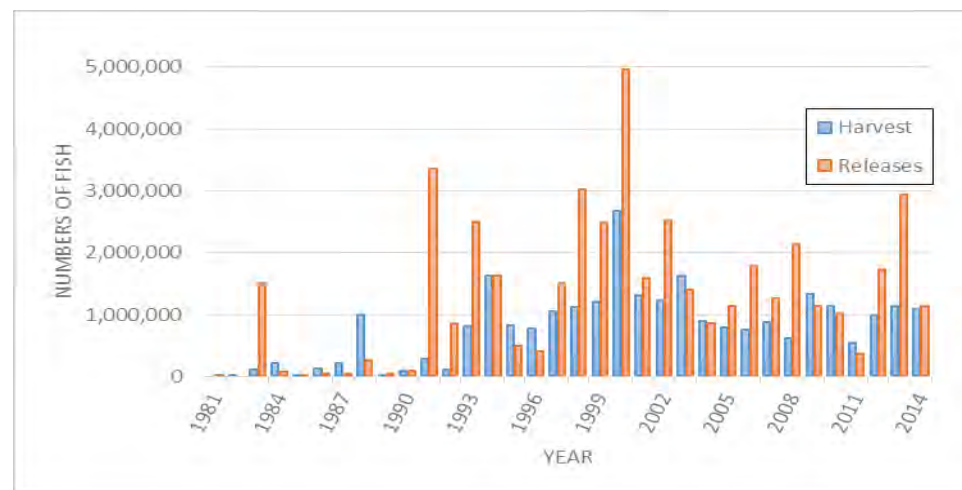
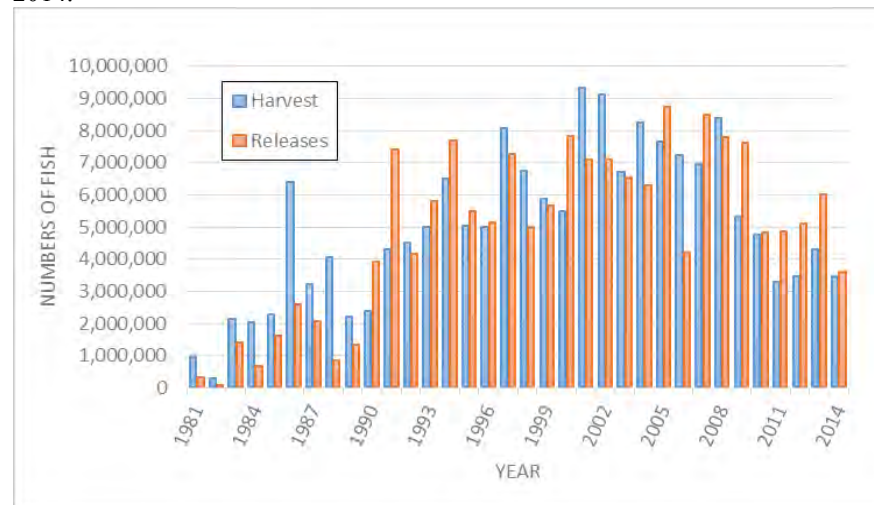


Figure 4. Virginia estimated recreational Atlantic croaker harvest and release, 1981-2014.<sup>9</sup>





**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. This new framework replaces the management trigger approach using the 10th percentile and is particularly useful for short-lived species such as spot. If the thresholds are triggered for two consecutive years, then state-specific management actions will be developed.<sup>5</sup> The ASMFC Spot Plan Review Team met in 2014 to review the trigger indices and did not recommend any management actions at this time.<sup>10</sup>

**Spot Stock Status**— Overfishing and overfished status remain unknown. Catch per unit effort (CPUE) data and harvest values have been used to evaluate the status of spot. There is some concern over declining trends, especially in the commercial fishery. 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 indicated a very strong 2010 year class but both 2011 JIs were low. The 2011 spot index derived from the EJFS JI was the lowest since 1967. Indices increase to near their time series means in 2012, but declined again in both 2013 and 2014.

### 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: 1950-2014.<sup>8</sup>

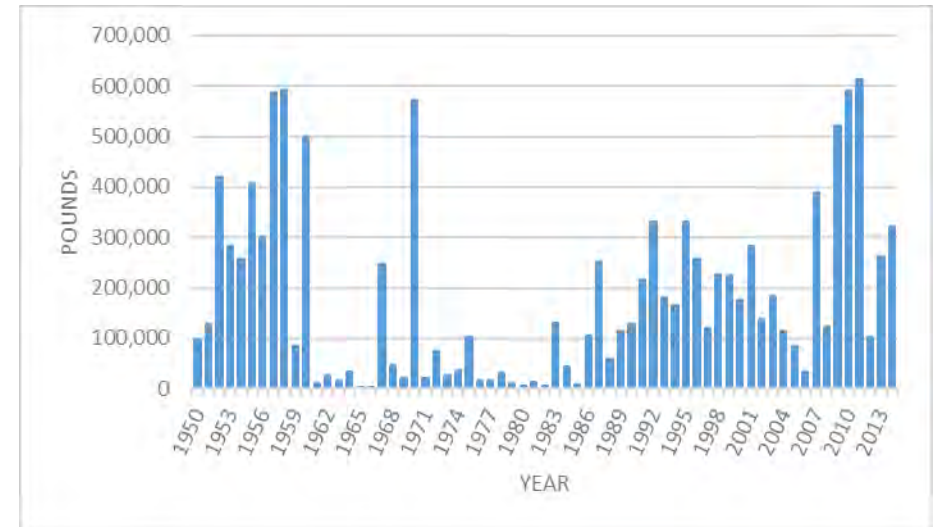


Figure 6. Virginia commercial landings of spot: 1950-2014.<sup>8</sup>

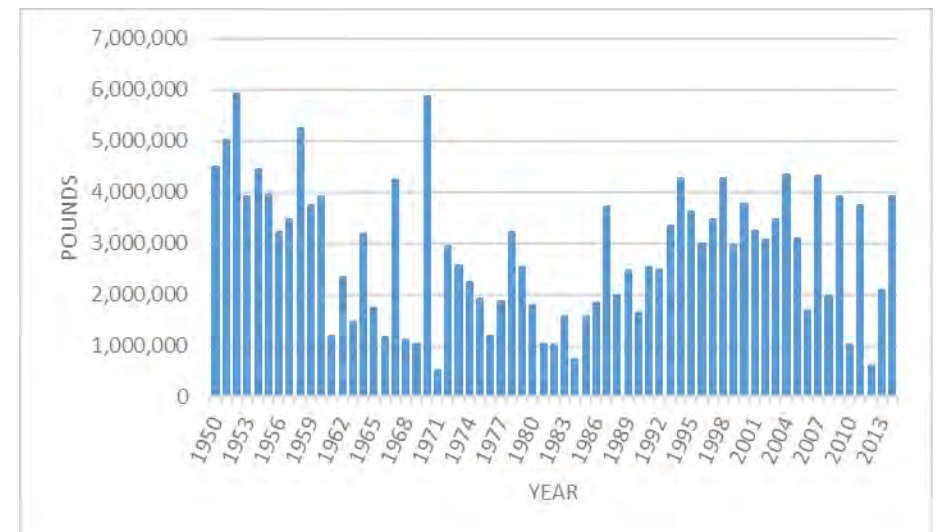


Figure 7. Maryland estimated recreational spot harvest and releases: 1983-2014.<sup>8</sup>

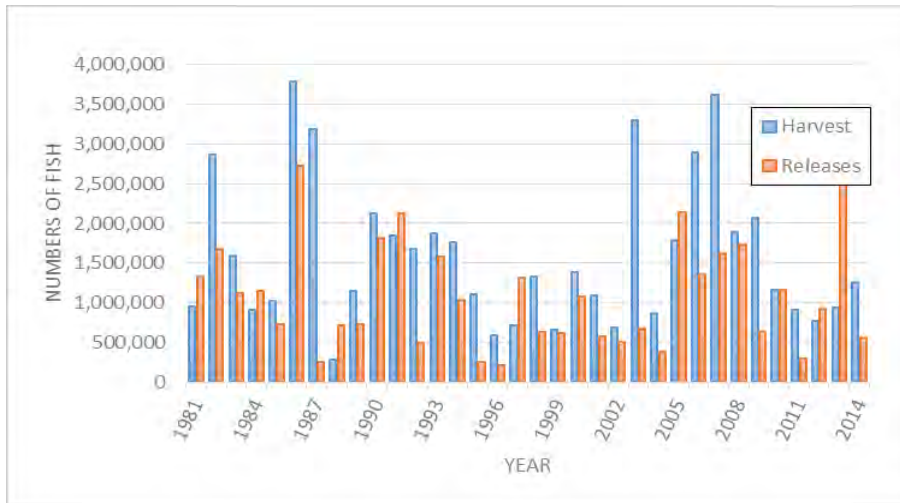
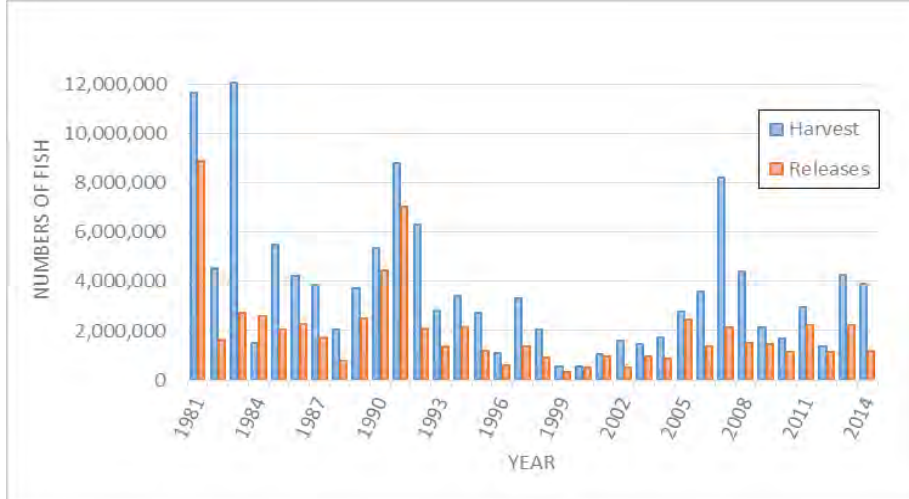


Figure 8. Virginia estimated recreational spot harvest and releases: 1983-2014.<sup>8</sup>



## 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 has a recreational minimum size limit of 9 inches for croaker and a creel limit of 25 fish per person per day. There is a commercial season from March through December and a 9 inch minimum size limit. There are no harvest restrictions for spot.

## 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 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 have been increasingly used as live bait in the recreational striped bass fishery in the Chesapeake Bay. The consequences of using small spot as bait are unknown. Spot used for this 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 2014a. 2014 Review of the Atlantic States Marine Fisheries Commission Fishery Management Plan for Atlantic Croaker (*Micropogonias undulatus*) 2013 Fishing Year. Accepted August 2014.

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

<sup>6</sup> Rickabaugh, H., Jr. 2015. Maryland Atlantic Croaker (*Micropogonias undulatus*) Compliance Report to the Atlantic States Marine Fisheries Commission – 2014. Maryland Department of Natural Resources Fisheries Service June 22, 2015.

<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, November 2015.

<sup>9</sup> Personal communication from the National Marine Fisheries Service, Recreational Fisheries Statistics Division, Marine Recreational Information Program, September 10, 2015.

<sup>10</sup> ASMFC 2014c. 2014 Review of the Atlantic States Marine Fisheries Commission Fishery Management Plan for Spot (*Leiostomus xanthurus*) – 2013 Fishing Year, Arlington, VA 14p.

<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. 2014. Maryland Spot (*Leiostomus xanthurus*) Compliance Report to the Atlantic States Marine Fisheries Commission - 2013 Maryland. Maryland Department of Natural Resources Fisheries Service October, 2014.

<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 10/15)			
<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 completion 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 has a 9” minimum size limit for the croaker recreational and commercial fisheries. MD & PRFC also have a 25 fish/person/day creel limit. MD has an open commercial season from March 16 through December. VA does not have any restrictions.
	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 but recommended the implementation of conservation measures when any two measures of relative abundance indices (with at least one a fishery independent index) were equal to or below the data set’s 10 <sup>th</sup> percentile. <b>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).</b>

1991 Chesapeake Bay Program Atlantic Croaker and Spot Fishery Management Plan Implementation (updated 10/15)			
Problem Area	Action	Date	Comments
<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	CBP jurisdictions have evaluated the effectiveness of bycatch reduction panels in pound nets and PRFC requires reduction panels for all pound nets. Some coastal states are using panels to reduce bycatch of small fish.
<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 assessment update (benchmark) 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 10/15)			
Problem Area	Action	Date	Comments
	<p>Action 3.2</p> <p>A) MD and PRFC will encourage research to collect data on croaker and spot biology, especially estimates of population abundance, recruitment, and reproductive biology.</p> <p>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</p> <p>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 bi-weekly from late May through early September, 2014. Atlantic croaker mean length from the onboard pound net survey was 249 mm total length in 2014, and was the second lowest value of the 22 year time series. Ages ranged from one to nine years old, with age two fish accounting for the majority of the catch. Atlantic croaker over age six have become less abundant since the mid-2000s. Spot mean length from the onboard sampling decreased slightly in 2014 to 194 mm total length, and was below the mean value of 204 mm for the 22 year time series. Atlantic croaker juvenile abundance from the Maryland Chesapeake Bay Blue Crab Trawl Survey, was high in 2012, but declined in both 2013 and 2014, to the 10<sup>th</sup> lowest value of the 26 year time series. The spot Chesapeake Bay juvenile trawl index declined in 2013 and 2014, with the 2014 value being the 3<sup>rd</sup> lowest of the 26 year time series.</b></p>

**1991 Chesapeake Bay Program Atlantic Croaker and Spot Fishery Management Plan Implementation** (updated 10/15)

[illegible]

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**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

ODU = Old Dominion University

PRFC = Potomac River Fisheries Commission

PRT = Plan Review Team

VIMS = Virginia Institute of Marine Science



## 2014 Maryland FMP Report (November 2015)

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

The Atlantic menhaden has been called “the most important fish in the sea” in recognition of its ecological value. Their ecological value has resulted in increased attention to the management of the species.<sup>1</sup> Beginning in 2013, a new coastwide commercial harvest quota was implemented for Atlantic menhaden to reduce exploitation by 20%. The coastwide quota was 170,800 MT or 377 million pounds and was based on the average harvest from 2009 through 2011. Maryland’s main management priority for menhaden during 2014 was to adhere to the ASMFC quota. This required more timely harvest data reporting and also implementing the regulatory requirement to close the fishery when the quota was met. The 2014 benchmark stock assessment focused on several issues from the 2009 and 2012 assessments, specifically, a reevaluation of age composition data, the lack of spatial modeling, the lack of a coastwide adult abundance index and patterns of retrospective analysis. As a result, the 2014 stock assessment concluded that menhaden are not overfished and overfishing is not occurring.<sup>2</sup>

#### ASMFC Fishery Management

A coastal Atlantic menhaden fishery management plan (FMP) was developed by the Atlantic States Marine Fisheries Commission (ASMFC) in 1981. The plan was revised in 1992, amended in 2001 (Amendment 1) and currently managed under Amendment 2 (2012) and several addendums (2004, 2005, 2006, 2009 2011, 2013). The coastal stock assessment was updated and revised in 2010. New biological reference points were developed and adopted in ASMFC Addendum V (2011). The goal of Addendum V is 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. The goal of ASMFC Amendment 2 is to reduce fishing mortality and to end overfishing. The amendment also seeks 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. Maryland is required to comply with Amendment 2 implementation plan requirements. In 2013, Technical Addendum 1 to Amendment 2 was adopted. It allows 1% of the total allowable catch to be set aside for episodic events. These types of events are defined as times and areas when/where menhaden are available in greater abundance than usual. These events typically take place along the New England coast. 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 striped bass, weakfish and bluefish. A menhaden ecosystem management objectives workshop was conducted by ASMFC in 2014. The outcome of the workshop was a statement of goals and objectives that will be considered as part of draft Amendment 3. The development of ecosystem reference points continues through the Biological Ecological Reference Points Workgroup under the direction of the Atlantic Menhaden Management Board.

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. 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 fishing mortality was estimated at 0.27, well under the threshold of 2.98 and the target of 1.03, so overfishing is not occurring. Details of the 2014 assessment can be found at the Atlantic Menhaden webpage of the commission website [www.asmfc.org](http://www.asmfc.org).

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%. 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 pounds and the 2015 quota was set at 5,628,568 pounds. The Potomac River and Virginia portion of the TAC was 0.62% and 85.32%, respectively. The Virginia quota for 2014 was set at 318,066,790 pounds and 349,873,884 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. Maryland submitted emergency regulations, effective June 1, 2013, to address the quota, catch limits, bycatch, permitting and monitoring requirements. For specific information on the new regulations go to <http://dnr.maryland.gov/fisheries/regulations/proposedregulations.asp>

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 (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

Operating under a new regulatory framework, the Maryland open menhaden fishery began in January 2013 and was closed at the end of June when new bycatch regulations became effective. Maryland commercial fishermen harvested 7,071,038 lbs of menhaden in 2013 (includes the open fishery and bycatch). Since bycatch is not considered part of the quota, Maryland was under the allotted quota with a total harvest of 4,211,660 lbs. The remainder of the total harvest, 2,859,378 lbs was caught as bycatch after the fishery was closed in June (landings data as of May 2014). After the fishery was closed there was a 6000 lb allowance per license per day. Watermen are required to report their menhaden bycatch on a daily basis. As a result of the new management measures, the 2013 harvest was most likely reduced between 27% and 34%<sup>3</sup>. Fishery closures assured that the Maryland fishery did not exceed its quotas. In 2014, the landings were similar but slightly lower, with 2,270,810 of bycatch pounds<sup>4</sup> reported from an annual total of 7,005,271 lbs. The bait fishery in Maryland is primarily a pound net fishery. This single gear type accounted for 91.3% of the 2014 total reported harvest.

Biological monitoring from the Maryland pound net (bait) fishery indicated that the majority of harvested menhaden were age 1 through age 3 fish (80%). The new ASMFC stock assessment incorporates this age distribution. Menhaden ages 1 through 7 were present in the samples. Maryland DNR will continue to collect biological data on fish sampled from commercial pound nets.

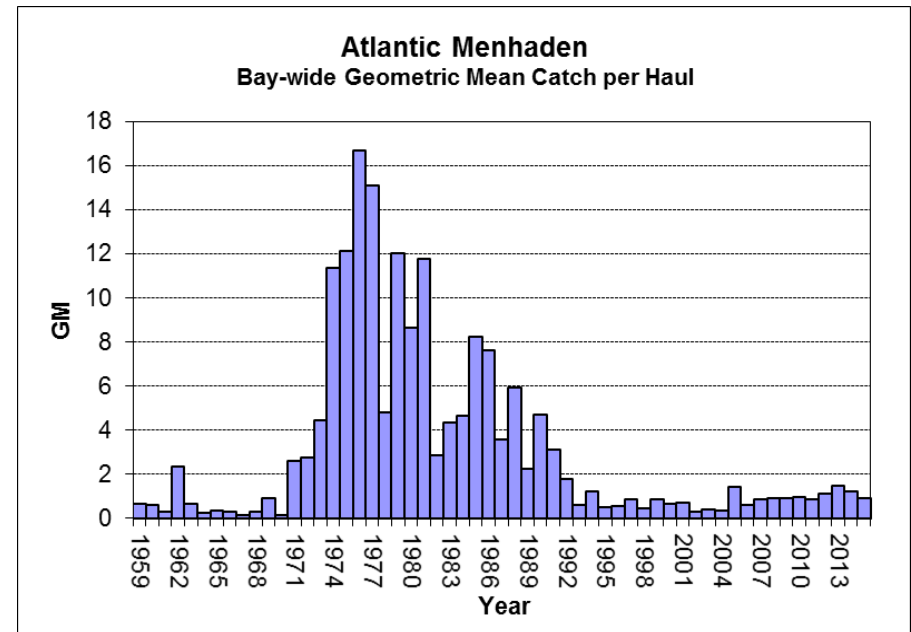
### Issues/Concerns

Significant changes in management were put in place 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, from which state quotas are allocated. All watermen harvesting menhaden from pound nets are required to obtain a bycatch permit to report their catch on a daily basis. Part of the quota is set aside as a buffer for non-pound net landings. Once the fishery is closed a bycatch limit of 6,000 lbs per day will be allowed for permit holders. Non-permit holders will be restricted to a 1,500 lb. bycatch limit.

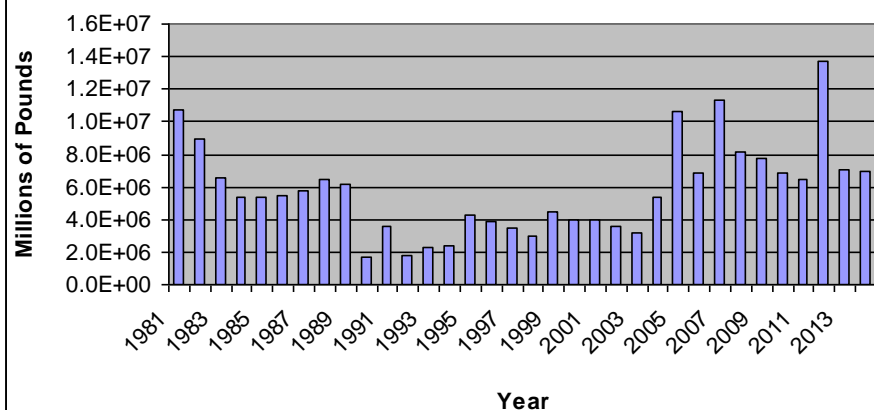
Menhaden have a unique role in the Chesapeake Bay ecosystem as both a primary filter-feeder and an important forage species for top predators (striped bass, bluefish, osprey, etc). The development of ecosystem-based biological reference points would be useful for managing the stock. Menhaden support 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. The 2014 benchmark coastal stock assessment addressed these issues and provided more clarity on the status of the stock.

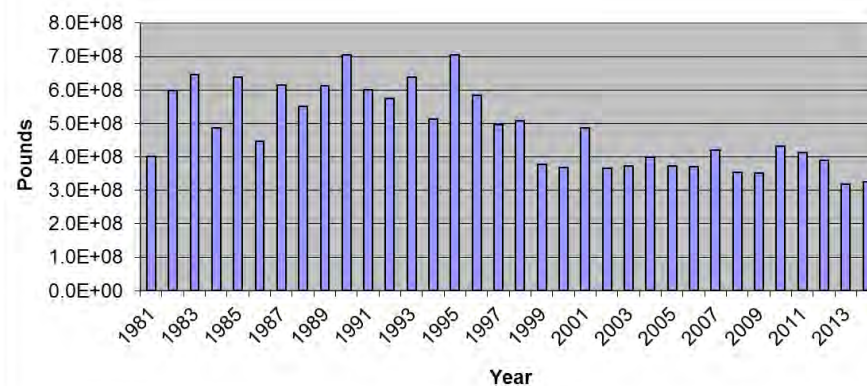
**Figure 1.** Geometric mean catch per haul of menhaden juveniles in the Maryland portion of the Chesapeake Bay, 1959-2015.<sup>5</sup>



**Figure 2. Atlantic Menhaden Bait Landings from Maryland, 1981-2014**



**Figure 3. Atlantic Menhaden Commercial Landings from Virginia, 1981-2014**



## References

- <sup>1</sup>Franklin, H.B. 2007. The Most Important Fish in the Sea: Menhaden and America. 280 p. Island Press.
- <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. 2014. Maryland Atlantic Menhaden (*Brevoortia tyrannus*) Compliance Report to the Atlantic State Marine Fisheries Commission – 2013
- <sup>4</sup>Rickabaugh, H.W. 2015. Maryland Atlantic Menhaden (*Brevoortia tyrannus*) Compliance Report to the Atlantic State Marine Fisheries Commission – 2014
- <sup>5</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.
- <sup>6</sup>Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division, November 12, 2015.

## **2014 Maryland FMP Report (July 2015)**

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

Interstate management of the black drum resource began in 2013 with the adoption of an Atlantic States Marine Fisheries Commission Interstate Fishery Management Plan (ASMFC) for Black Drum. Before 2013, the Chesapeake Bay region was the only regional plan along the Atlantic coast. The commercial fishery for black drum has been closed in the Maryland portion of the Chesapeake Bay since 1998.

#### **Chesapeake Bay FMP**

The Chesapeake Bay Black Drum Fishery Management Plan (CBFMP) 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 Chesapeake Bay Fishery Management Plan (CBFMP) for Black Drum in 2010 and determined that the plan is still an appropriate framework for managing the black drum stock.

The 2013 Interstate Fishery Management Plan (FMP) for Black Drum<sup>2</sup> was initiated because of increased recreational and commercial harvest, inconsistent coastwide regulations, the 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 (by January 1, 2014) and a minimum size limit of 14 inches (January 1, 2016). The Chesapeake Bay jurisdictions require a more conservative minimum size of 16".

#### **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>. Based on the assessment results, the black drum stock is not overfished and not experiencing overfishing. The 2014 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 2014 stock assessment was the first coastwide assessment for black drum. The assessment indicated biomass was slowly decreasing, but remained well above the level need 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 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 a mandatory commercial catch report. Virginia established a 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 one black drum per day per licensee. The harvest of black drum is primarily a recreational fishery. Both states and the Potomac River limit recreational harvest to one 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 generally reach maturity at 4 to 6 years of age and at a size over 21".

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 three 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 2014 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 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 commercial harvest of black drum in pounds from Maryland and Virginia, 1981 - 2013.<sup>3</sup>

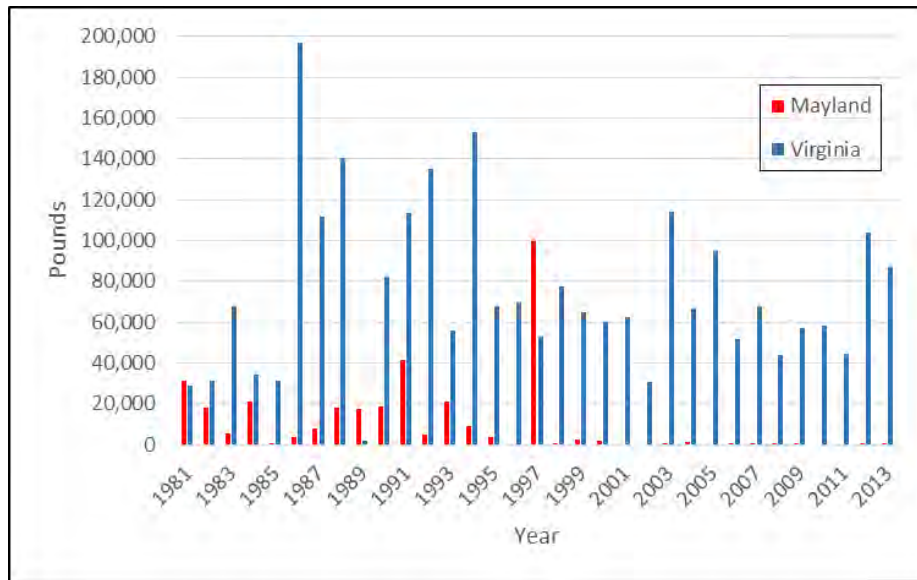
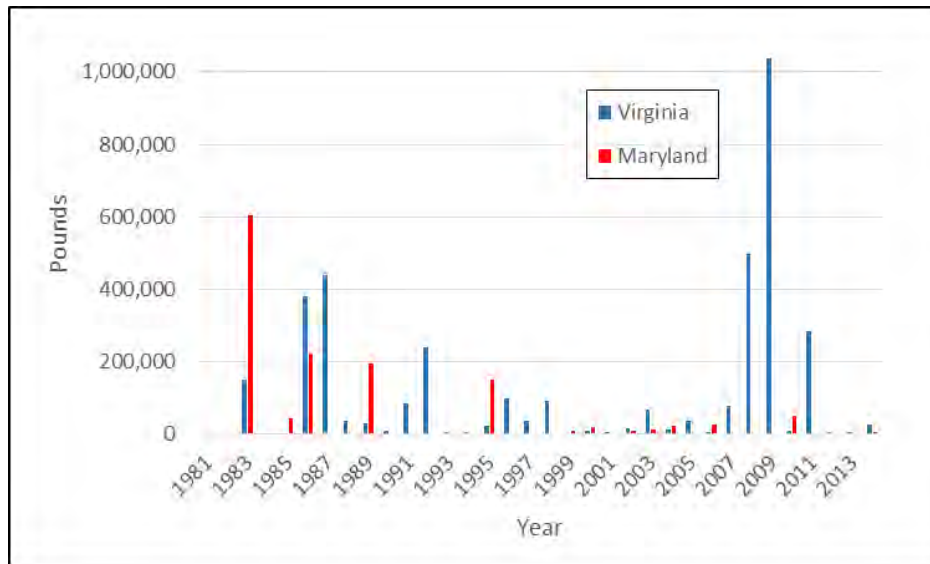


Figure 2. Recreational harvest estimate (MRIP) of black drum in pounds from inland waters for Maryland and Virginia, 1981 - 2014.<sup>4</sup>



## 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. July 16, 2015. <http://www.st.nmfs.noaa.gov/st1/commercial/>.
- <sup>4</sup> Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division. May 16, 2015. <http://www.st.nmfs.noaa.gov/st1/recreational/index.html>.

## **2014 Maryland FMP Report (August 2015)**

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

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 have been determined by tagging studies to be 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 CBFMP 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 (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.

#### **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 2011 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

data workshop is scheduled for June 29 – July 2, 2015 and a new stock assessment is scheduled for 2016.

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 2014 coastwide commercial quota was 2.24 million pounds and the recreational quota was 2.33 million pounds.<sup>5</sup> The coastal recreational harvest exceeded its 2013 recreational harvest limit (RHL) by 80,000 pounds and as a result the 2014 RHL was reduced 7%. Among the coastal states, Maryland receives 11% of the commercial quota which was 239,000 pounds for 2014.<sup>6</sup> 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 2014 was managed with a 12½" minimum size, 15 fish per person per day creel, and was open May 19 – September 18 and October 18 – 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).

### **The Fisheries**

Maryland's commercial harvest quota for 2014 was 239,000 pounds and 234,189 pounds were reported as harvest (Figure 1). Maryland's 2015 commercial quota is projected to be 239,000 pounds.<sup>11</sup>

The north and mid-Atlantic recreational harvest limit for 2013 and 2014 was 2.26 million pounds. Maryland's recreational harvest estimate increased from 35,100 pounds in 2013 to 68,400 pounds in 2014. Most years since 2006 show little variation (Figure 2).<sup>12</sup>

### **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 will increase the number of data sets that can be incorporated into the assessment models. This will facilitate a transition from length-based to age-based assessment models.

Tagging results indicate that black sea bass migration is limited to regional scales. The age-based model being developed will account for the regional variability. Addenda XXI, XXII, XXIII and XXV have been implemented to facilitate regional management including state-

to-state quota transfer. This management framework is being proposed on an annual basis.

Figure 1. Black sea bass harvested by the commercial fishery in Maryland: 1990 – 2014.<sup>12</sup>

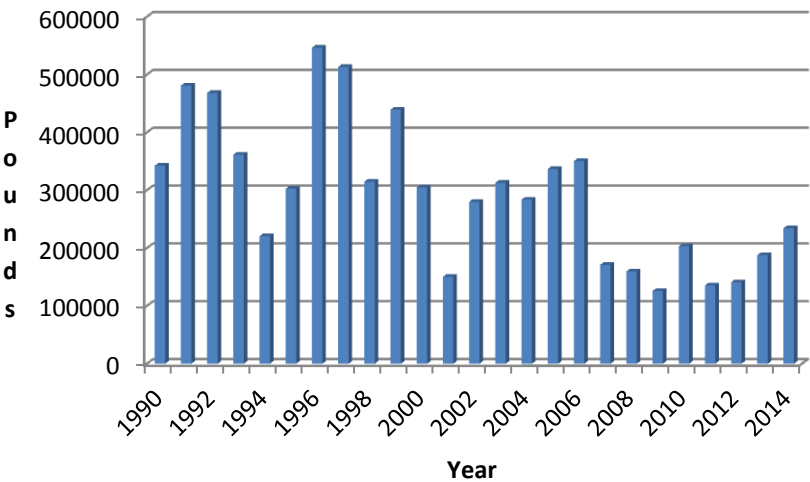
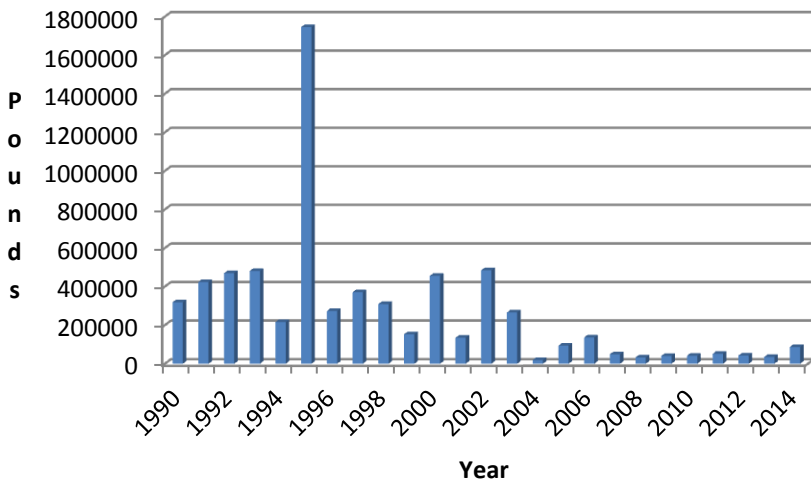


Figure 2. Estimated recreational harvest of black sea bass from Maryland: 1990-2014.<sup>10</sup>



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
- <sup>2</sup> Miller, T., R. Muller, B. O'Boyle, and A. Rosenberg. 2009. Report by the Peer Review Panel for the Northeast Data Poor Stocks Working Group. NOAA/NMFS, Northeast Fisheries Science Center. Woods Hole, MA.  
<http://www.nefsc.noaa.gov/saw/datapoor/DPReviewPanelReportFinal1012009.pdf>
- <sup>3</sup> Atlantic States Maine 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 Maine 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.
- <sup>5</sup> Federal Register / Vol. 78, No. 120 / Friday, June 21, 2013 / Rules and Regulations. Pp 37475-37480.  
<http://www.gpo.gov/fdsys/pkg/FR-2013-06-21/pdf/2013-14919.pdf>
- <sup>6</sup> Atlantic States Marine Fisheries Commission. 2007. Addendum XIX to the summer flounder, scup, and black sea bass fishery management plan: Summer flounder, scup, and black sea bass management. Atlantic States Marine Fisheries Commission. Washington, DC.
- <sup>7</sup> Doctor, S. 2015. Maryland's 2014 black seas bass (*Centropristis striata*) compliance report to the Atlantic States Marine Fisheries Commission. Maryland Department of Natural Resources. Annapolis, Maryland.
- <sup>8</sup> Federal Register / Vol. 79, No. 129 / Monday, July 7, 2014 / Rules and Regulations. Pp 38259-38265.  
<http://www.gpo.gov/fdsys/pkg/FR-2014-07-07/pdf/2014-15799.pdf>
- <sup>9</sup> ASMFC. 2013. Addendum XXIII to the summer flounder, scup and black sea bass fishery management plan for black sea bass recreational management in 2013. Atlantic States Marine Fisheries Commission. Arlington, Virginia.
- <sup>10</sup> Personal communication from the NOAA Fisheries Service, Northeast Regional Office, Fisheries Statistics Office. Accessed May 27, 2015. [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 May 27, 2015. 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.



1996 Chesapeake Bay and Atlantic Coast Black Sea Bass Fishery Management Plan Implementation Table (updated 7/2015)			
Strategy	Action	Date	Comments
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 1997 Continue	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.
		2003  2004  2009  <b>2014</b>	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.  <b>MD &amp; VA reduced their recreational creel to 15 fish/person/day.</b>
	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 2000 2002  2003  2010 2013	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 from January 1-May 18 and September 19-October 17.

1996 Chesapeake Bay and Atlantic Coast Black Sea Bass Fishery Management Plan Implementation Table (updated 7/2015)			
Strategy	Action	Date	Comments
		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 codend 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”
	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.	Continue  1996	Chesapeake Bay Program (CBP) jurisdictions are in compliance with vent requirements in pots and traps.  MD COMAR: Unobstructed escape vent in holding chamber of at least 2 ½” diameter, if circular, or 2 ½” stretched mesh size if square.

1996 Chesapeake Bay and Atlantic Coast Black Sea Bass Fishery Management Plan Implementation Table (updated 7/2015)			
Strategy	Action	Date	Comments
		1996	4VAC20-950-40: Two escape vents of 2 ½” circular dimension, 2” square dimension, or 1 3/8” by 5 ¾” 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 ½” 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 ½” in diameter, if circular, or 2 ½” 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

1996 Chesapeake Bay and Atlantic Coast Black Sea Bass Fishery Management Plan Implementation Table (updated 7/2015)			
Strategy	Action	Date	Comments
			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 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.	2.1a) Research on effects of hermaphroditism 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.	Continue  2009	Although the stock has been rebuilt, management 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	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

1996 Chesapeake Bay and Atlantic Coast Black Sea Bass Fishery Management Plan Implementation Table (updated 7/2015)			
Strategy	Action	Date	Comments
interjurisdictional efforts to maintain a comprehensive database on a baywide scale.		2010	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. Revised BRPs are $F_{40\%} = 0.42$ and $SSB_{40\%} = 27.6$ million pounds. Overfished threshold is $SSB_{threshold} = 24.0$ million pounds.
		2013	In 2013 $F = 0.21$ and $SSB = 24.6$ million pounds.
	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.
	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

1996 Chesapeake Bay and Atlantic Coast Black Sea Bass Fishery Management Plan Implementation Table (updated 7/2015)			
Strategy	Action	Date	Comments
		2015	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>The management of oyster sanctuary areas is under review and a final report is scheduled for completion on 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  2010 On-going	Reefs are qualitatively monitored with underwater video.  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  1996-2006  2007	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.  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

1996 Chesapeake Bay and Atlantic Coast Black Sea Bass Fishery Management Plan Implementation Table (updated 7/2015)			
Strategy	Action	Date	Comments
			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.
		Continue	USN Destroyer <i>Radford</i> is being prepared for reefing. 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 reefed 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</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>

1996 Chesapeake Bay and Atlantic Coast Black Sea Bass Fishery Management Plan Implementation Table (updated 7/2015)			
Strategy	Action	Date	Comments
	<p>activities that create turbidity sufficient to impact nearby SAV beds during the SAV growing season.</p> <ul style="list-style-type: none"> <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 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.</li> <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>2003</p> <p>2011</p> <p>2014</p> <p>2008</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. 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>
	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.	Continuing	Water quality criteria have been adopted <a href="http://www.chesapeakebay.net/issues/issue/nutrients">http://www.chesapeakebay.net/issues/issue/nutrients</a> .
	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>2003</p> <p>2011</p> <p>On-going</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. <b>Tracking of this indicator was discontinued in 2014 with a</b></p>



1996 Chesapeake Bay and Atlantic Coast Black Sea Bass Fishery Management Plan Implementation Table (updated 7/2015)			
Strategy	Action	Date	Comments
		2014	<p>programmatic focus on restoring water clarity and protecting existing Bay grass beds.</p> <p>SAV covered 59,927 acres in 2013. <b>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.</b></p> <p>See Chesapeake Bay Program website for updates on SAV restoration.  <a href="http://www.chesapeakebay.net/issues/issue/bay_grasses">http://www.chesapeakebay.net/issues/issue/bay_grasses</a></p>
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.	<p>3.3) Jurisdictions should strive towards achieving the following, especially in the salinity range of BSB.</p> <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>	<p>Continuing</p> <p>2006 Continuing</p> <p>2006 Continue</p> <p>2009 Continue</p> <p>2012</p>	<p>Programs have been expanded to the tributaries.</p> <p>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.</p> <p>MD developed a Blue Infrastructure that includes mapping structural habitat and SAV.</p> <p>Wetland mosquito ditches from the 1930s-1940s are being plugged to reduce tidal flow and restore wetland hydrology and function.</p> <p>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.</p>

1996 Chesapeake Bay and Atlantic Coast Black Sea Bass Fishery Management Plan Implementation Table (updated 7/2015)			
Strategy	Action	Date	Comments
		2014	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 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.	3.4a) Based on the 1992 baywide nutrient reduction plan reevaluation, the jurisdictions will: <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>	Continue	Maps that indicate regions of concerns for living resources have been developed.  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> .
		2009	President Obama executive order recommitting federal agencies to Bay restoration and regulatory enforcement.
		2012/2014	The Chesapeake Bay Program and Chesapeake Bay jurisdictions signed a new Watershed Agreement with 2 year milestones for nutrient reduction and water quality improvement.
	3.4b) Based on the 1994 Chesapeake Bay Toxics Reduction Strategy Reevaluation Report, the jurisdictions will emphasize the following four areas: <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> </ul>	Continue	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>  Chesapeake Bay Program is monitoring levels of mercury, PCBs, PAHs, organophosphate and organochloride pesticides.

1996 Chesapeake Bay and Atlantic Coast Black Sea Bass Fishery Management Plan Implementation Table (updated 7/2015)			
Strategy	Action	Date	Comments
	<ul style="list-style-type: none"> <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>		
	3.4c) The jurisdictions will continue to develop, implement and monitor their tributary strategies to improve bay water quality.	Continuing  2010 2013	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.

### 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

## 2014 Maryland FMP Report (September 2015)

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

Based on the female-specific biological reference points that were adopted in 2011 the Chesapeake Bay blue crab stock is not overfished and overfishing is not occurring. After being below the abundance threshold of 70 million spawning age female crabs in 2014, the estimated abundance of spawning age female crabs in the Chesapeake Bay at the beginning of the 2015 crabbing season increased to 101 million (Figure 1). Although the abundance of spawning age females is above the threshold it remains below the recommended abundance target of 215 million crabs. Conservative management measures have been continued as a risk-averse approach to protect the stock.

#### Status of Chesapeake Bay Blue Crab Management

The Chesapeake Bay Program (CBP) adopted a Blue Crab Fishery Management Plan (BC 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 BC 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 198 million in 2014 to 269 million crabs in 2015. The estimated abundance of spawning age female crabs was 101 million, an increase from 2014. The exploitation fraction was 17% in 2014, below the target (25.5%). The status of the stock from 2012-2015

based on the female-specific target and threshold is found on Table 1. The next stock assessment is scheduled to begin in 2016.

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 for 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 2014 estimate of male exploitation was 21% and no management action is recommended for male crabs at this time.<sup>1</sup> Estimates of male exploitation for 2015 cannot be calculated until the completion of the 2015 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 47% in 2015 after being slightly below the threshold in 2014.

#### 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 went into effect in 2013. 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 2014 the estimated abundance of spawning females was just below the minimum safe threshold of 70 million crabs which prompted additional protection for spawning-age females in the fall of 2014 and spring of 2015. Individual daily bushel limits were reduced in April 2015 and additional vessel bushel limits were put into place from September 2014 thru April 2015 to protect mature females. In 2015 the size limit for female peelers was raised from 3¼ inches to 3½ inches from April 1 - July 14<sup>th</sup> making the minimum size 3½ inches for the entire season in an effort to increase the number of immature females that reach reproductive maturity.

## **The Fishery**

As population levels change, maintaining the exploitation target may result in either an increase or a decrease in harvest. The 2014 baywide (Maryland, Virginia and Potomac River) commercial harvest was approximately 35 million pounds (Figure 2). The percentage of females removed by harvest in 2014 was approximately 17% 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 2.3 million pounds baywide in 2014. Adding up the harvest from each fraction of the harvesting sectors and across the entire Chesapeake Bay, the 2014 total harvest was approximately 37.3 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 new 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 is in progress

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.

Maryland DNR received federal disaster funding in 2008 to assist management efforts and to mitigate impacts to watermen from a declining blue crab fishery. The Maryland General Assembly also directed capital funding towards the efforts. Funding has been used for buying back commercial blue crab licenses; evaluating alternative management systems for the blue crab fishery; providing quality assurance of crabmeat products; creating new marketing programs and economic opportunities; removing derelict (ghost) pots; and seeking sustainability certification for the blue crab fishery and industry. The federal disaster grant ended in Sept. 2014.

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 have developed a management strategy to achieve the outcome and are developing biennial work plans by 2016.

[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. Some of the federal disaster money has been directed to 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 2015. In preparation for the new stock assessment the jurisdictions have determined terms of reference and will consider the development of abundance-based variable targets and thresholds. 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). 2014 Chesapeake Bay Blue Crab Advisory Report, June 2014.
- <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

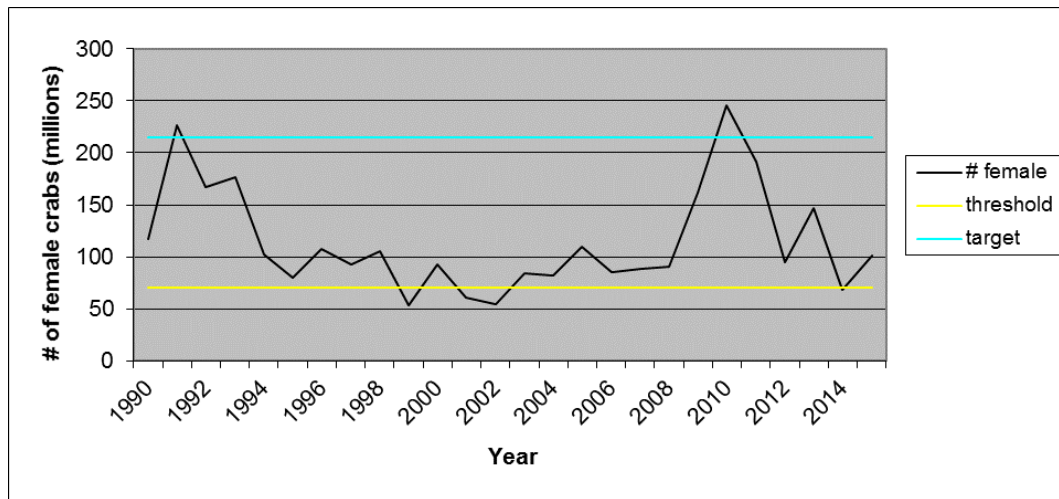
Table 1. Female-specific biological reference points and status of the blue crab stock, 2011-2015

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

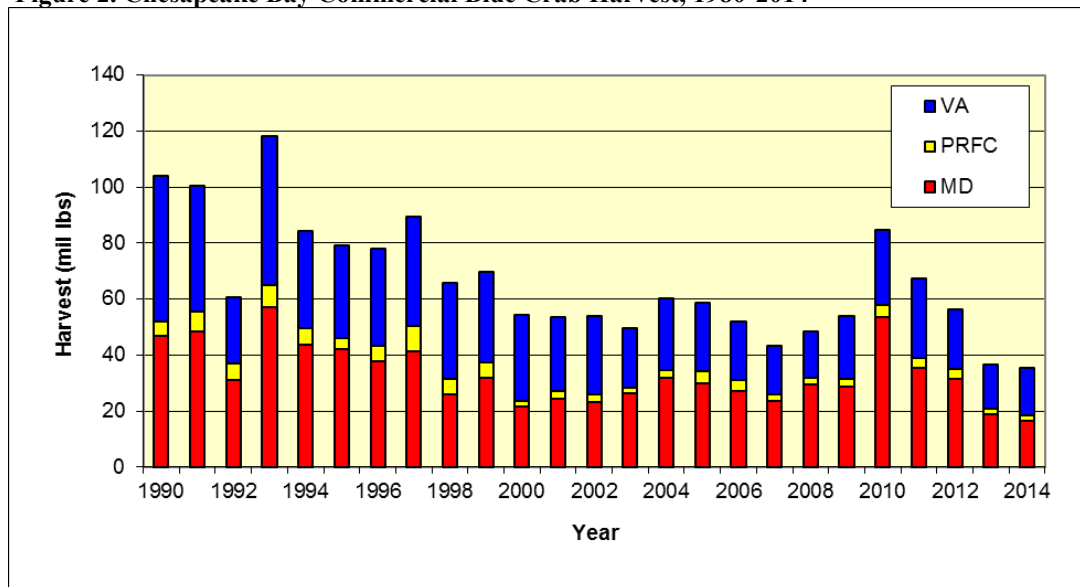
(2015 Chesapeake Bay Blue Crab Advisory Report)

\*Exploitation fraction cannot be calculated until the 2015 harvest data is complete

**Figure 1. Estimated abundance of spawning age female crabs (age 1+) in Chesapeake Bay, 1990-2015**



**Figure 2. Chesapeake Bay Commercial Blue Crab Harvest, 1980-2014**



<b>2003 Chesapeake Bay Program Blue Crab Fishery Management Plan Amendment 1</b> (updated 09/2015)			
<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>2015</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 (101 million crabs) is currently above the threshold level but below the target level. A new stock assessment is scheduled to begin in 2016.</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>2014</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 2014 female-specific exploitation was 17%, below the target level. An exploitation fraction for 2015 cannot be calculated until the completion of the 2015 fishery (December 2015).</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 2015, 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 09/2015)

[illegible]

<b>2003 Chesapeake Bay Program Blue Crab Fishery Management Plan Amendment 1</b> (updated 09/2015)			
<b>Problem Area</b>	<b>Action</b>	<b>Date</b>	<b>Comments</b>
			2011/2012, recruitment was the highest on record but declined by almost 50% the following year (2012-2013). <b>WDS results indicate that recruitment increased from 198 million age 0 crabs in 2014 to 269 million crabs in 2015.</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 09/2015)

<b>Problem Area</b>	<b>Action</b>	<b>Date</b>	<b>Comments</b>
	<p>Action 9 CBP jurisdictions will restore and protect SAV in the Chesapeake Bay to achieve the new goal of 185,000 acres by 2010.</p>	<p>Continue</p>	<p>Actions have been identified by CBP jurisdictions to achieve this goal, including the attainment of water quality in shallow-water bay grass designated use areas.</p>
		<p>2014</p>	<p>In 2014, there were an estimated 75,835 acres of underwater grasses in the Chesapeake Bay, an increase by 27%. SAVs were mapped using 4 salinity zones rather than geographic zones. The change to salinity zones better reflects SAV community types and species composition. For a more detailed description of current and historic status, go to:  <a href="http://web.vims.edu/bio/sav/sav14/exec_summary.html">http://web.vims.edu/bio/sav/sav14/exec_summary.html</a></p> <p>In the Chesapeake Watershed Agreement (June 2014), the SAV goal/outcome was adjusted to reflect a more reasonable timeframe. The outcome states: “Sustain and increase the habitat benefits of SAV in the Chesapeake Bay. Achieve and sustain the ultimate outcome of 185,000 acres of SAV bay-wide necessary for a restored Bay. Progress toward this ultimate outcome will be measured against a target of 90,000 acres by 2017 and 130,000 acres by 2025.”</p>
	<p>Action 10 CBP jurisdictions recognize the value of salt marsh-fringed habitats and will promote the protection and restoration of marsh-fringed shorelines, creeks and coves</p>	<p>Continue</p>	<p>Salt marsh habitats protect molting blue crabs and support many other prey species. These areas are susceptible to shoreline development and should be protected.</p>

**2003 Chesapeake Bay Program Blue Crab Fishery Management Plan Amendment 1** (updated 09/2015)

<b>Problem Area</b>	<b>Action</b>	<b>Date</b>	<b>Comments</b>
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	Action 11 Utilize the guidelines from the Fisheries Ecosystem Plan (FEP) to incorporate multi-species and ecosystem considerations into existing CBP fishery management plans.	Began 2005 Continue	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.
	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.	On-going	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 & are considered the foremost benthic consumer in the Bay foodweb.
	Action 13 Evaluate the impact of non-native crab introductions on the blue crab population and develop recommendations accordingly.	On-going	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.

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

## 2014 Maryland FMP Report (August 2015)

### Section 8. Bluefish (*Pomatomus saltatrix*)

Bluefish are a coastal, pelagic fish that inhabit inshore and offshore waters of the eastern coast of the United States. Bluefish migrate seasonally, north in the spring and summer and south in the fall and winter. Their migration ranges from Maine to Florida along the Atlantic coast. Estuaries and other nearshore habitats are used as nurseries by bluefish larvae and by juveniles. Bluefish have aggressive feeding habits which make them popular to recreational anglers. Commercial harvest of bluefish is less common because of the quality of the flesh.

#### Chesapeake Bay FMP

The Chesapeake Bay Bluefish Fishery Management Plan (CBFMP) was adopted in 1990 and amended in 2003. The CBFMP Amendment #1 adopted the Mid-Atlantic Fisheries Management Council (MAFMC) and the Atlantic States Marine Fisheries Commission (ASMFC) coastal overfishing definition and rebuilding schedule. Furthermore, the CBFMP Amendment #1 introduced ecosystem based management by incorporating water quality improvements, habitat conservation, and multi-species interactions into the management process.

The coastal bluefish stock is jointly managed by the MAFMC and ASMFC. 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. The goal of Addendum I to Amendment 1 (2012) was to significantly increase the amount of bluefish age and length data collected annually.<sup>1</sup> States having >5% of bluefish harvest, including Virginia, were required to increase sampling; Maryland is not one of those states. MAFMC has amended the FMP four times (2000, 2007, 2011, and 2014). The 2014 amendment limits paybacks due to recreational overages to time periods when bluefish are overfished. An omnibus amendment for all MAFMC species was developed and adopted in March 2015. The amendment adds various measures to improve and expand on the Standardized Bycatch Reporting Methodology.

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 coastwide stock. The most recent stock assessment update was completed in 2015 and projected stock status through 2016.<sup>2</sup> The bluefish stock was determined to be rebuilt in 2008 and currently is not overfished and overfishing is not occurring.<sup>2,4</sup> Catch estimates and juvenile recruitment data were included in the age-structured assessment program (ASAP) model to estimate fishing mortality (F) and stock biomass.<sup>4</sup> The definition of overfishing is  $F > 0.19$  and biomass (B) < 73,526 mt or 162 million lbs. Fishing mortality has remained low since 2000. The 2014 stock assessment update estimated 2013 fishing mortality at 0.118, below the target F of 0.19.<sup>4,6</sup> Total stock biomass was estimated at 273 million lbs; 84.3% of the target biomass of 324 million lbs.<sup>5,6</sup> Coastal recruitment has historically been variable, but a period of low recruitment (2009-2012) has led to a slight decline in stock biomass.<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 catch (TAC) for commercial and recreational fisheries. Seventeen percent of the TAC is allocated to the commercial fishery and the other 83% of the TAC is allocated to the recreational fishery. The commercial TAC is managed with state-by-state quotas. Maryland receives 3% of the coastwide commercial quota.<sup>5</sup> For a brief overview of the Atlantic coast bluefish management and fishery performance for 2014, go to: <http://www.mafmc.org/council-events/2015/bluefish-ap-meeting>. The 2015 Atlantic coast TAC is 5.119 million pounds for the commercial fishery and 13.073 million pounds for the recreational fishery.<sup>6</sup> Maryland's 2015 commercial quota is 153,662 pounds, a 31.4% decrease from 2014 (223,891).<sup>2,6</sup>

#### The Fisheries

The bluefish season is open all year (January 1 – December 31) for both the commercial and recreational fisheries. Maryland's minimum size limit is 8" for the commercial and recreational fisheries. Maryland's recreational fishery has a daily limit of 10 fish/per person/day.

Maryland's commercial landings in 2014 were 79,601 pounds, a 60% increase from 2013 (Figure 1).<sup>3</sup> The Marine Recreational Information Program (MRIP) final harvest estimate (A+B1) for 2014 was 170,228 fish (241,660 lbs) in Maryland, more than double the harvest from 2013 (Figure 2).<sup>8</sup> Live discards (B2) decreased from 260,957 in 2013 to 144,742 in 2014 (Figure 2).<sup>8</sup>

## Monitoring Programs

Bluefish data is collected by the Maryland DNR's Chesapeake Bay Finfish Program (CBFP) and its 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 Atlantic coastal bays to develop bluefish juvenile indexes.<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

A single-age key developed from limited data was used in the 2012 stock assessment.<sup>4</sup> The 2015 benchmark SA included more robust age data from multiple east coast states as required by Addendum 1 to Amendment 1.<sup>2</sup>

Age-0 bluefish have a bi-modal (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>

Discard mortality is an important factor for bluefish stock assessments. Recreational discard mortality data is limited. The bluefish Tech Committee conducted a thorough review of bluefish discard mortality literature from 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> The MAFMC is considering industry-funded monitoring of commercial discards, however there are currently no plans in place to apply this program to Maryland bluefish fisheries.

## 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. 2015. Maryland 2014 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.

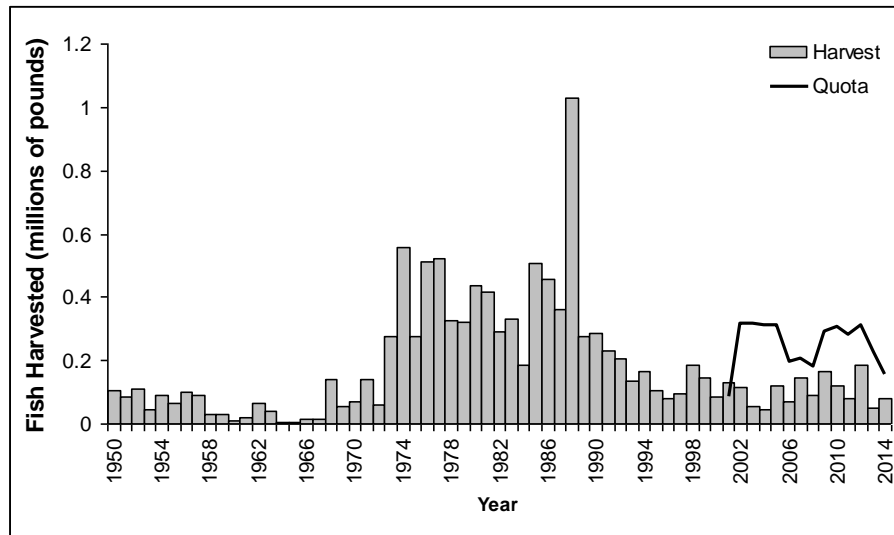
<sup>6</sup> Waite, M. 2011. 2011 Review of the Atlantic States Marine Fisheries Commission fisheries management plan for bluefish (*Pomatomus saltatrix*). Atlantic States Marine Fisheries Commission. Alexandria, VA.

<sup>7</sup> Fisheries of the Northeastern United States; Atlantic Bluefish Fishery; 2015 Atlantic Bluefish Specifications, 80:80 Fed. Reg. 23249-23252 (2015)

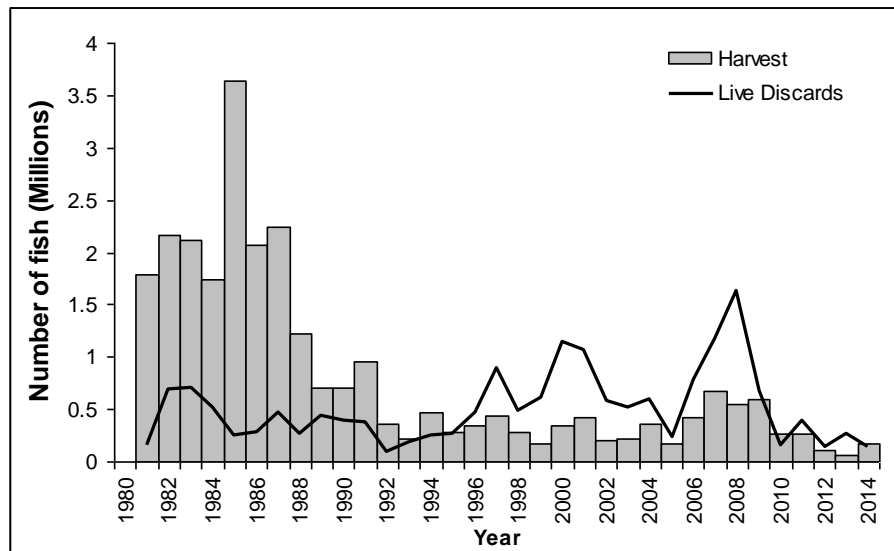
<sup>8</sup> Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division. June 15, 2015.

<sup>9</sup> Personal communication from the Atlantic Coastal Cooperative Statistical Program, Joseph Myers. (2015)

**Figure 1. Commercial bluefish landings in Maryland from 1950 to 2014.<sup>9</sup>**



**Figure 2. Estimated number of bluefish harvested and live discards by the recreational fishery in Maryland from 1981 to 2014.<sup>8</sup>**



2003 Amendment #1 to the 1990 Chesapeake Bay Bluefish Fishery Management Plan Implementation Table (updated 8/2015)			
Problem Area	Action	Date	Comments
<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  2013	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} = 0.19</math> and most recent F estimate is 0.118, 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 MAFMC/ASMFC. Individual state-by-state TALs are based on historic landings from 1981-1989.	Continue	TAL may vary annually. <b>NMFS revised 2015 commercial TALs of 157,330 lbs for MD and 622,629 lbs for VA. TAL has 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. 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.	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 RHL for 2015 is 12.951 million lbs.</b>
<b>Research and Monitoring Strategy</b> CBP jurisdictions will monitor the	<b>Action 3.0</b> CBP jurisdictions will continue to collect catch	Continue	Mandatory reporting is in effect in all CBP jurisdictions. MAFMC created a RSA program



2003 Amendment #1 to the 1990 Chesapeake Bay Bluefish Fishery Management Plan Implementation Table (updated 8/2015)			
Problem Area	Action	Date	Comments
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.	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.		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 ChesMMAF 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 new developments using septic systems.
		2013	Legislation for a stormwater fee based on impervious surface coverage was enacted.
			Chesapeake Bay Program monitors levels of mercury, PCBs, PAHs, organophosphate and

2003 Amendment #1 to the 1990 Chesapeake Bay Bluefish Fishery Management Plan Implementation Table (updated 8/2015)			
Problem Area	Action	Date	Comments
			<p>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">http://www.chesapeakebay.net/restoringwaterquality.aspx?menuitem=14728</a> nutrient reduction</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>	<p>2003 On-going</p> <p>2012</p> <p><b>2014</b></p>	<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. <b>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 2014 SAV acreage was 75,835.</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>

2003 Amendment #1 to the 1990 Chesapeake Bay Bluefish Fishery Management Plan Implementation Table (updated 8/2015)			
Problem Area	Action	Date	Comments
			MD developed a Blue Infrastructure that includes mapping structural habitat and SAV.  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.
	<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.	In progress   2012   2014	Fish collected from ChesFIMS & 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.  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.  <b>Results of the most recent stock assessment for menhaden which considered new data, indicate that menhaden are not overfished and overfishing is not occurring.</b>
	<b>Action 4.4</b> CBP jurisdictions will monitor the abundance of important bluefish forage species that are not	On-going	MD and VA juvenile seine surveys monitor the abundance of anchovies and silversides. Non-managed forage fish abundance is examined by



1990 Chesapeake Bay Bluefish Fishery Management Plan Implementation Table (updated 6/2015)			
Strategy	Action	Date	Comments
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.	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.	Dependent on harvest trends	Bay jurisdictions will coordinate with each other and with federal government. May include gear, trip, area, catch, and/or other restrictions.  See Amendment #1 Action 2.0
	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.	1991	VA will require new regulation for commercial hook and line fishery.  A) See Amendment #1 Action 2.1  B) See Amendment #1 Action 2.2
	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 modify the possession limit and/or minimum size limit.	1991	Will require new regulations. Jurisdictions will coordinate creel limits and size limits.  See Amendment #1 Action 2.2
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	2.1.1) Virginia and the Potomac River established a 10 fish per person per day	1991	See Action 1.1.2.2

1990 Chesapeake Bay Bluefish Fishery Management Plan Implementation Table (updated 6/2015)			
Strategy	Action	Date	Comments
Bay.	recreational creel limit and Maryland will establish a 10 fish creel limit to minimize wastage (see Action 1.1.2.3).		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 fishery in the Chesapeake Bay.	3.1.1) Maryland, the Potomac River Fisheries Commission, and Virginia will improve the catch and effort data collected from the bluefish 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.	1991	Will be accomplished in conjunction with other fish species reporting. Need to assess licensing, reporting, and follow up systems. VA will pursue mandatory reporting system.  See Amendment #1 Action 3.0

1990 Chesapeake Bay Bluefish Fishery Management Plan Implementation Table (updated 6/2015)			
Strategy	Action	Date	Comments
	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.		
	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, 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	1991	Will coordinate with CBSAC, universities, other agencies.  See Amendment #1 Action 3.2

1990 Chesapeake Bay Bluefish Fishery Management Plan Implementation Table (updated 6/2015)			
Strategy	Action	Date	Comments
	affect reproduction and growth of bluefish.		
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.	<p>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:</p> <ol style="list-style-type: none"> <li>1) Developing habitat requirements and water quality goals for various finfish species.</li> <li>2) Developing and adopting basinwide nutrient reduction strategies.</li> <li>3) Developing and adopting basinwide plans for the reduction and control of toxic substances.</li> <li>4) Developing and adopting basinwide management measures for conventional pollutants entering the Bay from point and non-point sources.</li> <li>5) Quantifying the impacts and identifying the sources of atmospheric inputs on the Bay system.</li> <li>6) Developing management strategies to protect and restore wetlands and submerged aquatic vegetation.</li> <li>7) Managing population growth to minimize adverse impacts to the Bay environment.</li> </ol>	Continue	<p>Agencies must coordinate closely; must continue work on habitat requirements for bluefish and other water quality issues in the Bay.</p> <p>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/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>  <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></p>



1990 Chesapeake Bay Bluefish Fishery Management Plan Implementation Table (updated 6/2015)			
Strategy	Action	Date	Comments
			<a href="http://www.chesapeakebay.net/issues/issue/dev/development">http://www.chesapeakebay.net/issues/issue/dev/development</a> See Amendment #1 Actions 4.0, 4.1, 4.2

### Acronyms

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

## 2014 Maryland FMP Report (July 2015)

### Section 9. Maryland Catfish Species

#### Introduction

No discussion of catfish management in Maryland is complete without addressing invasive catfish species, notably, blue catfish (*Ictalurus furcatus*) and flathead catfish (*Pylodictis olivaris*). The populations of both invasive species continue to expand into areas of the Chesapeake Bay and its tributaries where their presence was previously undocumented. They are also contributing more to the overall catfish harvest. The establishment of these invasive species is one of the most difficult problems in fisheries management.

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/ commercial fishing opportunities for invasive catfish and curtailing an "invasive" species.

A Fishery Management Plan has not been written for catfish in Chesapeake Bay but a technical report was written 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. 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 draft 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 (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 and 2014 (Figure 4).

## Management

There are no minimum size limits, no 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 2014, excluding non-natives, was over 2.2 million lbs. The 2014 commercial landings for blue and flathead catfish decreased from 2013 landings by 78,755 and 2,977 pounds, respectively. 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. 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 to the recoveries 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.

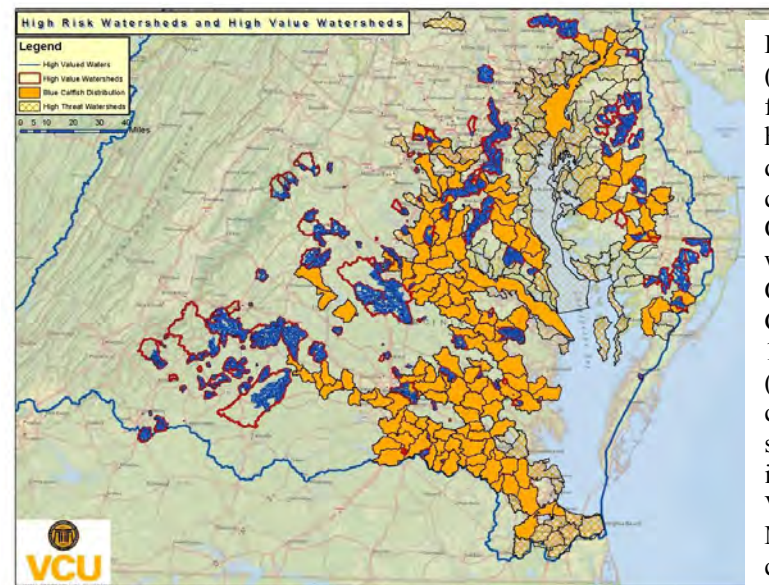


Figure 1. Current (solid polygons) and forecasted (cross-hatched polygons) distribution of blue catfish in Chesapeake Bay waters below Conowingo Dam. Geospatial units are 12-digit watersheds (HUCs). Data are compiled from several sources, including VCU, VIMS, VDGIF, and MdDNR; data were current as of 1 April, 2013.

## References:

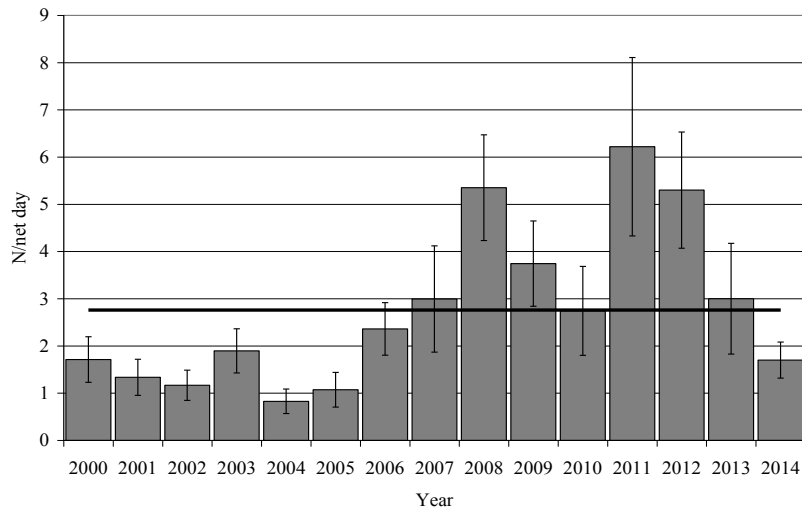
<sup>1</sup>Bilkovic, D.M. and T.F. Idhe. 2014. Review of the final report of the Sustainable Fisheries Goal Implementation Team Invasive Catfish Task Force. Chesapeake Bay Program Scientific and Technical Advisory Committee, No. 14-007, Edgewater, MD 46 pp.

<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.

**Figure 2. Channel catfish relative abundance (N/net day) from the Choptank River fyke net survey, 2000 – 2014. Horizontal line indicates time series average relative abundance.<sup>2</sup>**



<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 3. White catfish relative abundance (N/net day) from the Choptank River fyke net survey, 2000 – 2014. Horizontal line indicates time series average relative abundance.**

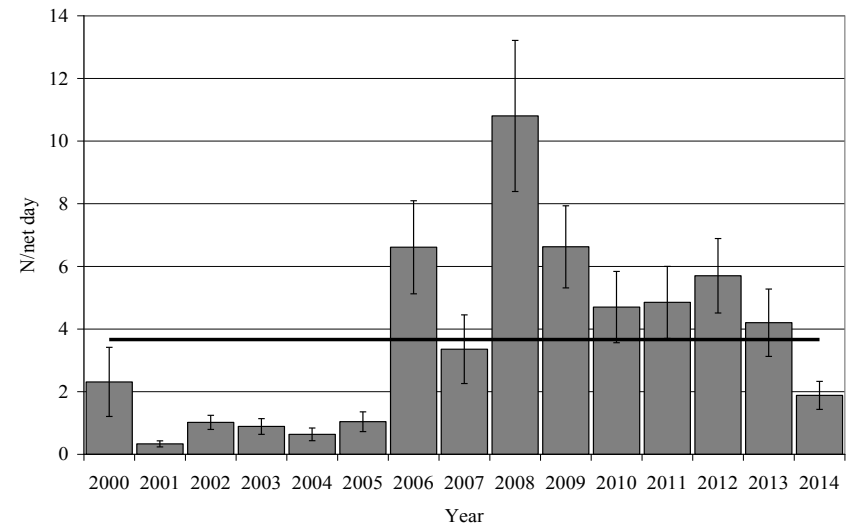


Figure 4. Maryland young-of-year (YOY) geometric mean catch per haul of channel catfish, 1975-2014.<sup>6</sup>

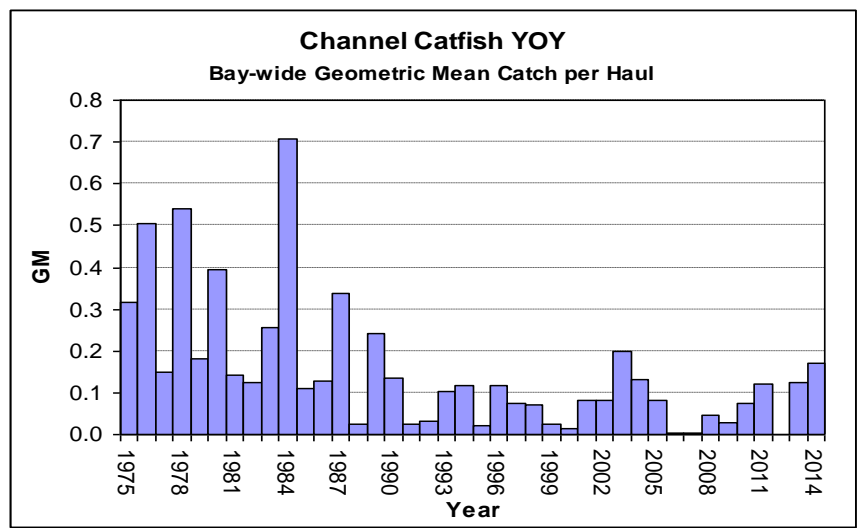
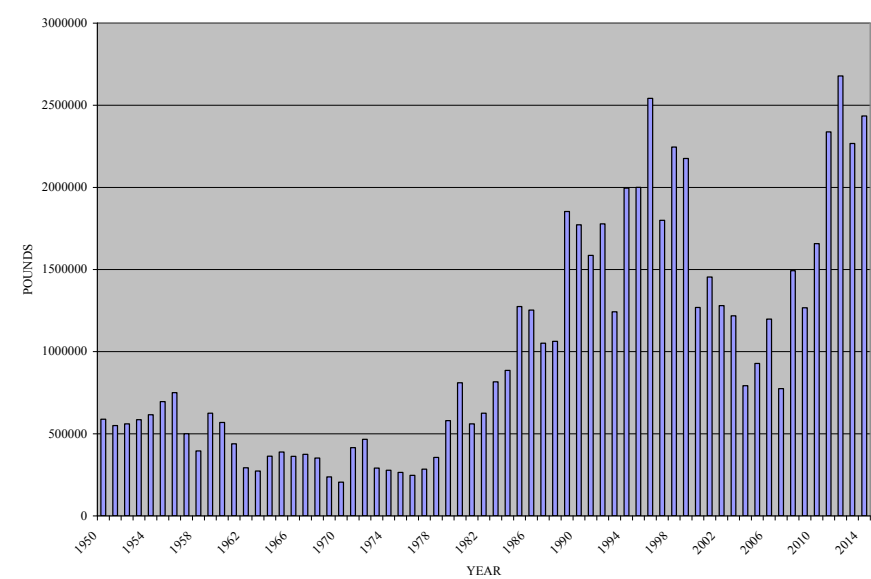


Figure 5. Maryland commercial catfish landings (MDDNR data)



## 2014 Maryland FMP Report (November 2015)

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

Two different fishery management plans (FMPs) apply to blue crabs in Maryland waters: one specific to the Chesapeake Bay and another plan specific to the Coastal Bays. The Coastal Bays Blue Crab Fishery Management Plan (Coastal BCFMP) was developed in 2001. The plan sets forth management measures to conserve the coastal blue crab stock, protect its ecological and socio-economic values, and optimize the long-term utilization of the resource. The 2001 Coastal Bay Blue Crab FMP was last reviewed in 2010. The Plan Review Team determined that the plan was still an appropriate framework for managing the resource.

The development of the Coastal BCFMP was triggered by the Comprehensive and Conservation Management Plan (CCMP) adopted for Maryland's Coastal Bays in 1999. The CCMP recognized Maryland's Coastal Bays as a separate, unique ecosystem from the Chesapeake Bay and 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 an annual basis. A comprehensive review of the CCMP was completed during 2013 and resulted in updated goals, objectives and actions. The review resulted in the completion of a revised plan, 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 Coastal Bays blue crabs. The Coastal Bays Finfish Investigation (CBFI) sample blue crabs as part of their trawl and seine surveys. Indices of relative abundance calculated from both the seine and trawl surveys indicate that the relative abundance of blue crabs has varied over time without any trends. 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 2014 commercial harvest of hard, soft and peeler crabs from the Coastal Bays was 1 million pounds, a slight decrease since 2013 (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 97.6% of the total commercial harvest in 2014. 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.

#### 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 and 3 ½" for soft crabs), 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 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

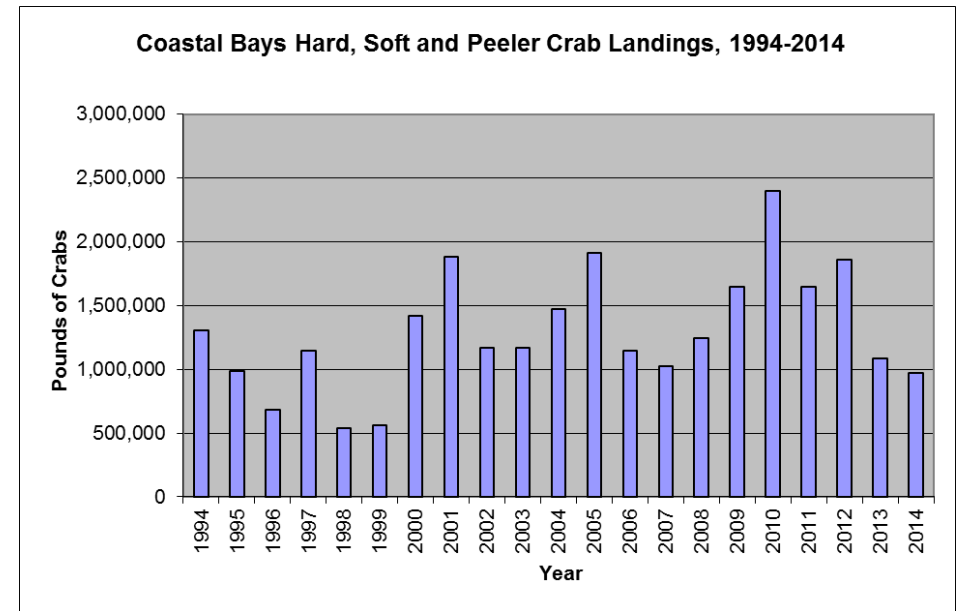
A parasitic dinoflagellate, *Hematodinium* sp., can cause mortality in blue crabs from the Coastal Bays. Studies conducted in 2005 and 2006 indicated that the number of infected crabs followed a seasonal pattern increasing from late summer through December. Results indicated that salinity and water temperature are vital components to 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) is currently studying the effects of *Hematodinium* on blue crabs on the Eastern Shore of Virginia.

[http://www.vims.edu/research/departments/eaah/programs/crustacean/research/hematodinium/eid\\_project/index.php](http://www.vims.edu/research/departments/eaah/programs/crustacean/research/hematodinium/eid_project/index.php)

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.

Maryland DNR began implementing an electronic method of reporting blue crab harvest in the Chesapeake Bay beginning 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.

**Figure 1. Total Maryland Coastal Bays Blue Crab commercial harvest in pounds, 1994-2014 (MD DNR data).**



<b>2001 Coastal Bays Blue Crab Fishery Management Plan Implementation</b> (updated 9/15)		
<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. <b>VIMS is currently conducting a disease study on crabs from the Eastern Shore of Virginia.</b>
	<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 has been 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 ( $F_{10}$ percent), and a fishing target that preserves 20 percent of an unfished stock. ( $F_{20}$ 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 1.0 million lbs. (2014). 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 $F_{20}$ 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



<b>2001 Coastal Bays Blue Crab Fishery Management Plan Implementation</b> (updated 9/15)		
<b>Objective/Problem</b>	<b>Action</b>	<b>Implementation</b>
		trawl and seine survey. Research 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. <b>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. A few crab harvesters from the Coastal Bays participated in the study during 2014.</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

<b>2001 Coastal Bays Blue Crab Fishery Management Plan Implementation</b> (updated 9/15)		
<b>Objective/Problem</b>	<b>Action</b>	<b>Implementation</b>
		penalty system should improve reporting.
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	A Maryland plan has not been developed. However, the Aquatic Nuisance Species Task Force developed a management plan for green crabs for the entire U.S. in 2002.
	<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 <u>Shifting Sands</u> (2009), a book about the Coastal Bays.
Prob. 2.5: Functional Role of Blue Crabs in the Natural Ecological	<b>2.5.1:</b> DNR will examine methods/studies to better understand the natural ecological functions of blue crabs in the coastal bays, including the establishment of a Marine Protected Area in the coastal bays.	No studies have been conducted on marine protected areas.

<b>2001 Coastal Bays Blue Crab Fishery Management Plan Implementation</b> (updated 9/15)		
<b>Objective/Problem</b>	<b>Action</b>	<b>Implementation</b>
Community.		
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 2.2.2.
	<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>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	Hydraulic Clam Dredging is currently prohibited in Maryland's

<b>2001 Coastal Bays Blue Crab Fishery Management Plan Implementation</b> (updated 9/15)		
<b>Objective/Problem</b>	<b>Action</b>	<b>Implementation</b>
	dredging in areas where female crabs are concentrated).	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 coastal bays by scrape and dredge to prevent these fisheries from developing and impacting SAV.	Completed.

<b>2001 Coastal Bays Blue Crab Fishery Management Plan Implementation</b> (updated 9/15)		
<b>Objective/Problem</b>	<b>Action</b>	<b>Implementation</b>
	<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 2013. At the time of this update, maps from VIMS surveys were not available for 2014. 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 (2015).</b>
	<b>5.4.2:</b> DNR will identify areas which have unsuitable levels of dissolved oxygen (i.e. < 3	Ongoing. (Maryland Department

<b>2001 Coastal Bays Blue Crab Fishery Management Plan Implementation</b> (updated 9/15)		
<b>Objective/Problem</b>	<b>Action</b>	<b>Implementation</b>
	mg/L) for blue crabs.	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

## 2014 Maryland FMP Report (August 2015)

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

#### 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 and revised in 2015 (<http://www.mdcoastalbays.org/pdf/ccmp.pdf>). 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 the 1999 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. The CCMP revision (2015) recommended possibly expanding the Coastal Bays Hard Clam FMP to include bay scallops (*Argopecten irradians*) and razor clams (*Ensis directus*). 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 2014, hard clam densities in all five bays were either stable or have increased, with the exception of Newport Bay, which experienced a sharp decline (MDNR Shellfish Monitoring & Assessment Program). The St. Martin River, which historically had very low hard clam densities, showed the greatest increase. 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, though still well below historic densities (Figure 1). Likewise, the hard clam population has increased in Sinepuxent Bay over the past two years, but remains at about 60% of its 1953 level. The most encouraging results have been from the northern bays

(Assawoman and Isle of Wight) which have shown 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 the 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 four years, Isle of Wight clam densities have leveled off below their historic highs, and recruitment has sharply dropped. The population in Assawoman Bay has quadrupled from critically low densities in 2006 and has stabilized over the past three years at about 36% 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 clams 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 2014, there were 17 active leases covering 173 acres. Both hard clams and oysters are being raised on these leases. Production figures were not available.

## Issues and/or Concerns

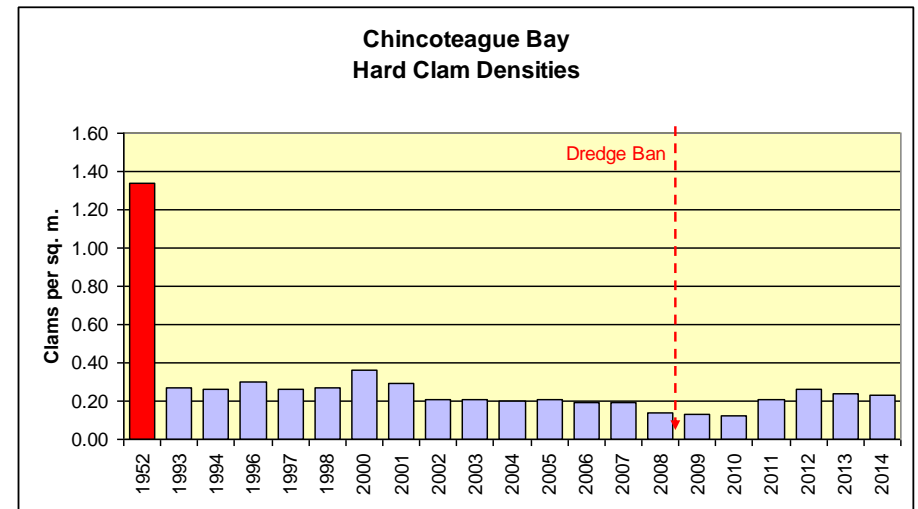
Most of the strategies and actions in the 2002 Coastal Bays Hard Clam Fishery Management Plan were developed to address hydraulic dredging. Since the use of hydraulic dredges is prohibited, these strategies and actions are now obsolete. A revised plan is scheduled for development.

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 is still being contested.

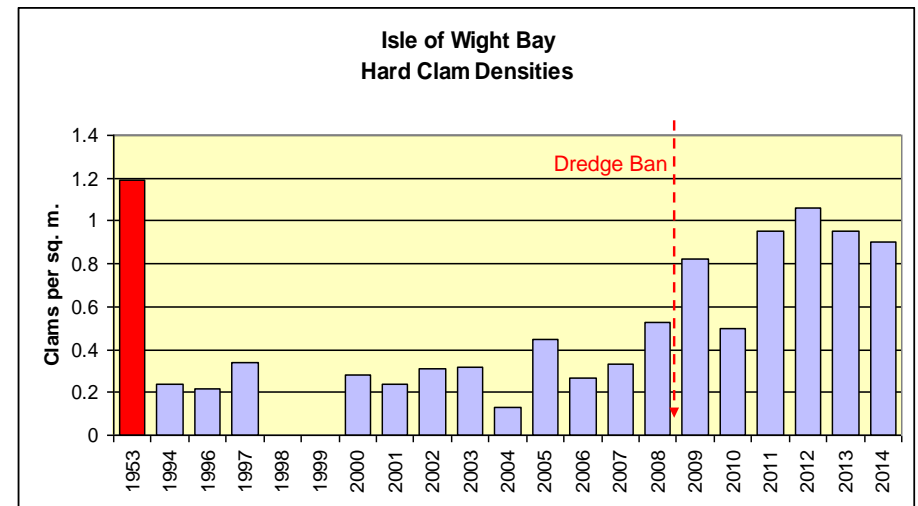
Non-native green crabs (*Carcinus maenas*) have been introduced, most likely as bait bucket introductions. This species has been recognized by the federal Aquatic Nuisance Species Task Force as an aquatic nuisance species. Green crabs are known clam predators and their impact on the hard clam population is unknown. 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

1. University of Maryland Center for Environmental Science. Integration and Application Network. Indicators – Coastal Bays Health Index – Maryland Coastal Bays Report Card – EcoCheck. 2009. [http://www.eco-check.org/reportcard/mcb/2009/indicators/coastal\\_bays\\_health\\_index/](http://www.eco-check.org/reportcard/mcb/2009/indicators/coastal_bays_health_index/)
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 07/15)</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 5 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 5 years.
Obj.2. Manage for a viable commercial hard clam harvest to maintain an economically stable fishery. Prob. 2.1: Potential Economic Harship 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 5 seasons. Commercial clam harvesters are required to report their daily catch of all clam species starting in 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,

<b>2002 Coastal Bays Hard Clam Fishery Management Plan (updated 07/15)</b>		
<b>Objective/Problem</b>	<b>Action</b>	<b>Implementation</b>
		<p>NOAA CBO and the Oyster Recovery 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.	<p>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.</p>
	<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</p>

<b>2002 Coastal Bays Hard Clam Fishery Management Plan (updated 07/15)</b>		
<b>Objective/Problem</b>	<b>Action</b>	<b>Implementation</b>
		<p>permitting as of 7-01-11 (SB 847 &amp; HB 1053). DNR will issue water column leases 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</li> </ul>

<b>2002 Coastal Bays Hard Clam Fishery Management Plan (updated 07/15)</b>		
<b>Objective/Problem</b>	<b>Action</b>	<b>Implementation</b>
		<p>the production of high quality shellfish runs ahead of MD.</p> <p>d) A study of the incidence of the clam 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.</p>
<p>Obj 4. Enhance and promote the recreational hard clam fishery.</p> <p>Prob. 4.1: Limited Access and Knowledge of Recreational Clamming Opportunities in Maryland's Coastal Bays</p>	<p><b>4.1.1</b> DNR will develop and distribute a public outreach brochure illustrating recreational clamming areas, access points, methods and harvest restrictions.</p>	<p>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.</p>
	<p><b>4.1.2</b> DNR will work with the Town of Ocean City and Worcester County to improve access to recreational clamming areas</p>	<p>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>.</p>
	<p><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.</p>	<p>Not yet initiated. Low priority.</p>
	<p><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.</p>	<p>Effectuated in 2002.</p>

<b>2002 Coastal Bays Hard Clam Fishery Management Plan (updated 07/15)</b>		
<b>Objective/Problem</b>	<b>Action</b>	<b>Implementation</b>
Obj.5. Minimize conflicts between coastal bay user groups and commercial hard clam fishermen. Prob. 5.1: Conflict Between Recreational Fishermen and Commercial Clammers.	<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.	Effectuated in 2002. Action item to be moved to history/background in new FMP which will be totally revised to include aquaculture.
	<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	<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>2002 Coastal Bays Hard Clam Fishery Management Plan (updated 07/15)</b>		
<b>Objective/Problem</b>	<b>Action</b>	<b>Implementation</b>
Concern on the Ecological Effects of Commercial Hydraulic Clam Dredging.		
<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>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,	<b>7.1.1</b> Develop strategies to restore water quality in areas closed to harvesting hard clams	Ongoing.

<b>2002 Coastal Bays Hard Clam Fishery Management Plan (updated 07/15)</b>		
<b>Objective/Problem</b>	<b>Action</b>	<b>Implementation</b>
maintain and enhance important hard clam habitats. Prob. 7.1: Water Quality	because of pollution	
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: a) Planting materials and sources; b) Enhancement areas; and c) Funding sources.	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.
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	This action is to be deleted and replaced with specific language on green crabs in a new FMP.
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	<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



<b>2002 Coastal Bays Hard Clam Fishery Management Plan (updated 07/15)</b>		
<b>Objective/Problem</b>	<b>Action</b>	<b>Implementation</b>
Activities.		
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 4 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

## 2014 Maryland FMP Report (July 2015)

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

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) Adaptive Resource Management (ARM) framework will ensure sufficient egg abundance to meet red knot and horseshoe crab needs.<sup>1</sup>

#### Fishery Management Plans (FMPs)

##### Chesapeake Bay

The Chesapeake Bay and Atlantic Coast Horseshoe Crab Fishery Management Plan (CBFMP) was adopted in 1994. The CBFMP 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 CBFMP 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 determine 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, which was critical to determine 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. Funding for the Virginia trawl survey has been secured for 2016. The ARM framework is scheduled to be reviewed and updated in 2016.

#### Stock Status

A coast wide horseshoe crab stock assessment update was completed in 2013 but limited data make it difficult to assess the status of the stock. To date, no overfishing, overfished, or depleted definitions and reference points have been developed.<sup>3</sup> 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.<sup>2</sup> Juvenile and adult male indices from the Delaware Bay region show evidence of population recovery.<sup>2</sup> 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 beaches has varied over the years. There was a significant increase starting in 2005 with a 3-fold increase from 2009 to 2010 (42,400 eggs/m<sup>2</sup> to 136,000 eggs/m<sup>2</sup>, respectively).<sup>4,5</sup> Egg density decreased in 2012 to 35,000 eggs/m<sup>2</sup> but reached 161,017 eggs/m<sup>2</sup> in 2013.<sup>3</sup> Peak egg density generally coincides with peak shorebird migration. Beginning in 2014, the Delaware and New Jersey egg survey will no longer be 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. In 2011, a mortality range of 5-30% was included in the ARM

assessment. Estimated annual mortality averaged 70,567 crabs from 2007 – 2012.<sup>3</sup> The estimated biomedical use was 546,000 crabs in 2013.

### **Current Management Measures**

Since 2013, Maryland's annual commercial quota has been 255,980 male horseshoe crabs and the quota will remain the same for 2015. Quota 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<sup>th</sup> 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. Harvest of female horseshoe crabs is prohibited. Permitted harvesters report landings weekly; non-permitted harvesters report landings monthly.

Three companies received scientific collection permits for the collection of horseshoe crab blood. The permit allows 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 analysis revealed 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. An adaptive management approach is being used to identify which alternative to implement. Alternative #4 is currently in place.

The U.S. Fish and Wildlife Service coordinates a coast-wide tagging program. Biomedical, conservation outreach, and research entities tag horseshoe crabs annually. Over 226,000 crabs have been tagged with a recapture rate of 11%. 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 remained the same in 2014. Along 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 1). Landings in 2014 were 148,269 horseshoe crabs or 58% of the quota.<sup>6</sup> The advent 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 2). Due to consistent, annual violation of the mortality threshold, the ASMFC Plan Review Team recommended that the ASMFC Management Board consider actions to decrease biomedical use and mortality of horseshoe crabs.<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. To date, the migratory red knot population has not shown any evidence of recovery despite the four-fold reduction in horseshoe crab harvest.<sup>7</sup>

Continued congressional funding for the Virginia Tech benthic trawl horseshoe crab survey is uncertain and the survey was discontinued in 2014.<sup>3,8</sup> Data from this survey is critical for use of the ARM model and stock assessments. The trawl survey is relatively inexpensive (\$200,000).<sup>3</sup> The biomedical industry provided partial funding for the 2012 trawl survey. These analyses are necessary to ensure that horseshoe crab spawning stock and egg production are sufficient to support migratory shorebird feeding (esp. red knot). The ASMFC horseshoe crab ARM committee has been actively working to find an alternative to the trawl survey. An index based alternative is being considered.

Reductions in Mid-Atlantic harvest quotas, particularly in Delaware Bay, have redirected harvest to the New York and New England fisheries. Localized

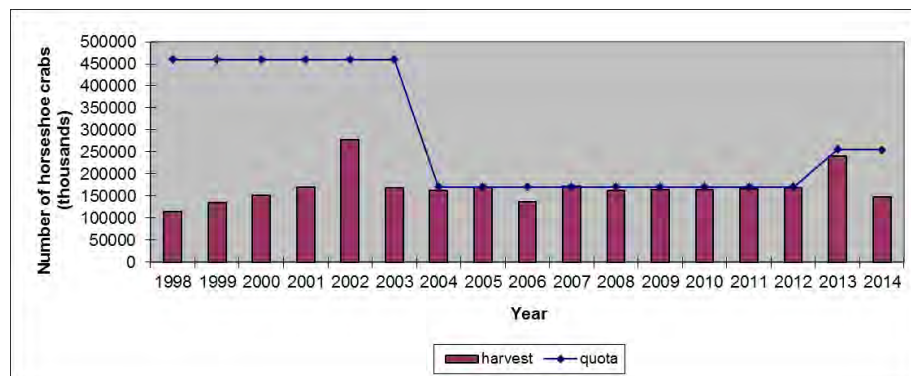
overharvest within these regions is possible meaning current harvest levels may not be sustainable.<sup>8,3</sup>

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>8</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>

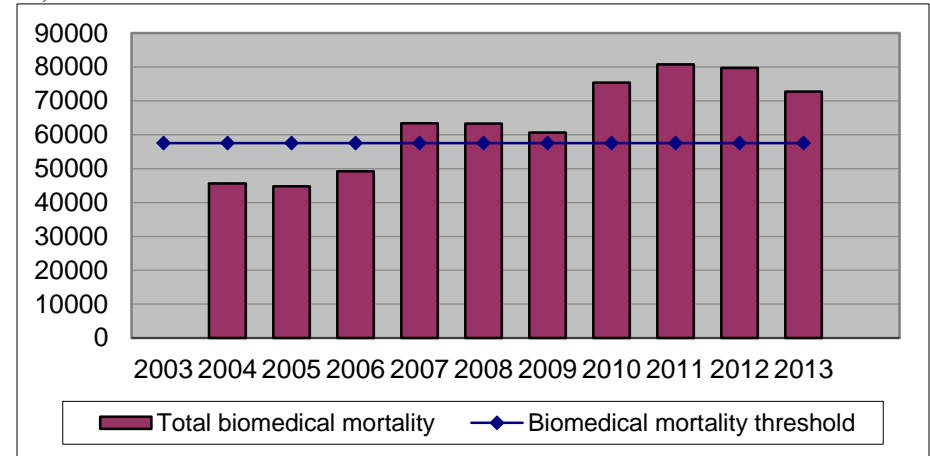
The bait industry has been importing three Asian horseshoe crab species to supply the bait market and take advantage of increased bait prices. Two concerns associated with importation of this non-native species are the introduction of non-native parasites and pathogens; and possible human health risks 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.<sup>3</sup> Maryland banned the import of Asian horseshoe crabs in 2013.<sup>9</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.

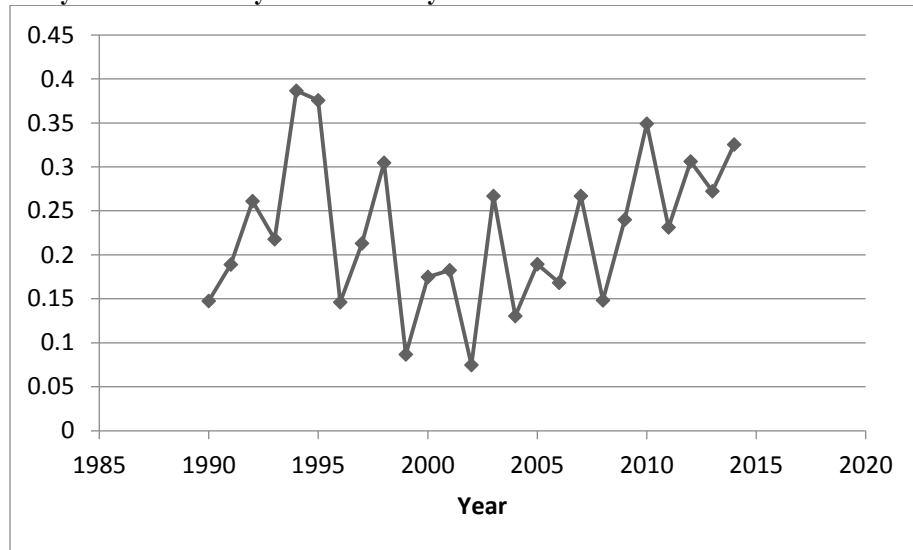
**Figure 1. Maryland's commercial horseshoe crab landings and quota: 1998-2014.**<sup>6,10</sup> The 2013 quota is restricted to male horseshoe crabs.



**Figure 2. Actual and threshold mortalities of horseshoe crabs bled for the biomedical industry: 2004-2012.**<sup>3</sup> The 2014 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.



**Figure 3. Geometric mean catch of horseshoe crabs per trawl from the Maryland Coastal Bays Trawl Survey: 1990 – 2014.<sup>6</sup>**



## 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. 2009. Horseshoe crab stock assessment for peer review. Stock Assessment Report No. 09-02 (Supplement A). Atlantic States Marine Fisheries Commission, Washington, DC.
- <sup>3</sup> ASMFC. 2013. 2013 review of the Atlantic States Marine Fisheries Commission fishery management plan for horseshoe crab (*Limulus polyphemus*): 2012 fishing year. Atlantic States Marine Fisheries Commission, Alexandria, VA.
- <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. 2015. Maryland's 2014 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> ASMFC. 2009. A framework for adaptive management of horseshoe crab harvest in the Delaware Bay constrained by red knot conservation, 2009. Stock Assessment Report No. 09-02 (Supplement B). Atlantic States Marine Fisheries Commission, Washington, DC.
- <sup>8</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>9</sup> Classification of Nonnative Aquatic Organisms. Annotated Code of Maryland § 08.02.19.04 (2013).
- <sup>10</sup> Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division. Retrieved from <http://www.st.nmfs.noaa.gov/index>

**1994 Chesapeake Bay and Atlantic Coast Horseshoe Crab Management Plan Implementation Table (updated 7/2015)**

<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 Open	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.
		Open	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 7/2015)			
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.
	1.2b Virginia will continue its ban on trawling within state waters.	1995	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. 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	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). MD Coastal Bays HSC trawl survey has been conducted since 1990.
		2002 Continue	Maryland Coastal Bays program began a volunteer spawning survey. Public reports of HSC spawning in Chesapeake Bay are kept on file.
		2007 Continue	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.</b>
		2008 Continue	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 78,000 crabs in 2013. <sup>3</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 7/2015)			
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	Reporting was implemented on January 29 <sup>th</sup> , 1996. Permit system currently required and used to monitor commercial harvest.
		2000	ASMFC instituted a 25% reduction in horseshoe crab bait landings using 1995-1997 as the reference period.
		2004 On-going 2005	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.
		2006	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.
		2004 Continue	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.
		2008	MD changed the HSC harvest ratio to 2:1 male:female ratio (issued by public notice).
		2009 Continue	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.
		2010 On-going	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.
		2011	Harvesters began importing Asian horseshoe crabs for bait market.
		2013	Maryland banned the importation of Asian horseshoe crabs.



1994 Chesapeake Bay and Atlantic Coast Horseshoe Crab Management Plan Implementation Table (updated 7/2015)			
Problem Area	Action	Date	Comments
	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.
	3.3 Maryland and Virginia will survey American eel harvesters and their use of horseshoe crabs by sex for bait.	1995 2000	No longer an issue. Both eels and horseshoe crabs are managed through ASMFC coastal FMPs.
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

## 2014 Maryland FMP Report (June 2015)

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

#### Chesapeake Bay FMP

The Chesapeake Bay is nearing the northern limit of Spanish mackerel's range. This migratory species is usually only available during the warmer months, but is targeted by some recreational fishermen when available. Commercial and recreational harvest occurs in both Maryland and Virginia most years<sup>1,2</sup>. King mackerel are far less common visitors to Maryland's coastal waters.

The Chesapeake Bay and Atlantic Coast King and Spanish Mackerel Fishery Management Plan (K/SM FMP) was adopted in 1994. The plan follows the coastal management requirements. The K/SM FMP was reviewed in 2014 and 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, 21 amendments have been adopted by the SAFMC, one applied only to the Gulf of Mexico. Four amendments 20a, 20b, the South Atlantic CMP Framework Action 2013 and CMP Framework Amendment 1 were implemented in 2014. The amendments made changes to the allocation of commercial quotas, changes to at-sea transfer rules and an increase in the total allowable catch of Spanish mackerel. Framework Amendment 2 is currently under secretarial review. 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 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 or along the mid-Atlantic coast. A stock assessment conducted by the Southeast Data, Assessment, and Review Process (SEDAR) in 2012 concluded that the Spanish mackerel stock along the entire US East Coast, 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. Based on the 2012 SEDAR stock assessment, the king mackerel stock along the US East Coast is not overfished and overfishing is not occurring.

#### 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 in Amendment 20b (2014). The north-south split occurs at the SC-NC border.

The Chesapeake Bay states 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>3,4</sup>. The amendment also requires recreational fishermen 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 (Fig. 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 exceed those from Maryland (Fig.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>1</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.

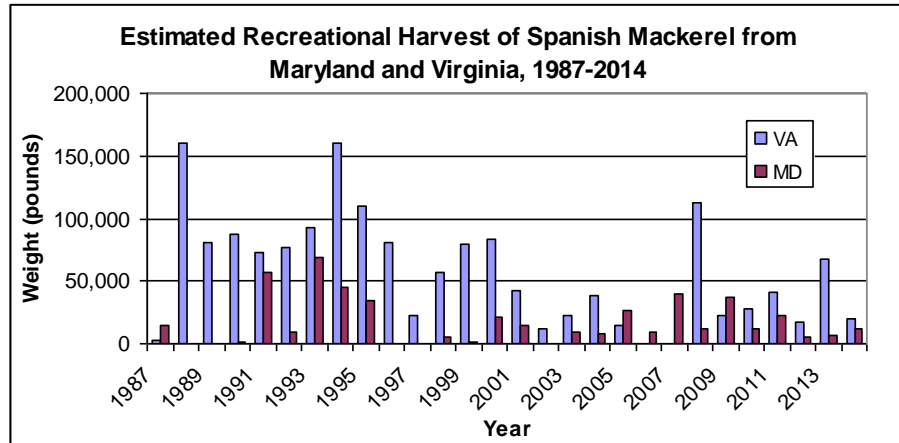
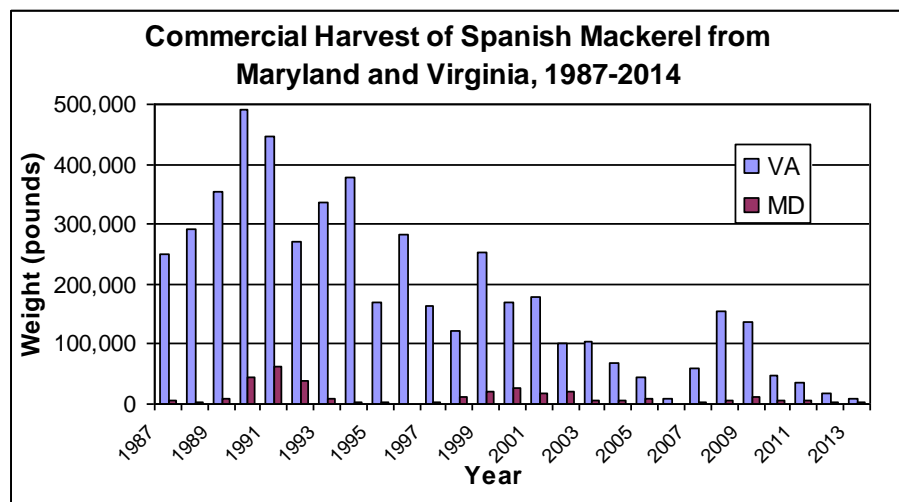


Figure 2.



## 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<sup>5</sup>.

## References

- <sup>1</sup> Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division, Marine Recreational Information Program June 25, 2015.
- <sup>2</sup> Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division, commercial harvest query June 25, 2015.
- <sup>3</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>4</sup> 2014. Rickabaugh, H.W. Jr. Maryland Spanish Mackerel (*Scomberomorus maculatus*) Compliance Report to the Atlantic States Marine Fisheries Commission – 2013. September, 2014.
- <sup>5</sup> 2014 Review of the 1994 Chesapeake Bay and Atlantic Coast King and Spanish Mackerel Fishery Management Plan, Annapolis, MD July 2014.

<b>1994 Chesapeake and Atlantic Coast King and Spanish Mackerel Management Plan Implementation Table (update 06/14)</b>			
<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)
	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. <b>The most recent stock assessment for the south Atlantic stock of Spanish mackerel was completed in December of 2012. A new King Mackerel Stock Assessment Report was completed in August 2014 for South Atlantic and Gulf of Mexico.</b>

<b>1994 Chesapeake and Atlantic Coast King and Spanish Mackerel Management Plan Implementation Table (update 06/14)</b>			
<b>Section</b>	<b>Action</b>	<b>Date</b>	<b>Comments</b>
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.
	Action 3.1.3. Virginia will monitor bycatch sold as crab bait from the pound net and haul seine fisheries.	1995	
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>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%20Ches%20Bay%20Watershed%20Agreement.with%20signatures-HIres.pdf">http://www.chesapeakebay.net/documents/FINAL Ches Bay Watershed Agreement.withsignatures-HIres.pdf</a></b> <b>The Agreement has fish habitat, forage fish, SAV and water quality outcomes that when reached will enhance habitat and prey availability for juvenile and adult Spanish mackerel.</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

## 2014 Maryland FMP Report (August 2015)

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

A Maryland oyster biomass index is computed annually to track relative abundance. The index is calculated from a set of sentinel sites from the Fall Survey and the 1993 index is used as a baseline. Although the 2014 biomass index was similar to 2013, oyster relative abundance has been increasing since 2010.

This increase is associated with low natural (including disease-related) mortality and strong year classes in 2010 and 2012. Since 2012, however, recruitment has been low. Oyster diseases persist in bay oyster populations, albeit at lower prevalence and intensity than in the past.

#### Chesapeake Bay Oyster Management

The Chesapeake Bay Oyster Management Plan (OMP) was adopted in 1989 and revised in 1994 and 2004. The 2004 OMP provides both a general framework and specific guidance for implementing a strategic, coordinated, multipartner management effort for oysters in the Bay. The OMP 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 baywide database to track restoration projects. Amendment #1 to the OMP was adopted in 2010. The amendment allows aquaculture and clamming activities within the larger, expanded sanctuary program (areas closed to shellfish harvest and areas with focused restoration activities); the use of new enforcement measures to protect sanctuary areas; and the implementation of sanitation guidelines. The 2004 OMP was reviewed in 2010. The Plan Review Team (PRT) 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 increases the network of oyster sanctuaries from 9% of available habitat to 24%; identifies areas for oyster aquaculture with a streamlined permitting process; and recommends a more targeted, scientifically managed, sustainable public fishery. The sanctuary expansion leaves **176,035** acres of natural oyster bar available for the wild oyster fishery. The PRT recommended a complete revision of the OMP. **Maryland is currently reviewing its sanctuaries, public shellfish fishery areas, and aquaculture program, with a report expected by July 2016. Revision of the OMP is on hold until the completion of the Maryland review and the resulting recommendations.**

A Maryland Oyster Advisory Commission (OAC) was established in 2007 and continues to provide advice on strategies for rebuilding and managing the oyster

population and fishery <http://dnr2.maryland.gov/fisheries/Pages/mgmt-committees/oac-index.aspx>.

The Sustainable Fisheries Goal Implementation Team (SFGIT) of the Chesapeake Bay Program (CBP) established a workgroup to develop quantitative oyster restoration metrics, define sampling protocols, and provide assessment techniques for sanctuary reefs. The group completed a consensus document describing a minimum suite of goals and metrics. 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> The document was formally adopted by the Executive Committee of the SFGIT in December 2011.

In 2014, the CBP adopted a new Watershed Agreement [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). One of the Sustainable Fisheries outcomes in the agreement is the restoration of oyster reefs in 10 tributaries by 2025. 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)\*. Maryland will select the next 2 tributaries for restoration after the 2016 oyster report is submitted and reviewed.

The Chesapeake Bay Program has completed the oyster management strategy [http://www.chesapeakebay.net/documents/22030/1b\\_oyster\\_ms\\_6-24-15\\_ff\\_formatted.pdf](http://www.chesapeakebay.net/documents/22030/1b_oyster_ms_6-24-15_ff_formatted.pdf) and is in the process of developing the biennial work plan for 2016-17. The work plan will detail actions necessary to reach the oyster outcome specified in the Watershed Agreement.

#### Stock Status

From harvest reports and DNR dredge survey data, it is apparent that oyster populations have improved over the past few years. The 2014 Maryland oyster biomass index (a measure of relative oyster abundance and weight) increased to 2.07, very close to last year's value of 2.09, the highest measured since the index started (1993) (Figure 1). The 2014 spatfall index, a measure of reproductive success and an index of potential population increase<sup>1</sup> was 11.3 spat/bushel, well below the 30 year median value of 19.4 spat/bushel (Figure 2). An estimated 642.71 million hatchery-raised spat produced by the University of Maryland Center for Environmental Science, Horn Point Laboratory, were planted in the Bay in 2014 to augment natural reproduction.

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 2014, the prevalence (percentage of oysters with the disease) of dermo disease was 52%, below the 25-year average, with a mean infection intensity of 1.8, also below average. MSX continued at low levels (2014 prevalence 2.2%), mainly as a result of lower salinities unfavorable to the disease. As a result, total natural oyster mortality (including disease-related mortality) during 2014 was relatively low at 11.2%.<sup>1</sup>

Stock assessment methodology studies were conducted in 2009-2010.<sup>4</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.<sup>4</sup> Recommendations were made to improve data collection from the fishery and the fall survey. Maryland DNR 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.

### 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 new Watershed Agreement to restore oysters to 10 tributaries by 2025, 5 each in Maryland and Virginia. Harris Creek was selected as Maryland's first restoration area. The oyster restoration target for Harris Creek is 377 acres. As of 2014, 141.7 acres of reef were constructed. Most of these areas were seeded with spat on shell with the remainder to be seeded in 2015. An additional 140 acres with good bottom were seeded with spat on shell. Reef construction and initial seeding is scheduled for completion in 2015. The Little Choptank River was selected as Maryland's second priority area for targeted oyster restoration. The restoration goal for the Little Choptank River is 440 acres. Reef construction began in 2014, with 125.7 acres built. An additional 18.2 acres with good bottom were planted with spat on shell. Seeding will continue in 2015. The Tred Avon has been selected as Maryland's third area for oyster restoration. The USACE began constructing reefs here in spring of 2015.

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). Preliminary harvest for the 2014-2015 season is 405,000 bushels, reflecting strong spat sets 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. Maryland DNR began implementing a new 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.

Legislation passed in 2011 included the expansion of lease areas, authority for DNR 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 the Oyster Recovery Partnership, DNR provides field support for in-the-water activities of oyster aquaculture production. Maryland DNR has implemented an electronic notification system for leaseholders. Beginning in 2013, leaseholders were required to submit monthly harvest reports. As of August 2015, there are 334 active lease areas that cover 4,183 acres. The preliminary estimate of 2014 harvest from leased areas was about 34,000 bushels.

### Citizen Involvement

The goal of Marylanders Grow Oysters (<http://www.oysters.maryland.gov>) is to engage 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 3000 growers on 31 tributaries. Additionally, over 2,000 school students are involved through educational programs with 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 that approximately 80% of oyster habitat has been lost over the last 25 years.<sup>2</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, DNR 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 on the bottom with spat attached 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, Maryland 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. The fossil shell planted in Harris Creek had the greatest number of spat of any of the substrates within that sanctuary.<sup>1</sup> To encourage recycling of oyster shells, the Oyster Recovery Partnership has developed the Shell Recycling Alliance, a group of over 150 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, 68,852 MD bushels of shell have been recycled with 18,616 MD bushels in 2014. Starting in July 2013, residents and businesses can receive a tax credit per bushel of recycled oyster shell up to \$750 per year.

The increase in sanctuary areas and aquaculture activities require additional law enforcement. New measures have been adopted to deter and issue citations for oyster poaching. Natural Resource 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. A new penalty system has resulted in license suspensions and revocations.

Maryland is preparing a report examining the performance of sanctuaries, public fishery areas, and aquaculture areas. The report is expected to be completed in July, 2016. No changes in management will be made until this report is submitted and reviewed.

## References

<sup>1</sup>Tarnowski, M. 2015. Maryland Oyster Population Status Report 2014 Fall Survey. Maryland Department of Natural Resources Shellfish Division & Cooperative Oxford Laboratory, <http://dnr2.maryland.gov/fisheries/Pages/shellfish-monitoring/reports.aspx>

<sup>2</sup> Report of the Oyster Metrics Workgroup. 2011. Restoration Goals, Quantitative Metrics and Assessment Protocols for Evaluating Success on Restored Oyster Reef Sanctuaries. Submitted to the Sustainable Fisheries Goal Implementation Team of the NOAA Chesapeake Bay Program, Annapolis, Maryland.  
[http://www.chesapeakebay.net/channel\\_files/17932/oyster\\_restoration\\_success\\_metrics\\_final.pdf](http://www.chesapeakebay.net/channel_files/17932/oyster_restoration_success_metrics_final.pdf)

<sup>3</sup>Wilberg, M.J., M.E. Livings, J.S. Barkman, B.T. Morris, and J.M. Robinson. 2011. Overfishing, disease, habitat loss, and potential extirpation of oysters in upper Chesapeake Bay. *Marine Ecology Progress Series* 436: 131-144.

<sup>4</sup>Wilberg, M. and T. Miller. 2010. Developing Spatially-Explicit Assessment Tools for Eastern Oyster in Chesapeake Bay. Technical Report No. TS-599-10 of the University of Maryland Center for Environmental Science.

## \*Acronyms

CBF – Chesapeake Bay Foundation

MDNR – Maryland Department of Natural Resources

NFWF – National Fish and Wildlife Foundation

NOAA – National Oceanic and Atmospheric Administration

ORP – Oyster Recovery Partnership

SERC – Smithsonian Environmental Research Center

TNC – The Nature Conservancy

USACE – U. S. Army Corps of Engineers

VIMS – Virginia Institute of Marine Science

VMRC – Virginia Marine Resources Commission

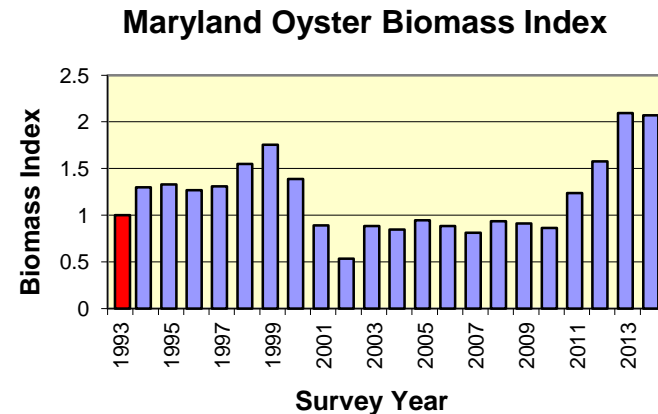


Figure 1. Maryland oyster biomass index, a measure of relative oyster abundance and weight, 1993 - 2014. (MDNR Fall Survey Report, 2015)



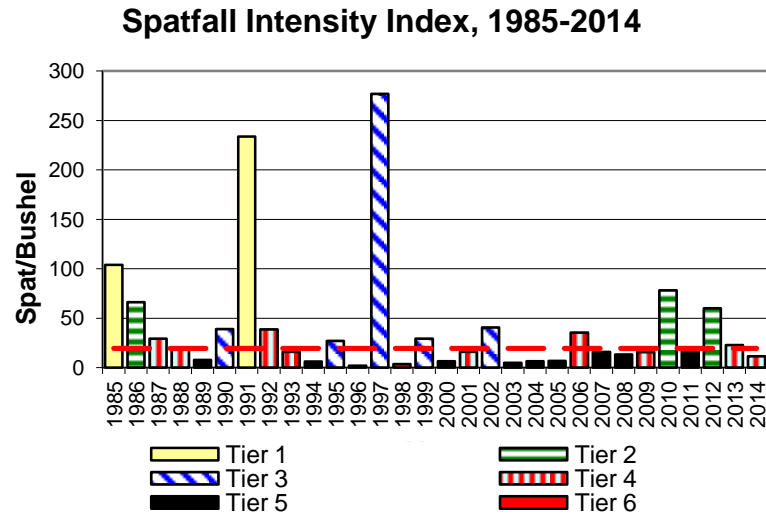


Figure 2. Maryland spatfall intensity index (spat per bushel) from "key bars" including rankings of statistically similar indices, 1985-2014 (MDNR Fall Survey Report, 2015). The statistical tiers provide an indication of the extent and contribution of spat from different geographic areas. To illustrate: 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>1</sup>

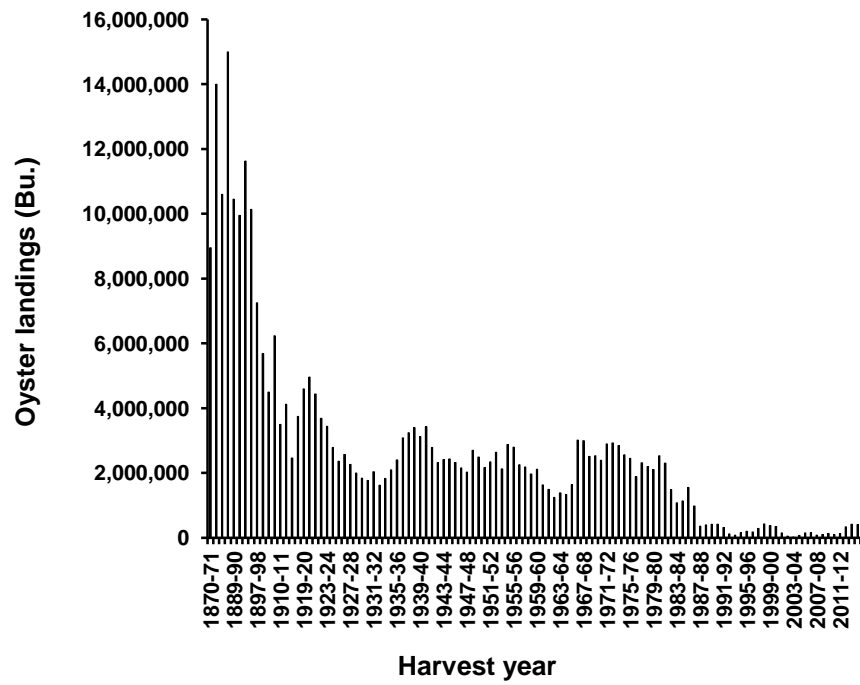


Figure 3. Maryland commercial oyster harvest, 1870 – 2014.  
Landings data for 2014-2015 are preliminary.

<b>2004 Oyster Management Plan (OMP) Implementation Table (updated 8/2015)</b>			
<b>Section</b>	<b>Action</b>	<b>Date/ Responsible agencies</b>	<b>Comments</b>
<p>Disease Strategy</p> <p>3.1A. Utilize disease management in all aspects of restoration &amp; harvest to minimize spreading disease</p> <p>3.1B. Develop &amp; implement disease strategies within each of the 3 designated salinity zones.</p>	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 EIS 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), and 1.2 billion spat (2013). <b>Production declined to 643 million spat in 2014 due to water quality issues along the east coast.</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. Sanctuary areas are being reevaluated and a report will be completed by 2016.
	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.

	3.5 Implement oyster surveys as necessary to obtain the best estimates of oyster population data: a) Increase the frequency & spatial intensity of sampling; b) Seek additional funding.	On-going	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 collections and evaluated the feasibility of including environmental factors into assessment models. A final report was completed in 2010 and available at <a href="http://www.dnr.state.md.us/irc/docs/00016171.pdf">http://www.dnr.state.md.us/irc/docs/00016171.pdf</a> . DNR/ MGS & NOAA are continuing to coordinate field operations to characterize benthic habitat. <b>DNR is surveying oyster sanctuaries to obtain population estimates.</b>
<p>Sanctuaries</p> <p>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>	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 Committee)	2004 2009 On-going	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 areas have been established. USACE conducted a study to evaluate 63 tributaries and sub-regions for the purpose of supporting restoration. 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>Active reef construction and seeding is occurring in all six tributaries selected for restoration.</b>
	4.2.2 Utilize existing protocols & standard operating procedures for recording or charting GPS coordinates for oyster sanctuaries in order to verify locations and track restoration progress.	Beginning in 2005 2008/2009 On-going	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>
	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 & future sanctuary initiative.	On-going	A study on alternative cultch material in MD was conducted in various salinities & the report is on file with DNR. 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. <b>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 also will be considering buried shell deposits within the Bay.
	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 has 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 will provide information to prioritize areas and facilitate decisions on shell reclamation techniques. 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. <b>MDNR has applied for a permit to recover shell from Man o' War Shoal.</b>
	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	Utilize the 1993 value as the baseline for measuring the increase in biomass; <b>oyster biomass estimates have doubled since 1993.</b> Maryland's biomass 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).
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	<p>Strategy 4.3.A: Zone 1 (5ppt to &lt;12ppt) Increase biomass &amp; 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</p> <p>Action 4.3.A.1 Identify priority areas in Zone 1 that would have the most success at reaching the defined project objectives</p> <p>Action 4.3.A.2 Rehabilitate and maintain oyster bottom habitat to provide planting substrate for seed oysters and optimal conditions for larval settlement</p> <p>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</p>	2005 On-going	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 low 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>	On-going	<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>Harris Creek, Little Choptank River, and Tred Avon River are undergoing active oyster restoration. To date 275 acres have been restored in these tributaries, including the placement of 1.7 billion spat. It is anticipated that by the end of 2015 initial restoration of Harris Creek will be completed at 372 acres, 125 acres will be restored in the Little Choptank River, and 24 acres will be restored in the Tred Avon River. 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.</b></p>
<p>Strategy 4.5 Implement the actions described in chapter III to address disease problems. In addition, the jurisdictions will take further action to minimize the spread of disease</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>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</p> <p>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</p>	<p>On-going</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 resistance is occurring (VIMS). In 2014, <b>Dermo disease was below the long-term average and MSX remained at low levels. It is difficult to separate the effects of environmental conditions, especially temperature and salinity, from improved survival due to disease resistance.</b></p>
<p>Sanctuaries (cont'd)</p> <p>Strategy 4.6 To facilitate the enforcement of closed areas, especially</p>	<p>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</p> <p>Action 4.6.2 Sanctuaries will be buoyed and marked</p>	<p>Began in 2003 and continue</p>	<p>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</p>

sanctuaries, implement the following actions:	Action 4.6.3 The public and judiciary will be notified about sanctuary areas through educational initiatives, public announcements and stakeholder meetings		a pilot program in Anne Arundel County to establish a Natural Resource Day in court. <b>This system has proven successful and has expanded to all but a few counties.</b> 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 4.6.4 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. 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.</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.
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.
	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 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.</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 MDNR, 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 interlab 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, Univ. of MD, 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. See comments for Action 3.2</b>



	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 (COE) 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 Baywide 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	On going 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.
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.	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.	2007	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.
	Action 6.3.2 Monitor restoration activities to clarify the interaction between selectively bred strains and wild stocks of oysters.	2005 UMD, ORP, VMRC	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.

Strategy 6.4 The members of the OMP drafting team will review the MD task force report & recommend changes to the OMP as appropriate regarding aquaculture strategies & actions	Action 6.4.1 Amend the OMP as necessary to incorporate new strategies and actions regarding aquaculture.	2009 2010	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>
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.	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.	Continue	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>
	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.
	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 Geologic Society  
MDNR = Maryland Department of Natural Resources  
MLEIN = Maritime Law Enforcement Information Network  
NCBO = NOAA Chesapeake Bay Office  
NOAA = National Oceanographic and Atmospheric Administration  
OAC = Oyster Advisory Commission  
OMP = Oyster Management Plan  
ORP = Oyster Recovery Partnership  
PEIS = Programmatic Environmental Impact Statement  
PRT= Plan Review Team  
SFGIT = Sustainable Fisheries Goal Implementation 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  
UAACE = U.S. Army Corps of Engineers  
VIMS = Virginia Institute of Marine Science  
VMRC = Virginia Marine Resources Commission

## 2014 Maryland FMP Report (July 2015)

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

The exceptional 2011 year-class provided higher catches of smaller “puppy” red drum in 2012 and 2013 in both Maryland and Virginia. Red drum catches in 2014 were inferior to the previous two years because as red drum mature they move out of the estuary and spend more time in coastal and offshore waters.

#### 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. 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 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. The CBRD FMP is scheduled for a review in 2015.

#### 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 peer reviewed ASMFC stock assessment found the stock to be relatively stable. Although there are data limitations for adult red drum, ASMFC believes that overfishing is likely not occurring. The fishing mortality threshold is 30% of a static spawning potential ratio (sSPR) and the fishing mortality target is 40% of a sSPR. Static (or equilibrium) spawning potential ratio is based on both female biomass and egg production. The average sSPR has been above the overfishing threshold ( $F_{30\%}$ ) since 1994 with the exception of 2002 and has been above the target ( $F_{40\%}$ ) since 1996 for the Northern stock. Fishing pressure and mortality appear to be stable and it is likely that the stock is not subject to overfishing.<sup>1</sup> The next benchmark assessment is scheduled for 2015/2016. In preparation for the 2015 assessment the ASMFC South Atlantic Management Board approved the Terms of Reference at the Fall 2014 meeting and the coastwide data compilation process began.

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. 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”. Virginia allows a slot limit of 18”-26” and a possession limit of 3 fish per day for both commercial and recreational fishermen. In 2014, Virginia proposed changes to their commercial red drum regulations, which would lower the maximum size limit one inch and increase the possession limit to 5 fish per day. The ASMFC South Atlantic Management Board accepted these changes in February of 2014, and the Code of Virginia was amended to include these changes effective January 1, 2015. 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 7,100 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 landings have averaged around 200,000 lbs. since 1990.

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>3</sup>

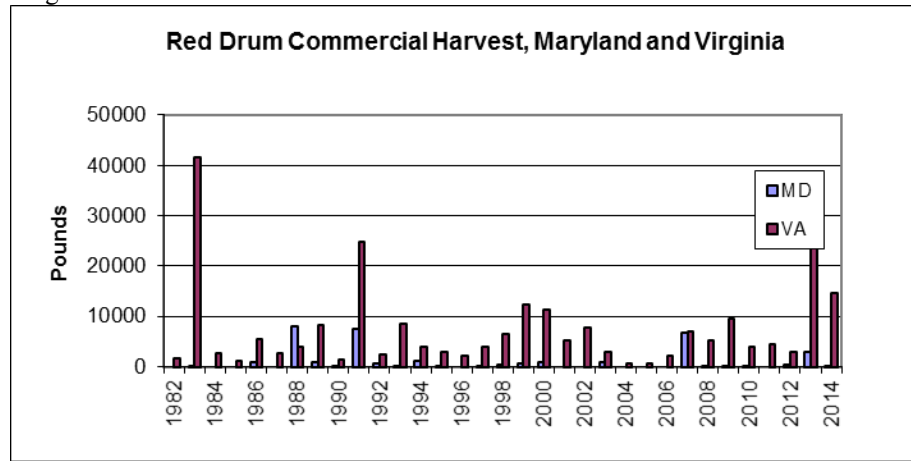
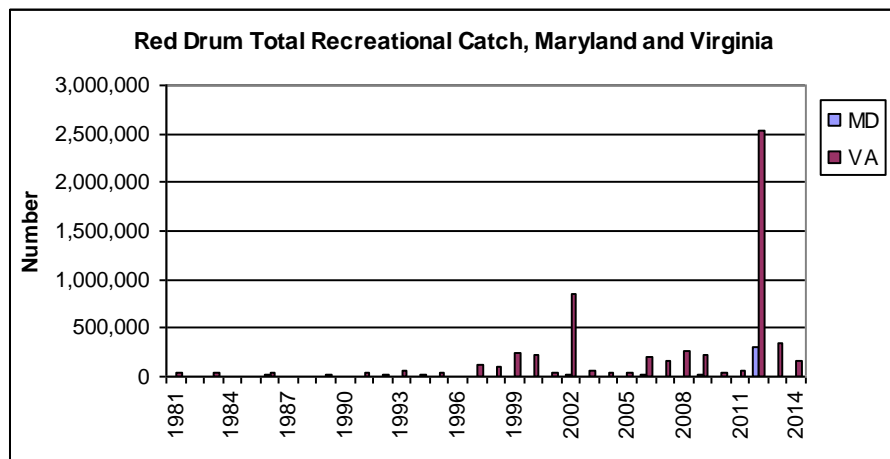


Figure 2. Total recreational red drum MRIP catch estimate for Maryland and Virginia, all modes combined, 1982-2014.<sup>4</sup> (Includes fish caught and released)



### Issues/Concerns

Red drum has 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 for red drum habitat needs 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> 2015 Review of the Atlantic States Marine Fisheries Commission Fishery Management Plan for Red Drum (*Sciaenops ocellatus*) 2014 Fishing Year. 22p.
- <sup>2</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>3</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>4</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>5</sup> Addendum I to Amendment 2 to the red drum fishery management plan: *Habitat Needs & Concerns*. Approved August, 2013. 24p.
- <sup>6</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)
- <sup>7</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)

<b>1993 Chesapeake Bay and Atlantic Coast Red Drum Management Plan Implementation Table (updated 6/15)</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 Continue	In compliance with coastal recommendations. VA has adopted a slot limit and now allows harvest of 18-26" red drum. <b>A new possession limit of 3 fish has been adopted for both recreational and commercial harvest effective Jan. 1, 2015.</b> 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.
	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.

<b>1993 Chesapeake Bay and Atlantic Coast Red Drum Management Plan Implementation Table (updated 6/15)</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 (ChesMMAAP) 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>Commercial landings for 2015 were 298 lbs. (MD) and 11,999 lbs. (VA).<sup>1</sup></b>
	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 (updated 6/15)</b>			
<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><b>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.</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 three 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>3</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>Sixteen red drum were sampled in 2013 and one in 2014.</b></p>



1993 Chesapeake Bay and Atlantic Coast Red Drum Management Plan Implementation Table (updated 6/15)			
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><b>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</b>  <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 2014, there were an estimated 75,835 acres of SAVs in the Chesapeake Bay.</b></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>6</sup>. The 2013 SAV estimate is 59,927 acres.</p> <p><b>The SAV outcome in the 2014 Chesapeake Watershed Agreement is to achieve an ultimate goal of 185,000 acres. Progress towards the goal/outcome will be measured against a target of 90,000 acres by 2017 and 130,000 acres by 2025.<sup>7</sup></b></p>

Acronyms:

ASMFC = Atlantic States Marine Fisheries Commission  
MRFSS = Marine Recreational Fisheries Statistics Survey  
PFRC = Potomac River Fisheries Commission

SAV = Submerged Aquatic Vegetation  
VIMS = Virginia Institute of Marine Science  
VMRC = Virginia Marine Resource Commission

## 2014 Maryland FMP Report (August 2015)

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

Over the past few years there has been a notable increase in scup landings from the Maryland winter trawl fishery. Scup commercial harvest in Maryland was minimal and highly variable from the late 1960's through 2012 compared to other Atlantic Coast states. Scup are rarely caught by recreational anglers in recent years from 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>1</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. 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 passed by the MAFMC. This amendment ensures that all FMPs of the Greater Atlantic Region, developed under the jurisdiction of the New England and Mid-Atlantic Councils, 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>2</sup>

#### Stock Status

The ASMFC 2012 scup stock assessment determined that as of 2011, scup are not overfished and overfishing is not occurring relative to the revised biological reference points (BRPs).<sup>3</sup> The current BRPs are a threshold fishing mortality ( $F_{40\%}$ ) of 0.177 and a target spawning stock biomass ( $SSB_{40\%}$ ) of 203 million pounds. Fishing mortality in 2011 was estimated to be 0.034. Spawning stock biomass was estimated to be 420 million lbs. in 2011.<sup>3</sup> The 2011 year class (age-0) was estimated to be 150 million fish, which is above the time series average.<sup>3</sup> The Scup Benchmark Stock Assessment Report was completed in August 2015. New reference points were defined in the assessment. Based on the new assessment, scup is not overfished and overfishing is not occurring. For more specific information, go to: <http://www.asmfc.org/uploads/file/55d238fb2015ScupBenchmarkStockAssessment.pdf>

#### Current Management Measures

The ASMFC/MAFMC determine a total annual quota that is divided between the commercial and recreational fisheries. 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>3</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 enacted 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 and 527,953 pounds in 2014 (Figure 1).<sup>10</sup> However, available commercial scup landings are limited because some of the data are confidential. The recent increase in harvest is due to several boats from New Jersey landing in Maryland and not 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 2014<sup>9</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 landings occur offshore and are highly variable. The MAFMC is currently reviewing commercial measures which may result in another amendment.

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.

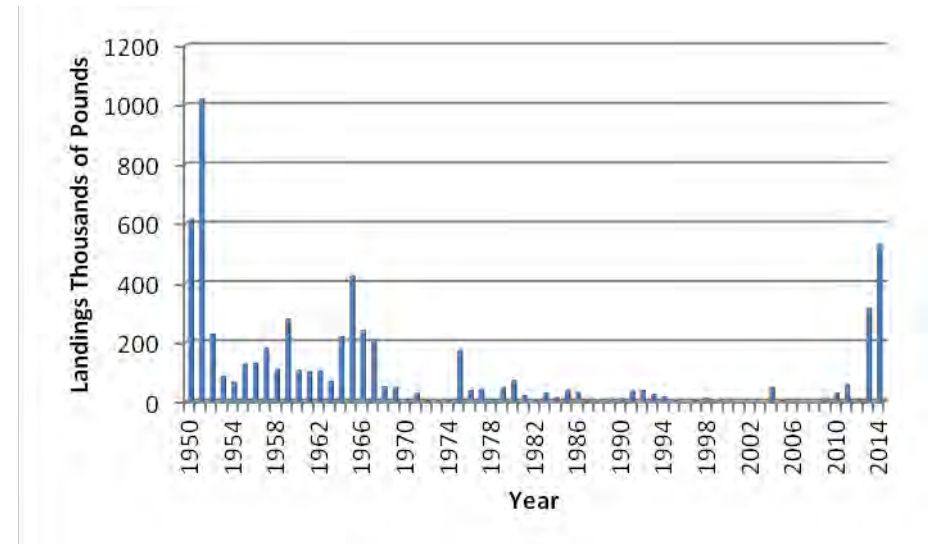
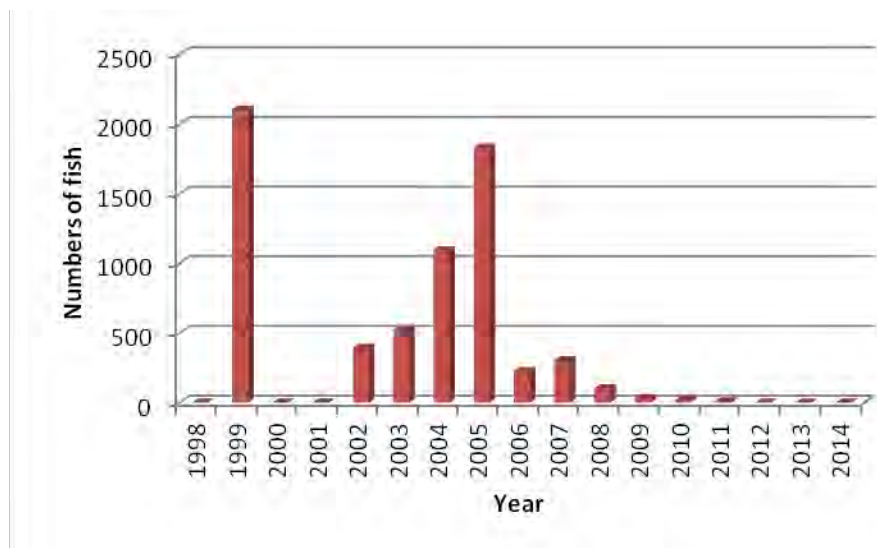


Figure 2. The recreational scup harvest in Maryland since 1998.<sup>10</sup>



## References

<sup>1</sup>Maryland Office of the Secretary of the State. COMAR 08.02.12.03. Retrieved July 25, 2011: <http://www.dsd.state.md.us/comar/comarhtml/08/08.02.12.03.htm>

<sup>2</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>3</sup>Terceiro M. 2012. Stock Assessment of Scup for 2012. US Dept. Commerce, Northeast Fisheries Science Center Ref Doc. 12-21;148p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at <http://www.nefsc.noaa.gov/publications/crd/>

<sup>4</sup>Doctor, S. 2015. Maryland's 2014 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. June 25, 2015: [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. June 25, 2015: <http://www.st.nmfs.noaa.gov/recreational-fisheries/index>.

## 2014 Maryland FMP Report (September 2015)

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

Although the 2013 benchmark stock assessment for striped bass along the Atlantic coast indicated the stock was not overfished and overfishing was not occurring, the updated biological reference points showed that fishing mortality (F) was above the new target F and that spawning stock biomass (SSB) was steadily declining. As a result, the Atlantic States Marine Fisheries Commission (ASMFC) Management Board adopted Addendum IV at their October 2014 meeting. The addendum requires the implementation of harvest reductions in the 2015 season to prevent SSB from dropping below the threshold level.<sup>1</sup> Since the Maryland trophy season is managed as part of the Atlantic fishery, regulations were changed to achieve a 25% reduction in harvest as required by Addendum IV. The remaining Chesapeake Bay summer/fall fishery was allowed a 20.5% reduction from 2012 levels because the stock is primarily a premigratory, male fishery and the Bay jurisdictions had already implemented a 14% reduction in 2013. The regulation changes are noted in the recreational part of the current management measures section.

#### Fishery Management Plans (FMPs)

In 1989 the Chesapeake Bay Program developed the Chesapeake Bay Striped Bass 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 failure. 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 (F, 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 fishing mortality (F) rate in 2015. Harvest reductions include a 25% reduction in the Atlantic and 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, which includes 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. Work will continue for future inclusion in an amendment to the CBSB FMP. 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, projected SSB estimates indicate that SSB will most likely fall below the threshold in the future. Striped bass are managed under biological reference points (BRPs) for F and SSB. BRPs were updated in 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  $F_{threshold}$  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>1</sup> Levels of F during 2012 ( $F=0.20$ ) exceeded the target level, but remained below the threshold level. The new target female SSB was 72,032 metric tons (159 million pounds) with a  $SSB_{threshold}$  at 57,626 metric tons (127 million pounds). The coastwide SSB in the 2013 Stock Assessment was 58,200 metric ton (128 million pounds) which is above the threshold but below the target.<sup>2</sup> Since harvest levels were predicted to reduce SSB below  $SSB_{threshold}$  by 2015 and raise F above  $F_{threshold}$ , Addendum IV was approved to reduce harvest levels in 2015. The updated 2013 Striped Bass Stock Assessment can be found on ASMFC's website at: <http://www.asmfc.org/uploads/file/AtlStripedBass2013AssessmentUpdate.pdf>

Maryland DNR has conducted the Estuarine Juvenile Finfish Survey since 1954 to measure young of year (YOY) striped bass abundance and 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>3</sup> The 2013 and 2014 JAI rebounded to 3.42 and 4.06, respectively, after having reached a historic low of 0.49 in 2012<sup>4</sup> (Figure 1). The Maryland JAI is one of six that are calculated for different regions of the Atlantic coast including Maine, New York, New Jersey, Virginia, and North Carolina. Recruitment failure for three consecutive years in any one of these six regions would trigger an ASMFC management action.<sup>3</sup>



## Current Management Measures

Maryland's 2014 striped bass quota was 4.7 million lbs., a 12% increase from 2013, and was distributed among two fishing sectors: commercial (42.5%) and recreational/charter (57.5%).<sup>5</sup> The Maryland Chesapeake Bay commercial quota was 1.93 million lbs. for 2014 (Figure 2).<sup>5</sup> The 2014 commercial quota allocated to the common pool fisheries was 30,740 pounds for hook and line and 46,111 pounds for drift gill net. The remaining quota was allocated to the individual transferable quota (ITQ) fishery with no gear-specific restrictions.<sup>5</sup> The Maryland Atlantic commercial quota was 126,396 pounds and could be harvested with drift gill net or otter trawl. The 2014 quota for recreational (including charter) fisheries in Chesapeake Bay was 2.60 million lbs. (excluding spring migratory fish; Figure 3).<sup>5</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 assigned to all participants. An ITQ guarantees each participating waterman a portion of the commercial quota. Watermen have the ability to temporarily transfer quota to other waterman with an ITQ. Quota allocation is based on a waterman's historical landings through February 29, 2012.

Commercial fisheries are managed using quotas and time 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 the commercial fisheries in compliance with Addendum IV. 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 Monday – Saturday and the haul seine fishery on 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 on Monday – Friday from January 1 – April 30 and November 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>3</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 daily harvest numbers and submit a weekly report. Fishermen and check stations have the option to submit harvest data electronically. Check stations are randomly sampled by MD DNR biologists to collect age, length and weight data, as well as validate reporting.

The recreational fishery is managed with minimum size limits, creel limits, tackle and bait restrictions, seasonal closures, and area closures.<sup>3</sup> Regulations to control 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.

Recreational angling is managed with a number of seasonal and spatial restrictions. No recreational harvest of striped bass was allowed in the Chesapeake Bay and Potomac River during the January 1 – February 28 catch and release fishery. The area of the catch and release fishery was restricted from March 1 – April 18. Fishing was 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 2014 spring trophy season took place from April 19 – 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. Anglers were allowed to harvest one fish ≥28 inches per day. 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 15. The 2014 harvest restrictions from May 16 – December 15 are two fish per person per day 18 – 28 inches, or one fish per person per day 18 – 28 inches and one fish per person per day >28 inches. The 2015 regulations changed for the summer/fall fishery due to implementation of Addendum IV. Anglers could harvest 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 16 and continues thru December 31. The use of eel as bait is prohibited from December 15 – 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 16 – May 3. The fishery is closed from May 4 – 15. The 2014 fishery re-opened with a one fish per person per day 18 – 26 inches from May 16 – 31. The 2015 fishery had a limit of one fish per person per day 20 -26 inches from May 16-31.

The 2014 Atlantic Coast recreational fishery was year-round with a limit of two fish per person per day at ≥28 inches. The 2015 regulations changed to a limit of one 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

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

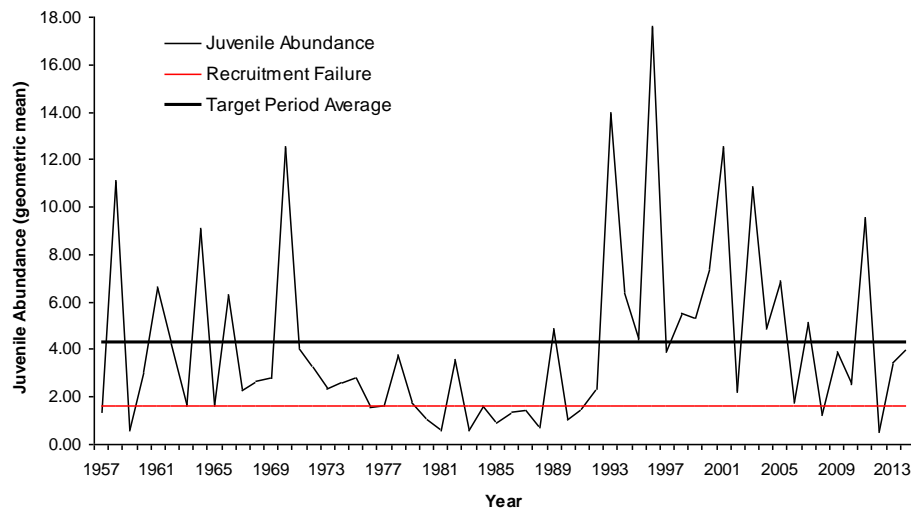
recreational regulations at <http://www.eregulations.com/maryland/fishing/stripped-bass/>. The complete list of commercial and recreational harvest restrictions are printed in the Code of Maryland Regulations (COMAR).

## The Fisheries

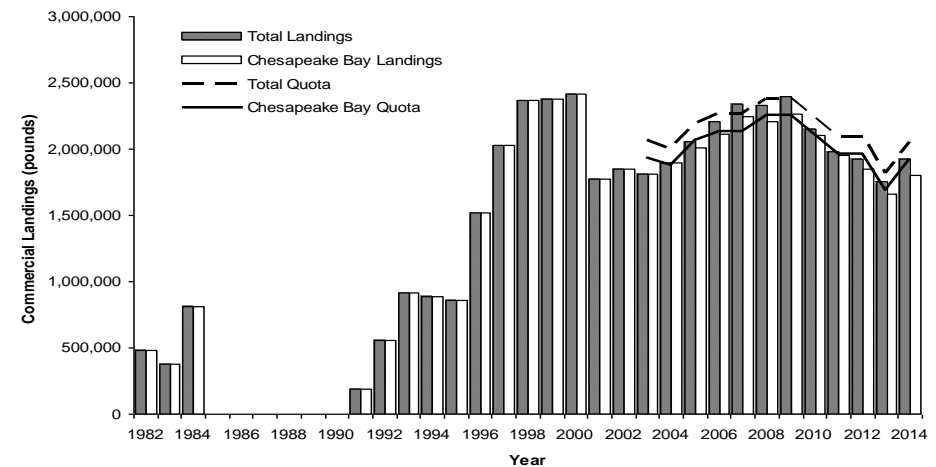
The 2014 Maryland commercial fishery in Chesapeake Bay harvested an estimated 1.81 million lbs.; 922,203 lbs from gill net, 218,987 lbs from hook and line, and 664,508 lbs from pound net/haul seine (Figure 2).<sup>5</sup> Atlantic coast landings were estimated at 120,923 lbs.<sup>5</sup>

NOAA Marine Recreational Information Program (MRIP) estimated recreational harvest in Maryland for 2014 to be 3.36 million lbs.: 3.34 million lbs. from Chesapeake Bay and 22,957 lbs from Atlantic Coast (Figure 3).<sup>5</sup> MD DNR's estimated total recreational harvest was 3.23 million lbs. (Figure 3): 3.20 million lbs. from Chesapeake Bay and 31,628 lbs. from the Atlantic coast.<sup>5</sup> Of the 2014 Chesapeake Bay harvest, 38,921 spring migratory fish were harvested by the trophy fishery (Figure 4).<sup>5</sup> The estimated discard mortality for striped bass is 9%, equal to 433,370 lbs. in 2014.<sup>5</sup>

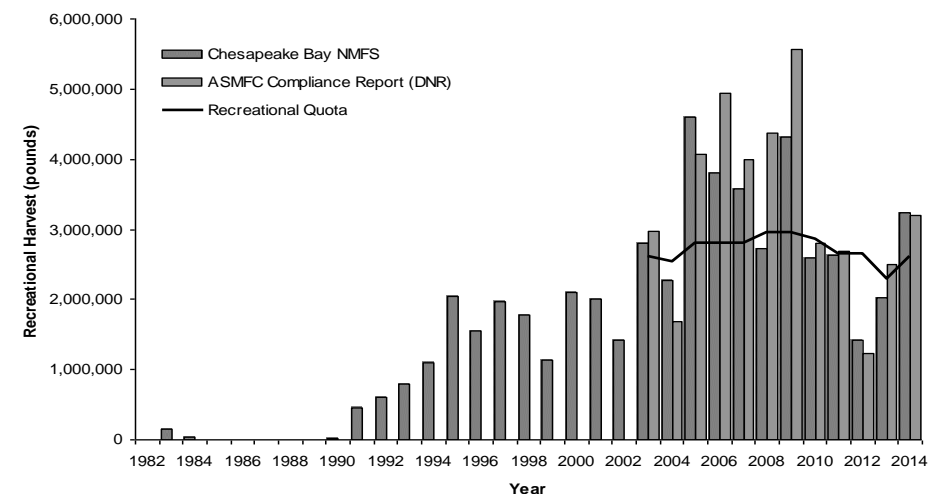
**Figure 1. Striped bass juvenile abundance index geometric mean values: 1957 – 2014.**<sup>4,5</sup> The red line represents the recruitment failure definition (1.60) and the bold line defines the target period average (1959-1972) of stable recruitment. The moratorium was in place from 1985 to 1989.



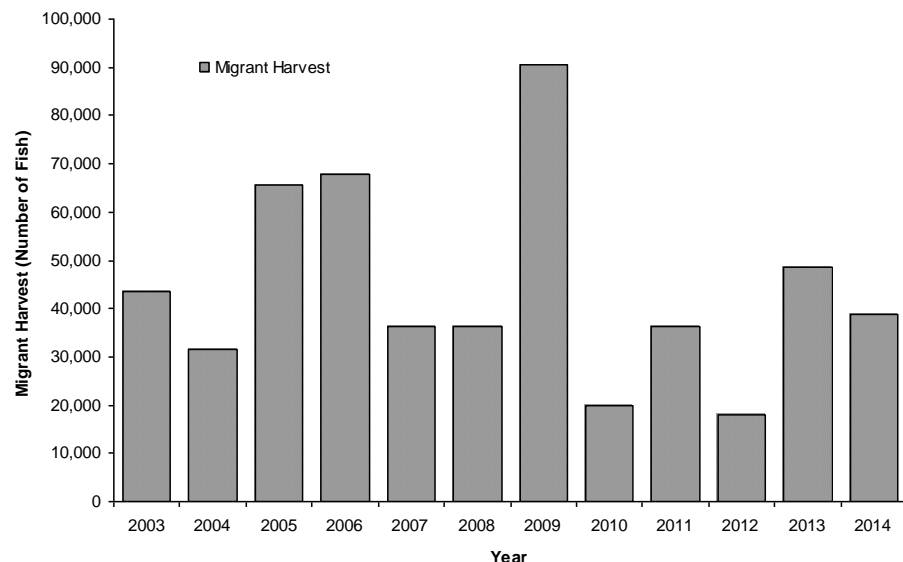
**Figure 2. Total commercial striped bass landings (Atlantic and Chesapeake Bay) and Chesapeake Bay landings<sup>5</sup> in Maryland from 1982 to 2014.** Total and Chesapeake Bay quota are shown for 2003-2014. Striped bass harvest moratorium was in effect from 1985 to 1989. (<http://www.asmfc.org/species/atlantic-stripped-bass>).



**Figure 3. Maryland recreational (including charters) striped bass landings and quota from 1981-2014.**<sup>5,6</sup> Striped bass harvest moratorium was in effect from 1985 to 1989.



**Figure 4. Maryland striped bass migrant harvest from 2003 to 2014.**<sup>5</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 a rise in F. Projections from the 2013 benchmark stock assessment indicated that SSB will likely fall below its threshold and that F will likely increase above its threshold. 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>7</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>8</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.

### References

- <sup>1</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.
- <sup>2</sup> Atlantic States Marine Fisheries Commission. 2013. Update of the Striped Bass Stock Assessment using Final 2012 Data. Prepared by Dr. Gary Nelson, MA DMF, ASMFC Striped Bass Technical Committee.
- <sup>3</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.
- <sup>4</sup> Maryland Department of Natural Resources Fisheries Service. 2014. Striped bass seine survey juvenile index: striped bass (YOY) [Data file]. Retrieved from <http://www.dnr.maryland.gov/fisheries/juvinindex/index.asp>
- <sup>5</sup> Maryland Department of Natural Resources. 2015. Maryland Striped Bass (*Morone saxatilis*) Compliance Report to the Atlantic States Marine Fisheries Commission 2014. Maryland Department of Natural Resources, Annapolis, MD
- <sup>6</sup> Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division. <http://www.st.nmfs.noaa.gov/index>
- <sup>7</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>8</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 9/2015)			
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>		Completed	Target was 1990 for a transition fishery.
		1995	The stock was deemed restored in 1995.
		1995 On-going	Juvenile abundance data is used by ASMFC to estimate coastal SSB and SCA of coastal stock.
		2003	Amendment VI changed the JAI recruitment failure definition from 90% to 75% of the index for three consecutive years.
		2010	Addendum 2 to Amendment 6 established a fixed recruitment failure value of 1.60.
		Continue	Strong recruitment of 1993, 1996, 2001, 2003, and 2011 year classes
		<b>2014</b>	<b>Addendum IV approved to implement management measures to reduce F in order to increase SSB.</b>
		<b>2015</b>	<b>New regulations implemented as required by Addendum IV.</b>
<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>	2000 Continue	All CB jurisdictions have implemented regulations to prevent exceeding $F_{target}$ .
		February 2003 Continue	CBP jurisdictions have the option to implement stricter regulations than required under ASMFC Amendment 6.
		2009	The overfishing definition is $F_{msy}=0.34$ . If coastwide estimated mortality rates exceed the target rate for 2 consecutive years, the ASMFC will develop management measures.
		On-going	<p>Bay jurisdictions are in compliance with ASMFC guidelines. CB F remains below the target of 0.27.</p> <p>See Strategy 1.2 comments for size limits and Strategy 2.4.1 comments for seasons and time restrictions.</p>

1989 Chesapeake Bay Striped Bass Management Plan Implementation Table (updated 9/2015)			
Strategy	Action	Date	Comments
		2013	<b>BRPs were changed in the update to the 2013 ASMFC Coastal Stock Assessment. New BRP's of a target F=0.18 and threshold F=0.22.</b>
	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.
1.2 Size limits and fishing mortality rates will be set to allow sufficient recruitment to the spawning stock.	1.2.1 The District of Columbia, Maryland, Virginia and the Potomac River Fisheries Commission will establish a minimum size limit of 18 inches total length in the Chesapeake Bay and tributaries during the transition fishery. Maryland may establish a larger minimum legal size during a May trophy fishery beginning in 1991.	On-going	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".
		2015	<b>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.</b>
	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.
		2012	Harvest tag criteria were standardized, coastwide, with Addendum III to Amendment 6.
	1.2.3 As a conservation measure, the District 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.	On-going	DC, MD, PRFC, and VA recreational fisheries are managed with a combination of the 18" – 28" slot limit and a 28" minimum size limit: 2 fish 18" - 28", or 1 fish 18" - 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 – March25 and ≥ 18"

1989 Chesapeake Bay Striped Bass Management Plan Implementation Table (updated 9/2015)			
Strategy	Action	Date	Comments
			from June 1 – December 15, and for gill net $\geq 18''$ 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 regarding the Susquehanna River.	Magothy - 1982 Patuxent - 1984 Pennsylvania – 1990	MD, PA, and USFWS discontinued stocking hybrid striped bass.
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.	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.	On-going  2013 2014	Quota allocation is periodically reviewed. Recreational and charter allocations have since been combined to be 57.5%.  <b>The CBP 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.</b>

1989 Chesapeake Bay Striped Bass Management Plan Implementation Table (updated 9/2015)			
Strategy	Action	Date	Comments
2.1 The striped bass harvest will be equitably allocated among user groups on a yearly basis.	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.	On-going	MD Department of Natural Resources, VA Marine Resources Commission, and PRFC have authority to close their fisheries when quotas are projected to be reached.
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.	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.	On-going	CB jurisdictions are in compliance.
	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.	On-going	CB jurisdictions are in compliance.
	2.2.4 Maryland and Virginia will establish annual quotas for their commercial fisheries.	On-going	State quotas are determined by ASMFC. CB FMP includes provisions for how jurisdictions allocate among sectors. MD adopted an allocation policy in 2011.
2.3 Selling and buying procedures and timely reporting requirements will be established to monitor and regulate harvest.	2.3.1 A) Maryland will establish check-in stations for the commercial sale of striped bass.	On-going	CB jurisdictions are in compliance.
	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.	On-going	CB jurisdictions are in compliance.
	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	2006 2009  2010	Electronic reporting was established for check stations and fishermen.  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

1989 Chesapeake Bay Striped Bass Management Plan Implementation Table (updated 9/2015)			
Strategy	Action	Date	Comments
	Potomac River Fisheries Commission will reduce the time period required for the finfish reporting system from monthly to weekly.	2011	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.
		2011	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.
		2011	MD House Bill 1252, established a misdemeanor charge and up to two years imprisonment for the unlawful capture of >\$20,000 worth of striped bass (based on sale proceeds).
		2014	<b>Maryland is conducting a SB Pilot Permit system for the commercial fishery. This e-reporting system should improve the accuracy of harvest reports.</b>
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: <ul style="list-style-type: none"> <li>The commercial gill net season will be within the period November through March 15.</li> <li>The commercial pound net/haul seine/fyke net/hook and line seasons will be within the period June through November.</li> <li>The recreational and charter boat seasons will be within the period June through November.</li> <li>There may be a May trophy fishery for recreational and charter boat fishing, effective May 1991, limited to a single trophy fish per boat per day.</li> </ul>	On-going	Fishing season dates are annually reviewed by ASMFC.
		Dates modified & subject to change	<b>Pound net, haul seine, hook and line fisheries were June 1 – November 30. Pound net sector was Monday – Saturday and haul seine was Monday – Friday. Hook and line: ITQ sector was Monday – Thursday, common pool sector's open days varied during the season. Drift gill net was open from December 1 – February 28. ITQ sector was Monday – Friday, common pool sector's open days varied during the season.</b> Atlantic coast: Monday – Friday from January 1 – April 30 and November 1 – December 31.
		Dates modified	Upper Chesapeake Bay (Susquehanna Flats)

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Strategy	Action	Date	Comments
		& subject to change	catch and release: March 1 – May 3, and the catch and keep: May 16 – 31. Spring trophy: 3 <sup>rd</sup> Saturday in April – May 15. Summer – fall recreational/charter boat: May 16 – 31 and June 1 – December 15.
	2.4.1 C) Virginia will establish fishing seasons within the following periods: <ul style="list-style-type: none"> <li>The commercial netting season will be within the period September through February.</li> <li>The recreational and charter boat seasons will be within the period June through December.</li> </ul>	Dates modified & subject to change Dates modified & subject to change	Commercial season is January 16 – December 31 ( $\geq 18''$ ) and March 26 – June 15 ( $\leq 28''$ ).  Recreational Chesapeake Bay spring trophy fishery: May 1 - June 15. Spring/summer fishery: May 16 - June 15. Fall fishery: October 4 - December 31
	2.4.1 D) The Potomac River Fisheries Commission will establish fishing seasons within the following periods: <ul style="list-style-type: none"> <li>The commercial gill net season will be within the period November through March.</li> <li>The commercial pound net/haul seine/hook and line seasons will be within the period June through December.</li> <li>The recreational and charter season will be within the period June through December.</li> </ul>	Dates modified & subject to change	Pound net, Haul Seine, and miscellaneous gear: February 15 – March 25 ( $18'' - 36''$ ) and June 1 – December 15 ( $\geq 18''$ ). Hook and line: February 15 – March 25 ( $18'' - 36''$ ) and June 1 – December 31 ( $\geq 18''$ ). Gill net: November <b>12</b> – February 14 ( $\geq 18''$ ) and February 15 – March 25 ( $18'' - 36''$ ).  Recreational seasons differ by size, possession, and bait limits. Spring season: April <b>20</b> – May 15. Fall season: May 16 – December 31.
	2.4.1 E) Maryland, the Potomac River Fisheries Commission and Virginia will annually review the need for a Bay spawning season fishery in relationship to the issue of parity with the coastal states.	Continue	Addressed by ASMFC.
2.4.2 Establish time periods when fishing is allowed to aid law enforcement and monitoring.	2.4.2 Maryland will prohibit commercial fishing on weekends and at night during the transitional fishery.	Completed <b>2014</b>	Weekend and evening/night fishing have been prohibited. <b>Saturday fishing was allowed in the pound net sector.</b>
2.4.3 Maryland, the Potomac River Fisheries Commission and Virginia will maintain appropriate striped bass fishing areas.	2.4.3 Maryland will continue to restrict fishing for striped bass in spawning areas and rivers, and spawning reaches as defined in COMAR 08.02.05.02. Virginia will continue to restrict fishing within the spawning reaches defined in VMRC Regulation 450-01-0034. The Potomac River Fisheries Commission will continue its prohibition on gill netting or striped bass fishing during April and May throughout the entire Potomac River during the transitional fishery.	Completed  On-going	Area closures are regulated.  Jurisdictions follow ASMFC harvest restrictions.

1989 Chesapeake Bay Striped Bass Management Plan Implementation Table (updated 9/2015)			
Strategy	Action	Date	Comments
2.4.4 The District of Columbia, Maryland, the Potomac River Fisheries Commission and Virginia will establish recreational and charter boat creel limits consistent with ASMFC guidelines and dependent on length of season.	2.4.4.1 The District of Columbia, Maryland, the Potomac River Fisheries Commission and Virginia will establish creel limits for the recreational and charter boat fisheries of up to five (5) fish per person per day within the established season.	On-going	Jurisdictions are in compliance with ASMFC harvest restrictions.  See Strategy 1.2 for creel limits.
	2.4.4.2 Maryland may allow one trophy fish per boat during a May trophy season.	On-going	Jurisdictions are in compliance with ASMFC harvest restrictions.  See Strategy 1.2 for creel limits.
2.5 Maryland, Virginia and the Potomac River Fisheries Commission will establish monitoring programs to provide timely knowledge of harvest and effort data.	2.5.1 Maryland, the Potomac River Fisheries Commission and Virginia will monitor harvest for the striped bass fishery by one or a combination of the following: <ul style="list-style-type: none"> <li>○ Utilize daily trip tickets for commercial and charter fishermen.</li> <li>○ Conduct port sampling of commercial vessels.</li> <li>○ Conduct onboard sampling of commercial catches.</li> <li>○ Utilize check-in station sampling to characterize exploited stocks.</li> <li>○ Require dealer logs</li> <li>○ Maintain Natural Resource Police activity reports.</li> <li>○ Utilize aerial overflights to estimate recreational effort.</li> <li>○ Conduct port and onboard sampling of recreational vessels.</li> <li>○ Conduct telephone surveys to estimate recreational participation.</li> <li>○ Utilize mail surveys to estimate recreational catch and effort.</li> <li>○ Utilize an enhanced National Marine Fisheries Service survey and/or Chesapeake Bay Stock Assessment Committee recreational monitoring data.</li> </ul>	1995 - 2003 On-going	Amendment V of the ASMFC FMP requires MD and VA to conduct annual juvenile abundance (JAI) surveys. CB jurisdictions are required to compile and submit commercial and recreational fisheries data.
		On-going	Monitoring programs include the Maryland Estuarine Juvenile Finfish Survey; spring spawning stock survey; spring tagging; commercial pound net, haul seine, hook and line, and drift gill net; and recreational Susquehanna Flats catch and release, spring trophy, spring-early summer and summer-fall recreational/charter boat seasons. Monitoring requirements may be changed as necessary.
		2007	Data collected from Federal waters is coordinated with NOAA Fisheries. Addendum I to Amendment 6 of the ASMFC FMP requires commercial and recreational catch, bycatch, discard, and mortality data. Discard mortality data gaps will be identified. Coastal stock data was used in a VPA model, but is now used in an SCA model.
		2008	Addendum 1 to Amendment 6 of ASMFC FMP requires states to address bycatch and angler education. States are required to collect commercial and recreational catch and bycatch data that is consistent with ACCSP standards, coordinate data collection from Federal waters with NOAA Fisheries, and review discard mortality studies for information gaps. States are to implement angler education about best practices for catch

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Strategy	Action	Date	Comments
		2011	and release fishing.  MD Senate Bill 414 and House Bill 396 authorize NRP officers to inspect licensed commercial vessels, vehicles, and premises where MD fishery resources may be stored. NRP officers are authorized to issue electronic citations. The law allows MDNR to suspend or revoke a license after providing the opportunity for a hearing.
	2.5.2 The District of Columbia will conduct an angler survey to determine striped bass fishing effort and harvest.	On-going	District Department of the Environment conducts monthly angler surveys.
2.6.1 The District of Columbia, Maryland and Virginia will establish regulatory procedures that allow for: 1) recognition of and incorporation of ASMFC requirements into state management, and 2) a periodic cycle of public review of management options. The Potomac River Fisheries Commission will promulgate regulations necessary to comply with the ASMFC and Chesapeake Bay Striped Bass Management Plans.	2.6.1 Maryland will propose legislation to authorize timely management actions and will develop guidelines for regulations. Virginia will promulgate regulations for timely management and seek legislation to correct any deficiencies if noted.	1990 On-going	Jurisdictions are in compliance with ASMFC and are coordinating through the Chesapeake Bay Program.
	2.6.2 The District of Columbia, Maryland, the Potomac River Fisheries Commission and Virginia will adopt consistent enforcement policies for the striped bass fishery throughout the Chesapeake Bay. Strategies to address enforcement needs will be developed.	On-going	ASMFC's Law Enforcement Committee develops minimum enforcement policies.
		2011          2011	Additional enforcement resources have been made available. Resources include additional officers, equipment, access to state of the art surveillance tools, legislation and regulation, increased penalty system, and a streamlined judicial framework.   MD Senate Bill 635 and House Bill 1154, require the revocation of an individual's 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.
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 & Delaware Canal		On-going	MD and VA have instituted tagging programs to estimate migration and mortality rates.  Gillnet survey is used to collect population data.



1989 Chesapeake Bay Striped Bass Management Plan Implementation Table (updated 9/2015)			
Strategy	Action	Date	Comments
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.		Completed	Studies demonstrating the effectiveness of circle hooks for reduced gut hooking and release mortality have been completed.
		2009	Research has linked striped bass recruitment with climate cycles. Wood & Austin, 2009, Synchronous multidecadal fish recruitment patterns in Chesapeake Bay, USA.
		2008 – 2011	SARC determined stock is not overfished is not undergoing overfishing.
		2012-2013	A benchmark stock assessment was completed in 2013.
		2014	<b>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</b>
3.1 The jurisdictions will continue to obtain stock information on striped bass in Chesapeake Bay.	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.	On-going	MD has a gill net survey to monitor the spring spawning stock.
		On-going	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.
3.2 Efforts will be made to improve our understanding of factors that affect reproduction and recruitment to the fishery.	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.	2007 Continue	Addendum I to Amendment 6 of the ASMFC FMP requires states to implement angler education about catch and release best practices.
		2009 Continue	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.
		On-going	Tagging study design and implementation requirements are coordinated with ASMFC.
4 – Declining Water Quality: Adequate spawning and nursery areas with good water quality are critical for striped	4.1 The first four action items are commitments under the 1987 Chesapeake	1990 On-going	Water quality issues are also addressed in the Chesapeake 2000 Agreement and most

1989 Chesapeake Bay Striped Bass Management Plan Implementation Table (updated 9/2015)			
Strategy	Action	Date	Comments
<p>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.</p> <p>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>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>2010</p> <p>2012 – 2013 2014</p>	<p>recently in the 2009 Executive Order.</p> <p>US EPA established a Chesapeake Bay TMDL “pollution diet” mandating nutrient and sediment reductions for compliance with the Clean Water Act.</p> <p><b>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></b></p>
	<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,</p> <p>b) Develop a Habitat Requirements Use Report which will detail resource needs by river segment,</p> <p>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</p> <p>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>1990 On-going</p>	<p>Currently addressed through the Chesapeake Bay Program’s 2 year milestones towards reaching the 2025 water quality goals.</p>

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Strategy	Action	Date	Comments
	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.		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>
	4.1 3 – Development and adoption of 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: a) Reduce discharge of metals and organic compounds from sewage treatment plants receiving industrial wastewater. b) Reduce the discharge of metals and organic compounds from industrial sources. c) Reduce levels of metals and organic compounds in urban and agricultural runoff. Reduce chlorine discharges to critical finfish areas.	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>
	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: a) Manage sewage sludge, dredge spoil and hazardous wastes. b) Improve dissolved oxygen concentrations in the Chesapeake Bay through the reduction of nutrients from both point and nonpoint sources. c) Continue study of the impacts of acidic conditions on water quality. d) Manage groundwater to protect the water quality of the Chesapeake Bay. e) Continue research to refine strategies to reduce point and nonpoint sources of nutrient, toxic and conventional pollutants in the Chesapeake Bay.	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/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>

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Strategy	Action	Date	Comments
	<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>b) Assess the consequences of the environmental impacts of acid deposition on water quality.</p> <p>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.</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>

## Acronyms

ACCSP – Atlantic Coastal Cooperative Statistics Program  
ASMFC – Atlantic States Marine Fisheries Commission  
CB – Chesapeake Bay  
CBP – Chesapeake Bay Program  
COMAR – Code of Maryland Regulations  
DCFM – District of Columbia Department of Consumer and Regulatory Affairs,  
Fisheries Management Section  
EPA – Environmental Protection Agency  
F – Fishing Mortality  
FMP – Fishery Management Plan  
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  
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

## 2014 Maryland FMP Report (July 2015)

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

Over the last two decades, the size of the summer flounder spawning stock along the Atlantic coast from North Carolina to Maine has increased six-fold with an increase in the number of age classes. There have also been shifts in the distribution and migratory patterns of summer flounder, both spatially and temporally.<sup>1</sup> Consequently, a regional, rather than state-by-state, conservation equivalency is being implemented for summer flounder in 2015. Maryland's region includes Virginia and Delaware. All states within a region have the same size limit, possession limit, and season.<sup>2</sup> For the Maryland/Delaware/Virginia region, the minimum recreational size is 16" with a 4 fish per person per day limit. Established state recreational harvest allocations will not be altered.<sup>1,2</sup>

#### Fishery Management Plans (FMPs)

In 1991, the Chesapeake Bay jurisdictions adopted the Chesapeake Bay Summer Flounder Fishery Management Plan (CBFMP). The CBFMP implemented management measures to reduce fishing mortality (F) and increase the spawning stock biomass (SSB). CBFMP strategies and actions were based on guidelines established by the ASMFC and MAFMC. As the summer flounder stock improved, the Chesapeake Bay jurisdictions developed Amendment #1 to the CBFMP in 1997. This amendment adopted all future reference points and quota determined by the ASMFC and MAFMC. Jurisdictions continue to implement commercial and recreational management measures as needed to meet these requirements. The CBFMP Amendment #1 also implemented a system of individual fishing quota (IFQ) permits for the commercial fishery. The CBFMP was reviewed in 2014.

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 Atlantic States Marine Fisheries Commission (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 Mid Atlantic Fishery Management Council (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 2016. Maryland submits an annual compliance report to ASMFC.

The ASMFC and MAFMC are developing an amendment to the summer flounder FMP. During 2014, the Council conducted 14 scoping hearings and compiled comments from the general public. As a result of the meetings, the amendment will address four areas of concern: goals and objectives, quota allocation, commercial management measures and recreational management measures. Scientists and Council members identified four issues that will be a subset of the areas of concern: fishery discards, ecosystem considerations and monitoring. The first area of concern, goals and objectives, will be addressed throughout 2015 with a conclusion by December 2015. For up-to-date information, visit <http://www.mafmc.org/actions/summer-flounder-amendment>

## 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> Current biological reference points (BRP) for summer flounder are  $F_{\text{threshold}} = 0.309$ ,  $SSB_{\text{target}} = 138$  million pounds, and  $SSB_{\text{threshold}} = 68.8$  million pounds. Fishing mortality has declined since the 1990s and was estimated at 0.285 in 2012, which was below  $F_{\text{target}}$ . SSB began increasing in the 1990s. The 2012 SSB estimate was 113 million pounds, which was between the  $SSB_{\text{target}}$  and  $SSB_{\text{threshold}}$  values. The 2013 review committee concluded that the summer flounder stock is not overfished and overfishing is not occurring. However, the stock assessment update, which includes fishery data through 2014, indicates a different result. Based on the 2013 BRPs, the summer flounder stock is not overfished but overfishing was occurring.<sup>4</sup> The 2015 assessment provides evidence that  $F$  has been underestimated and SSB has been overestimated since 2011. As a result of this finding, the commercial quota is projected to decrease for 2016 though 2017.

## 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 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 2014. 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 limits.

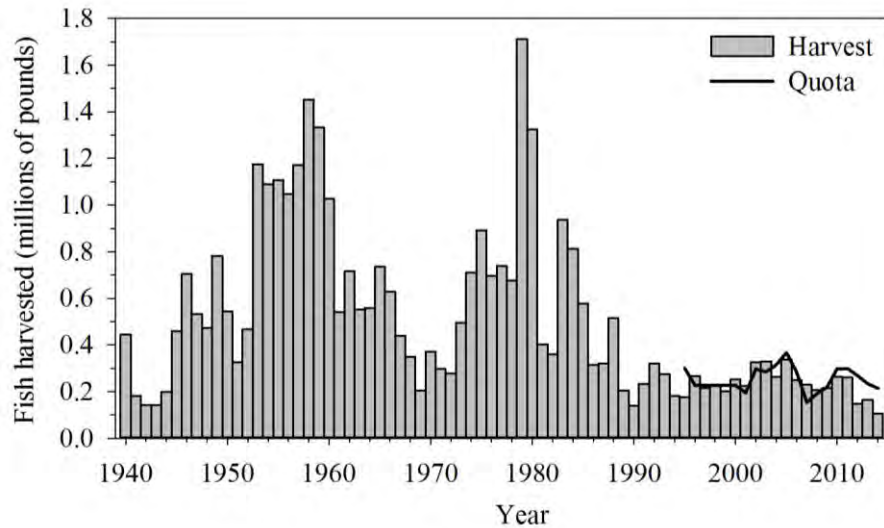
Maryland monitors summer flounder abundance, size, and age with an annual Coastal Bays trawl survey, beach seine survey, and commercial trawl landings from near-shore Atlantic waters. The Maryland Department of Natural Resources (MDNR) initiated the Maryland Volunteer Angler Summer Flounder Survey (MVASFS) 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

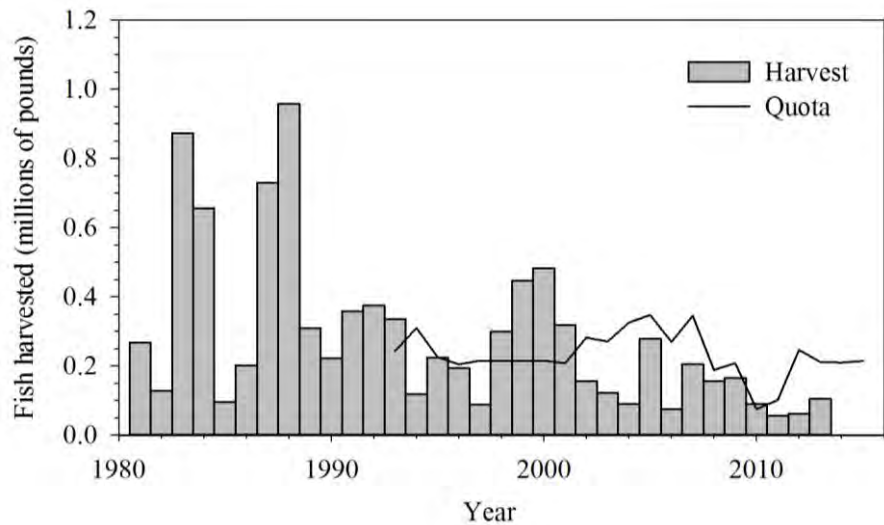
Maryland's 2014 commercial fishery harvested 164,384 pounds<sup>6</sup> The 2014 Maryland commercial quota was 214,298 pounds. (Figure 1).

Recreational landings of summer flounder was 79,119 fish with a combined weight of 178,148 pounds in 2014<sup>7</sup> (Figure 2).

**Figure 1. Maryland's commercial summer flounder harvest (1940-June 2014) <sup>5,6</sup> and quota (1994-2014).**



**Figure 2. Estimated recreational summer flounder harvest and quota in Maryland from 1981 to 2012.<sup>7</sup> Recreational quota is 2.9% of the total RHL, which are published in ASMFC FMP reviews**



## 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 has initiated a comprehensive review of the summer flounder management framework over the next three years. The MAFMC recommended the development of a new amendment. It has started with discussions on revising the goals and objectives of both the MAFMC and the ASMFC fisheries management plans and will continue with the development of new management options for both the recreational and commercial fisheries.

Commercial hook and line fishermen on the coast have requested that they fish at the 14" commercial size limit. Recently they were constrained to the recreational size limit. Trial seasons for a commercial hook and line minimum size of 14" have been established in Maryland. These seasons will be evaluated during 2014 and 2015. Season one is from May 1-15 and season two is from October 16-31. This fishery is restricted to coastal waters 1-3 miles from the shoreline to avoid spatial overlap and minimize conflict with the recreational fishery. Decreasing the size limit for the hook and line fishery allows consistency within the commercial fishery

## References



<sup>1</sup> Atlantic States Marine Fisheries Commission. 2015. Addendum XXVI to the Summer Flounder, Scup, Black Sea Bass Fishery Management Plan. Arlington, Virginia.

<sup>21</sup> Atlantic States Marine Fisheries Commission. (2014a). Addendum XXV to the summer flounder, scup, black sea bass fishery management plan; Summer flounder and black sea bass recreational management in 2014. Arlington, Virginia: Atlantic States Marine Fisheries Commission.

<sup>32</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/>

<sup>4</sup> National Marine Fisheries Service. 2015. Stock Assessment Update of Summer Flounder for 2015. Northeast Fisheries Science Center. Woods Hole, MA. June 29, 2015

<sup>53</sup> Doctor, S. 2015. Maryland's 2014 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 May 27, 2015.

<sup>7</sup> Personal communication from the NOAA Fisheries Service, Northeast Regional Office, Fisheries Statistics Office. Accessed May 27, 2015. [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 7/2015)</b>			
<b>Strategy</b>	<b>Action</b>	<b>Date</b>	<b>Comments</b>
1.1) The Bay jurisdictions will continue to implement management measures which reduce fishing mortality on the summer flounder stock and equitably allocate the harvest of summer flounder.	1.1a) The jurisdictions will implement annual quotas, individual quotas and/or possession limits in addition to seasonal restrictions, minimum mesh size requirements, minimum size limits, limited entry and license requirements to meet the coastwide commercial quota. The traditional balance of harvest between the Chesapeake Bay and the Atlantic coast will be maintained.	1998, 2004 Continue	ASMFC revised overfishing definition. Coastwide and state quotas are determined annually. ASFMC allowed a change in allocation. FMP actions are annually evaluated and adjusted to meet ASMFC coastal stock rebuilding targets.
		2008 2009	The ASMFC's Summer Flounder, Scup, and Black Sea Bass Board set the 2009 total allowable landings for summer flounder at 18.45 million pounds, up 2.68 million pounds from 2008. Officials determined from the 2008 June Stock Assessment Workshop (SAW) and Peer Review that summer flounder is no longer overfished, is not experiencing overfishing, but has not been rebuilt to target levels.
		2011	MD annual commercial quota is determined by NMFS/ASMFC. Commercial IFQ permits are issued. Limit without permit in Ocean/Coastal Bays is 100 lbs./individual/day. Limit without permit in Chesapeake Bay is 50 lbs./individual/day. PRFC annual commercial quota is determined by NMFS/ASMFC and deducted from MD's total annual quota. VA annual commercial quota is determined by NMFS/ASMFC and is 21.3% of the coastwide quota. Of the quota, 300,000 lbs. is set aside for tidal waters; 142,114 lbs. for the Chesapeake Bay waters; the remaining quota is allocated to non-Virginia waters (typically >3 miles offshore). For non-VA waters, harvest from 1st Monday in Jan. to the day prior to last Mon. in Nov. is allotted 70.7% of the quota. The remaining 29.3% of the quota is allotted to the last Monday of November to December 31. Allocation

Amendment #1 to the 1991 Chesapeake Bay Summer Flounder Fishery Management Plan Implementation Table (updated 7/2015)			
Strategy	Action	Date	Comments
		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.
	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.	2015	<b>Regional management was continued for 2015</b>
		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 7/2015)			
Strategy	Action	Date	Comments
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 administered by the states. All flounder landed by a vessel registered in a state will be counted towards that state's quota,	1993	ASMFC State allocations changed.
		1995	ASMFC capped coastwide quota & adjusted stock rebuilding schedule.

1991 Chesapeake Bay Summer Flounder Fishery Management Plan Implementation Table (updated 7/2015)			
Strategy	Action	Date	Comments
	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.	1998	ASMFC revised overfishing definition. See Amendment #1, Strategy 1.1, Action 1.1a
		2012	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.
		2013	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.
		2014	<b>The MAFMC began a major review of the summer flounder component of their management framework for summer. Completion is scheduled for 2017.</b>
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 requirements enacted through the Baywide Plan.	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.	On-going	Mesh size restrictions have been implemented.
	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 recommendations for conservation of the resource.	On-going  2014	Mesh size restrictions have been implemented.  <b>MAFMC has begun a major review of their management framework for summer flounder. Completion is scheduled for 2017.</b>

<b>1991 Chesapeake Bay Summer Flounder Fishery Management Plan Implementation Table (updated 7/2015)</b>			
<b>Strategy</b>	<b>Action</b>	<b>Date</b>	<b>Comments</b>
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 stock will be initiated.	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>
		<b>2014</b>	MD does not have a summer flounder tagging program.

1991 Chesapeake Bay Summer Flounder Fishery Management Plan Implementation Table (updated 7/2015)			
Strategy	Action	Date	Comments
			<b>Regional stock management is being implemented for 2014.</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 between abundances of adult and juvenile flounder.	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 juvenile summer flounder studies utilizing bottom trawls, beach seines and their	1977 On-going 1989 On-going  2001 – 2006	MD DNR conducts a summer blue crab trawl survey.  VIMS and MD DNR collaboratively conduct a winter dredge survey of blue crabs.  University of Maryland Center for Environmental Science Chesapeake Biological Laboratory,





1991 Chesapeake Bay Summer Flounder Fishery Management Plan Implementation Table (updated 7/2015)			
Strategy	Action	Date	Comments
to improved water quality and enhanced biological production.	1) Developing habitat requirements and water quality goals for various finfish species.	2014	<b>The CBP has developed a Chesapeake Watershed Agreement (2014) with fisheries and habitat outcomes. Summer flounder is not a focal species.</b>
	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: <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_grass">http://www.chesapeakebay.net/issues/issue/bay_grass</a>

1991 Chesapeake Bay Summer Flounder Fishery Management Plan Implementation Table (updated 7/2015)			
Strategy	Action	Date	Comments
	3.1 7) Managing population growth to minimize adverse impacts to the Bay.	1990 On-going	<a href="#">es</a> 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

## 2014 Maryland FMP Report (September 2015)

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

Tautog are a long-lived, slow-growing species. They prefer nearshore coastal waters, especially rocky reef areas, but have been caught as far inland as the Maryland Chesapeake Bay Bridge. They generally move inshore in the spring and summer and offshore in the fall and winter. Although tautog are managed as a single stock from North Carolina to Massachusetts, tagging data indicate there is limited movement north and south along the coast and intermixing between regions appears to be minimal. The most recent Atlantic Marine Fisheries Commission (ASMFC) stock assessment report (2015) considered a regional approach to assessing the tautog stock.<sup>1</sup> As a result, ASMFC has initiated the development of a new amendment to explore the use of regional management with region-specific reference points. Maryland will be part of a proposed regional approach with Virginia and Delaware.

#### Fishery Management Plans (FMPs)

The Chesapeake Bay and Atlantic Coast Tautog Fishery Management Plan (FMP) was adopted in 1998 by the Chesapeake Bay Program (CBP) to perpetuate the stock and maintain existing fisheries. The CBP FMP adopts ASMFC guidelines and requirements. The CBP 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:  $\text{SSB}_{\text{target}} = 59$  million lbs. and  $\text{SSB}_{\text{threshold}} = 44$  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% coastwide 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 2012 to achieve the required reduction. Maryland is required to submit an annual compliance report to ASMFC.

#### Stock Status

Over the years, ASMFC has conducted full and benchmark stock assessments for tautog (1995, 1999, 2002, 2005, 2011). The 2011 stock assessment update and subsequent corrections (2012) determined that tautog were below the  $\text{SSB}_{\text{target}}$  (26,800 mt or 59.1 million lbs.) and the  $\text{SSB}_{\text{threshold}}$  (20,100 mt or 44.3 million lbs.). Fishing mortality ( $F$ ) was estimated at 0.26, below the target ( $F_{\text{target}} = 0.15$ ).<sup>3,4</sup> The most recent stock assessment (2015) utilized data through 2013. Based on one unit 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> The 2015 stock assessment also evaluated the stock based on three regional divisions. Based on the regional assessment approach, the Southern New England 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 and a benchmark stock assessment in 2019.

#### 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 lost. Recreational anglers are restricted to hook and line.

#### The Fisheries

Maryland's commercial and recreational tautog harvest are minor components of the total coastwide landings. Commercial landings have remained at low levels since 2007 due to the limited possession allowance (Figure 1).<sup>6</sup> Maryland's tautog landings have averaged ~1% of coastwide landings.

Estimated tautog recreational total catch (includes released fish) from Maryland in 2014 was 2,545 fish. Preliminary estimate for 2015 is 15,973 fish (percent standard error = 58% and 81%, respectively).<sup>7</sup> In Maryland, the majority of tautog are caught by the recreational fishery.<sup>1</sup>

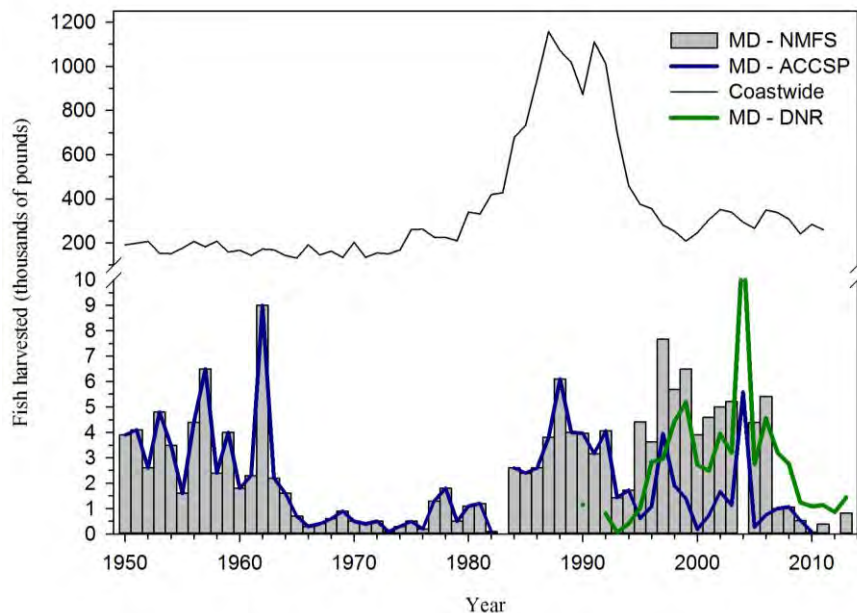
#### Issues/Concerns

Tautog are dependent on bottom structure, but managed as a single Atlantic coast stock. Egg and larval dispersal is believed to be coastwide. Juvenile and adult

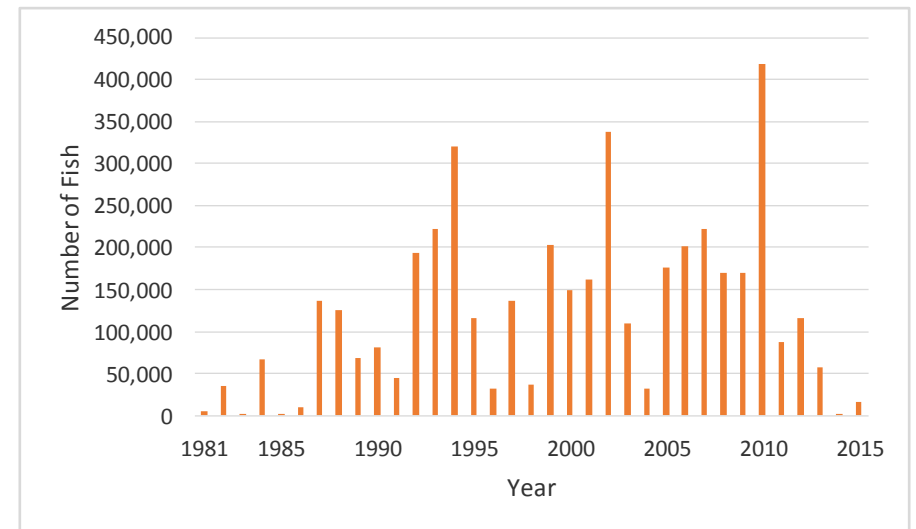
migration is limited and would best be managed as regional stocks.<sup>8</sup> Regional stocks and management options will be examined during the development of a new ASMFC amendment (2016). A DNA analysis of tautog is underway to determine if there is genetic separation in the coastal stock. Maryland is participating in this study.

Oyster reefs and submerged aquatic vegetation (SAV) are important estuarine habitats for tautog. Restoration of these habitats in Chesapeake and Coastal Bays is important, particularly for juveniles. Adult tautog are dependent on hard bottom and deep water coral habitats, found in ocean waters, whose extent are poorly documented.

**Figure 1. Maryland and coastwide commercial tautog landings (lbs.): 1950-2012.** No reported landings for 2013 or 2014 from NMFS database<sup>6</sup> Discrepancies between commercial landings reported NMFS, ACCSP, and MD DNR are due to differences in data confidentiality requirements.



**Figure 2. Estimated tautog recreational total catch from Maryland (number of fish): 1981-2015 (2015 preliminary).<sup>7)</sup>**



## 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> Atlantic States Marine Fisheries Commission. 2011. Addendum VI to the interstate fishery management plan for tautog. Atlantic States Marine Fisheries Commission, Arlington, Virginia.

- <sup>4</sup> Atlantic States Marine Fisheries Commission. 2011. 2011 Tautog Assessment Update Summary. Atlantic States Marine Fisheries Commission. Arlington, Virginia.
- <sup>5</sup> Maryland Department of Natural Resources. 2015. Maryland's 2014 tautog (*Tautoga onitis*) compliance report to the Atlantic States Marine Fisheries Commission. Maryland Department of Natural Resources, Fisheries Service. Annapolis, Maryland.
- <sup>6</sup> Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division. Commercial landings statistics <http://www.st.nmfs.noaa.gov/>
- <sup>7</sup> Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division. Recreational landings statistics.
- <sup>8</sup> Tuckey, T., N. Yochum, J. Hoenig, J. Lucy, and J. Cimino. 2007. Evaluating localized vs. large-scale management: The example of tautog in Virginia. Fisheries 32(1): 21–28.

1998 Chesapeake and Atlantic Coast Tautog Fishery Management Plan Implementation Table (updated 9/2015)			
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 ASFMC. The jurisdictions will continue to work towards a unified, Baywide management strategy.	1998 2000 2003 2005 2011  2011 2012  Continue	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%.  Based on the 2015 tautog benchmark stock assessment, the 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 the proposed regional approach with region-specific reference points and scheduled for completion in 2016.
	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> <li>• Ungalvanized or uncoated iron wire of 0.09"</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.

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	(2.39 mm) or smaller.		
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.	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.	Continue 1989-1999 Continue  2014	Annual fecundity estimates are much higher than previously thought. All states are required to collect data to support the coastwide stock assessment. Data are collected from cooperating head boat captains, trawl, and seine.  A DNA analysis of tautog is underway to determine if there is genetic separation in the coastal stock. Maryland is participating in this study.
	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.	Continue	Data from the Baywide trawl survey is used in the ASMFC stock assessment. However, very little data is collected on tautog.
	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.	Continue	Commercial reporting has been improved through more stringent penalties for late reporting and no reporting.  MD commercial landings have been <1% of the coastal harvest since 2007.
	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.	2009 Continue  2011 Continue  2011 On-going	MD contracted to have supplemental MRFSS recreational data collected.  MD implemented a coastal recreational saltwater license requirement.  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.  <b>Estimated total recreational catch was 2,545 fish (2014) and 15,970 fish (preliminary 2015).</b>
	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.	1972 Continue  1999 Continue	Juvenile tautog are sampled during the summer and fall coastal bays trawl and seine survey (not designed to target tautog).  MD Coastal Bays Fisheries Investigation 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 line.
2.2) The jurisdictions will promote research to determine the extent of migration and mortality	2.2) Research on migration of tautog between areas is encouraged. Tagging experiments to provide data	Continue	A study on the seasonal occurrence of tautog in the lower CB indicates that most fish tagged and released in inshore

1998 Chesapeake and Atlantic Coast Tautog Fishery Management Plan Implementation Table (updated 9/2015)			
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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 encouraged.	on tautog migration may be funded from sales of saltwater fishing licenses. The Virginia Game Fish Tagging Program will be continued.	2007 On-going  Continue	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 Continue	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.  Oyster aquaculture is increasing. <b>1,483 acres</b> of aquaculture have been permitted since 2011. <b>Several thousand acres are in application review.</b>
	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,	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).



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	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.).	2007 On-going	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.
		Continue	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.
		2008	44 NY subway cars were deployed off Ocean City.
		2011	USN Destroyer <i>Radford</i> was reefed on August 10, 2011. The vessel has since broken into 3 pieces but remains upright.
		On-going	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/vsrfd/f/reef.shtm">http://mrc.virginia.gov/vsrfd/f/reef.shtm</a>
	3.1.2B) VA has recently prohibited the use of all gear except recreational rod and reel, hand-line, 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.	Continue	MD and VA both adopted legislation that prohibits hydraulic clamming (and crab dredging in VA) in or near 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	Continue	MD implemented a living shorelines program in 1970 to encourage vegetative shoreline stabilization.  Regulations are in place to prohibit dredging through

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	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.	2003	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.  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 are currently under development and will include actions to reach the baywide goal of 130,000 acres by 2025.
	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 by the Chesapeake Bay SAV Policy Implementation Plan.	Continue	Water quality criteria have been adopted and there is a water quality outcome in the 2014 Chesapeake Watershed Agreement. <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. <b>2013 SAV acreage was 59.9 thousand and 2014 estimated acreage is 75,835.</b>
3.2.2) The jurisdictions will use The Submerged Aquatic Vegetation Habitat	3.2.2) When choices must be made in selecting SAV restoration projects, to fund and support under the	Continue	More emphasis is being placed on multispecies benefits when considering restoration projects. Long-term

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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.	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.		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	Wonders of Wetlands (WOW) curriculum was developed
		2006 Continue	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.
		2009 Continue	Wetland mosquito ditches from the 1930s-1940s are being modified to reduce tidal flow and restore wetland hydrology and function.
		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.
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).



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Strategy	Action	Date	Comments
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.	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.		

### 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  
 OCRF - 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

## **2014 Maryland FMP Report (July 2015)**

### **Section 20. Weakfish (*Cynoscion regalis*)**

The 2009 weakfish coastwide stock assessment determined the stock is depleted and overfishing is not occurring.<sup>1</sup> Using the term “depleted” rather than “overfished” is a signal that low stock size is not the direct effect of fishing. The stock assessment results indicated that fishing mortality has declined but natural mortality has increased leading to high total mortality. A benchmark assessment was initiated by ASMFC in 2014 and will be peer reviewed and evaluated for management use in late 2015 or early 2016.

#### **Fishery Management Plans (FMPs)**

The Chesapeake Bay Weakfish and Spotted Seatrout Fishery Management Plan (CBFMP) 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. 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 CBFMP 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**

Since 2009, the Atlantic coastwide weakfish stock has been considered depleted rather than overfished and overfishing has not been occurring. The term “depleted” is used when factors other than fishing mortality have resulted in a biomass decline. The last peer-reviewed stock assessment was completed for the Atlantic coastal stock in 2009. The stock spawning potential was estimated at 3%-4% of an unfished stock. Since 1995, the decline in biomass has been due to a sustained increase in natural mortality and not from an increase in fishing mortality (overfishing). The increased natural mortality was exacerbated by continued removals by commercial and recreational fisheries. Maryland’s fishery dependent and independent monitoring has shown both a decrease in mean adult age and low juvenile abundance. The ASMFC Weakfish Management Board adopted new percentage-based spawning stock biomass biological reference points (BRPs) in November 2009. The spawning

potential threshold was set at 20% and the spawning potential target was set at 30%. Despite more restrictive management measures, the depleted weakfish stock is unlikely to recover quickly.<sup>1</sup> The increase in natural mortality is attributed to predation, competition and changes in climate. A benchmark stock assessment was initiated in 2014. The data workshop was held in October 2014, the assessment workshop will be held in August 2015 and the peer review workshop will be held in late 2015 or early 2016.

#### **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 2014.

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. Maryland was required to provide 6 lengths and 6 age samples for 2014 (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 has been an increase in juvenile weakfish production in both the Bay and Coastal Bays in 2013 and 2014 but the catch remains below the long-term mean.

#### **Fisheries**

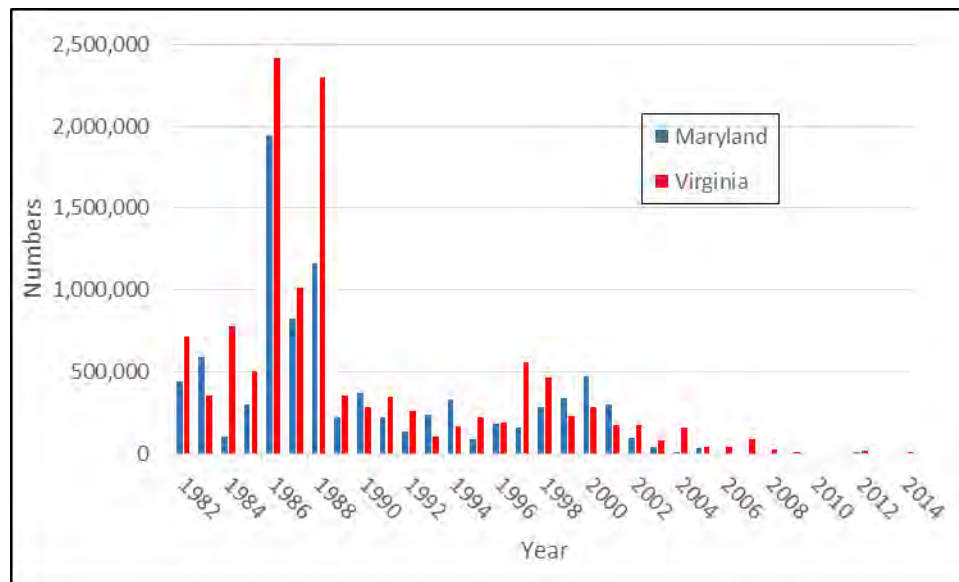
Both estimated recreational harvest and commercial landings of weakfish decreased in the early 2000s to very low values (Figures 1 & 2). Harvest estimates and landings values have remained at historically low levels. The recreational harvest estimates in 2014 were 1,062 fish in Maryland and 9,084 fish 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’s 2014 commercial landings were 2,130 lbs. Landings values for the past six years are the lowest on record for both states for the entire NMFS time series (1950-2013)<sup>4</sup>

#### **Issues/Concerns**

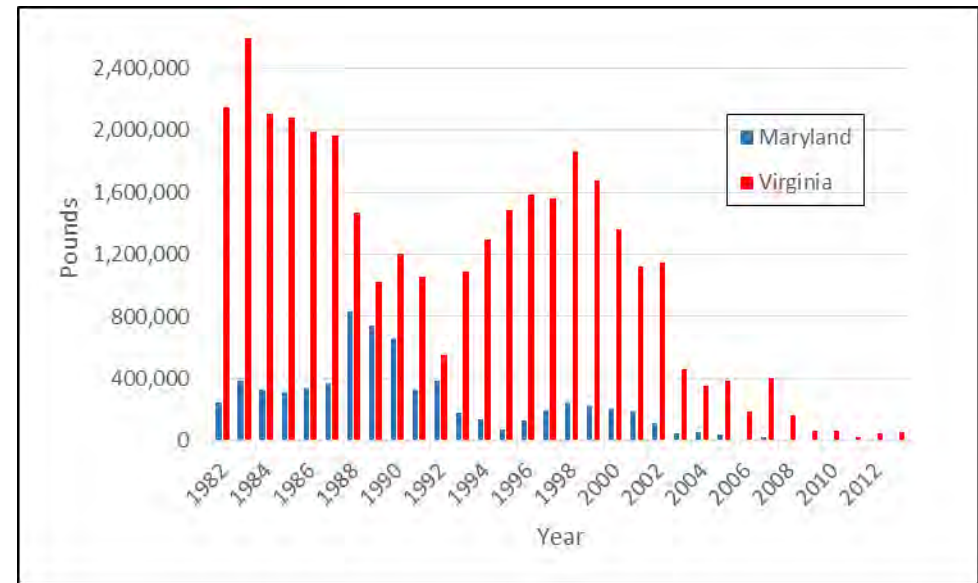
Factors such as predation, competition, and environmental changes, have increased natural mortality and appear to have a stronger influence on weakfish stock dynamics than harvest. Production of weakfish juveniles has not led to increased adult biomass.<sup>1</sup>

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 broad regional scale.

**Figure 1. Maryland and Virginia estimated recreational weakfish harvest in numbers, 1982-2014.<sup>3</sup>**



**Figure 2. Maryland and Virginia commercial weakfish landings, 1981-2013.<sup>4</sup>**



## References

- <sup>1</sup> NFSC. 48<sup>th</sup> Northeast Regional Stock Assessment Workshop (48<sup>th</sup> SAW) Assessment Summary Report. 2009. Reference Document 09-10, U.S. Department of commerce. Woods Hole, MA
- <sup>2</sup> ASMFC. 2013. 2012 Review of the Atlantic States Marine Fisheries Commission Fishery Management Plan for Weakfish (*Cynoscion regalis*) 2012 Fishing Year. ASMFC Board Approved October 23, 2012. 25p
- <sup>3</sup> Personal communication from the National Marine Fisheries Service, Marine Recreational Information Program, Fisheries Statistics Division July 20, 2014.
- <sup>4</sup> Personal communication from the National Marine Fisheries Service, Commercial Fisheries Statistics, Fisheries Statistics Division July 20, 2014.



<b>2003 Chesapeake Bay Program Weakfish Fishery Management Plan Implementation</b> (updated 7/15)			
<b>Section</b>	<b>Action</b>	<b>Implementati on</b>	<b>Comments</b>
<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.	<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	Annually reviewed and adjusted if necessary	The 2009 assessment results indicated that the weakfish stock is depleted, with SSB estimated at 3%-4% of an unfished stock well below the BRPs adopted in Addendum IV. The biomass decline is the result of increasing natural mortality while F remains low. Size and age structure of the stock has decreased. The ASMFC review team (2010) recommended the development of additional methods to analyze the stock in the next assessment <b>The ASMFC initiated a benchmark stock assessment in October 2014 to update stock status and better inform management decisions.</b>
	<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.	Annually	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.
<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.	<u>Action 2.1</u> The CBP jurisdictions will consider regional differences when determining state allocation issues and regulations.	As necessary	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,
	<u>Action 2.2</u> The CBP jurisdictions will consider the economic impacts of management measures on the fishery and promote the utilization of economic data in the management decision process.	Dependent on the availability of economic data	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 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	Annually	ASMFC Addendum III to Amendment 4 of the weakfish FMP aligns BRD certification requirements between state and federal waters



<b>2003 Chesapeake Bay Program Weakfish Fishery Management Plan Implementation</b> (updated 7/15)			
<b>Section</b>	<b>Action</b>	<b>Implementati on</b>	<b>Comments</b>
	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.		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 2014, otoliths were removed from six weakfish encountered during MD pound net sampling in Chesapeake Bay. Ages ranged from one to three years old.</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, remaining at a relatively high level through 2001, but generally decreased from 2003 to 2008, with moderate to low values since. <b>The Chesapeake Bay juvenile geometric mean in 2014 increased compared to 2013, and was the 12<sup>th</sup> highest value in the 26 year time series.</b> A second JI index s generated from the Coastal Bay Trawl survey. <b>The geometric mean from this survey increased in 2014 but was ranked 20<sup>th</sup> among the 26 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 collect and examine stomach contents data and examine the effects of environmental variables upon weakfish growth rates.	On-going	Data from the ChesMMA Survey, CHESFIMS project may be used to evaluate species interactions and 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.

## 2003 Chesapeake Bay Program Weakfish Fishery Management Plan Implementation (updated 7/15)

<b>Section</b>	<b>Action</b>	<b>Implementation</b>	<b>Comments</b>
<b>Habitat Management Strategy:</b> CBP jurisdictions will monitor and regulate activities which may be harmful to weakfish habitat.	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.	On-going          2014	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.  <b>The CBP developed a new Watershed Agreement (2014) with new and updated habitat outcomes.</b> 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>
	<u><b>Action 4.1</b></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.	Continue	The MD DNR water quality protection database focuses on watershed lands that are most important for improving water quality.
	<u><b>Action 4.2</b></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 management measures may be necessary.	Continue       2014	Data from the ChesMMAAP, CHESFIMS, and the MD Winter Trawl Survey will provide data on important forage species for weakfish. The CHESFIMS survey was discontinued after 2005 due to lack of funding.  The CBP developed a Watershed Agreement (2104) 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>
	<u><b>Action 4.3</b></u> The CBP jurisdictions will monitor the	Continue	The MD Estuarine Juvenile Finfish Survey and VIMS Juvenile Abundance Monitoring Surveys (formerly known as the VIMS

<b>2003 Chesapeake Bay Program Weakfish Fishery Management Plan Implementation</b> (updated 7/15)			
<b>Section</b>	<b>Action</b>	<b>Implementati on</b>	<b>Comments</b>
<b>Ecosystem Interactions</b> Management Strategy:	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.		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><b>Action 4.4</b></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, 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. A forage management strategy was developed in 2014/2015 and a biennial work plan is under development for 2016. The work plan will include actions to identify important forage species and how to manage for key predators.

#### **Acronyms:**

ACCSP =  
 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

## 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. .

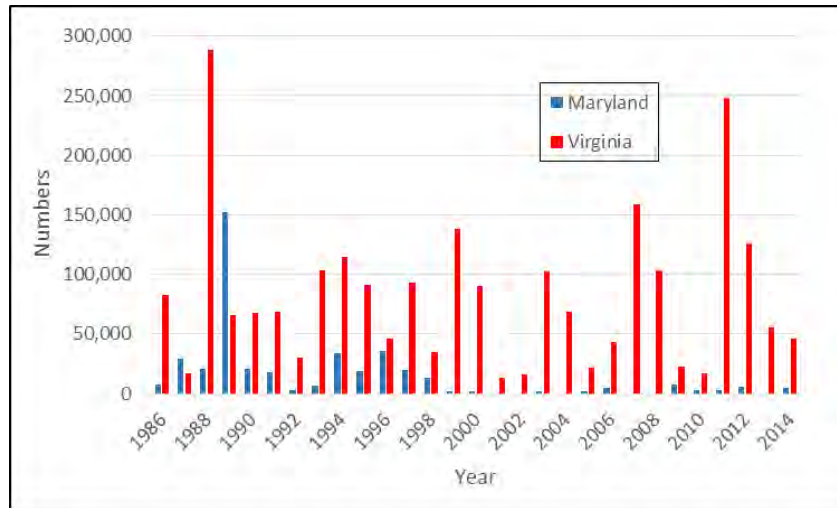
## Fisheries

The Marine Recreational Information Program (MRIP) estimated that Maryland recreational harvest has ranged from zero to 7,933 fish from 2005 to 2014, with higher catches occurring in the late 1980s and mid 1990s (Figure 3). Most estimates have a high percent 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 a range of 17,417 to 247,736 fish per year from 2005 to 2014 and lower PSE values. 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.

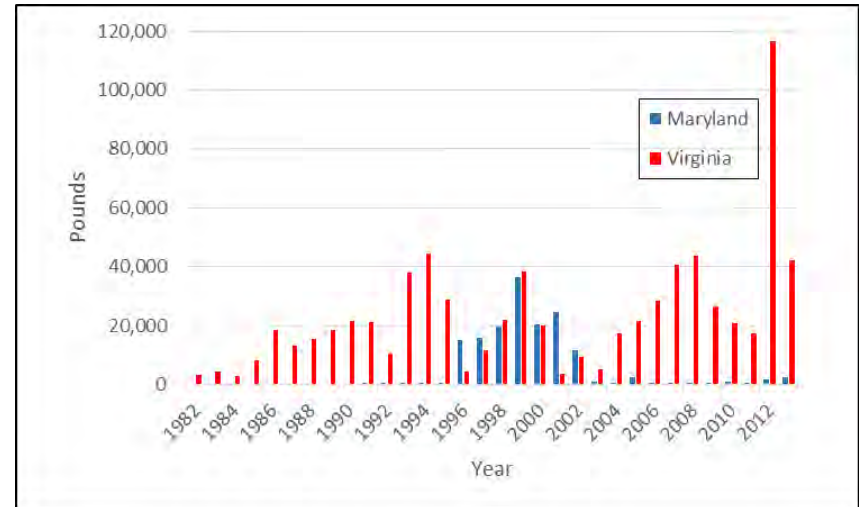
## Management Objectives and Measures:

The ASFMC FMP a size limit of 12" minimum total length is required. 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 in Virginia, and a 10 fish creel limit is imposed by 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.

**Figure 3. Estimated recreational harvest for spotted seatrout from Maryland and Virginia, 1986-2014.<sup>3</sup> (MRIP data)**



**Figure 4. Commercial spotted seatrout landings from Maryland and Virginia, 1982-2013.<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 July 20, 2014.
- <sup>3</sup> Personal communication from the National Marine Fisheries Service, Marine Recreational Information Program, Fisheries Statistics Division July 20, 2014.

## 2014 Maryland FMP Report (September 2015)

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

White perch are among the most important recreational and commercial finfish species in Maryland. The species has high sport and food value. White perch usually rank in the top five commercially valuable finfish in the state (\$1.2 - \$1.4 million wholesale value landed).<sup>1</sup> An estimated harvest of 312,273 pounds was taken by recreational fishermen in 2014.<sup>2</sup> White perch are commonly kept for food by sport fishermen. They are sold at reasonable prices by commercial fishermen “over the tailgate” or roadside stands as well as seafood markets.

#### 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 2015. No changes were 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 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>3</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 (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>4</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>4</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 was well above average in 2014 (Figure 2).<sup>4</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. The estimated recreational harvest of white perch in 2014 was below the long-term average of 587,130 lbs. (1981-2014) (Figure 4).

#### 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>3</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.

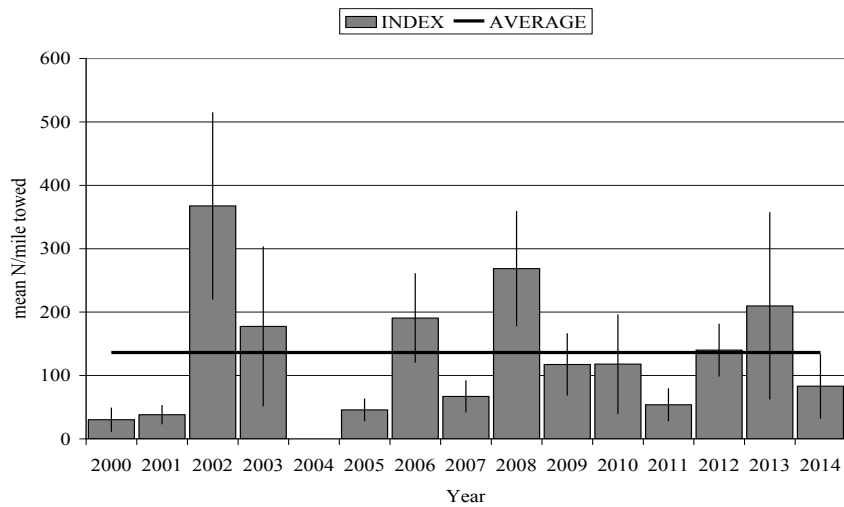


Figure 2. Maryland young-of-year geometric mean catch per haul for white perch, 1962 – 2014. (EJFS data)

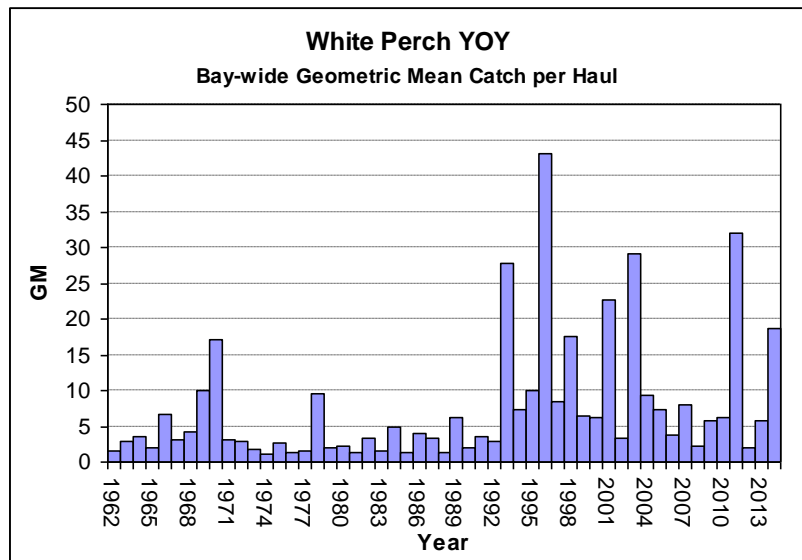


Figure 3. Commercial landings of white perch from Maryland, 1981-2014. <sup>1</sup>

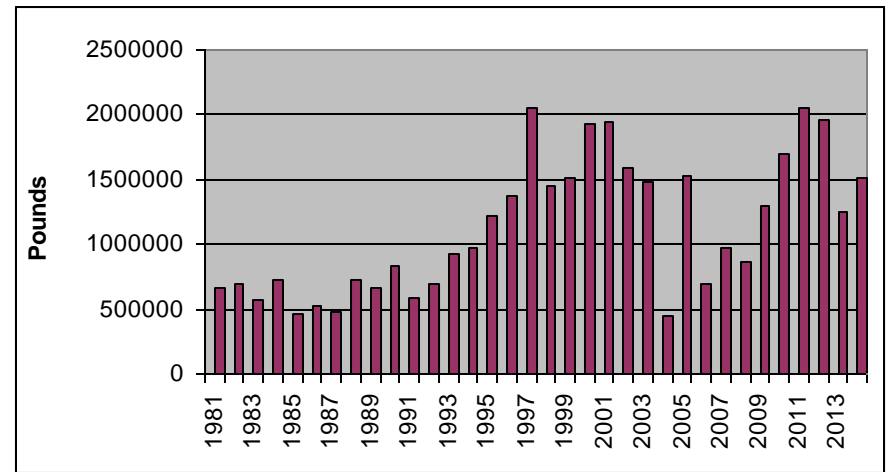
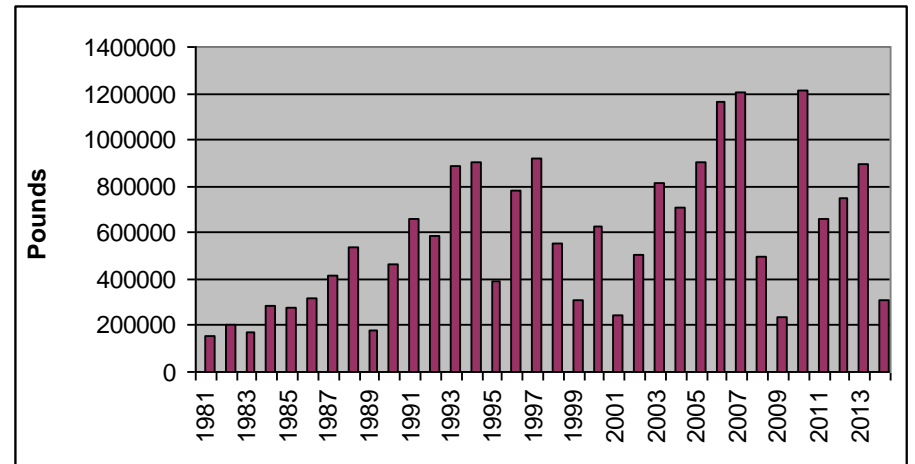


Figure 4. Estimated recreational white perch harvest from Maryland, 1981-2014. <sup>2</sup>



References:

<sup>1</sup> Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division, Commercial Fisheries. July 21, 2014.

<sup>2</sup> Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division, Recreational Fisheries. July 21, 2014.

<sup>3</sup> Piavis, P.G. and E. Webb III. 2012. 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>4</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.



<b>Draft 1990 White Perch Fishery Management Plan Implementation Table</b> (updated 7/15)			
<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 limit for commercial and non-H&L recreational set at 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. Since 2000, fishing mortality rates have been under <math>F=0.60</math> 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>White perch stocks are not overfished and overfishing is not occurring, based on the suggested <math>F_{\text{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	Watershed indicators for aquatic systems include water quality as well as components of aquatic systems, biological diversity, hydrologic, and terrestrial system. <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> 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 & strategies, and organizations. 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>
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**Acronyms:**

BRPs = Biological Reference Points

CPUE = Catch per Unit Effort

DNR = Department of Natural Resources

F = Fishing Mortality

H & L = Hook and Line

## Maryland FMP Report (July 2015)

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

The yellow perch fishery is often described by outdoor writers as a “harbinger of spring” because it is the first fishery of the year and one that is anticipated, despite its small size, by both recreational and commercial fishermen. This fishery is characterized by highly variable recreational fishing and a conservatively controlled and limited commercial harvest.

#### Maryland Fishery Management Plan (FMP)

The Maryland Tidewater Yellow Perch Fishery Management Plan (YPFMP), 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 YPFMP was reviewed in 2006 and 2013. The 2013 FMP review recommended an amendment that would include the new management strategies taken in 2009.

#### Stock Status

Yellow perch stocks are not overfished and overfishing is not occurring.<sup>1</sup> Yellow perch stock assessments have been conducted every two years up to 2005 and annually since 2007 for the upper Chesapeake Bay. The biological reference points (targets and thresholds) were updated using a spawning stock biomass per recruit model. The yellow perch assessment model was refined by adding three more years of data (2011-2013), re-examining fishery independent indices and weightings, and expanding the range of ages.<sup>2</sup> The revised Upper Bay population estimate has varied from 714,000 in 2011 to 632,000 yellow perch in 2012 to 887,000 in 2013 (Figure 1). A biomass estimate of 321,000 pounds was calculated for 2013. Recruitment to the population at age 2 has increased from an estimated 207,000 in 2011 to 234,000 in 2012.<sup>2</sup> Total instantaneous fishing mortality ( $F=0.23$ ) remains under the target  $F$  of 0.53. Both abundance (Figure 1) and biomass (Figure 2) estimates increased in 2013 while estimated fishing mortality decreased (Figure 3). Estimated recruitment in 2013 was just above 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. Fishing mortality for the commercial fishery in 2013 was calculated at 0.23, a minimal decrease from 0.28 in 2012 (Figure 3). 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. The commercial fishery has a slot limit of 8.5 to 11 inches. There are areas closed to commercial fishing. The recreational fishery is open year round, has no closed areas, a minimum size limit of 9 inches, and a creel limit of 10.

#### The Fisheries

The commercial quota was not reached for the three years prior to 2015. 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. The 2012 season was the first season in which the quotas were not reached or exceeded for any management region (Figure 5).

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 2500 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 3990 pounds, respectively (Figure 8). The Patuxent River quota of 2500 pounds was under harvested by 1389 pounds

### Issues and Concerns

A pilot project will be implemented for the 2016 commercial fishery to tag boxes rather than individual fish. This pilot project is in response to continued concerns about the expense and labor involved in tagging individual fish. Box tagging will be assessed to determine if accountability requirements are satisfied.

Some areas, such as the Severn River, continue to experience poor egg survivorship.<sup>3</sup>

Recreational harvest is unknown. It is believed to be within the recreational TAC, but estimates are unavailable.

### 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, III. 2014. Population assessment of yellow perch with special emphasis on head-of-Bay stocks. In Chesapeake Bay Finfish and Habitat Investigations. Maryland Department of Natural Resources, Federal Aid Annual Report, F-61-R-9. Annapolis, Maryland.

<sup>3</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, 1998-2013<sup>2</sup>

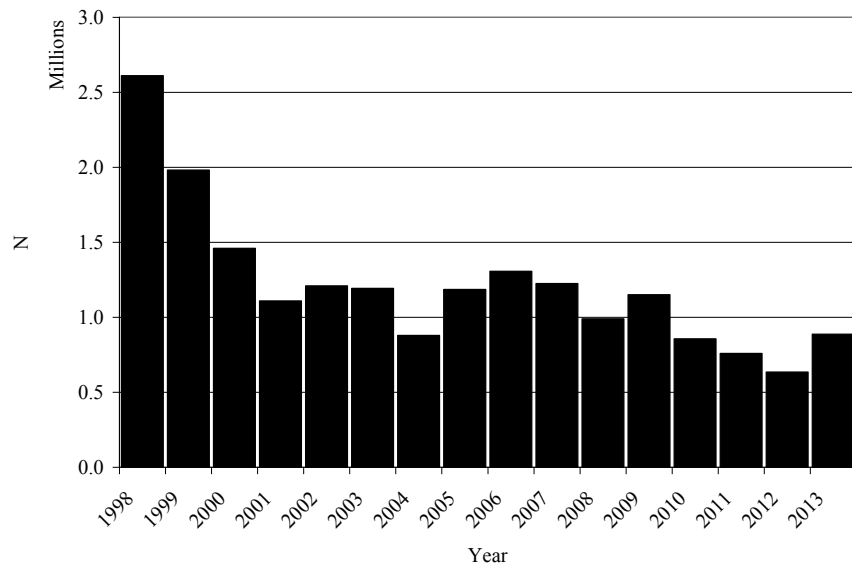


Figure 2. Estimated biomass of Upper Chesapeake Bay yellow perch, 1998-2013<sup>2</sup>

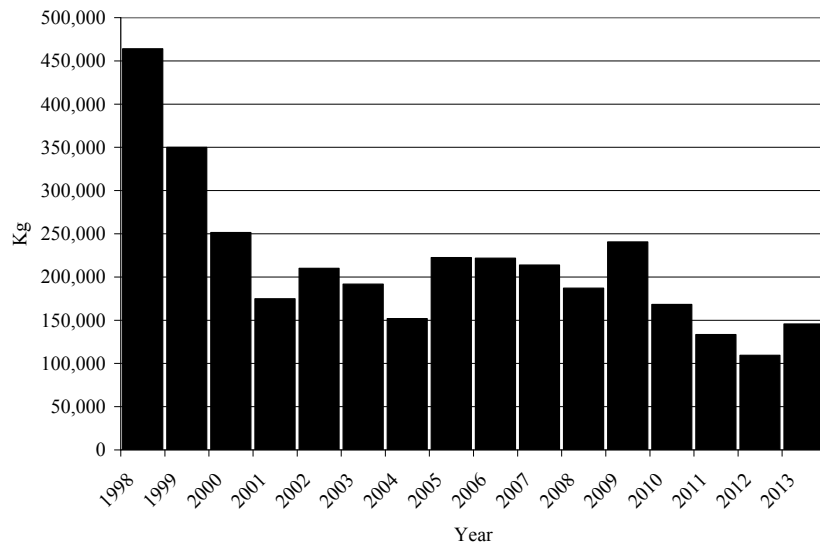


Figure 3. Instantaneous fishing mortality (F) estimates for Upper Chesapeake Bay yellow perch, 1998-2013.<sup>2</sup>

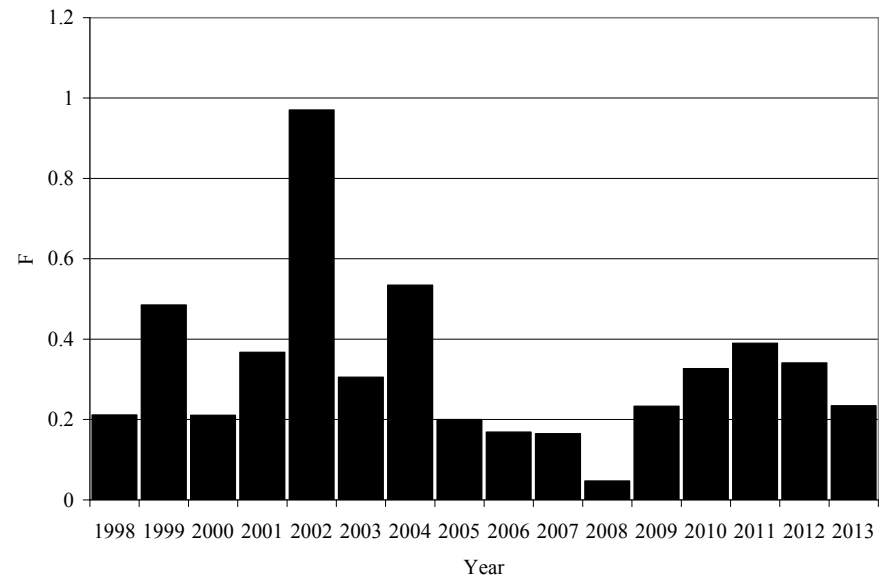


Figure 4. Yellow Perch recruitment estimates for Upper Chesapeake Bay, 1998-2013 with long-term average line.<sup>2</sup>

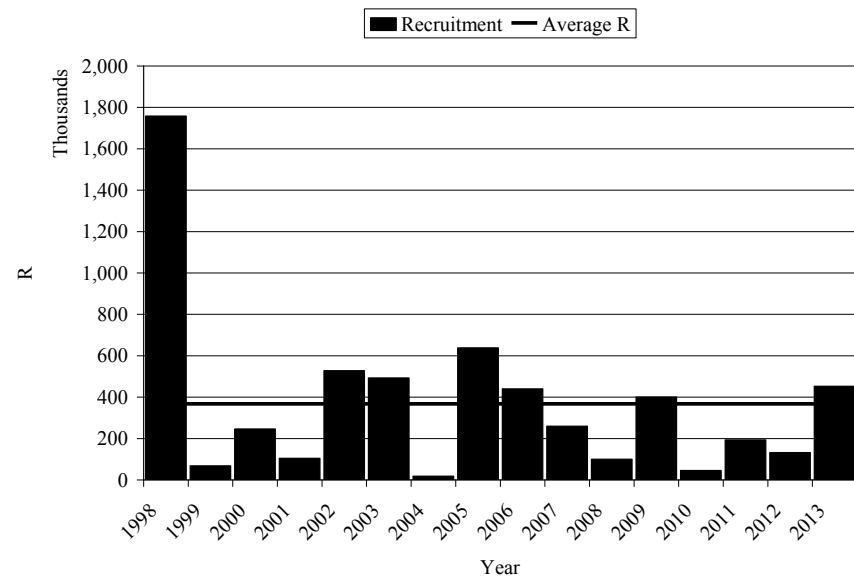


Figure 5. Maryland commercial yellow perch harvest by region, 2012

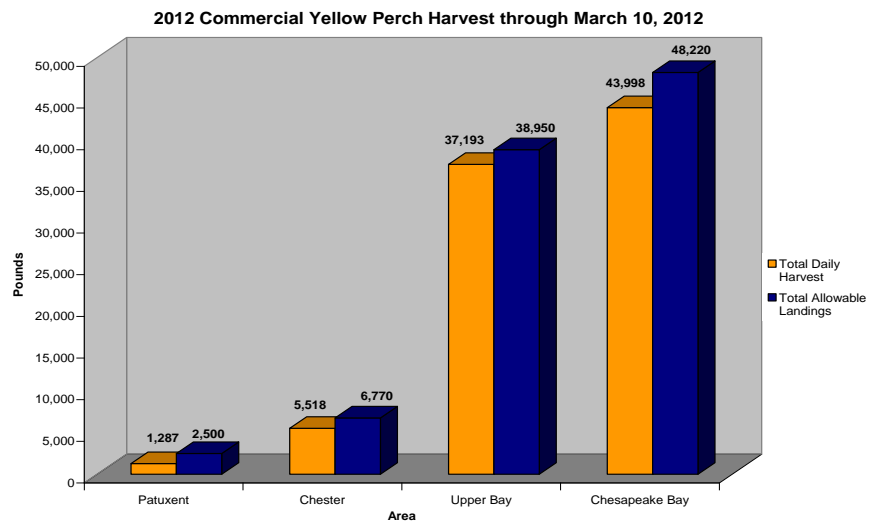


Figure 6. Maryland commercial yellow perch harvest by region, 2013

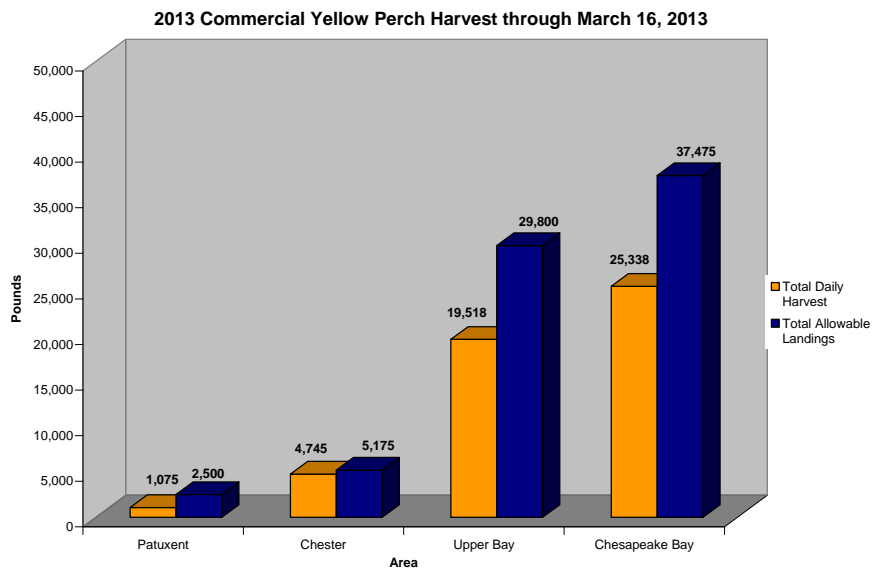


Figure 7. Maryland Commercial Yellow Perch Harvest by Region, 2014

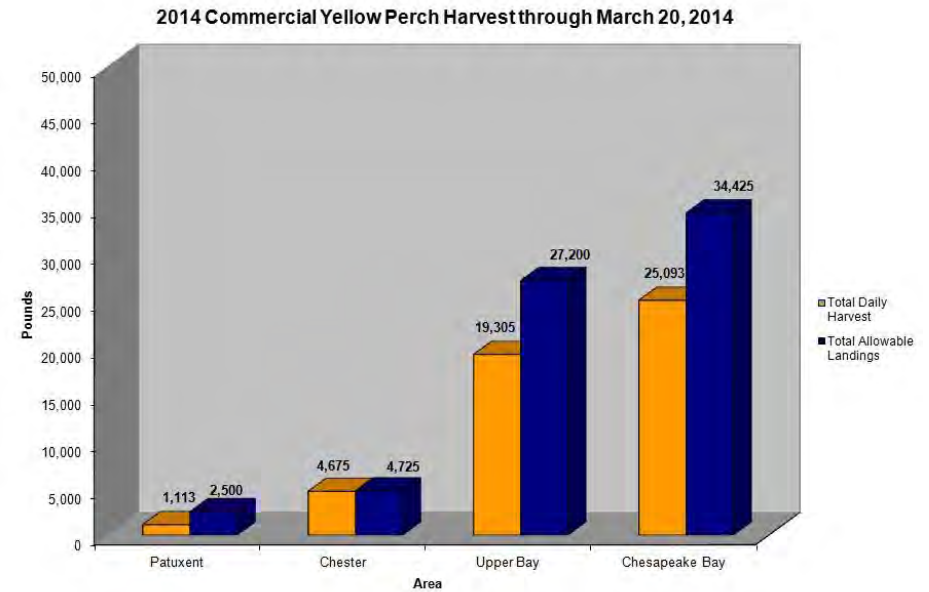
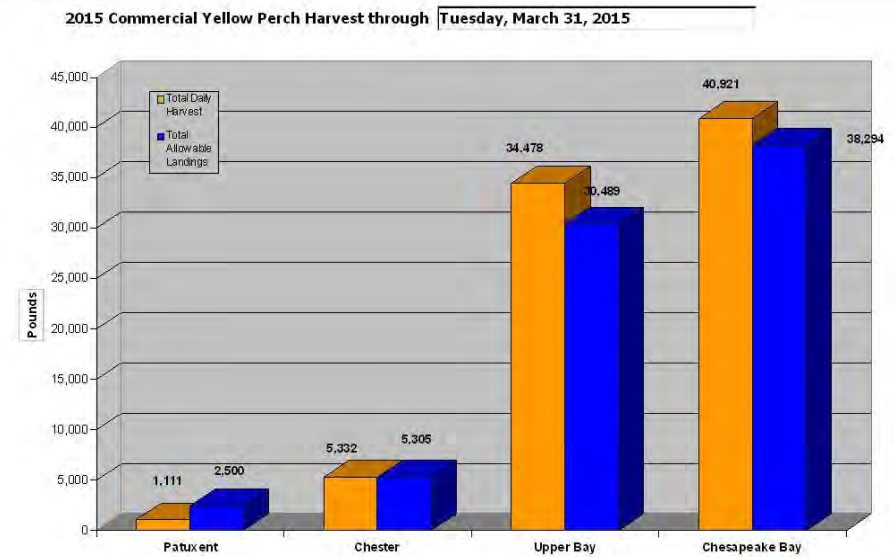


Figure 8. Maryland Commercial Yellow Perch Harvest by Region, 2015



<b>2002 Maryland Tidewater Yellow Perch Fishery Management Plan Implementation Table</b> (updated 09/2015)			
<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 development.
	2) Initiate a Severn River Ecosystem study that focuses on life history stage analysis to assess the effects of	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

2002 Maryland Tidewater Yellow Perch Fishery Management Plan Implementation Table (updated 09/2015)			
Section	Action	Date	Comments
	degraded habitat on stock abundance.		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. <b>The table is no longer used.</b>
	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 Watershed Restoration Action Plans and evaluate five watersheds annually.	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 fish samples and also evaluating disease. The Corsica River Project has been underway since 2005.



2002 Maryland Tidewater Yellow Perch Fishery Management Plan Implementation Table (updated 09/2015)			
Section	Action	Date	Comments
	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	Working with tributary teams and local riverkeepers but the scope of work should be broadened. 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>5306</b> pounds and the Patuxent River quota was 2500 pounds. Improved catch reporting included daily call-ins, verified by tagging. These measures were implemented in 2009 to improve accountability and have continued.
	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.

<b>2002 Maryland Tidewater Yellow Perch Fishery Management Plan Implementation Table</b> (updated 09/2015)
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Section	Action	Date	Comments
	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.

<b>2002 Maryland Tidewater Yellow Perch Fishery Management Plan Implementation Table</b> (updated 09/2015)			
<b>Section</b>	<b>Action</b>	<b>Date</b>	<b>Comments</b>
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 Committees 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.
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	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. The information provided by anglers in 2012 showed a decrease in the catch per angler hour (CPAH). Shoreline anglers reported the same CPAH as in 2010 and 2011, while boat anglers reported lower catch. Anglers exceeded average reported catches in the Bush, Wye, Northeast, Susquehanna, Patuxent, Chester, and Middle Rivers. 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.
Stock Status	19) Continue to sample commercial and recreational harvest of yellow	On-going	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

<b>2002 Maryland Tidewater Yellow Perch Fishery Management Plan Implementation Table</b> (updated 09/2015)			
<b>Section</b>	<b>Action</b>	<b>Date</b>	<b>Comments</b>
MD DNR will monitor yellow perch stocks in representative areas of the	perch and collect basic biological data. Additional biological data may indicate changes in the status of the stocks and require additional management measures.		periodically assess stocks. Upper Chesapeake Bay populations <b>decreased in 2011 and 2012 but increased in 2013. Recruitment has been under the long-term mean but increased in 2013.</b>
Chesapeake Bay in order to assess yellow perch stock status. Assessment and	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.	2003	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.
management efforts will be focused on areas already under special management measures, i.e., closed areas.	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.	2001 2005	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).
	22) Evaluate additional fishery-independent indicators of stock status, such as the trawl survey in the upper Bay.	On going	Current estimates of stock status are based on data from the upper Bay and Choptank.
	23) Review and evaluate yellow perch monitoring efforts biannually. Recommend changes in monitoring and protocol necessary to implement the yellow perch FMP.	2002 and even years thereafter	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.
Yellow Perch Outreach  MD will continue outreach efforts to engage fishing and	24) Utilize volunteers from the recreational fishing sector, such as the Coastal Conservation Association or watershed community associations, to obtain recreational data in areas not sampled by the MD DNR Multispecies	On-going	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 viewed at:

## 2002 Maryland Tidewater Yellow Perch Fishery Management Plan Implementation Table (updated 09/2015)

Section	Action	Date	Comments
non-fishing communities in stewardship of the yellow perch resource in tributary basins.	<p>Project. Explore the use of volunteer recreational survey using the web similar to the recreational survey implemented for striped bass.</p> <p>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.</p> <p>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.</p> <p>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><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  
 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

**2014 Maryland FMP Report (July 2015)**  
**Section 23. Brook Trout (*Salvelinus fontinalis*)**

**Introduction**

One of Maryland's most enjoyable but historically least publicized fishery resource is the native brook trout fishery. Commonly called "brookies" by those who fish for them, the brook trout is one of the most beautiful freshwater fish in Maryland. Like the lake and bull trout, brook trout are a member of a group of fish known as charr - the English name given to all members of this genus. Brook trout are highly valuable to Maryland for their recreational, economic, cultural and biological values. According to a study in Pennsylvania (Green et al. 2006), which has a similar wild brook trout fishery, wild trout anglers spent an average of \$45 per day when fishing, contributing more than \$2 million annually to local economies through direct and indirect expenses from fishing trips.

Because of their habitat and survival requirements, brook trout are typically found in Maryland's more pristine and remote areas. Biologically they are considered an indicator species, representative of a whole suite of unique aquatic and terrestrial organisms that occupy and share habitat. The brook trout is an iconic symbol of clean water and healthy aquatic systems since it's unable to thrive in poor water quality or degraded habitat. The disappearance of brook trout serves as a warning about the health of our waters and watersheds, an aquatic "canary in the coal mine." The decline of brook trout populations in Maryland has been drastic. Based on an initial review completed by the Eastern Brook Trout Joint Venture (EBTJV) in 2006, brook trout have been eliminated from 62% of their historic habitat in Maryland. The remaining populations are considered reduced, occupying less than 10 percent of their historic range. 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 vast majority of habitat is on private land and a mix of private/public lands. Most wild 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 (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. A 2006 assessment of brook trout status in 1,443 subwatersheds (sixth level hydrologic unit) located in the Chesapeake Bay watershed, resulted in 226 subwatersheds (16%) being classified as Intact (brook trout present in >50% of the streams); 542 (38%) were classified as Reduced (brook trout present in ≤50% of the streams), and 290 (20%) were classified as Extirpated (brook trout no longer exist in the streams) (Hudy et al. 2008). In Maryland, only 3 watersheds were classified as Intact (2%); 47 classified as reduced (33%); and 83 classified as extirpated (57%). Additionally, an approach was developed that assists with identifying subwatersheds with the greatest potential for successful brook trout protection, enhancement or restoration actions (Hanson et al. 2014). In the Chesapeake Bay watershed there are 103 Intact subwatersheds and 43 Reduced subwatersheds that are assigned high priority scores (≥0.79) for potential restoration, only one is in Maryland.

A finer scale assessment of brook trout populations in the Chesapeake Bay watershed was recently (2012-2014)

completed by the EBTJV in an effort to provide natural resource managers with better tools for detecting population changes and setting conservation priorities. This assessment entailed determining wild brook trout occupancy at the catchment scale (basically a single stream scale) and 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 are separated by a dam, unoccupied warm water habitat, downstream invasive species, etc.) and are assumed to be genetically isolated. The assessment found that there were 3,608 “Wild Brook Trout Only” patches in the Chesapeake Bay watershed with 166 patches in Maryland (4.5%).

Anthropogenic impacts have been identified as the primary reason for the documented declines with increasing urbanization, deforestation, exotic species, and mining being identified as a few of Maryland’s most imminent threats. Likewise the future of Maryland’s brook trout remains uncertain in the face of increasing water temperatures in response to climate change, the development of Marcellus shale natural gas resources, and an ever-increasing human population.

### **Status of the Fishery**

The statewide angling regulation for brook trout is currently no closed season, two fish harvested per day, possession limit of four fish, and no minimum size. There is no commercial harvest or fishery for brook trout. There are several areas in the state with special regulations that are more restrictive than the general statewide regulation with the purpose of providing improved angling catch rates and the opportunity to catch large brook trout (Figure 1). These areas are described in the annually published 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 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 Inland Fisheries Division 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. Figure 3 shows the current brook trout distribution as of 2014.

### **Status of Brook Trout FMP Work Effort**

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 (*Action 11.1.1 Develop a monitoring schedule to insure that all brook trout populations statewide are sampled at least once every 3 years*). The initial sampling effort revealed that a 3 year rotation was not feasible so a new 5 year rotation was developed and initiated in 2014. 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 2014, staff were able to sample 71 of the scheduled 79 streams (90%). Since there was a limited time period for completing the sampling, streams that were not sampled in 2014 were added to the 2015 sampling schedule. Table 1 lists by river basin, the number of streams sampled and the number of brook trout collected.

A second recommended focus area from the FMP review process was developing 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 by all Inland Fisheries Division staff involved with brook trout sampling efforts.

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 Service 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.

### **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*. Staff is working with the EBTJV on the development of a management strategy for brook trout. This strategy will help guide restoration efforts in the Bay watershed to meet the Brook Trout Outcome and will be compatible with Maryland's BTFMP. Partners will be developing a biennial work plan with specific and measurable actions. Participants 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 continue to work with Trout Unlimited representatives, MD DNR Inland Fisheries staff, Carroll and Baltimore County natural resources staff, and the National Aquarium staff to develop and implement a brook trout restoration effort on a watershed scale for the upper Gunpowder River 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 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.

Brook Trout Program staff are working with the Maryland Department of the Environment's Abandoned Mine Lands Division on a watershed scale restoration effort within the Casselman River watershed. 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 are planned for 2015 - 2016. Water quality and brook trout monitoring will continue annually.

### **Issues of Concern**

Initial statewide brook trout population sampling completed in 2014 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 5 year sampling rotation is completed. Two major factors are likely responsible: 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 the 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 have applied for grant funding through the State Wildlife Grant (SWG) program to investigate if gill lice are present in Maryland brook trout populations. 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 determine whether or not a 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 DNR Brook Trout webpage lists sites and names of state and national groups that are working for brook trout conservation (<http://dnr2.maryland.gov/fisheries/Pages/brook-trout/index.aspx>).

## References

- Greene, R., R. Weber, R. Carline, D. Diefenbach, M. Shields, M. Kaufmann, R. Moase and B. Hollender. 2006. Angler Use, Harvest and Economic Assessment on Wild Trout Streams in Pennsylvania. Pennsylvania Fish & Boat Commission, Bellefonte, PA.
- Heft, A. A. (ed.), N. Butowski, D. Cosden, S. Early, C. Gougeon, T. Heerd, A. Heft, Johnson, A. Klotz, K. Knotts, H. Lunsford, J. Mullican, K. Pavol, S. Rivers, M. Staley, M. Toms, P. Kazyak, R. Klauda, S. Stranko, R. Morgan, M. Kline and R. Hilderbrand. 2006. Maryland Brook Trout Fisheries Management Plan, Maryland Department of Natural Resources, Fisheries Service, Inland Fisheries Management Division, Annapolis, MD.
- Hudy, M, Teresa M. Thieling, Nathaniel Gillespie, and Eric P. Smith. 2008. Distribution, Status, and Land Use Characteristics of Subwatersheds within the Native Range of Brook Trout in the Eastern United States. North American Journal of Fisheries Management 28 (4):1069 - 1085.
- Mitro, Matthew G., Sue Marcquenski, Kari Soltau, and Paul Kanehl. 2014. Gill Lice as a Proximate Cause of Brook Trout Loss Under Changing Climatic Conditions. Proceedings of the Wild Trout Symposium XI, West Yellowstone, MT, pages 200-209.
- Sell, Matthew and Alan A. Heft. 2014. Brook Trout Program Field Sampling Manual. Maryland Department of Natural Resources, Fisheries Service, Inland Fisheries Division, Annapolis, MD.
- Whiteley, A. R., Jason A. Coombs, Mark Hudy, Zachary Robinson, Amanda R. Colton, Keith H. Nislow, and Benjamin H. Letcher. 2013. Fragmentation and patch size shape genetic structure of brook trout populations. Canadian Journal of Fisheries and Aquatic Sciences 70(5): 678-688.

Table 1. 2014 Statewide Brook Trout Sampling Effort by River Basin, as per the MD DNR Brook Trout Fisheries Management Plan.

<b>Year</b>	<b>River Basin</b>	<b># Streams Sampled</b>	<b>Total Brook Trout Collected</b>
2014	GU	3	3
2014	PA	11	0
2014	MP	8	193
2014	UNB	25	1692
2014	UP	3	9
2014	WC	2	16
2014	YG	19	468

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.



Figure 2. Historic Distribution of Brook Trout in Maryland by subwatersheds.

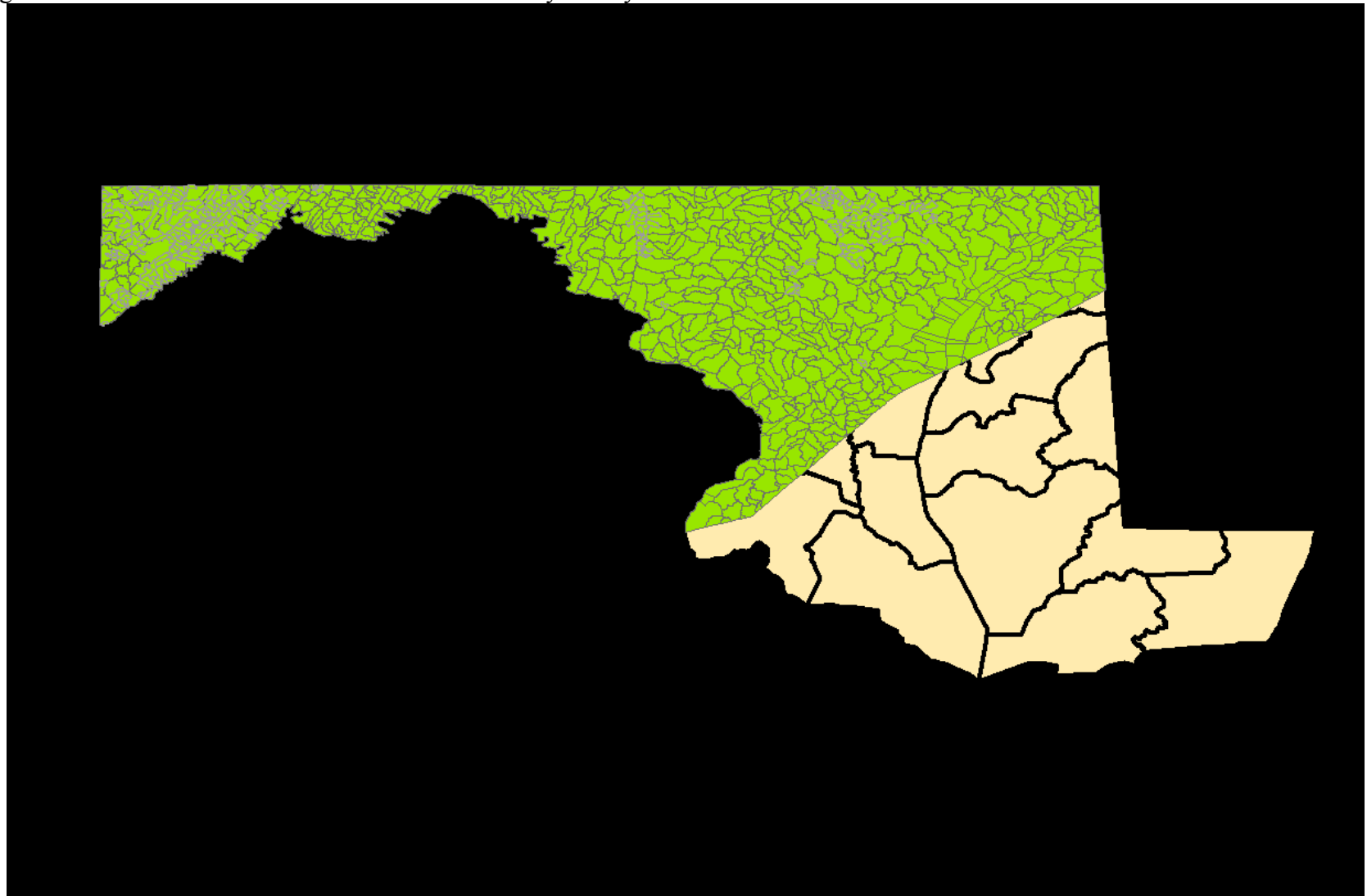


Figure 3. Current (2014) Distribution of Brook Trout in Maryland by subwatersheds.

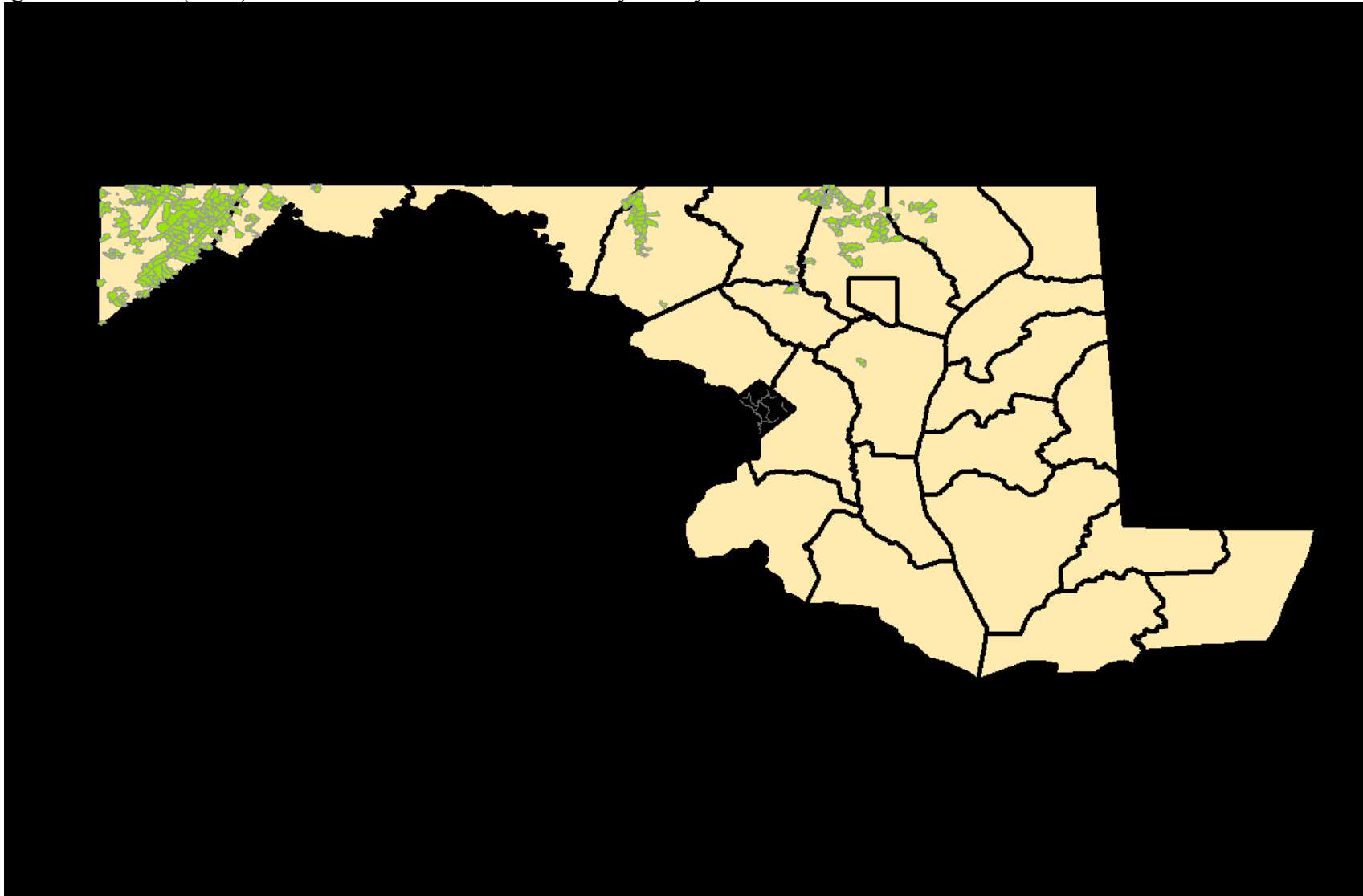




Figure 4. Maryland Brook Trout Program Webpage.



**2006 Maryland Brook Trout Fishery Management Plan Implementation Table** (updated 7/2015).

**Boldface text** indicates newly updated information. **Light yellow background** indicates priority strategies and actions for the upcoming year(s).

**Light turquoise background** indicates strategies and actions that are functionally complete.

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

efforts would have long term potential for long term restoration.			2016.
<b>Strategy 3.1</b> Identify and protect at- risk brook trout populations.	<b>Action 3.1.1</b> Determine at- risk populations by statewide fisheries region using current data, and then by using GEP index information once it becomes available.	<b>In progress Projected completion 2016</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.	<b>Pending</b>	Requires completion of 3.1.1.  <b>The priority list will be generated when the GEP map has been developed.</b>
<b>Strategy 4.1</b> Develop a brook trout management plan for the Savage River watershed upstream of the Savage River dam. This plan will be used as a blueprint for developing plans in other brook trout watersheds.	<b>Action 4.1.1</b> Develop a comprehensive Geographic Information System (GIS) database detailing land ownership and usage within the upper Savage River watershed, incorporating summer water temperatures and brook trout population abundance from the Maryland DNR's Inland Fisheries and MBSS databases.	2007 Continue	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.</b>
	<b>Action 4.1.2</b> Utilizing the GIS analysis, identify areas within the S R 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.  <b>Final report is being drafted. Report will include a prioritized list of impacted brook trout populations.</b>



	<b>Action 4.1.3</b> Identify areas within the Savage River that need additional conservation.	2007 Continue	Requires completion of 4.1.1.  <b>Final report is being drafted. Report will identify focal conservation areas for watershed associations.</b>
<b>Strategy 4.2</b> Present the information and recommendations in the BTFMP to the MD DNR Western Regional Team to solicit input and support.		2007 <b>Discontinued</b>	No action was formulated in the BTFMP.  MD DNR Western Regional team was disbanded in 2007. Strategy is no longer practicable and is not being pursued.
<b>Strategy 4.3</b> Develop a watershed-wide strategy for protecting habitat, Especially buffer protection and restoration in impacted headwater streams.		<b>Pending</b>	No action was formulated in the BTFMP.  <b>Action: Create a stream buffer and land use/land cover map to locate areas of concern. Threshold for negative impacts is 2% impervious surface. The map will incorporate existing state and federal land preservation and buffer strip restoration programs.</b>  <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.  <b>Action: Create a network of temperature loggers to monitor thermal impacts to streams.</b>  Instream water temperature is monitored annually in cooperation with MBSS and the Izaak Walton League. Each Inland Fisheries Region annually rotates 6 to several dozen

			temperature loggers among priority streams. There are three additional long-term monitoring sites. <b>Water temperature database development is planned to begin in 2014.</b>
<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.	<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.	2007  2007 – 2013 <b>On-going</b>	State fishery regulation was enacted to protect upper Savage River brook trout: COMAR 08.02.11.01.  Annual monitoring of trout population response is ongoing through at least 2013.  <b>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.</b>
<b>Strategy 4.6</b> Promote and encourage the development of a citizen-based Savage River watershed advocacy organization. MD DNR will provide technical support as needed.		2006 Completed	No action was formulated in the BTFMP.  Savage River Watershed Association (SRWA) formed and has partnered with DNR in protecting and restoring the watershed. SRWA framework is being used as a model for other watershed associations. Watershed associations will assist with FMP action implementation.

<b>Objective (Strategy) 5</b> Encourage riparian buffer habitat preservation and restoration.	<b>Action 5.1.1</b> Develop a list of target watersheds in Maryland that could benefit from the CREP program, rank each system based on brook trout population status (best to worst), headwater agricultural impact, and size and connectedness of the system.	Pending	Implementation requires completion of Strategy 4.3. Implementation will aid with at-risk population targeting.
	<b>Action 5.1.1</b> Using the list generated from Action 5.1.1, actively recruit and enroll farmers from the targeted watersheds into the CREP program.	Pending	Dependent on the completion of Action 5.1.1
	<b>Action 5.1.2</b> Create a list of the Federal, state, and NGO conservation and restoration programs that are available to landowners; inform Regional Fisheries managers and biologists of these programs so they can work with private landowners to improve land use and water quality.	Pending	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	This is the number 4 priority action.  <b>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>
		2011 On-going	<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</b>

			<b>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.
<b>Strategy 7.1</b> Develop statewide restoration guidelines for restoring extirpated brook trout populations.	<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.	<b>Pending</b>	This is the number 3 priority action.  <b>Implementation is dependent on 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 is scheduled for 2015 - 2016.</b>

	<b>Action 7.1.2</b> Incorporate a genetic component into the guidelines to direct brood fish selection location.	2010 - 2013  2014 Continue	UMCES Appalachian Lab has collected and inventoried brook trout genetics in all watersheds.  <b>Laboratory work and analysis scheduled for winter 2014.</b>
<b>Objective (Strategy) 8</b> Complete genetic inventory of discrete brook trout populations.	<b>Action 8.1</b> Secure funding (an estimated \$10,000) to complete the statewide brook trout genetic inventory. The USFWS State Wildlife Grant Program and EBTJV are two possible funding sources for completing this work.	Pending	Funds are being sought to complete the genetic inventory. <b>Partially completed in 2014, if funding secured will be fully 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	Strategy 9.1 aligns with Strategy 6.1.  Inland Fisheries advised the MD Taskforce on Fisheries Management and regularly updates the SFAC as new research, monitoring, and regulation information becomes available.
	<b>Action 9.1.2</b> Post the BTFMP on the DNR Fisheries Service webpage and request on-line comments on conservation measures as part of the regular review of the BTFMP.	2006 Continue  <b>Completed</b>	Strategy 9.1 aligns with Strategy 6.1.  BTFMP posted on line. Trout fishing information is available on the DNR Fisheries Service web site.  <b>A DNR Brook Trout webpage 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</b>



	<b>Action 11.1.2</b> Coordinate brook trout sampling efforts between Inland Fisheries and the MBSS to maximize efficiency. Where possible, reduce the number of sites Inland Fisheries needs to monitor. Fisheries should focus on monitoring streams for recreational fisheries, MBSS on sampling headwater, privately owned streams.	Began 2006 Formalized 2010 <b>On-going</b>	Inland Fisheries and MBSS have increased sampling coordination. <b>Action will continue annually.</b>
<b>Strategy 12.1</b> Develop a standardized sampling protocol for monitoring brook trout populations that includes: MBSS water quality and habitat data collection components; establishment of permanent sampling stations; number of stations per stream length; and fish collection methodology.	<b>Action 12.1.1</b> Create a sampling standardization committee with members from Inland Fisheries and MBSS to develop the sampling methodology.	2006  2011  <b>Pending</b>	MBSS sampling protocol informally adopted for portions of the Savage River.  MBSS sampling protocol requires more discussion before being implemented statewide. Integration of a multi-layer sampling protocol is being considered as a modification to the MBSS sampling protocol. <b>Implementation will be in stages with earliest start in 2015.</b>
	<b>Action 12.1.2</b> Conduct training with Inland Fisheries staff to implement the standardized methodology.	  2011	Completion of Action 12.1.1 is required.  Some informal training has been done to date.
	<b>Action 12.1.3</b> Collect summer water temperatures with in-stream temperature.	2007 <b>On-going</b>	Strategy 12.1 aligns with Strategy 4.4. Includes Inland Fisheries efforts and data from MBSS.
<b>Strategy 13.1</b> Develop a database that incorporates, and where possible, standardizes, the historic and current statewide brook trout information available from the Inland Fisheries, the MBSS,	<b>Action 13.1.1</b> Establish a data management group that includes a representative from each of the major groups (DNR, UM, and MBSS) to standardize the data collection format and create a statewide database of brook trout information.	2009 Completed <b>Continue as needed</b>	Action 13.1.1 is the number 2 priority (along with Action 3.1.3).  <b>Informal data management group has been established and convenes as needed.</b>

and the University of Maryland monitoring programs.	<b>Action 13.1.2</b> Identify other sources of brook trout data, such as MD Bureau of Mines, additional academic institutions, and Federal agencies, and incorporate the data into the statewide format.	<b>Completed</b>	Requires completion of Action 13.1.1.
	<b>Action 13.1.3</b> Develop a GIS database describing 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

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



## **2014 Maryland FMP Report (July 2015)**

### **Section 24. Largemouth Bass (*Micropterus salmoides*) in Maryland Tidewater**

Stock assessments for largemouth bass in tidal freshwater rivers of Chesapeake Bay watershed are performed each year and were completed for 2014. In general, the status of most tributary populations was unchanged or exhibited improvements from previous assessments. For the heavily fished Potomac River population, however, the current status warranted additional investigation that was performed throughout 2013 and 2014. Statewide regulations are currently being reviewed and additional ones are being considered. In 2015, greater restrictions on handling fish were imposed on tournament anglers via the permit issued to tournament directors. These restrictions included directors ensuring that bags containing black bass did not leak and had water in them when transporting fish. Three large fishing areas within Potomac River and three areas in the upper Chesapeake Bay are being considered as tidal, catch-and-return areas.

Stock assessments and management actions are described in the Fishery Management Plan (FMP) for Largemouth Bass in Maryland Tidewater (January 2014). The goal of the 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. When necessary, management actions are recommended to improve population structure and ultimately achieve reference points. The plan was developed in concordance with the Standard Operating Procedure (SOP) for the Tidal Bass Program (TBP) survey of largemouth bass. 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 annual reviews are reports posted on the TBP website:

<http://dnr2.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 not legal in Maryland and the recreational fishery includes pass-time fishing, live-release competitive sportfishing, and charter boat guiding. Adults are typically caught and released by anglers throughout the year. 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**

The largemouth bass stocks within tidal rivers of the Maryland portion of the Chesapeake Bay watershed were assessed in 2014 and the assessment was internally peer-reviewed in Spring 2015. The review team concluded that the Potomac River stock had undergone greater than average levels of annual mortality in 2008 and 2009, but that those levels are

currently normal or below average. In addition, habitat loss has greatly affected the Potomac River and upper Chesapeake Bay stocks. Habitats have been steadily, but slowly improving since 2011 when tropical storms created conditions that lessened the distribution of submerged aquatic vegetation (SAV). Since habitat loss has affected populations within the Potomac River and upper Chesapeake Bay watershed, there are two actions that the TBP is taking. First, as noted in the FMP, the TBP is continuing to monitor changes in the distribution of SAV and continuing to identify important habitats for promoting population growth of these stocks. Second, the TBP may propose both educational outreach and regulation changes to help minimize fishing mortality and restrict movement of fish from important habitats that promote population growth of stocks

The stocks in both the Potomac River and upper Chesapeake Bay demonstrated improved reproduction over previous years. Indices for distribution of juveniles are above the average management targets for the stock; those for catch, however, remain below average. Stocks in other tidal rivers have also demonstrated improved reproduction and catches of adults are mostly unchanged. Stocks from the Patuxent River, Marshyhope Creek, Wicomico River, and Pocomoke River are less fished than the upper Chesapeake Bay and Potomac River. While they each represent unique demographics that are reflective of unique habitats, recent annual differences in catch, age structure and stock size have been minimal. Thus, management targets for these stocks are within acceptable reference points noted in the FMP.

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

The reported number of largemouth bass caught, weighed, and released by anglers during sport fish tournaments was 19,678. Currently, 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 will be reportable for stocks in specific Maryland tidal rivers of the Chesapeake Bay watershed.

There is a minimum size limit of 12-inches for largemouth bass between June 15 and March 1 in tidewater. This minimum size limit essentially prevents smaller or younger fish from being harvested (~ 1 % of anglers) or being moved around and experiencing handling stress during competitive sportfishing tournaments. There currently 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 nest 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.

## Biological Reference Points

Reference points in the 2014 Tidal Bass FMP were updated to improve management of targeted fisheries (see Table 1).

In addition, an index and reference points to reflect changes in age 1+ largemouth bass were included for targeted rivers.

## Focus Areas 2015-16

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) Determine the appropriate management units of populations using genetic markers, particularly in the upper Chesapeake Bay. The genetic relationship among individuals collected from several streams in the upper Chesapeake Bay should be determined in the next 10 years by identifying a lab capable of performing the work and requesting appropriate funding.
- 4) 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.
- 5) Determine economic impact of the fishery using statewide angler creel surveys and determining the economic impact of tournaments.
- 6) Develop a forage fish index by increasing the quality of data collected on forage fish during the tidal bass survey, which is done by optimizing survey methods, and calculating a forage fish index in 2015 with existing data.

**Fishery Management Plan for Largemouth Bass in Maryland Tidewater Implementation Table (updated 6/15)**

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 2014	Survey completed for 2014 (see Table 2 and Table 3 for survey results).
	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	Jan - Feb 2015	Black Bass Annual Review completed, placed online( <a href="http://dnr2.maryland.gov/fisheries/Pages/bass/reports.aspx">http://dnr2.maryland.gov/fisheries/Pages/bass/reports.aspx</a> ) and disseminated among anglers and tournament directors. Federal Aid Report completed, but not provided on-line.
	1.1.3 Discuss indices with members of partner agencies, organizations, and universities to evaluate causes or consequences of	Feb 2015	Action taken during the black bass roundtable included partner agencies and stakeholders. Voluntary restrictions in creel limit have been adopted by some tournament organizations. Catch-and-return areas will be proposed in 2015 to help maintain spawning stock in productive bass areas.

	changes in the indices		
	1.1.4 Develop new indices, such as angler satisfaction indices, or adjust existing indices as needed	Jun 2015	Indices adjusted to reflect new baseline dataset for Potomac River and for Patuxent River.
	1.1.5 Improve sharing of data with other Department biologists and programs, such as the Blue Infrastructure Initiative and GIFS	Mar - Jun 2015	Reviewed and critiqued aspects of GIFS that will improve use of the system.
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		No work was done on this action between June 2014 and June 2015.
	1.2.2 Discuss the scope of data collection with regional managers and directors within Inland Fisheries so that data collection is determined to be sufficient for meeting the demands of the Department	Aug 2014	The first caucus of regional biologists was held to discuss problems with the Tidal Bass Survey and identify resolutions. Data collection was improved to objectively and consistently account for the occurrence of species other than largemouth bass.

	1.2.3 Allow internal and external peer-review of data collection and analysis to refine methods based on expert opinions	Aug 2014 - Jun 2015	Two publications were externally reviewed, critiqued by experts, and ultimately accepted for publication; each publication contained information on Tidal Bass Survey collection methods and analysis of catch data. Survey methods are adequate for meeting objectives of this Fishery Management Plan.
	1.2.4 Deliver technical reports to regional managers, other internal reviewers, and reviewers of refereed journals for review of methods and data analysis		No work was done on this action between June 2014 and June 2015.
	1.2.5 Assess and/or improve sampling equipment for efficiency	Jun - Aug 2014; November - December 2014	During summer, work was performed to check the effectiveness of electrodes aboard the southern region electrofishing boat; During November/December, QA/QC checks performed on dataset after data were entered into the Inland Fisheries database, GIFS. Datasheets were edited and updates to GIFS were suggested to improve data entry from data sheets.
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	Jun 2014 - Jun 2015	Reference points were re-evaluated and readjusted in the 2014 Tidal Bass FMP; reference points were used to assess population status in winter 2014 (see Table 1).

	2.1.2 Obtain additional data for populations surveyed less than 10 years and develop reference points	Sep - Oct 2014	Data were collected from Patuxent River to complete a base-line, 10 year dataset
	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	Dec 2014	Reference points from the literature (see Table 1) were used to evaluate populations from rivers that do not have a reference dataset of at least 10 years; these evaluations were provided in the 2015 Federal Aid Report.
	2.1.4 Adjust reference points as additional data are acquired for inter-correlations and importance in reflecting the status of populations		No work was done on this action between June 2014 and June 2015.

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 2014	Indices were compared to 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	Nov 2014 - Jun 2015	Management actions were evaluated to help improve the fishery of Potomac River and protect fishery of the upper Chesapeake Bay. In addition to public scoping and meetings with other jurisdictions, spatial modeling was conducted to determine the influence of catch-and-return areas. Additional strategies such as targeting black bass anglers with conservation materials and developing reef habitat in the Potomac River are also on-going.
	2.2.3 Conduct population modeling to determine if and how management actions will influence indices and the population	Dec 2014 - Jan 2015	Spatial modeling was conducted to determine how catch-and-return areas would influence populations of largemouth bass in the Potomac River and upper Chesapeake Bay



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	Jun 2014 - Jun 2015	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.
	2.3.2 Promote registration and activity reporting of tournament directors, for communication and compliance of permit restrictions	Mar 2015	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 itself (i.e., reporting requirements, no leaking bags).
	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 2015	A stakeholder roundtable meeting was held at the Chesapeake Bay Foundation. 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> .
	2.3.4 Perform angler creel surveys, as necessary, to determine angler satisfaction, catch, and	Jan - May 2015	A statewide creel survey was developed and issued to provide angler exploitation indices; additional datasets were evaluated for their utility (Chesapeake Catch, Angler's Log, MRFS); angler exploitation indices and reference points have not

	harvest rates by recreational anglers		yet been fully developed.
	2.3.5 Produce studies and provide guidance on live well operating procedures to reduce mortality of Largemouth Bass	Nov 2014	Reviewed and updated guidelines on live release and handling tips in the Maryland Fishing Guide 2015.
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		No work was done on this action between June 2014 and June 2015.
	3.1.2 Ensure that the most informative variables are being measured during the Tidal Bass Survey by conferring with MD NDR Fisheries Habitat and Ecosystem Program		No work was done on this action between June 2014 and June 2015.
	3.1.3 Use a habitat suitability index and consult anglers and regional managers to identify habitats important for the spawning success and	Jun 2014 - Jun 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. A spatial

	growth of Largemouth Bass		map illustrating these coves is available via the Tidal Bass Program website.
	3.1.4 Consult published literature and experts to help identify valuable habitat for spawning success and growth of Largemouth Bass	Jun 2014 - Jun 2015	Published literature on spawning habitat for largemouth bass was summarized in an upcoming publication in fall 2015 in American Midland Naturalist.
	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.
	3.1.6 Consider the effects of climate change on Largemouth Bass habitat and develop adaptive management to address possible changes	Jun 2014 - Jun 2015	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.
	3.1.7 Utilize the proposed Climate Sensitive Areas for use in land-use planning and increased protection of vulnerable habitats especially in regards		No work was done on this action between June 2014 and June 2015.

	to Largemouth Bass habitat		
	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		No work was done on this action between June 2014 and June 2015.
	3.1.9 Write letters on official letterhead to stakeholders or on behalf of stakeholders to acknowledge and promote the significance of the fishery		No work was done on this action between June 2014 and June 2015.
	3.1.10 Promote a level of imperviousness that is lower than 10% of the drainage		No work was done on this action between June 2014 and June 2015.
	3.1.11 Ensure that natural variability in stream discharge is maintained by		No work was done on this action between June 2014 and June 2015.

	encouraging "smart growth" and limiting channelization		
	3.1.12 Encourage lower levels of nitrogen and phosphorus waste from entering waterways via non-point and point sources	Apr - Jun 2015	Electronic communication with Chesapeake Bay Trust, Wicomico River Trust, and Salisbury University was prompted to encourage greater mitigation of nitrogen and phosphorus pollution into the upper Wicomico River. A Wicomico Creek-watchers report was issued in June and provided a progress report. Both nitrogen and phosphorus have declined in abundance and their source is tied to stormwater rather than the wastewater treatment plant. The City of Salisbury is exerting effort to obtain money and solutions for stormwater management.
	3.1.13 Proactively work through a comprehensive plan renewal process to identify and protect important habitat features		No work was done on this action between June 2014 and June 2015.
	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	Sep - Oct 2014	Data for invasive snakeheads were collected as part of the Tidal Bass Survey; these monitoring data were presented at a USFWS interagency taskforce to discuss impacts of snakeheads. 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

	would affect the Largemouth Bass fishery		River. Impacts of blue catfish on resources used by largemouth bass are being evaluated.
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	Jan-Mar 2014; Nov 2014	The addition of habitat structures to spawning coves was evaluated; however, these additions were not effective; work indicates natural habitat (such as submerged aquatic vegetation (SAV)) is important for productivity. 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 2014. It was decided to continue monitoring the issue and to annually discuss changes in the fishery.

	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.
	3.2.3 Tidal Bass Program staff may work with Artificial Reef Program staff (MARI) as needed to develop reefs and other artificial habitat for Largemouth Bass	Feb - Jun 2015	An artificial reef ball project is proposed, partially funded, and may be permitted for Smoots Bay (National Harbor). This project should be completed in 2016. It will compensate for grass lost from the area in the last decade.

	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 2014 and June 2015.
	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 2014 and June 2015.
	3.2.6 Promote low sedimentation of streams		No work was done on this action between June 2014 and June 2015.
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	Dec 2014	A public meeting was held with the Potomac River Fisheries Commission to allow the general public to voice concerns regarding the Potomac River fishery.



	4.1.2 Evaluate the adequacy of current regulations in supporting the sustainability and quality of the fishery	Jun 2014 - Jun 2015	Current regulations were evaluated by MDDNR staff to determine what changes may be made to improve the sustainability of the Potomac River and upper Chesapeake Bay fisheries. Catch-and-return areas were suggested, as well as reduced creel limits during the summer. Both of these actions, are being considered by MDDNR. A reduced creel during summer is already voluntarily implemented by some organizations. A limit on the number of tournaments is not likely because the infrastructure implement a limit does not exist for other States that share borders with Maryland waters.
	4.1.3 Establish relationships between fishery independent data, angler catch, and angler satisfaction		No work was done on this action between June 2014 and June 2015. Data regarding angler satisfaction will be collected in 2016.
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	Jun - Oct 2014; Jun - Jul 2015	In June, largemouth bass were released to the Potomac River, where populations have suffered recruitment declines. In October, juveniles were released to Gunpowder River, where habitat conditions limit the reproduction of largemouth bass. Largemouth bass were stocked in Mattawoman Creek in June 2015 and in the Patuxent River in July 2015.
	4.2.2 Generate a stocking strategy with an objective to either support or improve the	Jun - Oct 2014	Based on the hatchery assessment performed in summer 2014, it was determined that advanced fingerlings (6 - 10") should be released to the Gunpowder River and fingerlings (2 - 4") should

	fishery		be released to the Potomac River.
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	Jun-Oct 2014; Dec 2014	Provided funding and in-kind support for research on keeping adult largemouth bass alive in live-wells at Mississippi State University. In December, clarified requirements on existing permits for tournament directors that will help reduce handling stress on adults. It is also being considered to target black bass anglers with current information on reducing handling stress of bass that anglers intend to keep alive. Catch-and-release areas are also being proposed to help promote the survivorship of older, larger fish.
	4.3.2 Improve and promote angler awareness that increases survivorship of Largemouth Bass during catch-and-release fishing		No work was done on this action between June 2014 and June 2015.
	4.3.3 Engage in meaningful studies that benefit the angling community by		No work was done on this action between June 2014 and June 2015.

	informing them on methods to improve survivorship		
	4.3.4 Enforce restrictions on holding more than 5 bass/angler/day by specially permitted release boat captains	Jun - Oct 2014; Apr - Jun 2015	Tournaments with release boats were attended by staff. 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.
	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	Feb 2015	Transportation of largemouth bass among river systems was discouraged at the annual stakeholder meeting.
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	May-Jun 2014	Worked with intra-departmental personnel on an angler access map that helps direct anglers to fishing spots. Promoted the map via the Allan Ellis radio program in summer 2014.

	Bass fishery should be provided		
	4.4.2 Determine crowding of angler access points and mitigate, when possible		No work was done on this action between June 2014 and June 2015.
	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 2014 and June 2015.
	4.4.4 Create and/or advertise new angler access points to the tidewater Largemouth Bass fishery		No work was done on this action between June 2014 and June 2015.
	4.4.5 Promote small craft and shore based angler access		No work was done on this action between June 2014 and June 2015.
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	Jun-Aug 2014	Incentive programs, such as the statewide invasive species record, were promoted to help control and manage invasive species (Northern snakehead).
	5.1.2 Monitor, protect or enhance the	Aug 2014	A monitoring strategy was implemented within the Tidal Bass Program for documenting the

	availability of prey for Largemouth Bass by partnering with other agencies or other programs within MD DNR		availability of prey. Partnering divisions also provide data from the Maryland Biological Stream Survey and Juvenile Finfish Seine Survey. There was no work toward protecting or enhancing the availability of forage.
	5.1.3 Control or limit pollution sources to impaired waterways in order to improve the sustainability of Largemouth Bass populations	Apr - Jun 2015	Progress was made in providing outreach materials on how pollution will be limited by waste water treatment plant upgrades and stormwater management; concerned stakeholders were contacted with relevant information; collaboration with Salisbury University was established to jointly monitor water quality on the upper Wicomico River.
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	Jun-Aug 2014	Progress was made to identify components of ecosystem function essential for sustainability of largemouth bass populations, particularly those components related to SAV.
	5.2.2 Identify possible threats to the maintenance and function essential for the sustainability of Largemouth Bass	Jun - Aug 2014	Ecosystem threats to the fishery in the Potomac River and upper Chesapeake Bay were largely identified as ones related to loss of SAV. Other threats may include a loss of forage fish, which is being evaluated in Fiscal Year 2016.
	5.2.3 Preserve		No work was done on this action between June

	ecosystem components that are essential and potentially threatened		2014 and June 2015.
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	1.1.4 Develop new indices, such as angler satisfaction indices, or adjust existing indices as needed	Jun 2015	Indices adjusted to reflect new baseline dataset for the Potomac and Patuxent Rivers.
	1.1.5 Improve sharing of data with other Department biologists and programs, such as the Blue Infrastructure Initiative and GIFS	Mar - Jun 2015	Reviewed and critiqued aspects of GIFS that will improve use of the system.
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		No work was done on this action between June 2014 and June 2015.
	1.2.2 Discuss the scope of data collection with regional managers and directors within Inland Fisheries so that data collection is determined to be sufficient for meeting the demands of the Department	Aug 2014	The first caucus of regional biologists was held to discuss problems with the Tidal Bass Survey and identify resolutions. Data collection was improved to objectively and consistently account for the occurrence of species other than largemouth bass.

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. Reference points of biological indices of Largemouth Bass (*Micropterus salmoides*) in tidal tributaries of the Chesapeake Bay were generated from Cleveland 25th and 75th percentiles for available years (N = number of years) of survey or creel data (1999 - 2014). Abbreviations are: catch per unit effort (CPUE) for all Largemouth Bass and juveniles (Juv); proportional size distribution (PSD) for juveniles, 200-305 mm and 200-381 mm fish; proportional occurrence (OCC) of juveniles among sampled sites; relative weight (Wr); body condition (Kn); instantaneous mortality (Z); growth rates (GR) for exponential (EXP) and von Bertalanffy growth models (VBGF); slope of the length-weight regression (LW); mortality (M) for small (Sm) and large (Lg) tournaments (TX); catch per angler hour (CPAH) for tournaments; and habitat suitability index (HSI).

Fishery Independent		<i>CPUE</i>	<i>Cor-CPUE</i>	<i>CPUE, 1+</i>	<i>JuvCPUE</i>	<i>Juv%OCC</i>	<i>JuvPSD</i>	<i>PSD<sub>305</sub></i>	<i>PSD<sub>381</sub></i>
CHESTER (N=9)	25 <sup>th</sup>	13.796	0.985	20.318	11.914	0.123	0.065	0.635	0.293
CHESTER (N=9)	75 <sup>th</sup>	41.756	4.55	57.092	25.575	0.631	0.219	0.823	0.823
CHOPTANK (N=13)	25 <sup>th</sup>	14.232	1.079	12.510	10.481	0.279	0.149	0.630	0.295
CHOPTANK (N=13)	75 <sup>th</sup>	48.350	3.112	37.108	22.087	0.433	0.327	0.739	0.351
POTOMAC (N=15)	25 <sup>th</sup>	50.730	5.841	27.723	26.611	0.577	0.351	0.572	0.261
POTOMAC (N=15)	75 <sup>th</sup>	100.899	15.107	59.817	50.707	0.831	0.622	0.810	0.353
UPPERBAY (N=13)	25 <sup>th</sup>	63.458	5.409	31.964	22.011	0.500	0.621	0.697	0.310
UPPERBAY (N=13)	75 <sup>th</sup>	101.299	12.069	69.864	49.713	0.769	0.842	0.820	0.560
PATUXENT (N=10)	25 <sup>th</sup>	23.460	2.867	21.117	15.624	0.409	0.191	0.565	0.216
PATUXENT (N=10)	75 <sup>th</sup>	56.087	7.435	45.283	20.458	0.522	0.388	0.746	0.351
<i>Add'l Reference</i>		<i>na</i>	<i>na</i>	<i>na</i>	<i>na</i>	<i>na</i>	<i>na</i>	<i>≈ 0.572</i>	<i>≈ 0.245</i>

Fishery Independent		<i>-Z</i>	<i>GR-EXP</i>	<i>GR-VBGF</i>	<i>LW-Slope</i>	<i>W<sub>r</sub></i>	<i>K<sub>n</sub></i>
CHESTER (N=9)	25 <sup>th</sup>	0.685	60.296	60.482	3.142	0.999	0.994
CHESTER (N=9)	75 <sup>th</sup>	0.605	65.394	65.582	3.230	1.003	1.003
CHOPTANK (N=13)	25 <sup>th</sup>	0.774	64.124	64.292	3.218	0.997	0.993
CHOPTANK (N=13)	75 <sup>th</sup>	0.540	67.744	67.982	3.310	1.002	1.005
POTOMAC (N=15)	25 <sup>th</sup>	0.877	62.116	62.354	3.132	1.000	0.986
POTOMAC (N=15)	75 <sup>th</sup>	0.614	69.677	69.265	3.285	1.001	1.000
UPPERBAY (N=13)	25 <sup>th</sup>	0.767	64.083	3.168	3.168	1.002	0.990
UPPERBAY (N=13)	75 <sup>th</sup>	0.603	68.469	3.236	3.236	1.006	0.998
PATUXENT (N=10)	25 <sup>th</sup>	0.787	60.880	61.027	3.181	0.998	0.982
PATUXENT (N=10)	75 <sup>th</sup>	0.565	65.454	65.690	3.248	1.006	0.991
CHESTER (N=9)	25 <sup>th</sup>	0.685	60.296	60.482	3.142	0.999	0.994
CHESTER (N=9)	75 <sup>th</sup>	0.605	65.394	65.582	3.230	1.003	1.003
CHOPTANK (N=13)	25 <sup>th</sup>	0.774	64.124	64.292	3.218	0.997	0.993
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PATUXENT (N=10)	25 <sup>th</sup>	0.787	60.880	61.027	3.181	0.998	0.982
PATUXENT (N=10)	75 <sup>th</sup>	0.565	65.454	65.690	3.248	1.006	0.991

<i>Add'l Reference</i>		$\approx 0.57$	$\approx 68.44$	$\approx 68.44$	$\approx 3.00$	$\approx 1.000$	$\approx 1.000$
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Fishery Dependent		Spawning Season			Non-Spawning Season		
		<i>Sm TX IM</i>	<i>Lg TX IM</i>	<i>CPAH</i>	<i>Sm TX IM</i>	<i>Lg TX IM</i>	<i>CPAH</i>
N	25 <sup>th</sup>	11	11	11	11	10	15
POTOMAC	75 <sup>th</sup>	0.011	0.013	0.211	0.014	0.013	0.250
POTOMAC	25 <sup>th</sup>	0.015	0.028	0.287	0.027	0.035	0.389
N		9	5	10	10	7	9
UPPERBAY	25 <sup>th</sup>	0.004	0.000	0.278	0.007	0.010	0.164
UPPERBAY	75 <sup>th</sup>	0.018	0.022	0.307	0.034	0.027	0.219
<i>Add'l Reference</i>		≤ 0.05	≤ 0.05	<i>na</i>	≤ 0.05	≤ 0.05	<i>na</i>

Habitat		<i>HSI</i>
N		8
ALL RIVERS	25 <sup>th</sup>	0.714
ALL RIVERS	75 <sup>th</sup>	0.817
<i>Add'l Reference</i>		<i>na</i>

Table 2. Stock assessment of largemouth bass populations in 2012 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.

River	N	CPUE	Cor-CPUE	PSD <sub>305</sub>	PSD <sub>381</sub>	-Z	GR-EXPrise	GR-VBGF	LW-Slope	W <sub>r</sub>	K <sub>n</sub>
Upper Bay	28	62.02 ▼	8.78	0.87 ▲	0.59 ▲	NA	68.49 ▲	68.73	3.15 ▼	1.01 ▼	1.00 ▲
Potomac	46	44.16 ▼	5.84 ▼	0.97 ▲	0.55 ▲	-0.57 ▼	64.63	65.05	3.12 ▼	1.01	1.00
Patuxent	28	20.11	2.97	0.49 ☹	0.35 ☺	NA	65.45	65.69	3.03	1.03	1.01
Wicomico	25	10.77	1.09	0.67 ☺	0.41 ☺	0.42 ☹	62.43	62.72	3.18	1.01	1.00
Marshyhope	25	28.25	2.97	0.79 ☺	0.19 ☹	0.87 ☺	62.60	62.87	3.07	1.00	1.00
Pocomoke	28	44.80	4.66	0.48 ☹	0.16 ☹	0.64 ☺	64.13	64.50	3.09	0.99	1.00
Gunpowder	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

<sup>1</sup>NA = Not Available; Gunpowder River were not surveyed because of malfunctioning equipment.

Table 3. Juvenile production for largemouth bass populations in 2013 for targeted drainages of the Chesapeake Bay watershed. When an index fell below the 25<sup>th</sup> percentile computed for available data for that river, the ▼ symbol is given. When a metric fell above the 75<sup>th</sup> percentile computed for available data for that river, then the ▲ symbol is given. n.c. = value falls within the 25<sup>th</sup> and 75<sup>th</sup> percentiles. Abbreviations for indices are in text. The sample size for JuvCPUE and JUV%OCC is given in parentheses as N.

River	JuvCPUE	JUVPSD	JUV%OCC (N)
Upper Bay	52.20 ▲	0.68	0.79 (19) ▲
Potomac	25.98	0.77 ▲	0.82 (34)
Patuxent	18.79	0.57	0.36 (22)
Wicomico	8.87	0.25	0.29 (17)
Marshyhope	17.39	0.47	0.41 (17)
Pocomoke	21.36	0.46	0.84 (19)
Gunpowder	NA	NA	NA