



Larry Hogan, Governor
Boyd Rutherford, Lt. Governor
Jeannie Haddaway-Riccio, Secretary

October 29, 2020

The Honorable Paul G. Pinsky
Chair, Senate Education, Health and Environmental Affairs Committee
2 West Miller Senator Office Building
Annapolis, Maryland 21401

The Honorable Kumar P. Barve
Chair, House Environment and Transportation Committee
Room 251 House Office Building
Annapolis, Maryland 21401

Re: Submission of Report on Fishery Management Plans

Agency: Maryland Department of Natural Resources

Report Authority: Natural Resources Article § 4-215(g) (MSAR #11194)

Dear Chairs Pinsky and Barve:

In accordance with Section 4-215(g) of the Natural Resources Article, the Department of Natural Resources hereby submits the annual summary of its Fishery Management Plans to the Legislative Committees. The document addresses the requirement to regularly report on the status of each managed stock in the Chesapeake Bay and Coastal Bays of Maryland and consists of a species introduction and implementation table for each Fishery Management Plan.

If you have any questions about this submission, please do not hesitate to contact James W. McKitrick, Director, Legislative and Constituent Service, via email at Jamew.mckitrick@maryland.gov or at 443-510-5013.

Sincerely,

Jeannie Haddaway-Riccio
Secretary

enclosure

cc: Sarah Albert, Legislative Library (5 hard copies)
James W. McKitrick
Ryane Necessary, Legislative Policy Committee

2016 Fishery Management Plans Report to the Legislative Committees

Prepared by

Maryland Department of Natural Resources

Fishing and Boating Services

Fishery Management Plan Program

May 2017



2016 Fishery Management Plans

Report to the Legislative Committees

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May 2017

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2016 Fishery Management Plan (FMP) Legislative Report (May 2017)

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

Background

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

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

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

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

The Sustainable Oyster Population and Fishery Act of 2016 (2016 Senate Bill 937/Statute §4-215) requires the Department in consultation with the University of Maryland Center for Environmental Science (UMCES) to conduct a study on oysters and complete a report by December 2018. The second interim report was completed in May 2017.

Introduction

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

drafted and is expected to be incorporated by reference into regulation in 2018.

Fishery management plans are updated on a regular basis and used to be periodically reviewed to evaluate progress towards meeting goals and objectives. Before 2016, an FMP update consisted of Fishing and Boating Services (formerly Fisheries Service) (FABS) staff compiling the most recent information on the status of management strategies and actions for each FMP species. An FMP review consisted 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 process was 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) examined the monitoring data for status and trends of the species being reviewed; 2) updated the recreational and commercial fishery statistics; 3) implemented coastal recommendations (ASMFC and/or MAFMC); 4) integrated habitat and trophic considerations; 5) tracked the progress/implementation of management actions; 6) addressed any new issues; and , 7) made 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 were presented to the Sport Fisheries Advisory Commission and the Tidal Fisheries Advisory Commission as part of the review process. The commissions provide additional input as necessary. If an amendment or revision was recommended by the review team, the process for developing FMPs began. Beginning in 2013, the review process also included the 2012 Fisheries Service Allocation Policy.

Fishery management plan reviews ended in 2015 and are no longer conducted. The only process for FMPs is the annual legislative report. The FABS staff will rely on requests from the TFAC and SFAC members regarding what species will be reviewed, if any.

The second Interim Report to the Oyster Advisory Committee required by the Sustainable Oyster Population and Fishery Act of 2016 was submitted. The main purpose of the 2016 Act was to conduct a study to address a sustainable oyster population and fishery. The Department in consultation with staff from UMCES have started to conduct a stock assessment with the ultimate goal of developing biological reference points (BRPs) for oysters. Once the assessment is completed, the Department will work with stakeholders to determine if any additional management measures are necessary and if so, identify possible management approaches. To date, the terms of reference for the stock assessment and a timeline have been completed. Data has been compiled and the stock assessment is underway.

Amendment 2 to the 1997 Chesapeake Bay Blue Crab FMP (May 2012) included a strategy about pilot management studies and Action 11: *Prepare a written evaluation of any pilot study and submit it to the General Assembly as part of the annual FMP report.* In 2012, the Department in conjunction with stakeholders implemented a pilot study to evaluate the use of an electronic reporting system to improve the reliability of harvest data in the blue crab fishery. Results, to date, demonstrate that electronic reporting is a viable and verifiable means to report harvest data. Each year since the study began, the reporting system has systematically been improved. The

report for 2015-2016 is included in the annual Chesapeake Bay Blue Crab FMP, Section 7 of this report.

Fish Habitat and Land Conservation

Maryland FABS 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, FABS has been working with the Chesapeake Bay Program on fish habitat. The central message about fish habitat 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 FABS study examined how the amount of impervious surface (due to the amount of development) affects water quality and then impacts fish spawning. The DNR Ecosystem and 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

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 FABS 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 go to

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

A Chesapeake Watershed Agreement was completed in 2014 and defined goals and outcomes to restore and protect the Chesapeake Bay. The goals address sustainable fisheries, vital habitats, water quality, toxic contaminants, healthy watersheds, stewardship, land conservation, public access, environmental literacy, and climate resiliency. These goal categories led to the development of specific outcomes and the development of management strategies to outline what steps to take to achieve the outcomes. Of particular importance to fisheries are the blue crab abundance and management outcomes, the oyster outcome, the forage fish outcome, the fish habitat outcome, the brook trout outcome, the stream health and wetlands outcomes, and the fish passage outcome. During 2016, the partners of the Chesapeake Bay Program continued implementing their 2-year

work plans for 2016/2017 that contain specific actions for each outcome. For the most recent information on the work plans, go to:

http://www.chesapeakebay.net/blog/post/bay_program_releases_final_two_year_work_plans

Fishery Statistics

The commercial fishery from Maryland waters encompasses more than 30 different species. The total harvest of finfish and shellfish species from Maryland waters during 2016 was more than 54 million pounds worth over \$100 million. These non-confidential harvest landings and value point to the importance of sustainably managing our fishery resources (Table 1).

Table 1. Non-Confidential Harvest Landings and Value from Maryland Waters, 2016.

Species	Pounds	Value
BLUE CRAB	39,090,582	\$56,600,742
WHITE PERCH	1,885,731	\$13,573,662
OYSTERS	347,771 Bushels	\$12,317,884
STRIPED BASS	1,426,138	\$5,347,130
CLAM - SOFTSHELL	30,588 Bushels	\$2,395,796
CATFISH - CHANNEL	1,977,868	\$1,798,957
SCALLOP - SEA	141,943	\$1,699,058
AMERICAN EEL	569,962	\$1,573,094
TUNAS AND SWORDFISH	190,566	\$960,857
SEA BASS BLACK	271,483	\$890,464
MENHADEN	5,573,530	\$836,030
FLOUNDER SUMMER	144,043	\$587,695
AMERICAN LOBSTER, JONAH CRAB, AND WHELKS	77,313	\$376,500
OTHER: INCLUDING DOLPHINFISH, SNAPPING TURTLE, PORGY, MONKFISH	403,074	\$227,174
CATFISH - BLUE	169,829	\$225,873
SHARK - DOGFISH - SPINY	1,294,246	\$220,022
CARP AND BULLHEAD CATFISH	367,000	\$216,061
YELLOW PERCH	63,635	\$131,088
SPOT AND CROAKER	119,166	\$112,063
HORSESHOE CRAB	148,263	\$76,722
BLUEFISH UNC	66,693	\$52,021
SNAKEHEAD AND CRAPPIE	8,694	\$38,530
SMOOTH DOGFISH AND OTHER SHARKS	77,338	\$34,765
RIVER HERRING	1,191	\$24,773
TOTAL	54,068,288	\$100,316,960

2016 Maryland FMP Report (June 2017)

Section 1. American Eel (*Anguilla rostrata*)

Addendum IV (adopted in 2014) of the Atlantic States Marine Fisheries Commission (ASMFC) American Eel Fishery Management Plan established a yellow eel catch cap of 907,671 lbs. for the Atlantic coastal states. Under this addendum if coastwide harvest exceeds the catch cap for two consecutive years or exceeds the catch cap by 10% (998,438 lbs.) in any one year, then Maryland would need to implement a commercial quota. The preliminary 2016 coastal harvest of 914,012 lbs. was below the threshold to initiate state-specific quotas for the yellow eel fishery in 2017. However, if the 2017 harvest exceeds the 907,671 lbs. catch cap for a second consecutive year, Maryland will need to implement a quota starting in 2018.

American eels have a unique life history strategy. 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 Central America to Greenland. As the larvae approach the continental shelf, they change into glass eels, which actively swim to coastal areas. After approximately 2 months, the glass eels become pigmented and are referred to as elvers. The elvers either remain in estuaries or continue their migration to rivers and streams. They continue to grow into larger, immature yellow eels and spend most of their life in this stage. Their final life stage occurs when yellow eels become sexually mature and change into 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 the American eel population difficult to assess and a challenge to manage.

Fishery Management

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

The ASMFC adopted a coast wide FMP for American Eel in 1999. The goal is to conserve and protect the American eel resource to ensure its continued role in the ecosystem while providing the opportunity for its commercial, recreational, scientific, and educational use. The ASMFC developed the FMP to address data needs and other information that indicated the decline of some segments of the American eel population. Jurisdictions are required to implement fishery-independent young-of-the-year (YOY) monitoring surveys and to 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 to collect catch and effort data. Addendum II (2008) recommended stronger regulatory language by state and federal agencies to improve upstream and downstream passage at dams, particularly for emigrating silver eels. Addendum III (2013) and Addendum IV (2014) were adopted with the goal of reducing mortality of glass (Maine and South Carolina only), yellow, and silver eels. Addendum III management measures include commercial minimum size, gear restrictions, seasonal closure, and recreational size and creel limits. Addendum IV established a coast wide commercial catch cap for the yellow eel fishery, triggers for the implementation of state-by-state commercial quotas, and a quota for the glass eel fishery.¹

Stock Status

The ASMFC conducted an American eel stock assessment in 2012. Compiled data from the Atlantic Coast indicated that trends in yellow eel abundance indices have been variable. For example, the Hudson River and South Atlantic indices indicated decreasing abundance, no trends were evident in the Delaware Bay/Mid-Atlantic Coastal Bay indices, and there has been relatively stable abundance in the Chesapeake Bay. As a whole, the stock assessment models identified declines in abundance for YOY (elver) and yellow-phase American eel. The prevalence of declining indices resulted in a determination that the American eel stock is depleted. The depleted nature of the eel stock is attributed to the synergistic effect of harvest pressure, reduced habitat availability (blockages), increased habitat impairment (pollution), introduction of a swim bladder parasite, and climate change.² The 2012 assessment was considered a benchmark or baseline assessment. A stock assessment update is scheduled for 2017. To date, climate change considerations have not been included in stock assessments. However, updated information suggests that North Atlantic Ocean currents and habitats are changing. Physical oceanographic processes have been linked to the abundance and recruitment of juvenile American eels making them vulnerable to climate change.³

The U.S. Fish and Wildlife Service (USFWS) conducted an in-depth status review of eels and published a 12-month finding (October 2015). The finding concluded that

the American eel resource is stable and does not need protection under the Endangered Species Act (ESA).⁴

Chesapeake Bay biological reference points for American eel have not been established and stock status in the Bay remains unknown. However, based on fishery dependent and independent surveys completed under the Maryland Eel Population Study, all three indices of abundance have indicated positive trends and increases in abundance since the late 1990's. Significant increases in landings since 2010 without notable changes to fishing mortality further supports the increased abundance trends in Maryland's portion of the Chesapeake Bay.^{5,6}

Current Management Measures

Glass eel and elver fisheries are prohibited in Maryland. In 2014, the commercial and recreational minimum size limit was increased from 6" to 9." There is no harvest limit for the commercial fishery but beginning January 1, 2014, there is a seasonal closure from September 1st to December 31st for all gears except spears and baited eel pots. The recreational creel is 25 eels per person per day. As of January 1, 2017 eel pots are required to have a minimum mesh size of ½" x ½".

Starting in 2015, a yellow eel catch cap of 907,671 lbs. was implemented for the Atlantic coastal states as part of ASMFC Addendum IV. The coastwide catch cap has two management triggers that would result in the implementation of a state-by-state commercial yellow eel quota: if the catch cap is exceeded by more than 10% in a given year (998,438 lbs.) 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 quotas are based on average landings from 2011-2013 and Maryland's quota would be 465,968 lbs. Based on preliminary 2016 data, the coastal harvest exceeded the catch cap. However, management action to implement a quota will be required in 2018 if the 2017 coastal harvest exceeds the catch cap for the second consecutive year.

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 Sassafra River, a silver eel trap survey from Gravel Run (Corsica River), and YOY survey in the Coastal Bays.⁵ Yellow and silver eels are subsampled for sex and age determination and the prevalence of the swim bladder parasite, *Anquillicola crassus*. Average prevalence rate among Chesapeake Bay eels was 52% from 2004-2015.⁵ The effect of the parasite on yellow and silver eel stages is unknown.

The Maryland Department of Natural Resource Fish Passage Program added eels to its list of targeted species many years ago. Blockage removal projects consider whether or not eels would benefit from implementing a proposed project. The ASMFC published the Proceedings of a Workshop on American Eel Passage

Technologies (July 2013). The workshop participants agreed that traditional fish passage structures (fishways and fish lifts) are ineffective at passing juvenile eels and specialized eel passage structures are necessary. A specialized eel ladder was built at Daniels Dam (Patapsco River) in 2014 and is passing eels upstream in small quantities. Once the down-river Bloede Dam is removed (tentative date - 2018), more eels are expected to use the eel ladder at Daniels Dam.

The Fishery

Ninety-nine percent of commercially harvested American eel were caught using eel pots.⁷ Maryland's commercial fishery landed 583,578 lbs. of American eel during 2016. From 1989-2009 eel harvest averaged approximately 300,000 lbs. with little variability. From 2010-2016, annual harvest nearly doubled to 588,000 lbs. and comprised 58% of the total coastwide harvest (Figure 1).^{8,9} Commercial crabbers are allowed to harvest American eel for use as trotline bait. The 2016 reported trotline bait harvest was 13,653 lbs. The 23- year average eel harvest from commercial crabbers is 23,224 lbs. Eel landings reported on crab harvester forms are not included in National Marine Fisheries Service (NMFS) commercial landings data.⁷

Recreational harvest data for American eel is not available from the Marine Recreational Information Program (MRIP) because of lack of data.⁸ Consequently, the recreational harvest of eel is considered to be negligible.

Issues/Concerns

In 2010, the USFWS received a petition to list the eel as a threatened species under the ESA and was followed by a lawsuit in 2012. After an in-depth review, the USFWS concluded that the American eel resource was stable and did not warrant protection under the ESA.

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

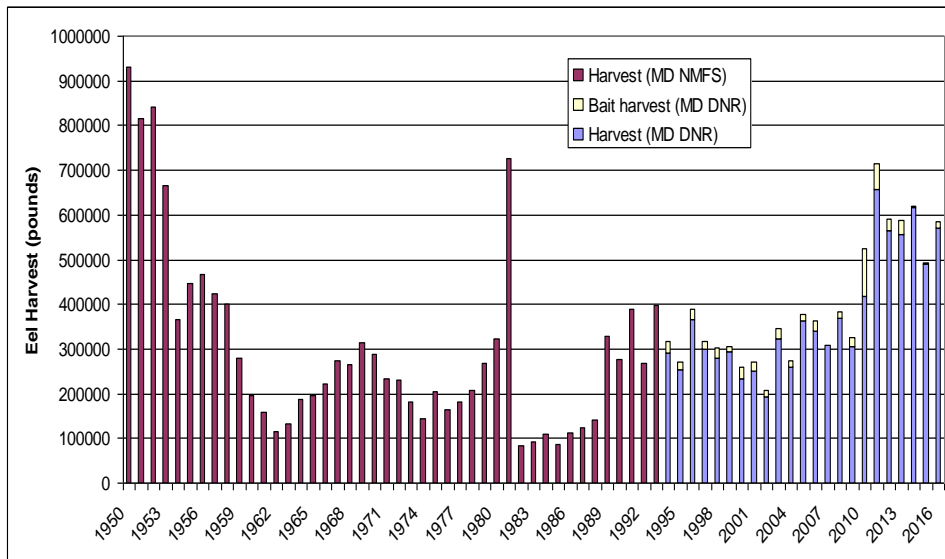
A multi-jurisdiction and multi-year undercover operation into the illegal trafficking of American glass eels by the USFWS resulted in ten "guilty" pleas through 2016. The guilty pleas, which accounted for more than \$2.6 million worth of eels, had been harvested illegally in various East Coast states.^{10,11}

Stream and river blockages continue to reduce American eel access to significant amounts of historic habitat. Downstream movement of yellow and silver eels is particularly problematic at hydropower structures where mortality can be as high as 100%. The USFWS monitors eel abundance at the Conowingo Dam, the first major obstruction to eel passage on the Susquehanna River. Beginning in 2008, a seasonal elver ladder is operated at the dam in order to capture and transport eels upstream. In 2016, over 2,531 elvers were moved upstream.¹² The USFWS and the National Park Service (NPS) are also working on constructing eelways at Dams 4 and 5 on the Potomac River. The design and permits have been completed but will need additional funding. Federal agencies recently developed a technical memorandum on design guidelines for nature-like fishways.¹³ 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.¹⁴ Mussels provide important ecological services as water filters in freshwater. Providing fish passage so American eels have the opportunity to move into freshwater habitat will facilitate the rebuilding of freshwater mussel populations.

Figure 1. American eel commercial landings in Maryland, 1950-2016.

Data for the years 1950-1993 obtained from the National Marine Fisheries Service.⁷ Data for years 1994-2016 was provided by Maryland Department of Natural Resources⁸



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¹¹ <https://www.justice.gov/opa/pr/seven-men-plead-guilty-illegally-harvesting-and-selling-american-eels>

¹² <https://www.fws.gov/northeast/marylandfisheries/>

¹³ Turek, J., A. Haro, and B. Towler. 2016. Federal interagency nature-like fishway passage design guidelines for Atlantic Coast diadromous fishes. Interagency Technical Memorandum. 47pp.

¹⁴ Lellis, W.A., B. S. White, J.C Cole, C.S. Johnson, J.L. Devers, E.V.S. Gray, H.S. Galbraith. 2013. Newly documented host fishes for the Eastern Elliptio mussel *Elipitio complanata*. *Journal of Fish & Wildlife Management*: June 2013, Vol. 4, No. 1, pp.75-85

1991 Chesapeake Bay American Eel Management Plan Implementation Table (updated 06/17)

Strategy	Action	Date	Comments	
<p>1.1 The jurisdictions will adopt a conservative management approach until stock assessment analyses have been completed for American eels in the Bay.</p>	<p>1.1A) Maryland and the Potomac River Fisheries Commission will adopt a minimum size limit of 6 inches for American eels in the Bay.</p>	<p>1992 1993</p>	<p>Glass eel and elver fisheries are prohibited in the Chesapeake Bay. No commercial harvest limit. Commercial season open all year for pots and traps. VA restricts other gear to January 1 to August 31. MD, PRFC, VA recreational limit is 25 eels/person/day. Limit for charter/head boat captain or crew is 50 eels/day. There are no harvest regulations in District of Columbia and PA.</p>	
	<p>B) Virginia will continue its prohibition on the taking of elvers and will adjust its definition to correspond to a 6” minimum size limit.</p>		<p>2005/2006</p>	<p>A coastal stock assessment was conducted in 2005 but the peer review panel determined that the terms of reference were either partially or insufficiently met.</p>
			<p>2012</p>	<p>A benchmark coastal stock assessment was completed in 2012 and concluded that eels are depleted along the coast.</p>
			<p>2013</p>	<p>Addendum III to the Interstate Eel FMP required an increase in minimum size from 6” to 9” for all fisheries. Starting in 2014, harvest of eels are prohibited from 9/1-12/31 by any gear other than a baited eel pot or spear. i.e. no harvest of eels with fyke or pound nets.</p>
			<p>2014</p>	<p>Addendum IV was released for public comment during summer 2014 and adopted in October 2014. The addendum establishes a coastwide commercial catch cap for the yellow eel fishery, the implementation of state-by-state commercial quotas if management triggers are met and a quota for the glass eel fishery.</p>
			<p>2015/2016</p>	<p>Maryland initiated an amendment to the CBAE FMP to adopt current & future ASMFC management requirements, update the status of the eel resource, and provide a framework for managing and monitoring the fishery. Amendment 1 was adopted by reference into MD regulations in the fall 2016. A state-by-state 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. Preliminary harvest suggests the coastwide quota was exceeded in 2016. If the 2017 coastwide harvest exceeds the quota, implementation of state-by-state quotas will be required in 2018. If a quota is necessary, Maryland would be allocated 465,968 lbs.</p>
			<p>2017</p>	<p>See Amendment 1 -Action 4</p>

1991 Chesapeake Bay American Eel Management Plan Implementation Table (updated 06/17)

Strategy	Action	Date	Comments
Continue 1.1	1.2A) Maryland will implement a ½ x ½” minimum mesh size for eel pots. B) Virginia and the Potomac River Fisheries Commission will continue to enforce a ½ x ½” minimum mesh size for eel pots. Virginia will continue to enforce the escape panel requirements in ½ x ½” mesh pots.	1993 Continue 2017	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 ² escape panel of ½” x ½” mesh. In MD, pots with mesh size <½” require escape panels. Virginia requires a ½” x 1” escape panels in ½” x ½” mesh pots. Addendum III (2013) to the Interstate Eel FMP requires that by January 1, 2017 the entire pot must be ½” x ½” mesh. Escape panels will no longer be allowed in small mesh pots (< 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.	Continue 2010 2013	CBP fish passage goal of 2,807 miles opened by 2014. The 2010 SRAFRFC restoration plan did not have specific restoration goals for eel. Addendum III (2013) to the plan specifies eel restoration goals http://www.srbc.net/pubinfo/docs/SRAFRFC_American_Eel_Restoration_Plan_20140527_220124v1.pdf There are no harvest regulations in PA.
	2.1 Maryland will require the reporting of American eels used for the crab bait fishery on their finfish reporting forms.	1993 2007 Continue	Watermen with crab licenses report the amount of eels caught for bait on their crab reporting forms. Information gathered from the Crab Reporting Forms indicate that previous bait estimates were probably too high. ASMFC requires coastal states/jurisdictions to collect eel catch and effort data from all eel fisheries. MD commercial crabbers are required to report their harvest and effort of eels used for bait. These forms were changed in 2010 and may have increased reporting. Commercial crabbers can use up to 50 eel pots with no catch limit.
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	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. B) PRFC will continue to collect catch and effort data from their commercial fishery.	1997 2000 2006 Continue 2017	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. See Amendment 1-Action 1
	3.2 Maryland, the Potomac River Fisheries Commission, and Virginia will encourage research to	Continue 2000	The ASMFC coastal eel FMP required states/jurisdictions to conduct an annual young of year survey.

1991 Chesapeake Bay American Eel Management Plan Implementation Table (updated 06/17)

Strategy	Action	Date	Comments
<p>factors that influence recruitment in the Bay; and how economic aspects affect the eel fishery.</p>	<p>collect basic biological and socioeconomic information.</p>	<p>2006 2007 2010 2015</p>	<p>MD initiated an annual fishery independent eel pot survey and silver eel survey. Eels are also sampled for disease (swimbladder parasite <i>Anquillicolla crassus</i>) prevalence. CB long term average (2004-2015) was 52%.</p> <p>USFWS determined there was no need to list eels as endangered or threatened.</p> <p>USFWS was petitioned a second time in 2010 for an eel status review.</p> <p>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. USFWS completed an American eel biological species report that reviews the best available information on eels in support of the status review.</p>
<p>4.1 The District of Columbia, Environmental Protection Agency, Maryland, Pennsylvania, the Potomac River Fisheries Commission, and Virginia will continue to promote the commitments of the 1987 Chesapeake Bay Agreement. The achievement of the Bay commitments will lead to improved water quality and enhanced biological production. In addition, the jurisdictions have committed to providing upstream passage for migratory fishes.</p>	<p>4.1 The jurisdictions will continue to provide for fish passage at dams, and to remove stream blockages wherever necessary.</p>	<p>2005 2009 2014 2008 2010 2012 2015 2017</p>	<p>The CBP fish passage goal was updated to include opening an additional 1,000 miles of tributary from 2005 to 2014 or 2,807 miles by 2014. The 2014 CB Watershed Agreement (prompted by Executive Order 13508) included an outcome for opening 1,000 miles of migratory fish passage by 2025 (baseline mileage 2,041). American eel was identified as one of the focal species.</p> <p>ASMFC approved Addendum II to the Coastal eel FMP which placed an emphasis on improving upstream and downstream passage.</p> <p>USFWS conducted a study to determine the timing & cues for out-migrating eels in the Shenandoah River. Results of the study indicate that outmigration is variable and sometimes protracted.*</p> <p>Study of the Embry Dam removal on the Rappahannock River indicated that the restoration resulted in increased numbers of eels as far as 100 miles upstream.**</p> <p>Through 2015, MD DNR's Fish Passage Program has completed 79 projects and reopened 457 miles of upstream habitat in Maryland.</p> <p>Designs and permits have been obtained for the construction of eel ladders at Dams 4 and 5 on the Potomac River. USFWS and NPS</p>

1991 Chesapeake Bay American Eel Management Plan Implementation Table (updated 06/17)			
Strategy	Action	Date	Comments
Strategy 4.1 Continued			are working to find funding for the eel passage and ecological restoration effort. MD DNR supports the restoration efforts.
	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:	Continue	Chesapeake Bay Program develops, revises, and monitors goals and strategies for restoration.
	A) Developing habitat requirements and water quality goals for various finfish species.	2014	The 2014 CBP Watershed Agreement revised the goals and outcomes for natural resources, water quality and stewardship. For more information: http://www.chesapeakebay.net/chesapeakebaywatershedagreement/page
	B) Developing and adopting basinwide nutrient reduction strategies.	2014	Results of the 2012-2014 assessment period indicate that 34% of the water quality standards for dissolved oxygen, water clarity/underwater grasses and chlorophyll a for the Chesapeake Bay were met during this time.
	C) Developing and adopting basinwide plans for the reduction and control of toxic substances.	2014	In 2014, 59% of the Chesapeake Bay met the bottom habitat goal, scoring at least three on the one-to-five Benthic index of Biotic Integrity scale.
	D) Developing and adopting basinwide management measures for conventional pollutants entering the Bay from point and nonpoint sources.	2015	In 2015, there were an estimated 91,621 acres of underwater grasses in the Chesapeake Bay, achieving 49% of the 185,000-acre goal.
	E) Quantifying the impacts and identifying the sources of atmospheric inputs on the Bay system.		
F) Developing management strategies to protect and restore wetlands and submerged aquatic vegetation.			
G) Managing population growth to minimize adverse impacts to the Bay environment.			

* 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/EelShenandoah.pdf>

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

Amendment 1 to the 1991 Chesapeake Bay American Eel Management Plan Implementation Table (2016)

Strategy	Action	Date	Comments
<p>Stock Status: Since the American eel resource consists of a single, migratory stock along the Atlantic coast, Maryland will support and cooperate with the Atlantic States Marine Fisheries Commission's (ASMFC) data collection and stock assessment processes.</p>	1. Follow the ASMFC guidance and compliance requirements for American eel.	2016	Maryland participated in an ASMFC sponsored otolith exchange (aging) for American eel. Staff read approximately 250 samples provided by participating aging labs from Maine to Florida. The goal is to develop a standardized protocol for processing and reading samples, compare ageing accuracy in and between ageing labs, and identify any persisting issues along the coast.
		2017	MD has conducted an American eel population study since 1997 that includes collecting catch and effort data from the commercial eel fishery, the completing an annual young-of-year survey, and submitting an annual compliance report to ASMFC.
	2. Continue to collect biological data to support coastal stock assessments and contribute to the development of biological reference points.	2017	The Maryland American eel Project conducts ongoing surveys that provide relative abundance estimates and biological data, including length, weight, age, and sex that are critical to coastal stock assessments.
	3. Improve stock status by reducing overall mortality and enhancing population levels by increasing the availability of habitat, especially through the removal of blockages to upstream and downstream migration.	2017	Designs and permits have been obtained for the construction of eel ladders at Dams 4 and 5 on the Potomac. USFWS and NPS are working to find funding for the eel passage and ecological restoration effort. MD DNR is in support of the restoration effort and has agreed to be an ally in search for obtaining funding for the project.

Amendment 1 to the 1991 Chesapeake Bay American Eel Management Plan Implementation Table (2016)

Strategy	Action	Date	Comments
	4. As the status of the American eel stock changes over time, adjust management strategies to meet conservation and protection objectives.	2017	A coastwide stock assessment update is scheduled for Fall 2017.
Fishery Management: Maryland will reduce overall mortality on the American eel resource as required by the Atlantic States Marine Fisheries Commission (ASMFC). When the American eel stock is rebuilt, management strategies may become less restrictive.	5. Maryland will establish an eel harvester permit for all commercial eel harvesters including crab license holders, in order to obtain timely, accurate and verifiable harvest reporting for American eels caught from Maryland waters. If a state quota is implemented, the Department will require daily reporting with the procedures and protocols to be determined.	2017	An eel harvester permit will be required for all commercial eel harvesters, including crab license holders intending to harvest eels for bait. If the state quota is implemented, the Department can modify, open or close the season or adjust catch limits by public notice
	6. Maryland will continue to implement minimum size limits, possession limits, mesh size requirements, seasonal restrictions, gear restrictions and other management measures as necessary to meet the management framework for protecting and conserving the American eel resource.	2017	Addendum III to the ASMFC Interstate Eel FMP (2013) required ½” x ½” mesh for the entire eel pot starting January 1, 2017. Escape panels will no longer be allowed in small mesh pots (< ½” mesh).
	7. Maryland will implement and manage the commercial eel fishery by a quota system when one of the ASMFC management triggers is met.	TBD	Dependent on annual coastal harvest.
	8. Maryland will continue to prohibit an elver fishery.	Continue	Maryland and Virginia implemented a minimum size limit of 6” for American eels in 1991. The minimum size limit prohibits an elver fishery.
	9. Maryland will work with the stakeholders to evaluate and discuss challenges and priorities in managing the American eel fishery.	2016	In 2016, an Eel Workgroup, comprised of industry participants was formed with a goal of developing a framework for managing a yellow eel quota, if required.

Amendment 1 to the 1991 Chesapeake Bay American Eel Management Plan Implementation Table (2016)

Strategy	Action	Date	Comments
Monitoring: Maryland will continue to conduct fishery dependent and fishery independent monitoring in the Chesapeake and Atlantic Coastal Bays to collect biological data essential for stock assessments and managing the American eel resource.	10. Maryland will continue to conduct an annual YOY survey, the fishery independent adult surveys and the commercial harvest survey. Continue 10.	Continue 2016	ASMFC implemented mandatory commercial reporting by life stage. ASMFC adopted Addendum I (2006) to the Coastal Eel FMP to improve data collection and subsequent stock assessments. Maryland’s American eel Project has conducted an annual YOY survey since 2000, a fishery independent eel pot survey in the Sassafras River since 2006, a fishery dependent biological survey since 1997, and a silver eel study at a Corsica River tributary since 2006. The program also compiles and analyzes catch and effort data annually from the commercial eel pot fishery. Maryland participated in an ASMFC sponsored otolith exchange (ageing) for American eel. Staff read approximately 250 samples provided by participating ageing labs from Maine to Florida. The goal is to develop a standardized protocol for processing and reading samples, to compare ageing accuracy in and between labs, and to identify any persisting issues along the coast.

Acronyms

- ASMFC – Atlantic States Marine Fisheries Commission
- CB – Chesapeake Bay
- CBP – Chesapeake Bay Program
- ESA – Endangered Species Act
- FMP – Fishery Management Plan
- NPS -- National Park Service
- PFC – Pennsylvania Fish Commission
- PRFC – Potomac River Fisheries Commission
- SRAFRFC – Susquehanna River Anadromous Fish Restoration Cooperative
- USFWS – United States Fish & Wildlife Service

2016 Maryland FMP Report (June 2017)

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

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

In 2016, the United States Fish and Wildlife Service (USFWS) and Exelon Generation Company, LLC (Exelon) came to a settlement agreement regarding modifications needed for fish passage at Conowingo Dam on the Susquehanna River, as part of the Federal Energy Regulatory Commission relicensing process. The agreement addresses impediments to American shad spring spawning migrations at the hydro-project and allows for adaptive restoration efforts as the population grows during the length of the 50 year license. The improvements to fish passage will result in the transport of a greater number of American shad to spawning habitat and bolster the population moving into the future.

Fishery Management Plans (FMPs)

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

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

states with commercial and/or recreational (excluding catch and release) American shad fisheries to have approved fishing and habitat sustainability plans. The Potomac River Fisheries Commission (PRFC) submitted a sustainable fishery management plan for American shad in 2012. Habitat restoration plans were approved by ASMFC for Maryland, District of Columbia, and Virginia in 2014 and can be found on the ASMFC website (<http://www.asmfc.org/species/shad-river-herring>). The ASMFC has scheduled a stock assessment update for American shad in 2018.

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

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

Stock Status

American shad harvest in Maryland declined in the late 1950s and reached historic low levels in the mid-1970s where it has remained¹ (Figure 1). The Maryland Department of Natural Resources (MD DNR) population estimates for the Conowingo Dam tailrace indicate that American shad abundance increased from 1998 to 2001, decreased after 2001 through 2007, and has remained relatively stable at low levels with a slight increase in recent years.^{1,2} The 2016 American shad population estimate for the Susquehanna River below Conowingo Dam was 153,171 fish^{1,2} (Figure 2). In 2016, 14,267 American shad passed through the east fish lift at

Conowingo dam, an improvement from last year's count which was the lowest recorded passage since 1989.³

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

Abundance of wild (non-hatchery reared) and repeat (spawned in previous years) spawning American shad varies among river systems. Approximately 46% of American shad in the Conowingo Dam tailrace were of wild stock during 2016. Fifty-six percent of male and 53% of female American shad in the Potomac River were repeat spawners in 2016.² In the Choptank River, adult American shad are infrequently encountered by monitoring surveys and 90% of juveniles in 2015 were hatchery reared. Since there is evidence of natural reproduction in the Choptank River, the restoration program has expanded sampling to locate where staging and spawning occurs.⁴

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 2014.⁵ 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.⁵ Monitoring on these rivers will occur every three years to continue trend data, now that stocking has ceased. A stable population of spawning adult hickory shad has been present in the lower Susquehanna River since 1996⁵ without any stocking. Eighty-five percent of female and 60% of male hickory shad in Deer Creek were repeat spawners during 2016.¹

Current Management Measures

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

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

The National Marine Fisheries Service (NMFS) enacted the New England Fishery Management Council's (NEFMC) Amendment 5 to the Atlantic Herring FMP in 2014.⁶ Amendment 5's objectives to improve monitoring and minimize bycatch of river herring catch are anticipated to also reduce at-sea mortality of shad.⁶

The Mid-Atlantic Fishery Management Council (MAFMC) adopted Amendment 14 (2014) to the Atlantic Mackerel, Squid, and Butterfish FMP to improve monitoring of these fisheries and to limit shad mortality in the Atlantic mackerel fishery. The MAFMC approved an annual incidental shad and river herring catch cap of 180,779 lbs. for the Atlantic mackerel fishery for 2016-2018.⁷ The shad and river herring estimated incidental catch from the Atlantic mackerel fishery for 2016 was 2,359 lbs., combined, and comprised 4.74% of the incidental catch cap.⁷ The National Marine Fisheries Service (NMFS) did not approve all measures in Amendment 14. An increase in observer coverage was disapproved.⁸ The MAFMC and NEFMC hope to address the need for increased observer coverage in the Omnibus Industry-Funded Monitoring Amendment currently in development. NMFS has the final decision on what management recommendations will be adopted for fisheries in federal waters. The MAFMC determined in October 2016 that it was not necessary to include shad and river herring as stocks in the Atlantic Mackerel, Squid, and Butterfish FMP.

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.¹ Bycatch is limited to 2 dead American shad for personal use per day.

The Marine Recreational Information Program (formerly Marine Recreational Fisheries Statistics Survey, MRFSS) stopped collection of American shad and hickory shad recreational data in 2009. Recreational catch and release fisheries for American and hickory shad occur in the tailrace below Conowingo Dam. Catch and release fisheries – primarily hickory shad – also occur in Deer Creek and Octoraro Creek, tributaries to the lower Susquehanna River. Maryland DNR conducts a voluntary angler logbook survey and an annual creel survey of shoreline anglers along the Conowingo Dam tailrace.² Beginning in 2014, anglers can participate in the logbook survey online through MD DNR's website (<http://dnrweb.dnr.state.md.us/fisheries/surveys/login.asp>). Data from the American shad logbook and angler surveys indicate a decrease in catch rate since 2000 (Figure 3).^{1,2} The trend mirrors the catch rate trend of the MD DNR tagging survey (Figure

3). An active catch and release recreational fishery for both shad species also occurs in the Potomac, Patuxent, and Choptank rivers.⁴ Current shad release mortality in the recreational fishery is unknown. In 1998, catch and release mortality of 309 American shad at the Conowingo Dam tailrace was calculated to be 0.97%.⁹ Mortality from the current recreational fishery is believed to be negligible.¹

Issues/Concerns

Conowingo Dam is the most significant remaining blockage to American shad migrating up the Susquehanna River in Maryland even though there is a fish lift. Although American shad are captured in the lift, hickory shad have rarely been documented using the fish lift.^{1,3} In 2016, the USFWS and Exelon came to a settlement agreement regarding modifications needed for fish passage at Conowingo Dam on the Susquehanna River, as part of the Federal Energy Regulatory Commission relicensing process. It will take several years to implement the fish passage improvements once a new license has been issued; expected in 2018.

Comparisons between scale age and a fish's known age revealed a notable amount of bias and error.¹⁰ 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.¹⁰

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 ASMFC Amendment 3. Although the Maryland commercial finfish reporting forms have a designation for discards/bycatch, fishermen are not required to report bycatch or discards.

Figure 1. Time series of commercial landings of American shad, 1950-2016 in Maryland and Virginia.¹¹

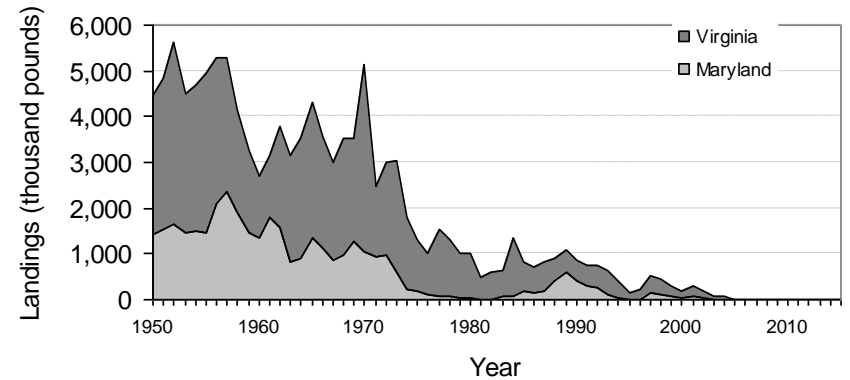


Figure 2. American shad passed at Conowingo Dam's east fish lift (1997-2016).² American shad population estimate for the Conowingo Dam tailrace (1986-2016).³ and the status of American shad restoration in the Potomac River (2000-2015; E. Cosby, PRFC, pers. comm.).

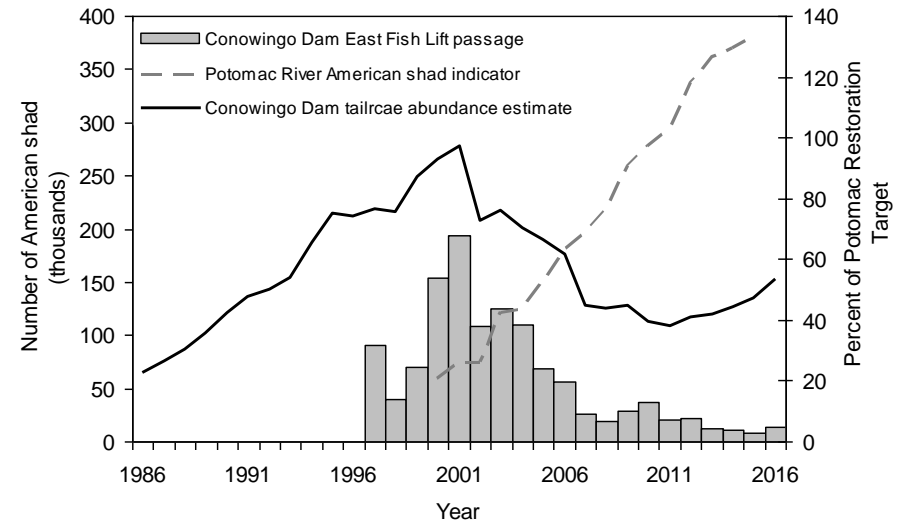
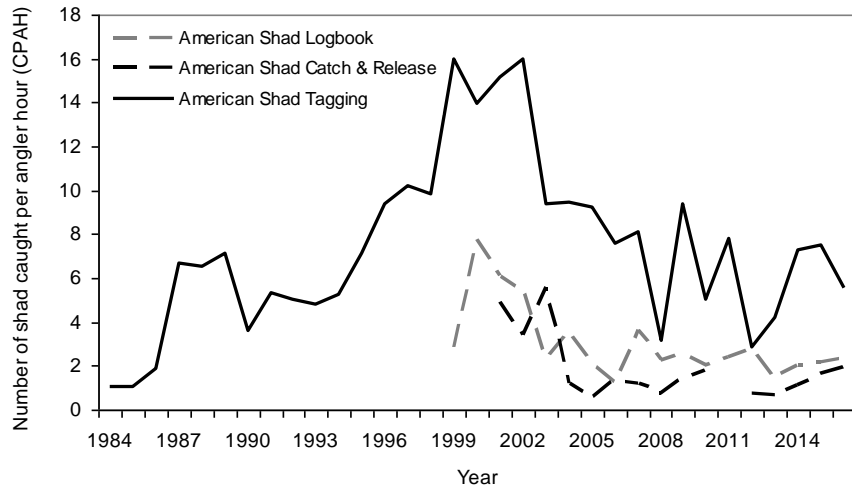


Figure 3. Average catch per angler hour from the MD DNR tagging study (1984-2016), the recreational angler logbook survey for American shad (1999-2016), and American shad catch and release fishery below Conowingo Dam (2001-2014, no data for 2011).³



References

- ¹ Lipkey, G. K. 2017. Maryland's 2016 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.
- ² Maryland Department of Natural Resources. 2017. Chesapeake Bay Finfish Habitat Investigations. US FWS Federal Aid Project F-61-R-9 2012 – 2015. Maryland Department of Natural Resources, Annapolis, Maryland.
- ³ Pennsylvania Fish and Boat Commission. 2017. Susquehanna River American shad. <http://www.fishandboat.com/Fish/PennsylvaniaFishes/Pages/SusquehannaShad.aspx>
- ⁴ Stence, C. P., M. W. Baldwin, and M. Bowermaster. 2017. American shad restoration in three Maryland rivers. US FWS Federal Aid Project F-57-R Segment 16 Progress Report. Maryland Department of Natural Resources, Annapolis, Maryland.

- ⁵ Stence, C. P., M. W. Baldwin, and M. Bowermaster. 2017. Hickory shad restoration in three Maryland rivers. US FWS Federal Aid Project F-57-R Segment 16 Progress Report. Maryland Department of Natural Resources, Annapolis, Maryland.
- ⁶ Federal Register 79(30) February 13, 2014 Rules and Regulations. Final Rule. Fisheries of the Northeastern United States; Atlantic Herring Fishery; Amendment 5.
- ⁷ Personal communication from the National Marine Fisheries Service, Greater Atlantic Region Fisheries Office. Northeast Region Quota Monitoring Report. June 15, 2016. http://www.greateratlantic.fisheries.noaa.gov/ro/fso/reports/reports_frame.htm
- ⁸ 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.
- ⁹ 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.
- ¹⁰ 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.
- ¹¹ 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*)

In October of 2016, the Mid-Atlantic Fisheries Management Council (MAFMC) re-affirmed their decision not to include river herring and shad as stocks in the Atlantic Mackerel, Squid, and Butterfish FMP. The Council continues to pursue development of biologically meaningful incidental catch caps and the means to monitor the effectiveness of incidental catch caps in these fisheries. A recent study by Hasselman et al. (2015) attributes a greater percentage of blueback herring caught as incidental catch in the ocean fisheries as originating from Mid-Atlantic stocks. Conclusions from this paper are corroborated by continued observations of low relative abundance of blueback herring in the Nanticoke River despite the closure of the directed river herring fishery in 2012.

Fishery Management Plans (FMPs)

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

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

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

dynamics (stock assessment history, anthropogenic mortality, life history, connectivity, and stock structure), and socioeconomic (cultural, economic, and environmental considerations, restoration, and management guidelines).

The National Marine Fisheries Service (NMFS) and the ASMFC published a coastwide conservation plan (2015) for river herring that utilizes input from experts throughout the species range (River Herring Technical Expert Working Group-TEWG) and is intended to be a dynamic web-based plan that can be easily updated. It can be accessed at

<https://www.greateratlantic.fisheries.noaa.gov/protected/riverherring/conserv/index.html>

The plan has the following goals: identify key research needs for assessment and conservation, increase coordination of river herring research and conservation, identify funding sources for river herring research and conservation, identify conservation actions to address threats, cultivate research groups to address key topics, improve information to be used in the next assessment, improve information used in conservation efforts, further conservation efforts to address threats, and increase outreach about river herring.

Stock Status

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

Spawning adult river herring in the Nanticoke River were sampled from commercial fyke and pounds nets. Sixty-seven percent of alewife and 33% of blueback herring were repeat spawners.^{2,3} Maryland Department of Natural Resources (MD DNR) conducted the fourth year of a fishery independent river herring gill net survey in the North East River, developed to assess the spawning stock of alewife and blueback in the upper bay region. In 2016, 652 river herring were sampled, a decrease from the 1200 encountered in 2015.² Sixty-nine percent of alewife herring were repeat spawners and 46% of blueback herring were repeat spawners in 2016. Seine surveys are used to calculate juvenile abundance indices (JAI) which have varied without trend since 1980.^{2,3} The JAIs for alewife and blueback herring were below average in 2016 for the Chesapeake Bay region.²

Current Management Measures

Maryland, Virginia, and the Potomac River Fisheries Commission (PRFC) instituted a recreational and commercial river herring moratorium, January 1, 2012. All river herring and river herring products imported into Maryland must include a bill of sale

from a state with an approved river herring fishery³ (Maine, New Hampshire, New York, North Carolina, and South Carolina).

The NMFS enacted the New England Fishery Management Council's (NEFMC) Amendment 5 to the Atlantic Herring FMP in 2014.⁴ Amendment 5's objectives to improve monitoring and minimize bycatch of river herring catch are anticipated to also reduce at-sea mortality of shad.⁴

The MAFMC adopted Amendment 14 (2014) to the Atlantic Mackerel, Squid, and Butterfish FMP to improve monitoring of these fisheries and limit shad and river herring mortality in the Atlantic mackerel fishery. The MAFMC approved an annual incidental shad and river herring catch cap of 180,779 pounds for the Atlantic mackerel fishery for 2016-2018. The shad and river herring estimated incidental catch from the Atlantic mackerel fishery for 2016 was 2,359 pounds: 4.74% of the incidental catch cap.⁵

The NMFS did not approve all measures in Amendment 14. An increase in observer coverage was disapproved.⁶ The MAFMC and NEFMC hope to address the need for increased observer coverage in the Omnibus Industry-Funded Monitoring Amendment currently in development. NMFS has the final decision on what management recommendations will be adopted for fisheries in federal waters. The MAFMC determined in October 2016 that it was not necessary to include shad and river herring as stocks in the Atlantic Mackerel, Squid, and Butterfish FMP.

The Fisheries

Alewife and blueback herring recreational fishery data have not been available from the Marine Recreational Information Program (MRIP) since 2009. All commercial and recreational river herring fisheries in Maryland are under a moratorium. 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 failed to rebound after 1976 and prior to the fishery closure in 2012. Recreational catch and release angling is allowed but data is limited. The recreational fishery is believed to be minimal.³ 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 workshop⁷ took place to compare age estimates and methodologies among Atlantic coast states. River herring age is determined from scales using the same methodology as for American shad (previously discussed),

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

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

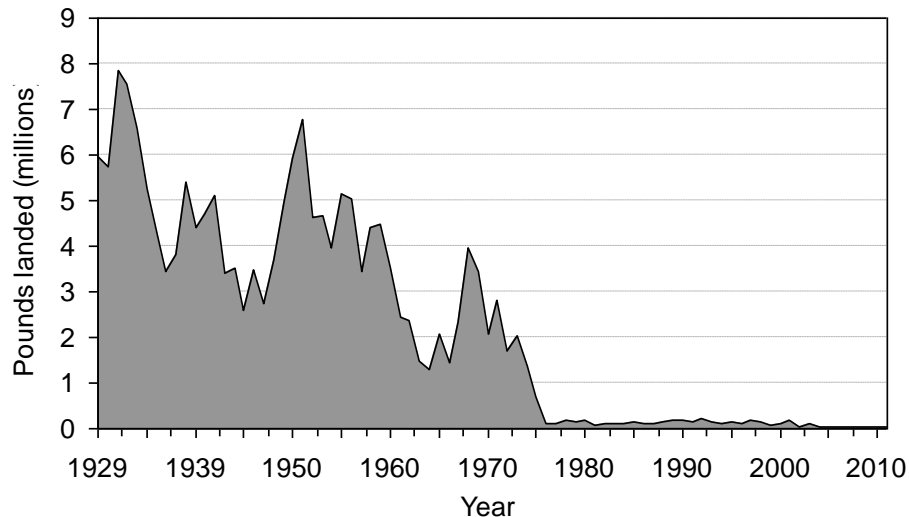
River herring mortality sources include harvest, bycatch, discard, pollution, and predation. In Maryland, mortality from hydroelectric turbines is considered insignificant because they are rarely encountered in Conowingo Dam's fish lifts and passed upstream.³ Ocean trawl bycatch of juvenile river herring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

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

more attractive for private owners.

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

Figure 1. Time series of commercial landings of shad river herring (alewife and blueback, 1929-2011) in Maryland.^{3,9}



References

¹ 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.

² Maryland Department of Natural Resources. 2017. Chesapeake Bay finfish habitat investigations. US FWS Federal Aid Project F-61-R-9 2012 – 2016. Maryland Department of Natural Resources, Annapolis, Maryland.

³ Lipkey, G. K. 2017. Maryland's 2016 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.

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

⁵ Personal communication from the National Marine Fisheries Service, Greater Atlantic Region Fisheries Office. Northeast Region Quota Monitoring Report. June 15, 2017. http://www.greateratlantic.fisheries.noaa.gov/ro/fso/reports/reports_frame.htm

⁶ 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.

⁷ Atlantic States Marine Fisheries Commission. 2014. 2013 river herring ageing workshop report. Atlantic States Marine Fisheries Commission. Arlington, Virginia. http://www.asmfc.org/files/Science/RiverHerringAgeingWorkshopReport_August2014.pdf

⁸ Atlantic States Marine Fisheries Commission. 2016. Report on the River Herring Data Collection Standardization Workshop. Atlantic States Marine Fisheries Commission. Arlington, Virginia. http://www.asmfc.org/uploads/file/56fc3c6dRH_DataCollectionStandardizationWorkshopSummary_March2016.pdf

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

⁹ 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 06/2017)

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

1998 Amendment 1 to the 1989 Chesapeake Bay Alosid [sic] Management Plan Implementation Table (updated 06/2017)			
Strategy	Action	Date	Comments
		2015	Between 2014 and 2015, shad abundance decreased from 44 to 30% of the goal. For more information: http://www.chesapeakebay.net/indicators/indicator/american_shad_abundance
		2010	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 06/2017)			
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	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.
		Continue	
		1982	PRFC has had a moratorium on directed shad harvest in Potomac River since 1982.
		Continue	
		1992	DCFM implemented a moratorium on shad harvest within District of Columbia waters of the Potomac River in 1992.
		Continue	
		1998	Amendment 1 to the CB Alosine FMP 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	1.1.2 Virginia will utilize the Virginia Marine Resources Commission's Stock Assessment	1994	VA implemented a moratorium on the harvest of American and hickory shad from the Bay in 1994.

1989 Chesapeake Bay Alosid [*sic*] Management Plan Implementation Table (updated 06/2017)

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

1989 Chesapeake Bay Alosid [*sic*] Management Plan Implementation Table (updated 06/2017)

Strategy	Action	Date	Comments
Continue 1.3	Continue 1.3	2007 2014	From 1994-2015, 44.5 million American shad and 111.6 million hickory shad have been stocked. Hickory shad are considered self-sustaining in the Patuxent River. Hickory shad considered self-sustaining in the Choptank River.
1.4 Pennsylvania will continue to prohibit the harvest of American shad in the Susquehanna River and its tributaries, and American and hickory shad in the Conowingo Reservoir while restoration efforts are in progress.	1.4 As restoration of alosids [<i>sic</i>] progresses over dams in the Susquehanna River, additional regulations in Pennsylvania will be promulgated to protect these species until a degree of restoration is achieved	Continue Continue	PA prohibits the harvest of American and hickory shad in the Susquehanna River watershed. Insufficient recreational catch data are available post-2008. There is a recreational catch and release fishery below Conowingo Dam.
2.1 Maryland, Pennsylvania and Virginia will continue to participate in the ongoing ASMFC-coordinated coastal fishery stock identification and ocean landing studies of alosids [<i>sic</i>].	2.1 Maryland, Pennsylvania and Virginia will participate in the ongoing ASMFC alosid [<i>sic</i>] management program, both in Board and Scientific and Statistical Committee activities, with the goal of providing adequate protection to the component of the coastal stock which returns to the Chesapeake Bay to spawn.	Continue 1997 1999 2007 2008 2012 2012-2013 Continue	MD, VA, and PRFC participate in the ASMFC shad management board and technical committee. ASMFC conducted a stock assessment in 1997. Amendment 1 to the ASMFC shad plan adopted a strategy to keep fishing mortality below F_{30} . ASMFC Amendment 3 specified the American shad total mortality threshold to Z_{30} for the coastal stock. ASMFC completed a stock assessment in 2007. The ASMFC Review Panel recommended the development of population specific reference points. American shad and river herring mortality rates have increased. Alosa bycatch in ocean fisheries are contributors, but data is limited. Bycatch mortality in Chesapeake Bay has not been estimated. The ASMFC Management Board approved the 2012 river herring stock assessment. MAFMC adopted Amendment 14 which imposes a 520,000 lb. Alosa bycatch limit to the Atlantic mackerel fishery. NEFMC has adopted Amendment 5 to the Atlantic herring FMP. Both amendments will

1989 Chesapeake Bay Alosid [sic] Management Plan Implementation Table (updated 06/2017)

Strategy	Action	Date	Comments
Continue 2.1	Continue 2.1	2014 Continue	improve bycatch reporting. MD and VA participated in the TEWG for river herring coordinated by NMFS and ASMFC to inform and develop a coastwide conservation plan for river herring.
2.2 Virginia will follow ASMFC recommendations 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	1991 Continue Continue	Tagging studies indicated that the coastal fishery is mixed and highly variable from year to year. Continuation of tagging programs is recommended. DNA data is used to identify populations within the mixed ocean stock. MD and VA obtain tissue samples for research upon request.
	2.2 B) Control the coastal intercept fishery through a combination of gear restrictions, seasonal and area closures, and harvest limits	2005 Continue	ASMFC Amendment 1(1999) 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 Continue	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 Continue 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 superceded by the ASMFC's 2012 moratorium on river herring harvest.
2.3.2 Maryland and Virginia will ensure that river herring by-catch in the foreign and domestic mackerel fisheries is minimized.	2.3.2 Maryland and Virginia will monitor river herring by-catch through the mid-Atlantic Fishery Management Council and support the following recommendations: a) The foreign fishery will stay 20 miles offshore.	Continue	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.	Continue 2015	River herring bycatch is monitored by the MAFMC, NEFMC, NMFS, and NAFO. MAFMC approved an 180,779 lb. incidental shad and river herring bycatch limit for the Atlantic mackerel fishery for 2016-2018. The fishery will close early if the incidental bycatch limit is exceeded.

1989 Chesapeake Bay Alosid [*sic*] Management Plan Implementation Table (updated 06/2017)

Strategy	Action	Date	Comments
Continue 2.3.2	2.3.2 c) Intercept fisheries will be discouraged.	2012-2015	MAFMC under Amendment 14, approved an 180,779 lb. Alosa bycatch limit to the Atlantic mackerel fishery for 2016-2018. NMFS has approved NEFMC Amendment 5 to the Atlantic herring FMP. Both amendments will improve at-sea observer bycatch reporting and monitoring.
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 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	VIMS, MD DNR and DCFM have Alosine juvenile surveys and calculate indices for each species. http://dnr.maryland.gov/fisheries/Pages/stripped-bass/juvenile-index.aspx
		Continue 2010 Discontinued	ASMFC Amendment 2 requires river herring JAI surveys. VA & MD continue to provide data to coastal stock assessment Preliminary stock recruit indices for river herring were developed and presented to the ASMFC's Herring Stock Assessment Sub-committee (SAS). The effect of bycatch, environmental factors, and stock change on the relationship requires further study. No trends were detected for American shad and there was insufficient data for hickory shad. Initial stock-recruit analyses indicated that a river herring JAI was a predictor of future year class strength. The SAS decided not to pursue development of the indices.
	3.1 B) Maryland will continue research projects for American shad in the upper Bay and Nanticoke River which provide annual estimates of adult shad. (Currently being implemented)	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.
		2011 2013 Continue	The Nanticoke River commercial survey is the data source for the river herring spawning population assessment. The Nanticoke River commercial survey will continue during the moratorium. A fishery independent gill net survey was conducted in the Northeast River to monitor spawning river

1989 Chesapeake Bay Alosid [sic] Management Plan Implementation Table (updated 06/2017)

Strategy	Action	Date	Comments
Continue 3.1			herring.
	3.1 C) Virginia will improve assessment of current fishing rates on shad stocks in territorial waters and seek to improve catch and effort data through mandatory reporting. (1990)	1995 Continue	Commercial landing data have been improved on a coastwide basis with the establishment of ACCSP. Limited American shad bycatch fisheries exist.
	3.1 D) The VMRC Stock Assessment Program will provide additional fishery dependent data collection for Virginia's shad fisheries (on-going)	Continue	Required by the ASMFC.
	3.1 E) Virginia will initiate an ocean intercept tagging program to determine stock composition in the coastal shad fishery (1990)	1991-1992 Completed	Tagging work completed in 1992. Results indicated coastal catch is mixed and highly variable.
	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)	2005 1990 Continue Continue	Ocean intercept shad fishery was closed. Mortality rates are calculated for river herring in the Nanticoke River. Exploitation rate estimation has not been a priority. MD began a moratorium on river herring in 2012.
	3.1 G) Virginia will cooperate with research institutes to implement a survey of selected shad and herring spawning grounds, compiling information on basic spawning stock characteristics including relative adult abundance, juvenile abundance, size, age and sex ratios. (Currently being implemented)	1990 Completed 1995 2009 2009 Continue	A map of historic shad and herring spawning areas has been completed. Tributary-specific targets were considered. The FMPC and ad hoc Fish Passage workgroups met to discuss how to address the development of targets. No targets were adopted. CBSAC sponsored a workshop to evaluate different methodologies and recommended a multi-metric approach. ASMFC Amendment 2 requires adult river herring spawning/population assessment and Amendment 3 (2010) requires adult American shad spawning/population assessment.
	3.1 H) American shad abundance will be investigated in the Potomac River, a system of historic importance, through a joint effort by Maryland, Virginia, and District of Columbia. (1991)	Continue 1991 Continue 2011	MD striped bass juvenile seine and gill net surveys collect American shad data. DCFM has been sampling the upper Potomac for shad and river herring since 1991. The juvenile survey on the Potomac indicates shad

1989 Chesapeake Bay Alosid [*sic*] Management Plan Implementation Table (updated 06/2017)

Strategy	Action	Date	Comments
<p>Continue 3.1</p>	<p>Continue 3.1 H</p>	<p>2015</p>	<p>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.</p> <p>The PRFC American shad pound net survey indicates that CPUE in the Potomac River is 133% of the CBP restoration target.</p>
<p>4.1 The Chesapeake Bay Program’s Fish Passage Workgroup has analyzed the problem of impediments to Alosid [<i>sic</i>] migration and presented its recommendations for acceptance in December 1988. Maryland will develop a multi-faceted program based on the program’s recommendations to restore spawning habitat to migratory fishes by removing blockages. Virginia, through its Anadromous Fish Restoration Committee, will develop a comprehensive inventory of dams and other impediments restricting the migration of the shad and river herring to their historical spawning grounds and establish fish passage facilities. The Pennsylvania Fish Commission (PFC) will continue to refine its inventory of low head dams through SRAFRFC and continue to promote fish passage at structures on the Susquehanna River tributaries having the potential for Alosid [<i>sic</i>] spawning and nursery habitat. Maryland, Virginia, District of Columbia, U.S. Fish and Wildlife Service and Corps of Engineers will continue its work for fish passage at Little Falls and Rock Creek.</p>	<p>4.1 The District of Columbia, Maryland, Pennsylvania and Virginia will implement the plan adopted by the Fish Passage Workgroup to remove barriers. Projects include:</p> <p>A) Permanent fish passage facilities are being designed and will be constructed at Conowingo Dam at a cost of \$12.5 million. (1989)</p>	<p>Variable</p> <p>Completed</p> <p>2010</p> <p>2011</p> <p>Continue</p> <p>2012</p> <p>2009 - 2012</p> <p>2014 Continue</p>	<p>Actions 4.1A - 4.1C, 4.1E, and 4.1G - 4.1I have been completed. Actions 4.1D, 4.1F, and 4.1J – 4.1L are underway.</p> <p>Conowingo Dam East Fish Lift is operational.</p> <p>SRAFRFC adopted the Migratory Fish Management and Restoration Plan for the Susquehanna River Basin in 2002, which was revised in 2010. This plan sets restoration goals for all Alosine species.</p> <p>The last significant blockage in MD for spawning American shad passage is the Conowingo Dam.</p> <p>Shad passage at Conowingo is being evaluated as part of the FERC relicensing process. Shad upstream passage efficiency at Conowingo was estimated in 2010 at 45% and in 2012 at 26%.</p> <p>American shad telemetry study detected fall-back behavior, where many fish enter the East Fish Lift, but leave without passage.</p> <p>Fish passage and habitat studies conducted as part of the FERC relicensing process are available at: http://www.exeloncorp.com/locations/ferc-license-renewals/Conowingo/Pages/Documents.aspx</p> <p>FERC has not renewed the license for the Conowingo Project. The project is currently operating on an annual license under the provisions</p>

1989 Chesapeake Bay Alosid [sic] Management Plan Implementation Table (updated 06/2017)

Strategy	Action	Date	Comments
Continue 4.1	Continue 4.1 A	2016	<p>of the old license. The current license expired on September 1, 2014. The federal and state agencies are still working out the details for balancing hydropower production with all the other uses of the lower Susquehanna River including environmental considerations.</p> <p>Exelon has come to an agreement with USFWS for improvements of fish passage at Conowingo Dam. The planning and modeling for these improvements will begin in 2017/2018, but construction and modifications will not begin until the license is renewed: tentatively scheduled for 2018.</p>
Continue 4.1	4.1 B) Design planning and implementation of fishways at Holtwood, Safe Harbor and York Haven dams on the Susquehanna River. (In progress)	<p>1986 Completed</p> <p>2010 Continue</p> <p>2015</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. All improvements were completed by 2015.</p> <p>York Haven Power Company, LLC plans for a “nature-like” fishway were approved by Dauphin County commissioners and building is slated to begin in 2018-2020.</p>
	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</p> <p>2014</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.</p> <p>The tool is currently being used and was updated in 2014/2015. Another update is slated for 2017/2018.</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 Chesapeake Bay Alosid [*sic*] Management Plan Implementation Table (updated 06/2017)

Strategy	Action	Date	Comments
Continue 4.1	Continue 4.1 D	1989-2007 Continue	VA has removed 6 dams, breached 3, and built passage structures at 9 as of 2015. Several fish passage projects are being pursued. VA dam removal status is available at http://www.dgif.virginia.gov/fishing/fish-passage/
		2009	Between 1989 and 2013, approximately 2,576 miles of habitat were reopened to anadromous and resident fish.
		Continue	From 1986 to 2003, >340 million American shad fry and fingerlings were cultured and released in Susquehanna, James, Pamunky, Mattaponi, Rappahannock, Potomac & Choptank rivers. Rappahannock River stocking began in 2003.
		2011-2013 Completed	Patuxent River hickory shad have been restored and stocking discontinued. Limited monitoring will continue. Marshyhope stocking was discontinued after 2011. Choptank River hickory shad have been restored and stocking discontinued. American shad are only stocked in the Choptank River as of 2011.
		2010 Continue	Additional wells were drilled at Manning hatchery and liners added to existing ponds to accommodate increased river herring culture.
		2013 2015	Union Dam and Simkins Dam on Patapsco River were removed. Removal of Bloede Dam on the Patapsco River is scheduled for 2017-2018.
			Experimental stocking of American shad, hickory shad, and river herring in the Patapsco River began in 2013. 542,600 alewife, 290,000 American shad, 200,000 blueback, and 615,000 hickory shad were stocked in 2015.
		2014 Continue	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).

1989 Chesapeake Bay Alosid [sic] Management Plan Implementation Table (updated 06/2017)

Strategy	Action	Date	Comments
Continue 4.			
	4.1 E) A demonstration fish ladder project has been developed with the Chesapeake Bay Foundation and the town of Elkton as an example with public access. (1989)	Completed	Elkton dam fishway was built in 1993. Thousands of herring and resident fish have used the fishway to access 12 miles of upstream habitat for spawning, forage, and cover. Fish Passage staff documented over 7,000 alewife and blueback herring using the fishway in 1999.
		2005	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.
		2009	In 2009, there was some evidence of river herring spawning upstream of the Elkton Dam.
		2014	In 2014, river herring were observed below the fish ladder but sediment deposits are inhibiting fish from using the ladder. The town of Elkton is responsible for maintaining the ladder and will make provisions for improving access when their MDE permit is renewed in 2016.
	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	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

1989 Chesapeake Bay Alosid [*sic*] Management Plan Implementation Table (updated 06/2017)

Strategy	Action	Date	Comments
Continue 4.1		2009-2013 Completed	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: J) Sources of adult fish used for restocking areas will be coordinated with other states and agencies. (1990)	Continue Continue	Hatchery-rearing methods are standardized. MD, VA, and PA strip spawn. DE hatchery spawning is hormone free. Jurisdictional coordination is good. All American shad broodstock used by MD, VA, PA, and USFWS are from the Potomac River. MD stocks larval, early juvenile, and late juvenile stages to improve stocking success rate. PA stocks some American shad from the Delaware and Susquehanna Rivers.
	4.1 K) The reintroduction of alosid [<i>sic</i>] stocks will require specific regulatory measures to protect the	Continue	Moratorium in place for American and hickory shad. Hickory shad data is insufficient for most tributaries

1989 Chesapeake Bay Alosid [*sic*] Management Plan Implementation Table (updated 06/2017)

Strategy	Action	Date	Comments
Continue 4.1	newly-introduced fish until populations have been established.	2010 2011 2013	to determine population status. Juvenile downstream survival has to be improved at dams having Francis turbines: Holtwood and York Haven. Normandeau studies at Safe Harbor (2008) and Conowingo (2012) indicate ~86% survival of adult American shad during downstream passage. Moratorium is in place for river herring. Allocation of shad and herring resources among stakeholders has been deferred until the species stocks are declared restored.
	4.1 L) Monitoring is essential in gauging the impact of fish passage projects on restoration efforts.	1999 Continue Continue Continue	ASMFC Amendment 2 encourages assessment of fishway passage efficiency/inefficiency for river herring. Boshers Dam vertical slot fishway is monitored for passage each spring. American shad plus 23 other species are known to use the passage. 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 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.	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 2014	SRAFRFC adopted a new Alosine Management and Restoration Plan for the Susquehanna River Basin in 2002. Restoration Plan was revised in 2010 http://www.dec.ny.gov/docs/fish_marine_pdf/r7fsraf_cfinal.pdf 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.
	4.2.2 A) Maryland, Pennsylvania, and Virginia working within SRAFRFC, will promote using Susquehanna River brood stock for hatchery production.	Discontinued 2002	Brood stock are no longer collected from the Susquehanna River. MD, VA, PA, and USFWS use American shad brood

1989 Chesapeake Bay Alosid [sic] Management Plan Implementation Table (updated 06/2017)

Strategy	Action	Date	Comments
		Continue	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.
		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.
	4.2.2 B) Virginia will expand funding to the recently constructed Pamunkey/Mattaponi Indian Reservation shad hatcheries.	1993 Continue	Funding was from VMRC, but is now provided by VDGIF.
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. 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) C) Operation of turbines as necessary to meet the DO standard (1989) D) Monitored spills as necessary (1989) E) A schedule of minimum and continuous flows (1989)	Continue 1988 – 1991 Completed Continue Continue 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. All 7 Francis turbines now have turbine venting systems and partial intake air injection system. Power generation is adjusted as needed. Water releases are closely monitored to maximize pool volume. The dam and reservoir are managed to meet required water flows. However, the minimum flow (cfs) is not continuously maintained, but rather allowed to fluctuate below the minimum within the management window. The minimum flow requirement is not daily but rather the average monthly flow. Flow requirements are being negotiated.
4.4 Maryland DNR has proposed new criteria for use in the revised water use classification and water quality standards system setting standards for	4.4 Establish new categories in the water classification system to guide resource management based on the physical habitat and water quality	2007	Maps delineating particular habitats of concern are used for developing water quality standards.

1989 Chesapeake Bay Alosid [*sic*] Management Plan Implementation Table (updated 06/2017)

Strategy	Action	Date	Comments
		2010 2012 Continue 2014 Continue	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 Jurisdictions adopted the Chesapeake Watershed Agreement (2014) to set specific restoration goals and timeframes. For more information: http://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignatures-Hires.pdf
	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.	Continue 2014 Continue	Chesapeake Bay Program develops, revises, and monitors goals and strategies for chemical contaminants. For more information: http://www.chesapeakebay.net/issues/issue/chemical_contaminants Jurisdictions adopted the Chesapeake Watershed Agreement (2014) to set specific restoration goals and timeframes. For more information: http://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignatures-Hires.pdf
	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 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.	2011 2008 Continue 2011 Continue	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. MD DNR Fisheries Service is studying spawning and hatching success with associated habitat and watershed conditions including land use. Analyses indicate that urbanization is detrimental to Alosine spawning. Sediment accumulation behind Conowingo Dam is nearing capacity. At capacity, the Dam will no

1989 Chesapeake Bay Alosid [sic] Management Plan Implementation Table (updated 06/2017)

Strategy	Action	Date	Comments
		<p>2014 Continue</p>	<p>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.</p> <p>Jurisdictions adopted the Chesapeake Watershed Agreement (2014) to set specific restoration goals and timeframes. For more information: http://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignatures-Hires.pdf</p>
	<p>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).</p> <p>1) Determine the relative contributions to acidic deposition from various sources of acid deposition precursor emissions and identify any regional variability.</p> <p>2) Assess the consequences of the environmental impacts of acid deposition on water quality.</p> <p>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.</p>	<p>Continue</p> <p>2014</p> <p>Continue</p>	<p>Chesapeake Bay Program develops, revises, and monitors goals and strategies for air pollution. For more information: http://www.chesapeakebay.net/issues/issue/air_pollution</p> <p>Jurisdictions adopted the Chesapeake Watershed Agreement (2014) to set specific restoration goals and timeframes. For more information: http://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignatures-Hires.pdf</p>

Acronyms:

ACCSP – Atlantic Coastal Cooperative Statistics Program
 ASMFC – Atlantic States Marine Fisheries Commission
 CBAMP – Chesapeake Bay Alosa Management Plan
 CBP - Chesapeake Bay Program
 CBSAC – Chesapeake Bay Stock Assessment Committee

Cfs – Cubic feet per second
 CPUE – Catch per unit effort
 DCFM – District of Columbia Fisheries Management
 DO – Dissolved oxygen
 EPA – Environmental Protection Agency
 FERC – Federal Energy Regulatory Commission
 FMP - Fishery Management Plan

GIS – Geographic information system
GIT – Goal implementation team
GM – Geometric mean
JAI – Juvenile abundance index
MAFMC – Mid-Atlantic Fisheries Management Council
MD DNR – Maryland Department of Natural Resources
NAFO – Northwest Atlantic Fisheries Organization
NEFMC – New England Fishery Management Council
NMFS – National Marine Fisheries Service
NOAA – National Oceanic and Atmospheric Administration
PA FBC – Pennsylvania Fish and Boat Commission
PFC – Pennsylvania Fish Commission
PRFC – Potomac River Fisheries Commission
SAS – Stock assessment sub-committee
SRAFRC – Susquehanna River Anadromous Fish Restoration Committee
STAC - Chesapeake Bay Program, Scientific and Technical Advisory Committee
TEWG – Technical Expert Working Group
TMDL – Total maximum daily load
USACE – United States Army Corps of Engineers
USFWS – United States Fish and Wildlife Service
VCU – Virginia Commonwealth University
VGIF – Virginia Game and Inland Fish
VIMS – Virginia Institute of Marine Science
VMRC – Virginia Marine Resource Commission
WIP – Watershed implementation plan
YOY – Young of year

2016 Maryland FMP Report (March 2017)

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

Atlantic croaker and spot commercial and recreational harvests from the Chesapeake Bay have declined in recent years. Coastwide harvest has followed the same trend. Atlantic croaker age structure and both species size structures have been truncating over time, indicating a shift in the populations to younger, smaller fish. The Atlantic States Marine Fisheries Commission (ASMFC) will be evaluating benchmark stock assessments (peer reviewed in March 2017) and updating the traffic light analysis – a method to evaluate fishery and abundance trends- for both species (in progress) to determine if coastwide management measures are necessary. Maryland and the Potomac River Fisheries Commission (PRFC) have some regulations for Atlantic croaker, but spot are currently unregulated. Both species are part of coastwide stocks (not resident to Chesapeake Bay) and most coastal jurisdictions do not have any regulations for either species.

Fishery Management Plans (FMPs)

The Chesapeake Bay Atlantic Croaker and Spot Fishery Management Plan (CBCS FMP) was adopted in 1991. The FMP's goal is to: "Protect the Atlantic croaker and spot resource in the Chesapeake Bay, its tributaries, and coastal waters, while providing the greatest long term ecological, economic, and social benefits from their usage over time." To accomplish this goal, management strategies were developed to prohibit the harvest of small fish (age 1 and younger) of both species and to recommend monitoring and research programs for stock assessments and habitat needs. The CBCS FMP was reviewed in 2014 by the Maryland Plan Review Team. It was determined that the plan is an appropriate framework for managing the croaker and spot resources. The team recommended that the plan be reviewed again in 2017 after the completion of coastal stock assessments and the development of new management triggers. However, the Maryland FMP review process is no longer being implemented.

The 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 interstate croaker FMP was adopted in November 2005, which replaced the original FMP, and established a spawning stock biomass target and threshold.¹ Addendum I (2010) to Amendment 1 modified the management area and biological reference points. Addendum II to Amendment 1 for croaker (2014) established a precautionary management framework using the Traffic Light Approach.

An Omnibus Amendment to the Interstate Fishery Management Plans for Spanish Mackerel, Spot, and Spotted Seatrout was adopted in 2011 to allow these species to be managed under the authority of the Atlantic Coastal Fisheries Cooperative Management Act.² Addendum I to the Fishery Management Plan for Spot (2014) established a similar precautionary management approach using the Traffic Light Approach for spot. There have been no interstate management requirements for either Atlantic croaker or spot.

Atlantic croaker - Biological reference points (BRPs) were established for croaker in the mid-Atlantic region in 2005. The BRPs were revised in 2011 (Addendum I) following the 2010 ASMFC stock assessment and now apply to the entire Atlantic coastal stock.³ 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 support changing management.¹ 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.⁴ The traffic light approach (TLA) was approved in Addendum II to Amendment 1 of the Atlantic Croaker FMP (August 2014).⁵ 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.⁶ Juvenile indices (seine and trawl) for the Maryland portion of the Chesapeake Bay have been calculated for every year since 1959. Maryland started a 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.⁷ The 2010 stock assessment indicated that biomass was increasing and the age-structure of the population was expanding from the late 1980's through 2008. A new benchmark stock assessment was completed and peer reviewed in March of 2017, and is slated for final consideration by the

ASMFC South Atlantic Board in August 2017. MD DNR staff participated in the data workshop in September 2015, both assessment workshops in 2016 and the March 2017 review workshop. Analysis of TLA for 2014 showed that the population characteristic (commercial and recreational landings) tripped for the second year in a row. The abundance characteristic also declined in 2014 but the proportion of metrics was below the 30% threshold. No management action was required but the declining values in all adult indices is concerning. The TLA was not updated in 2015 or 2016, since the stock assessment was being conducted, but is currently being updated for comparison to stock assessment results. Atlantic croaker ages were determined from fish captured in Maryland pound nets and 2015 was the first year in which no fish older than age 7 were present. Age 7 and age 8 croaker were present in 2016, but only accounted for 0.1% of sampled Atlantic croaker.

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.⁸ Commercial landings have declined to moderate levels in recent years. Maryland’s 2015 landings were 397,879 lbs. and Virginia 2015 landings were 4.6 million lbs.; both declined for the third consecutive year and were below their long-term means (NMFS data). Preliminary Maryland landings indicate a more significant decline in 2016. Recreational harvest and release estimates from the Marine Recreational Information Program (MRIP) are higher for Virginia than Maryland for the majority of years and decreased in both states in 2016 (Figures 3 and 4).⁹ The decline in 2016 recreational harvest was greater in Maryland than in Virginia.

Figure 1. Maryland commercial landings of Atlantic croaker from 1950-2015.⁸

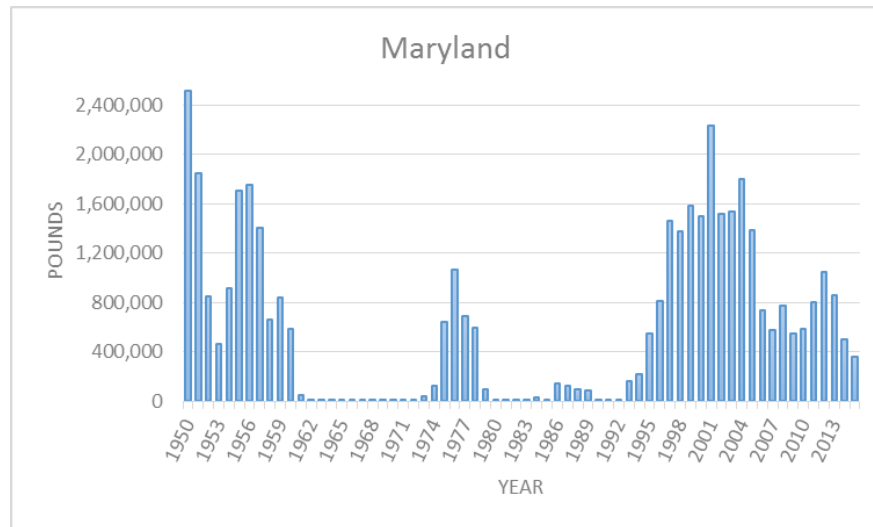


Figure 2. Virginia commercial landings of Atlantic croaker: 1950-2015.⁸

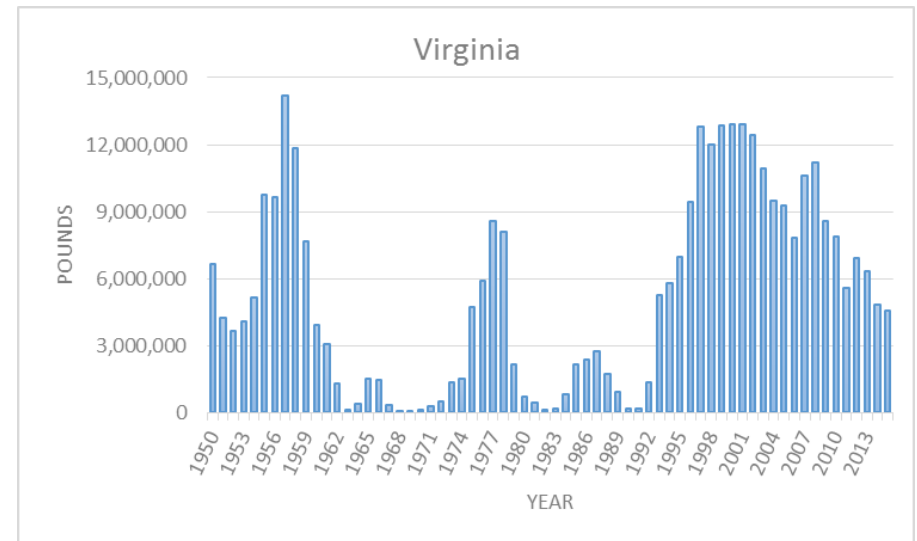


Figure 3. Maryland estimated recreational harvest and release for Atlantic croaker: 1981-2016.⁹

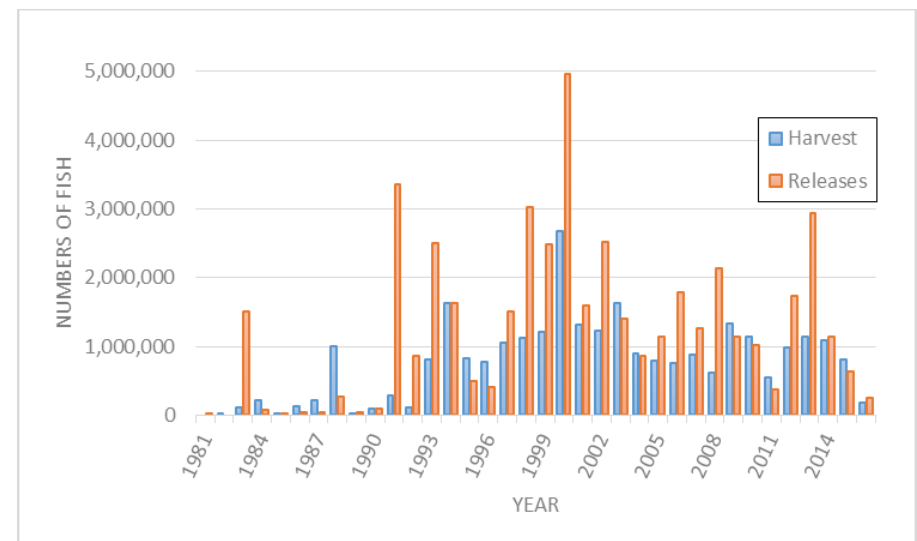
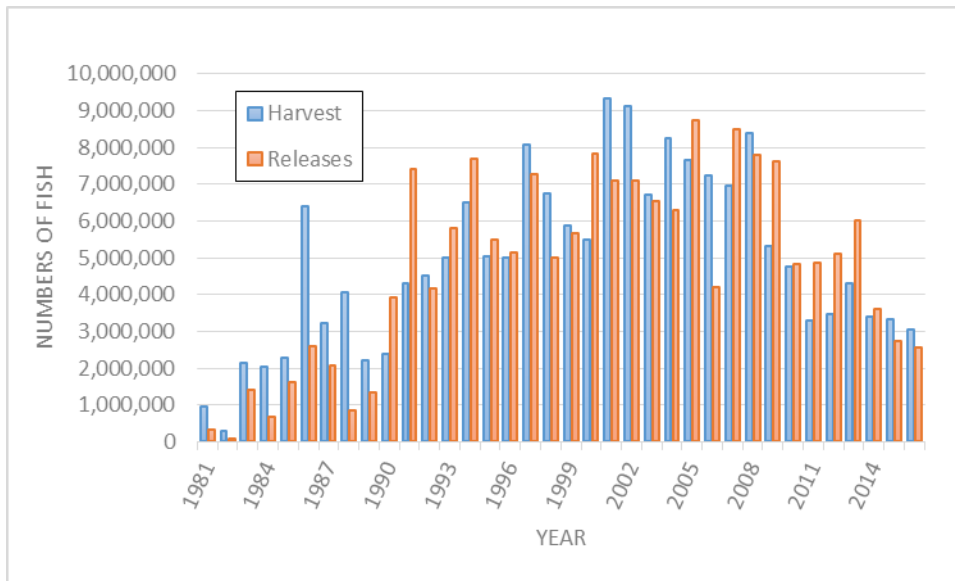


Figure 4. Virginia estimated recreational Atlantic croaker harvest and release, 1981-2016.⁹



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.^{2,11} The TLA incorporates multiple data sources into a single metric and includes both population abundance and harvest data. If the threshold of 30% is triggered for two consecutive years, then state-specific management actions will be developed.⁵ The ASMFC Spot Plan Review Team (PRT) met in 2015 to review the trigger indices.¹⁰ The review team found that the harvest composite index (recreational and commercial harvest) was above the threshold in 2012 and 2013 but was below the threshold in 2014. The abundance composite index (SEAMAP and NNFS surveys) was triggered in 2014 since it was above the 30% threshold but both harvest and abundance indices need to be over the threshold before management action is triggered. Although the PRT did not recommend any management actions at this time, there was concern over declining harvest trends and low fishery independent index values.¹⁰

Spot Stock Status— Overfishing and overfished status remain unknown. The first benchmark stock assessment was developed in 2016 and peer reviewed in March 2017. Maryland DNR staff participated in the data workshop in September 2015, both assessment workshops in 2016, and the 2017 peer review workshop. The

ASMFC South Atlantic Board will review the assessment in August 2017 to decide if and/or how to use the assessment to guide management. The TLA will also be updated and presented to the board in August 2017. Two juvenile indices (JI) are calculated to evaluate recruitment of spot in Maryland’s portion of Chesapeake Bay. A JI is calculated for spot from the MD DNR Blue Crab Trawl Survey (BCS) and another from the Maryland Estuarine Juvenile Finfish Survey (EJFS). These indices are highly variable. Chesapeake Bay juvenile indices were near their time series means in 2012, but have declined steadily to a level near the time series low in 2015 for both surveys. The 2016 values increased but remain below average.

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. Both states had commercial landings and recreational harvest well below average in 2015 and 2016, respectively. Maryland’s preliminary 2016 commercial landings indicates a decline from the 2015 value.

Figure 5. Maryland commercial landings of spot: 1950-2015.⁸

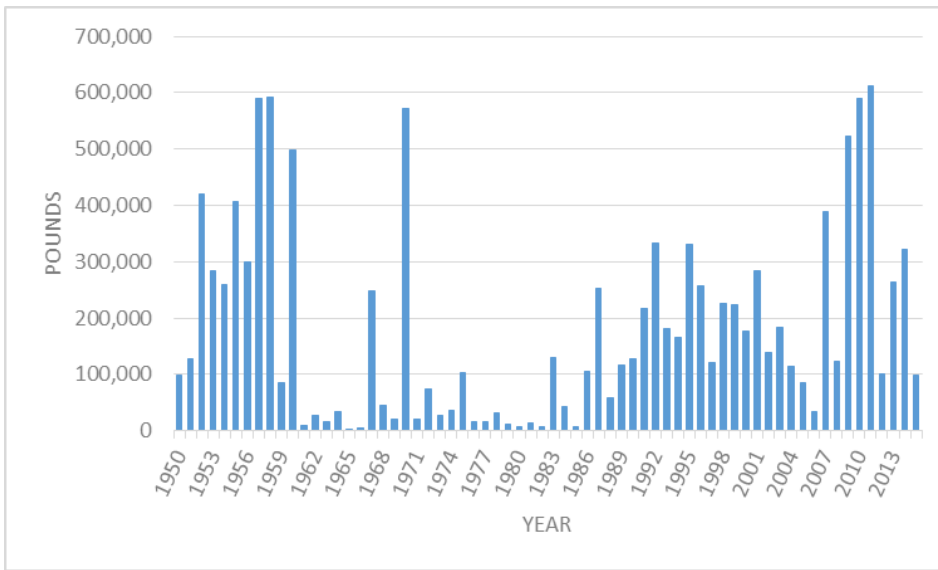


Figure 6. Virginia commercial landings of spot: 1950-2015.⁸

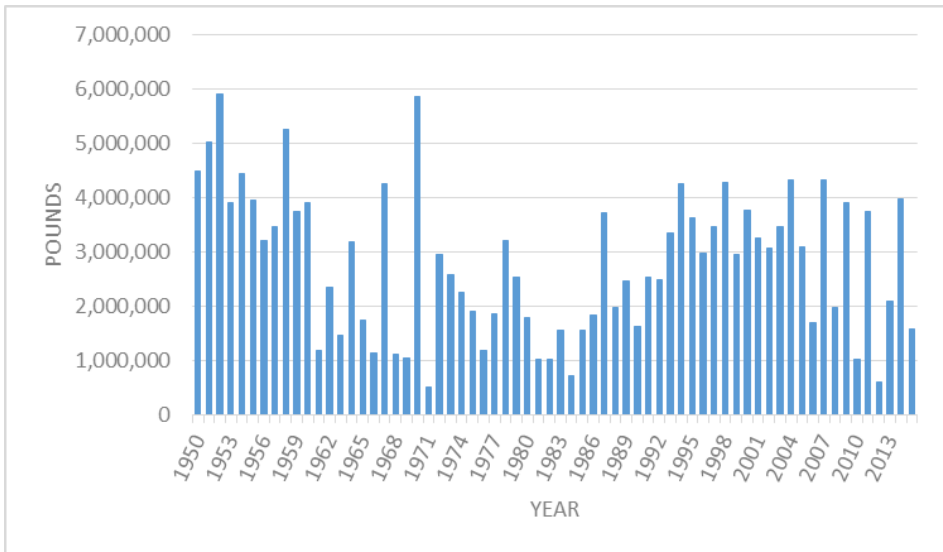


Figure 7. Maryland estimated recreational spot harvest and releases: 1983-2016.⁹

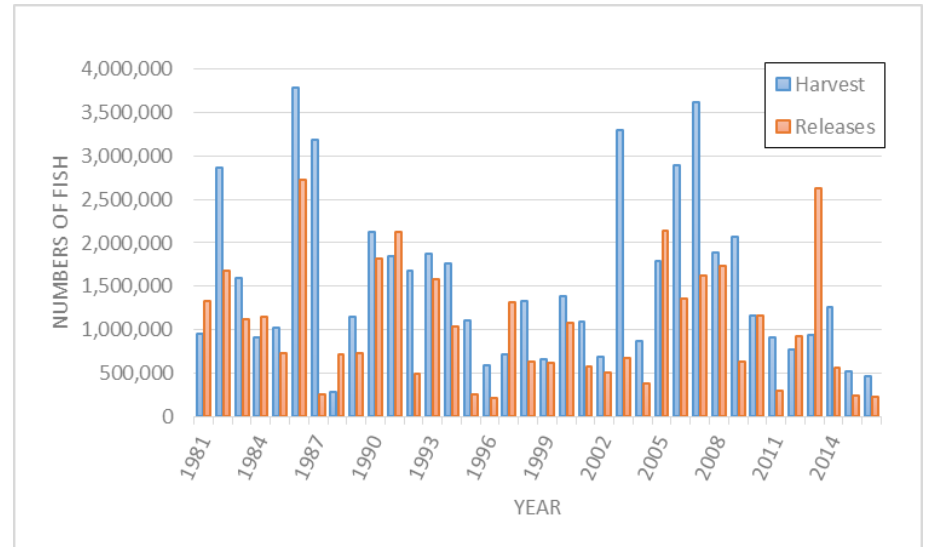
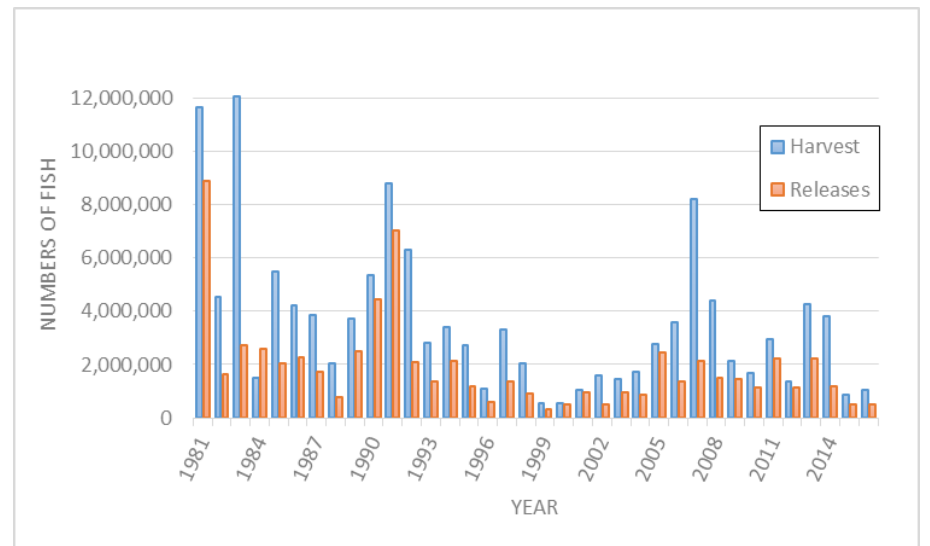


Figure 8. Virginia estimated recreational spot harvest and releases: 1983-2016.⁹



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.^{6,12} Maryland and PRFC have a recreational minimum size limit of 9 inches for croaker and a creel limit of 25 fish per person per day. Maryland has a commercial season from March through December and a 9 inch minimum size limit. There are no harvest restrictions for Atlantic croaker in Virginia or for spot in any of the Chesapeake Bay jurisdictions.

Issues/Concerns

Continued monitoring of the commercial and recreational harvest of both croaker and spot is important in order to obtain data for conducting stock assessments and evaluating the status of the stocks. There is some concern about the overall decreasing trend in commercial landings of spot along the coast. The ASMFC Spot Plan Review Team will continue to monitor the trend and make management recommendations if necessary. The use of circle hooks to reduce recreational discard mortality is encouraged. Both species are caught indirectly and together during other fishing activities; bycatch mortality is a continued concern. Small spot, for example, could account for as much as 80% of the shrimp trawl catch by weight and 60% by number, depending on area.¹³ States are encouraged to use bycatch reduction devices to reduce bycatch.

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

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¹ 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.

² 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.

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

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

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

⁶ Rickabaugh, H., Jr. 2017. Maryland Atlantic Croaker (*Micropogonias undulatus*) Compliance Report to the Atlantic States Marine Fisheries Commission – 2016. Maryland Department of Natural Resources Fisheries Service May 25, 2017.

⁷ ASMFC. 2010. Atlantic Croaker 2010 Benchmark Stock Assessment. Washington DC.

⁸ Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division, June 30, 2017.

⁹ Personal communication from the National Marine Fisheries Service, Recreational Fisheries Statistics Division, Marine Recreational Information Program, June 30, 2017.

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

¹¹ 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.

¹² Rickabaugh, H., Jr. 2016. Maryland Spot (*Leiostomus xanthurus*) Compliance Report to the Atlantic States Marine Fisheries Commission – 2015. Maryland Department of Natural Resources Fisheries Service September, 2016.

¹³ 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.

1991 Chesapeake Bay Program Atlantic Croaker and Spot Fishery Management Plan Implementation (updated 03/17)

Problem Area	Action	Date	Comments
<p>Stock Status Annual abundance of Atlantic croaker and spot is highly variable from year-to-year. Little information is available on the causes of stock fluctuations.</p>	<p>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.</p>	<p>2005</p> <p>2010</p> <p>Continue</p> <p>2015</p> <p>2017</p>	<p>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.</p> <p>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.</p> <p>A coast wide stock assessment for both species was initiated in 2015 and was peer reviewed in 2017. The assessments will be presented to ASMFC in 2017.</p>
	<p>1.2.1 A) MD and the PRFC have a minimum size limit for Atlantic croaker.</p> <p>B) VA does not have a minimum size limit for Atlantic croaker.</p>	<p>Continue</p> <p>1993</p> <p>Continue</p>	<p>CBP jurisdictions will promote the increase in yield per recruit for the Atlantic Croaker and spot fisheries.</p> <p>MD and PRFC have a 9” minimum size limit and a 25 fish/person/day creel limit for croaker recreational fisheries. MD has an open commercial season from March 16 through December with a 9” minimum size limit. VA does not have any restrictions for Atlantic croaker.</p>
	<p>1.2.2 CBP jurisdictions will evaluate the need to implement a minimum size limit for spot.</p>	<p>1992</p> <p>2009</p> <p>2011</p> <p>2014</p> <p>Continue</p>	<p>No recommendations have been made for spot.</p> <p>There is some concern over declining juvenile abundance.</p> <p>The ASMFC omnibus amendment, approved in 2011, did not require additional management criteria.</p> <p>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).</p>

1991 Chesapeake Bay Program Atlantic Croaker and Spot Fishery Management Plan Implementation (updated 03/17)

Problem Area	Action	Date	Comments
<p>Harvest of Small Croaker and Spot 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.</p>	<p>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.</p> <p>B) Virginia will continue its prohibition on trawling in state waters. Virginia will maintain its 2⁷/₈ inch minimum mesh size for gill nets</p> <p>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.</p> <p>D) PRFC will continue its prohibition on gill net fishing in the summer.</p>	<p>Continue</p> <p>2004 Continue</p> <p>Continue</p>	<p>Commercial trawling is prohibited within the Chesapeake Bay in both MD and VA.</p> <p>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).</p> <p>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”.</p>
	<p>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.</p>	<p>1992 Continue</p>	<p>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.</p>
<p>Research and Monitoring Needs There is a lack of stock assessment data for both Atlantic croaker and spot stocks in the Chesapeake Bay.</p>	<p>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.</p>	<p>Continue</p> <p>2010 Continue</p>	<p>The amount of data available for croaker has increased since the 2003/2004 coastal stock assessment.</p> <p>The 2010 ASMFC coastal stock benchmark assessment concluded that the coastal Atlantic croaker population is a single stock. Addendum 1 to the ASMFC FMP changed the management unit to a single stock and modified the BRPs. Stock assessment data for Atlantic croaker and spot is collected by the MD Estuarine Juvenile Finfish Survey, and VIMS Juvenile Abundance Surveys (formerly known as the VIMS Trawl Survey and the VIMS Juvenile Seine Survey), NEAMAP and ChesMMAP. Both Maryland and Virginia collect age, length, weight and sex data from commercially harvested spot and croaker.</p>

1991 Chesapeake Bay Program Atlantic Croaker and Spot Fishery Management Plan Implementation (updated 03/17)

Problem Area	Action	Date	Comments
	<p>3.2 A) MD and PRFC will encourage research to collect data on croaker and spot biology, especially estimates of population abundance, recruitment, and reproductive biology.</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>2008 Continue</p> <p>2011 Continue</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 & 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.</p> <p>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>Commercial pound net sampling in Maryland’s portion of the Chesapeake Bay was conducted from late May through early September, 2016. Atlantic croaker mean length from the onboard pound net survey was 254 mm total length in 2014, below the third lowest value of the 24 year time. Ages ranged from 1` to 8 years old, with age 4 fish accounting for the majority of the catch. Atlantic croaker over age 6 have become less abundant since the mid-2000s. Spot mean length from the onboard sampling decreased in 2016 to the 24 year time series low of 175 mm total length.</p> <p>Atlantic croaker juvenile abundance from the Maryland Chesapeake Bay Blue Crab Trawl Survey was high in 2012, declined through 2015 to the 2nd lowest value of the 27 year time series, increased in 2016, but was still below the time series mean. The spot Chesapeake Bay juvenile trawl index increased in 2016 after declining from 2013 to 2015, but was still below the time series mean. The 2015 value was the lowest of the 28 year time series.</p>

1991 Chesapeake Bay Program Atlantic Croaker and Spot Fishery Management Plan Implementation (updated 03/17)

Problem Area	Action	Date	Comments
<p>Habitat and Water Quality Issues Habitat alteration and water quality impact the distribution of finfish species in the Chesapeake Bay</p>	<p>4.1CBP 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>2000 Continue</p>	<p>Water quality and living resource commitments were updated and renewed in the Chesapeake Bay 2000 Agreement. These activities include the discharge of toxic pollutants or excessive nutrients into the Chesapeake Bay and its tributaries, interruption or changes in water discharge patterns, deposition of solid waste, sewage sludge or industrial waste into the Bay (which may lead to anoxic conditions), rapid coastal development, unregulated agricultural practices, net coastal wetland loss or the dredging of contaminated sub-aqueous soils. Based on the most recent available data, scientists project that 58% of the pollution reduction efforts needed to achieve the Bay restoration goals have been implemented since 1985. Excess nitrogen, phosphorus and sediment are the major pollutants. The greatest challenge to achieving restoration is population growth and development which destroys forests, wetlands and other natural areas.</p>
	<p>A) Developing habitat requirements and water quality goals for various finfish species.</p>	<p>2009</p>	<p>Habitat and water quality objectives and actions were delineated in the President’s Executive Order and provide more current strategies for managing resources in the Chesapeake Bay. Estuaries are designated as Habitat Areas of Particular Concern (HAPC) for spot.</p>
	<p>B) Developing and adopting basinwide nutrient reduction strategies.</p>	<p>2014 Continue</p>	<p>The CBP developed a new Watershed Agreement in 2014 with outcomes and strategies that address sustainable fisheries, vital habitats, water quality, toxic contaminants, healthy watersheds, stewardship, land conservation, public access, environmental literacy and climate resiliency. For more information see:</p>
	<p>C) Developing and Adopting basinwide plans for the reduction and control of toxic substances.</p>		<p>http://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignatures-Hires.pdf</p>
	<p>D) Developing and adopting basinwide management measures for conventional pollutants entering the Bay from point source and non-point 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 (SAV).</p> <p>G) Managing population growth to minimize adverse impacts to the Bay environment</p>	<p>2016-2017</p>	<p>Of particular interest for croaker and spot is the evaluation of forage in the Chesapeake Bay as part of the sustainable fisheries outcomes. A two-year work plan (2016-2017) was developed to address forage in the Bay and a STAC workshop was held in 2014. Both small spot and croaker were important forage for several of the key predator species. For more details, go to the workshop report at http://www.chesapeake.org/pubs/346_Ihde2015.pdf</p>

Acronyms

ASMFC - Atlantic States Marine Fisheries Commission;

BRDs – Bycatch Reduction Devices

BRPs - Biological Reference Points

CHESFIMS - Chesapeake Bay Fishery Independent Multispecies Fisheries Survey

ChesMMAP - Chesapeake Bay Multispecies Monitoring and Assessment Program;

CBP - Chesapeake Bay Program

F – Fishing mortality

FMP - Fishery Management Plan

NEAMAP – Northeast Area Monitoring and Assessment Program

NMFS - National Marine Fisheries Service

ODU - Old Dominion University

PRFC - Potomac River Fisheries Commission

PRT - Plan Review Team

SEAMAP - Southeast Area Monitoring and Assessment Program

SSB – Spawning Stock Biomass

STAC - Scientific and Technical Advisory Committee

TLA - Traffic Light Approach

VIMS - Virginia Institute of Marine Science

2016 Maryland FMP Report (August 2017)

Section 4. Atlantic Menhaden (*Brevoortia tyrannus*)

The development of Amendment 3 to the Atlantic States Marine Fisheries Commission's (ASMFC) Interstate Fishery Management Plan (FMP) for Atlantic Menhaden continued through 2016 with a draft available for public comment in August 2017. The amendment focuses on evaluating state allocations of the total allowable catch (TAC) and potentially enacting interim reference points that take into account the ecological importance of menhaden. Peer-reviewed, ecologically based reference points will not be available in time for inclusion in Amendment 3. The last benchmark stock assessment in 2014 concluded that the menhaden stock is not overfished and overfishing is not occurring.¹ As a result, ASMFC increased the TAC for the 2015 and 2016 fishing years to 187,880 MT, and raised it again for the 2017 fishing year to 200,000 MT. The Atlantic Menhaden Technical Committee determined there was a 0% change of overfishing the stock at this level using the current reference points. The TAC will be evaluated again after the adoption of Amendment 3 to make any adjustments if the reference points are changed. Addendum 1 to Amendment 2 was adopted and provided operational flexibility to Chesapeake Bay pound netters during the bycatch fishery beginning in 2016.

ASMFC Fishery Management

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

ASMFC in 2014, and another workshop on ERPs was conducted in 2015. The outcomes of these workshops are being used to guide the development of ERPs. A review of the models used to develop ERPs is expected to be completed in 2019. The ASMFC initiated the development of Amendment 3 in May 2015 with a projected completion date in November 2017. The Amendment addresses commercial fishery allocation and reference point selection for the Atlantic coast stock. The public information document was available for review from late 2016 through early 2017. The public comments were used to help develop options in the amendment. Draft Amendment 3 was endorsed for public review in August 2017 with an open public comment period in September and October. In addition to the amendment, a socioeconomic study was conducted to understand the impacts of potential regulation changes on the fishing industry, and presented to the ASMFC Atlantic Menhaden Board in 2016.

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.² 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 consideration 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.¹ The 2014 assessment addressed several issues from the previous assessments. The age at maturity was corrected and alternative selectivity patterns in the fishery were utilized and resulted in a higher estimated proportion of age 1, 2, and 3- year old fish in the population. Most significantly, the new assessment used nine new fishery-independent indices rather than the single Chesapeake Bay pound net index that was used in the 2010 assessment. The 2014 benchmark assessment concluded that the Atlantic menhaden resource is not overfished. Total instantaneous fishing mortality was estimated at 0.27, well under the threshold of 2.98 and the

target of 1.03. As a result, overfishing is not occurring. Details of the 2014 assessment can be found on the ASMFC webpage (www.asmfc.org) under Atlantic Menhaden fisheries management. The next stock assessment update is scheduled for 2017.

Coastal recruitment indices have been generally low since the 1980s. In Maryland, juvenile menhaden are sampled annually through the Estuarine Juvenile Finfish Survey. The index of juvenile menhaden has been low since 1992 (Figure 1). The development of new management actions and reduced harvest could contribute to higher recruitment but environmental conditions seem to be a major factor driving recruitment.

Management Measures

The coastal overfishing designation in 2013 resulted in management measures to reduce harvest by 20% compared to the 2009 to 2011 average harvest. Based on the 2010 BRPs, a total allowable catch (TAC) of 170,800 MT (376,549,574 lbs.) was calculated for the Atlantic states for 2013. The coastal TAC was allocated state-by-state based on average state landings (2009-2011). Maryland's 2014 quota was 1.37% of the TAC or 2,320 MT (5,116,874 lbs.), Virginia's was 85.32% of the TAC (318,066,790 lbs.), and PRFC's was 0.62% of the TAC (2,334,607 lbs.). Since Maryland did not have any regulations for menhaden other than a prohibition on purse seining, new regulations were required to implement the ASMFC management measures. Following the 2014 coastal stock assessment, ASMFC increased the TAC by 10% to 187,880 MT for 2015 and 2016 (May 2015) and to 200,000 MT for 2017 (October 2016) as interim measures until new reference points and possible allocation changes are addressed in Amendment 3. The increased TAC will be divided by the allocation set in Amendment 2. The increased 2015 and 2016 quotas for Maryland, Virginia and PRFC were 5,628,568 lbs., 349,873,884 lbs. and 2,545,599 lbs.

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

The Fishery

The 2016 Maryland open fishery was closed on August 27, 2016, and reported landings were 4,639,986 lbs.³ The fishery was then capped at a 6,000 lb. per day bycatch limit for pound net fishermen who held bycatch landing permits and a 1,500 lb. per day limit for all other fisheries. Two fishermen working on the same vessel, each with a bycatch permit, were allowed to land up to 12,000 lbs. per vessel in 2017. The bycatch fishery landed an additional 995,708 lbs. for a total 2016 Maryland harvest of 5,635,694 lbs.⁴ (Figure 2). The bait fishery in Maryland is primarily a pound net fishery. This single gear type accounted for 94% of the 2016 total reported harvest. Virginia's total Atlantic menhaden harvest for 2015 (2016 data not yet available) was 353,934,037 lbs.⁵ (Figure 3) and includes the reduction and bait fishery from both the Chesapeake Bay and Atlantic Ocean. None of the Bay jurisdictions have exceeded their open fishery quota since the quotas were enacted in 2013.

In 2016, biological monitoring from the Maryland pound net (bait) fishery and the fishery independent gillnet survey in the Choptank River, indicated that the majority of harvested menhaden were age 1 through age 3 fish (92%). Menhaden ages 1 through 5 were present in the samples of both surveys. Maryland DNR will continue to collect biological data on fish sampled from commercial pound nets and will continue the Choptank River gillnet survey.

Issues/Concerns

Significant changes in management were put in place in Maryland on June 29, 2013 to meet the state-specific quotas set forth by ASMFC compliance requirements. The commercial fishery continues to be managed under a coastal TAC with subsequent state quotas. All watermen harvesting menhaden from pound nets are required to obtain a bycatch permit and to report their catch on a daily basis. Once the fishery is closed a bycatch limit of 6,000 lbs. per day is allowed for permit holders (12,000 lbs. per vessel, if two fishermen with bycatch permits are working together). Non-permit holders are restricted to a 1,500 lb. bycatch limit.

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

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

Figure 1. Geometric mean catch per haul of Atlantic menhaden juveniles in the Maryland portion of the Chesapeake Bay, 1959-2016.⁶

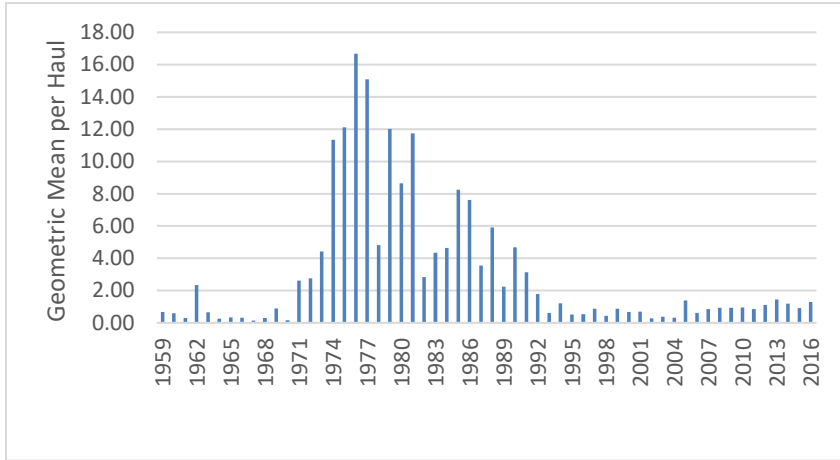


Figure 2. Maryland Atlantic menhaden commercial landings, 1981-2016.

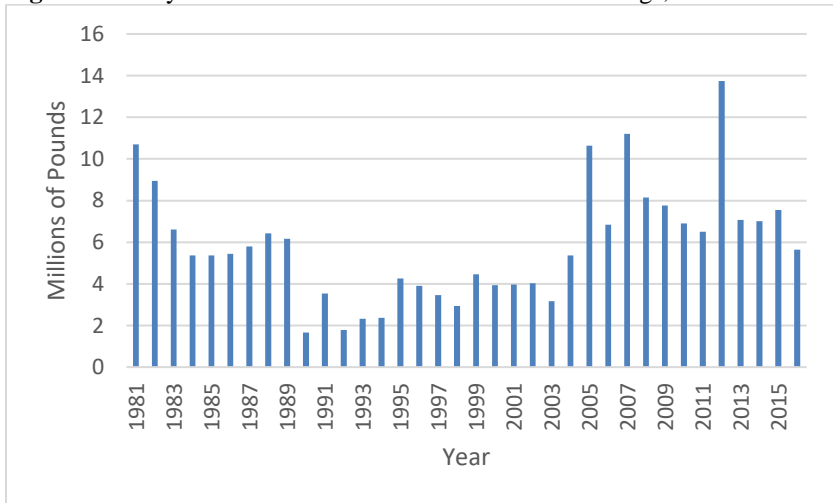
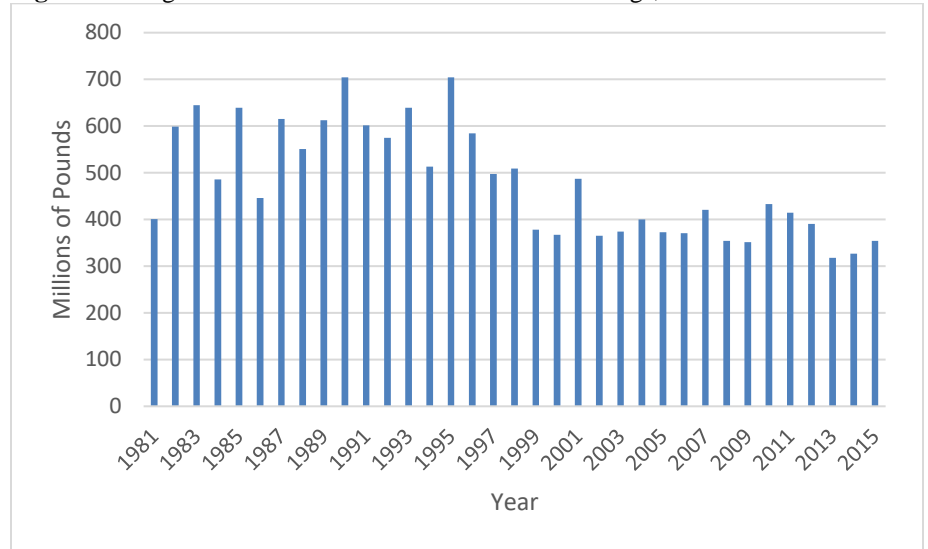


Figure 3. Virginia Atlantic menhaden commercial landings, 1981-2015.



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2016 Maryland FMP Report (April 2017)

Section 5. Black Drum (*Pogonias cromis*)

There were no management changes for black drum in 2016. Both recreational and commercial harvests remained steady for Chesapeake Bay jurisdictions. Black drum are a migratory species and coastwide management by the Atlantic States Marine Fisheries Commission (ASMFC) began in 2013. The coastwide stock is not considered overfished and overfishing is not occurring.

Fishery Management Plans (FMPs)

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

The ASMFC Interstate Fishery Management Plan for Black Drum¹ (ASMFC FMP) (June 2013) was initiated because of increased recreational and commercial harvest, inconsistent coastwide regulations, unknown condition of the stock, and concerns about harvesting immature and breeding black drum. All states are required to maintain their current level of restrictions on the black drum fishery and establish a maximum possession limit (January 1, 2014) and a minimum size limit of 14 inches (January 1, 2016). The Chesapeake Bay jurisdictions have implemented a more conservative 16-inch minimum since the mid-1990s.

Stock Status

The first coastwide benchmark stock assessment for black drum was conducted in 2014 and approved for management use in 2015.² The 2015 benchmark stock assessment used a Depletion Based – Stock Reduction Analysis and determined that the stock is not overfished and not experiencing overfishing.¹ The assessment indicated biomass was slowly decreasing, but remained well above the level needed to sustain maximum sustainable yield. Tagging data, life history data, and genetic results using nuclear microsatellite markers indicate black drum are from a single U.S. Atlantic coast stock. If there are no changes in harvest and fishing mortality, the next benchmark stock assessment is scheduled for 2020.

Current Management Measures

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

Maryland monitors commercial pound nets in Maryland's portion of the Chesapeake Bay and black drum are occasionally encountered (zero to 44 per year). Over 24 years of monitoring, fish length has ranged from 10 to 52 inches. The fishery independent seine survey conducted in the Maryland Coastal Bays has captured low numbers of juvenile black drum throughout most of the 28-year time series (zero to 77 fish per year), indicating some use of the area as nursery habitat.

The Fisheries

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

Issues/Concerns

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

The ASMFC released a new fish habitat report that includes a section on black drum habitat by life stage, areas of particular concern, and threats. Some of the habitat recommendations for black drum of particular importance to Maryland include minimizing wetland loss, promoting living shorelines, evaluating the role of submerged aquatic vegetation (SAV) and other submerged structures, and continuing to support habitat restoration projects that enhance or restore bottom habitat.³ The full report can be found at http://www.asmfc.org/files/Habitat/HMS14_AtlanticSciaenidHabitats_Winter2017.pdf

Figure 1. Reported Chesapeake Bay commercial harvest of black drum in pounds from Maryland and Virginia, 1981 - 2015.⁴ PRFC landings are divided between the states by NMFS based on the state in which the fish are sold.

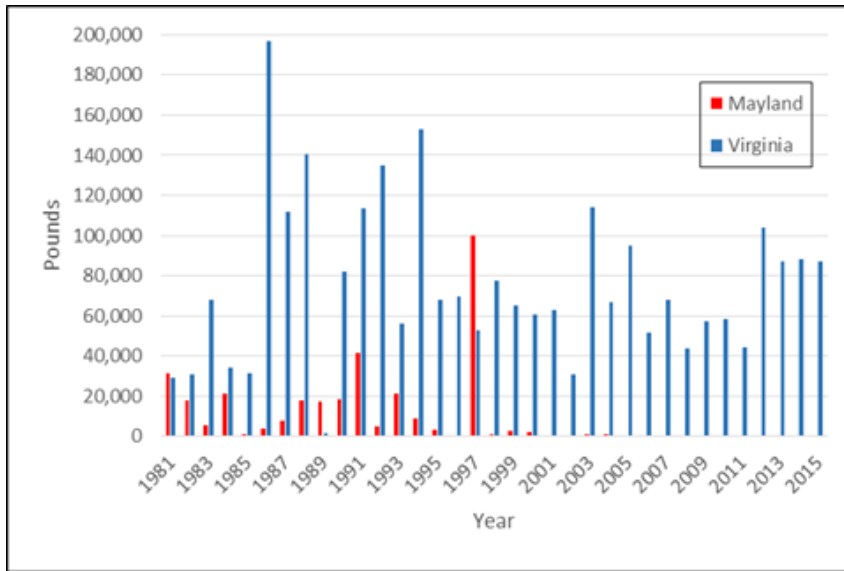
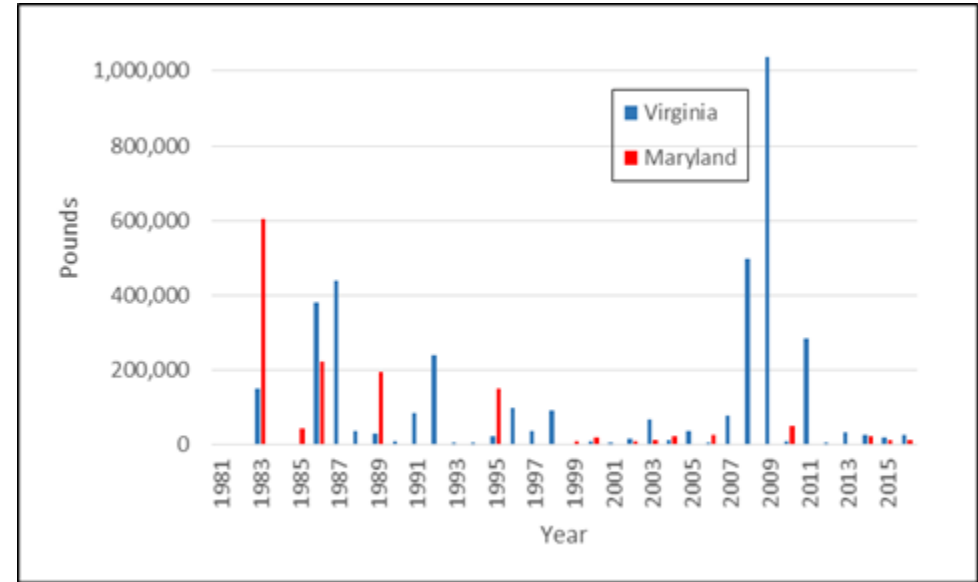


Figure 2. Recreational harvest estimate (MRIP) of black drum in pounds from inland waters for Maryland and Virginia, 1981 - 2016.⁵ 2016 data is preliminary.



References

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- ³ Atlantic Sciaenid Habitats: A Review of Utilization, Threats, and Recommendations for Conservation, Management, and Research. 2017. Atlantic States Marine Fisheries Commission Habitat Management Series No. 14, Arlington, VA.
- ⁴ Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division. March 24, 2017. <http://www.st.nmfs.noaa.gov/st1/commercial/>.
- ⁵ Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division. March 24, 2017. <http://www.st.nmfs.noaa.gov/st1/recreational/index.html>.

1993 Chesapeake Bay Program Black Drum Implementation (updated 05/17)

Problem	Action	Date	Comments
1. Status of Stock	1. Virginia (VA) will continue tagging black drum to determine coastal movements of the Chesapeake Bay Stock, fund research to determine age, fecundity, and spawning periodicity, and sample the commercial and recreational catch to determine length, weight, and sex. Maryland (MD) will continue to support the Old Dominion University (ODU) drum tagging study	Continue 1998-1999 2015	VA's tagging program is opportunistic. Between 2007 and 2012 over 1300 black drum were tagged from Virginia waters. The ODU tagging study is complete. ODU has an ongoing otolith aging study for black drum. Forty-eight black drum were collected in 2007 with an average age of 33.8 years (range 0- 64 years) MD conducted an adult tagging program from commercial pound nets in 1998 and 1999. ASMFC conducted a peer reviewed coastwide stock assessment in 2014/2015. ¹ The assessment determined black drum were not overfished and overfishing was not occurring. Priority research recommendations include increased age and length samples from commercial and recreational fisheries, better bycatch information including lengths of discarded fish, continued fishery independent surveys and the development of an adult fishery independent survey.
2. Fishing Mortality	2a VA will limit entry into the commercial black drum fishery and continue to require commercial black drum fisherman and buyer to obtain a permit and report weekly. VA will continue a 16-inch minimum size limit, 120,000 pound commercial quota, a 1 fish/person/day recreational creel limit, and continue monitoring commercial and recreational landings.	1992 1994 Continue	Fully implemented. VA will emphasize the need for timely reporting.
	2b MD will adopt a 16 inch minimum size limit and a 1 fish/person/day recreational creel limit	1994 Continue	MD REG: COMAR 08.02.05.15 The minimum size limit (16") with a creel limit of 1 fish/person/day and a maximum of 6 fish/boat.
	2c Potomac River Fisheries Commission (PFRC) will consider similar size and bag limits once VA and MD regulations are established	1994 Continue	PFRC adopted a 16-inch minimum size limit and 1 fish/person/day creel limit for recreational and commercial fisheries
	2d MD and PFRC will assess the need for commercial black drum harvest restrictions as data becomes available	1994 1998 Continue	MD- Beginning in 1998, the commercial catch of black drum from the coastal bays and tributaries, and the Chesapeake Bay and its tidal tributaries is prohibited except for scientific investigation. Total allowable landings from the Atlantic Ocean are 1,500 pounds.

1993 Chesapeake Bay Program Black Drum Implementation (updated 05/17)

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

Acronyms

- ASMFC – Atlantic States Marine Fisheries Commission
- CBP – Chesapeake Bay Program
- COMAR – Code of Maryland Regulations
- MRIP – Marine Recreational Information Program
- NMFS- National Marine Fisheries Service
- ODU – Old Dominion University
- PRFC – Potomac River Fisheries Commission
- SAV – Submerged Aquatic Vegetation

2016 Maryland FMP Report (July 2017)

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

The 2016 coastwide stock assessment for black sea bass confirmed that the stock is at a high level of abundance and overfishing is not occurring. Results of the stock assessment indicate a larger allowable harvest is possible and the quotas for 2017 for both recreational and commercial have been increased. Unfortunately, the recreational harvest limit has been exceeded annually from 2012 to 2015. Consequently, the northern region was required to reduce harvest by 23%. A species usually associated with structure, black sea bass favor complex habitats such as coldwater corals in federal waters, oyster reefs in Chesapeake Bay, and natural hard bottom. The movements of black sea bass has been determined by tagging studies and are more regional than coastwide migrations. As a result, regional management has been implemented and the coastal management framework is evaluated on a yearly basis.

Chesapeake Bay FMP

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

Black sea bass were incorporated as one component of the Atlantic States Marine Fisheries Commission (ASMFC) and Mid-Atlantic Fishery Management Council (MAFMC) joint management framework for summer flounder and scup in 1996 with a Black Sea Bass Fishery Management Plan (ASMFC/MAFMC BSB FMP). The ASMFC/MAFMC FMP implemented permit requirements for charter boats, commercial fishermen, and seafood dealers; specifications for fishing gear; and criteria to designate special management zones around artificial reefs. A progressive

implementation schedule was instituted to increase minimum length, reduce landings, modify gear, and introduce a commercial quota system. Several addenda (ASMFC), frameworks (MAFMC), and amendments have been implemented to modify the overfishing mortality threshold and target exploitation rates and quota management.

Addenda IV (2001), VI (2002), XVI (2005) improved upon the timeliness of developing and implementing management requirements. Framework 1 (2001) established a research set-aside quota. The ASMFC/MAFMC Amendment 13 (2002, 2003) was developed to reduce fishing mortality, improve yield, align and minimize jurisdictional regulations; and revised the commercial quota system. Addendum XII (2004) instituted state-by-state quota shares for the commercial fishery; Maryland's share is 11%. Addendum XIII (2004) and Framework 5 (2004) established that a commercial quota can be specified for up to three years at a time. Addendum XIX (2007) continued state-by-state commercial quota management which began in 2003. Framework 7 (2007) improved the efficiency of implementing management actions as stock status changed. Amendment 16 (2007) standardized requirements for bycatch reporting. Addendum XX (2009) streamlined the procedures for commercial quota transfer among states. Addenda XXI (2011), XXIII (2013), and XXV (2014) provided flexibility for regional management measures. Addendum XXVII (February 2016) continued the use of adaptive regional management measures for the recreational fishery in 2016 and 2017.

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. A benchmark stock assessment was completed in 2016.¹ The results indicated that the stock is not overfished and

overfishing is not occurring. The assessment grouped the data from the northern and southern portions of the north and mid-Atlantic as individual entities and then combined them for the final stock model. The 2015 combined retrospective-adjusted total biomass (32,010 MT) was much greater than the biomass at maximum sustainable yield (BMSYproxy =17,256 MT) and was well above the biomass threshold of 8,628 MT. In addition, the combined retrospective-adjusted spawning stock biomass (SSB= 22,176 MT) was well above the SSBMSY proxy of 9,667 MT and the SSB proxy threshold of 4,834 MT. Coastwide recruitment has improved, fishing mortality (F) has declined since 2007, and SSB has been increasing. The next benchmark stock assessment is scheduled for completion by January 2017 followed by another benchmark assessment in 2018.

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 (Figure 1). The 2016 trawl index was higher than the grand mean ending several years of below mean indices. Maryland does not collect fishery-dependent black sea bass data.

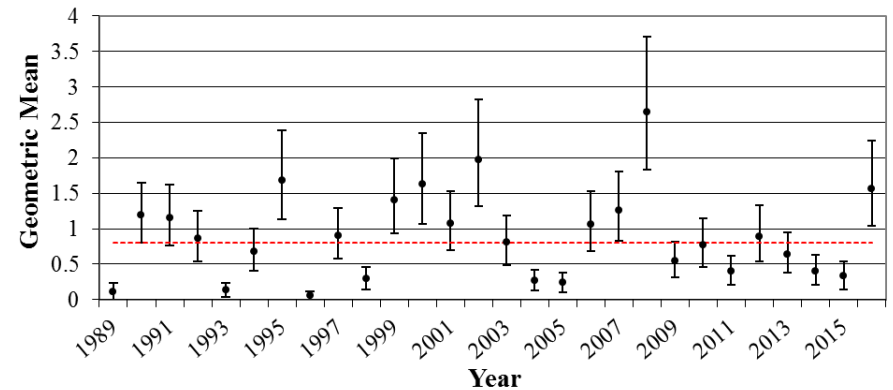
Current Management Measures

The coastwide commercial fishery is allocated 49% of the total allowable catch and the recreational sector is allocated the remaining 51%.² Among the coastal states, Maryland receives 11% of the commercial quota. In a given fishing season, excess quota in one state can be transferred to another state which has exceeded its quota.

The Maryland commercial black sea bass fishery is managed through limited entry. A permit transfer from a licensed fisherman is required to enter the fishery and individual fishing quotas are assigned to each black sea bass permit holder. Quota reserved for permit holders who do not enter the fishery is reallocated among declared permit holders. However, an individual is not allowed to have >20% of the quota. Overages are deducted from the following year's quota allocation. Quota is allocated among four commercial sectors: 87% pots, 11% trawl, 1% hook and line,

and 1% for all other fishing gear. Licensed commercial fishermen without a commercial black sea bass permit card are limited to landing 50 lbs. per day. The commercial fishery has an 11 inch minimum size limit.³

Figure 1. Black sea bass trawl index of relative abundance (geometric mean) with 95% confidence intervals (1989-2016). Dotted line represents the 1989-2015 time series grand mean.



Maryland's recreational fishery (including federal waters) in 2016 was managed with a 12½ inch minimum size, 15 fish per person per day creel, and was open May 15 – September 21 and October 22 – December 31.³ In Maryland, almost all of the recreational black sea bass fishery occurs in federal waters.⁴ A recreational quota is not allocated among the states but a coastwide total allowable landings (TAL) is determined. Since 2012, states have worked together to establish regional regulations to comply with ASMFC requirements (conservation equivalency). There are no changes in recreational fishing measures for 2017.

The Fisheries

In 2016 there were eleven pot fishermen and three trawlers that met the minimum requirements to receive a Maryland black sea bass landing permit. A permit is required to commercially land more than 50 pounds of black sea bass per day in Maryland. Preliminary 2016 commercial landings from Maryland's are 271,809 lbs. with a quota of 298,289 lbs. (Figure 2).⁵

Based on MRIP estimates (March 2017), Maryland's preliminary 2016 recreational black sea bass harvest was 56,763 fish with a total weight of 82,016 lbs. (Figure 3).⁶ Most black sea bass are harvested from September through December.

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.¹³ Standardization of methods was hoped to increase the number of data sets that could be incorporated into the assessment models. However, age in black sea bass is extremely variable. The nature of the tail and the propensity to break off the filament confound management based on age at length.

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

Although the 2016 stock assessment indicated the stock is above the biomass target and overfishing is not occurring the increased total allowable catch will not apply to the northern states 2017 recreational fishery. The recreational harvest limit has been exceeded annually from 2012-2016.

Minimum sizes in the northern states are impacting the number of fish that can be harvested. Minimum sizes in the northern states are 15 inches. Because the recreational harvest limit is in pounds, the allowed harvest includes 25% less fish at a 15- inch size limit than at a 12.5- inch size limit.

Figure 2. Black sea bass harvested by the commercial fishery in Maryland: 1990 – 2016.¹²

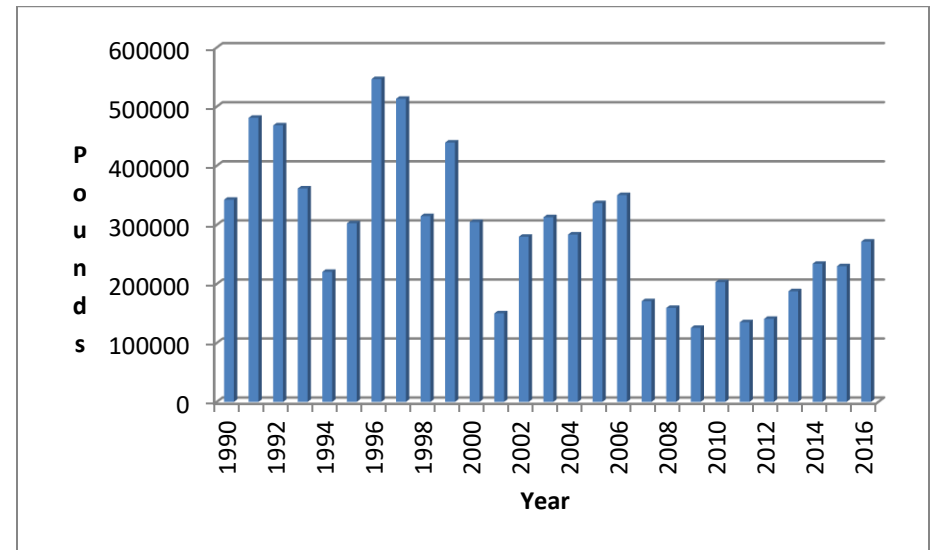
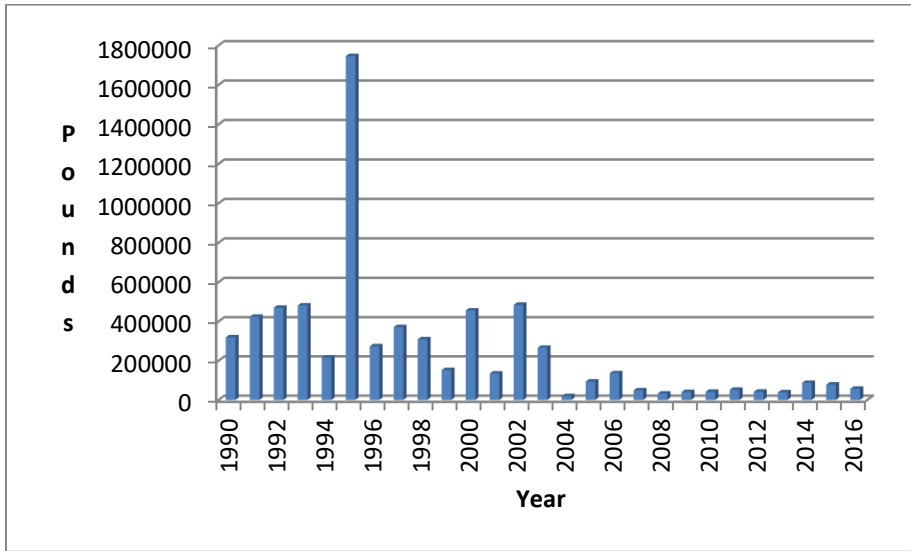


Figure 3. Estimated recreational harvest of black sea bass from Maryland: 1990-2016.¹⁰



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³ Doctor, S. 2017. Maryland's 2016 black seas bass (*Centropristis striata*) compliance report to the Atlantic States Marine Fisheries Commission. Maryland Department of Natural Resources. Annapolis, Maryland.

⁴ 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.

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⁶ Personal communication from the National Marine Fisheries Service Fisheries Statistics Division. Accessed on March 09, 2017. <https://www.st.nmfs.noaa.gov/recreational-fisheries/access-data/run-a-data-query/queries/index>.

⁷ 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 07/2017)

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 2003 2003 2004 2009 2014	BSB have exceeded the survey index since 2003 and are not considered overexploited. The minimum size limit for the commercial fishery was 11 inches and for the recreational fishery was 11.5 inches with a 25 fish/day /person creel limit. In MD, individual commercial BSB quota and limit are identified on a BSB permit card. Non permitted individuals are limited to landing ≤50 lbs. MD & VA with an 11" minimum size limit for the commercial fishery. MD recreational minimum BSB size limit increased to 12.5" with a creel limit of 25/person/day VA recreational minimum BSB size limit increased to 12.5" with a creel limit of 25/person/day. MD & VA reduced their recreational creel to 15 fish/person/day and maintained the 12.5" size limit.
	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.	2002 Continue 2003 2010 2013 2015-2016	Amendment 13 of the MAFMC and ASMFC's Summer Flounder, Scup and BSB FMP changed the management of the commercial fishery from coastal quarterly quotas to state by state allocations. MD is allotted 11% of coastwide landings and VA is allotted 20%. The BSB fishery is open year round in MD & VA until quota is met. MD & VA implemented recreational closures from January 1 to May 21 and October 12 to October 31. Closure was revised to

1996 Chesapeake Bay and Atlantic Coast Black Sea Bass Fishery Management Plan Implementation Table (updated 07/2017)			
Strategy	Action	Date	Comments
Continue 1.1	Continue 1.1B)		January 1-May 18 and September 19-October 17. Closure adjusted to January 1 to May 14 and September 22 to October 21.
		2010	Stock was assessed in 2010.
		2012	The black sea bass coastal stock is not overfished and overfishing is not occurring based on 2012 revised BRPs.
		2015-2016	Benchmark coastal stock assessment completed in 2016.
1.2) Management agencies will require the use of escape panels, trawl efficiency devices, selective mesh sizes, culling devices and/or other methods to promote gear efficiency and reduce bycatch.	1.2A) VA, MD, and PRFC will investigate the potential for innovative devices designed to reduce the bycatch of juvenile finfish in non-selective fisheries. Continued testing of these bycatch reduction devices will be encouraged.	2000 Continue	PRFC tested plastic escape panels for pound nets. The device can provide escapement provide escapement for up to 80% of undersized fish.
	1.2B) VA and MD will work with MAFMC/ASMFC to develop and require the use of more efficient gear consistent with policies designed to reduce bycatch and/or discards.	As specified	No specific gear alterations have been recommended.
	1.2C) VA and MD will implement a mesh size of 4.0 inch diamond mesh for trawl vessels harvesting more than 100 pounds of BSB per trip. Changes in minimum mesh size will be implemented based on MAFMC/ASMFC recommendations. VA will continue its ban on trawling in state waters. PRFC will continue its ban on Potomac River.	1996	Mesh size requirements for the commercial fishery are appropriate for the minimum size requirements.
		1980 1981 1992 2004 On-going	MD COMAR 08.02.05.21: Minimum mesh: larger nets are required to possess a minimum of 75 meshes of 4 ½” diamond mesh in the cod-end or the entire net must have a minimum mesh size of 4 ½” throughout; smaller nets must have 4.5" mesh or larger throughout. Maximum roller rig trawl roller diameter ≤ 18”
Continue		Chesapeake Bay Program (CBP) jurisdictions are in compliance with vent requirements in pots and traps.	
	1.2D) VA and MD will require escape vents in BSB pots, based on the recommendations of MAFMC/ASMFC. The minimum size requirements		

1996 Chesapeake Bay and Atlantic Coast Black Sea Bass Fishery Management Plan Implementation Table (updated 07/2017)

Strategy	Action	Date	Comments
Continue 1.2	will be considered after the MAFMC completes its study on escape vents.	1996	MD COMAR: Unobstructed escape vent in holding chamber of at least 2 ½” diameter, if circular, or 2 ½” stretched mesh size if square.
		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

1996 Chesapeake Bay and Atlantic Coast Black Sea Bass Fishery Management Plan Implementation Table (updated 07/2017)			
Strategy	Action	Date	Comments
Continue 1.2	Continue 1.2F)		releases (pop-up devices), or similar magnesium alloy fasteners; or c) ungalvanized or uncoated iron wire of 0.094” or less in diameter. Pots and traps having wooden slats will remove one set of parlor slats so it is 1 1/8” apart.
2.1) VA and MD will work with 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.
	2.2A) 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.
2.2) The jurisdictions will promote research to define movements and mortality of BSB between state and federal waters.	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.

1996 Chesapeake Bay and Atlantic Coast Black Sea Bass Fishery Management Plan Implementation Table (updated 07/2017)			
Strategy	Action	Date	Comments
2.3) MD, VA and PRFC will continue to support interjurisdictional efforts to maintain a comprehensive database on a baywide scale.	2.3A) The jurisdictions will collect information on commercial landings.	2008	MD does not have a fishery-dependent monitoring program. Data is occasionally collected from the recreational for-hire fishery. Northeast Data Poor Stocks Working Group determined that BSB are undergoing overfishing, but the stock is not overfished.
		2010	ASMFC Technical Committee declared stock rebuilt. Revised BRPs are $F_{40\%} = 0.42$ and $SSB_{40\%} = 27.6$ million pounds. Overfished threshold is $SSB_{\text{threshold}} = 24.0$ million pounds.
		2015 2016	Maryland commercial landings were 230,018 lbs. in 2015. Preliminary commercial landings for 2016 are 271,809 lbs.
	2.3B) VA will continue to supplement MRFSS data with more detailed catch statistics at the state level.	1996-1997 2012	MRFSS is used to collect recreational catch data. MRFSS replaced with the MRIP survey.
		2015 2016	Maryland recreational estimate was 78,000 lbs. (57,600 fish) for 2015. Estimated recreational landings from MD are 103,995 lbs. (Sept. 2017)
	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.	3.1a.A) 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

1996 Chesapeake Bay and Atlantic Coast Black Sea Bass Fishery Management Plan Implementation Table (updated 07/2017)			
Strategy	Action	Date	Comments
provide additional habitat for the BSB population.	Continue 3.1b.A)	1996-2006	MD terminated its program in 1996. Artificial reef development was administered in the Chesapeake Bay by MD Environmental Service and in the Atlantic Ocean by the Ocean City Reef Foundation (OCRF).
		2007	MD Artificial Reef Committee and the MD Artificial Reef Initiative (MARI) were established to develop reefs in cooperation with OCRF. Both MARI and OCRF accept private donations while MD contributes funds when available for reef development projects.
2008		44 NY subway cars were deployed off Ocean City.	
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.	
	3.1b.B) VA recently prohibited use of all gear except recreational rod and reel, hand-line, spear, or gig on four artificial reefs in state waters.	1998 Continue	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.	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. • Protect SAV and potential SAV habitat from physical disruption. Implement a tiered approach	Continue	MD implemented a living shorelines program in 1970 to encourage vegetative shoreline stabilization. Regulations are in place to prohibit dredging through SAV beds. Tiered designation and prioritization of SAV beds has not been implemented.

1996 Chesapeake Bay and Atlantic Coast Black Sea Bass Fishery Management Plan Implementation Table (updated 07/2017)

Strategy	Action	Date	Comments
Continue 3.2)	<p>to SAV protection, giving highest priority to protecting Tier I and II areas but also protecting Tier III areas from physical disruption.</p> <ul style="list-style-type: none"> • Avoid dredging, filling or construction activities that create turbidity sufficient to impact nearby SAV beds during the SAV growing season. • Establish an appropriate undisturbed buffer around SAV beds to minimize the direct and indirect impacts on SAV from activities that significantly increase turbidity. • 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. • Educate the public about the potential negative effects of recreational and commercial boating on SAV and how to avoid or reduce them. 	<p>2003</p> <p>2008</p> <p>2011</p> <p>2014</p>	<p>Avoidance of dredging, filling and construction impacts to SAV is strictly enforced by MDE and USACE with input from DNR, USFWS, and NMFS.</p> <p>MD has not established undisturbed buffers. VA has established buffer criteria.</p> <p>The revised SAV goal adopted by Chesapeake Bay Program is restoration of 185,000 acres of SAV by 2010 and planting 1,000 acres of SAV by 2008. Only 15% of restoration target was met by 2008. There's been very little long-term survival from SAV plantings.</p> <p>MD legislated that shoreline stabilization projects must use living shoreline techniques unless demonstrated to be infeasible.</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>
	3.2b) Set and achieve regional water and habitat quality objectives that will result in restoration of SAV through natural revegetation as recommended	Continue	Water quality criteria have been adopted http://www.chesapeakebay.net/issues/issue/nutrients .

1996 Chesapeake Bay and Atlantic Coast Black Sea Bass Fishery Management Plan Implementation Table (updated 07/2017)			
Strategy	Action	Date	Comments
Continue 3.2)	by the Chesapeake Bay SAV Policy Implementation Plan.		
	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.	2003 2011 Continue 2014 2015	Bay wide SAV restoration goal was 1,000 acres planted by 2008. In 2012, the restoration planting goal was revised to 20 acres per year. Little progress has been made since 2010 and a SAV restoration goal was not included in the new Chesapeake Watershed Agreement. One acre was planted in 2013. Tracking of this indicator was discontinued in 2014 with a programmatic focus on restoring water clarity and protecting existing Bay grass beds. SAV covered 59,927 acres in 2013. SAV increased 27% to 75,835 acres in 2014. This increase is attributed to a rapid expansion of widgeongrass and a modest recovery of eelgrass. Between 2014 and 2015, SAVs increased by 21% for a total of 91,621 acres. This marks 3 years of consecutive growth. See Chesapeake Bay Program website for updates on SAV restoration. http://www.chesapeakebay.net/issues/issue/bay_grasses
3.3) Establish a goal of no net loss of wetlands and a long term goal of a net resource gain for tidal and nontidal wetlands as recommended in the Chesapeake Bay Wetlands Policy.	3.3) Jurisdictions should strive towards achieving the following, especially in the salinity range of BSB. <ul style="list-style-type: none"> • Define the resource through inventory and mapping activities. • Protect existing wetlands. • Rehabilitation, restoring and creating wetlands. • Improving education. • Further research. 	2006 Continue Continue 2006 Continue	Programs have been expanded to the tributaries. GIS mapping activities are underway to target protection and restoration efforts habitat resources, but habitats are not targeted for a single, specific species' benefit. MD developed a Blue Infrastructure that includes mapping of BSB habitats such as structural habitat and SAV. MD developed a Blue Infrastructure that includes mapping structural habitat and SAV.

1996 Chesapeake Bay and Atlantic Coast Black Sea Bass Fishery Management Plan Implementation Table (updated 07/2017)			
Strategy	Action	Date	Comments
Continue 3.3)	Continue 3.3)	2009 Continue	Wetland mosquito ditches from the 1930s-1940s are being plugged to reduce tidal flow and restore wetland hydrology and function.
		2012	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.
		2014	See Chesapeake Bay Program website for updates on wetland rehabilitation and restoration. http://www.chesapeakebay.net/indicators/indicator/tidal_wetlands_abundance http://www.chesapeakebay.net/indicators/indicator/restoring_wetlands
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"> • Expand program efforts to include tributaries. • Intensify efforts to control nonpoint sources of pollution from agriculture and developed area. • Improve on current point and nonpoint source control technologies. 	Continue	Maps that indicate regions of concerns for living resources have been developed.
		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. See Chesapeake Bay Program website for updates on nutrient reduction. http://www.chesapeakebay.net/track/restoration

1996 Chesapeake Bay and Atlantic Coast Black Sea Bass Fishery Management Plan Implementation Table (updated 07/2017)

Strategy	Action	Date	Comments
Continue 3.4)	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"> • Pollution Prevention: Target “Regions of Concern” and “Areas of Emphasis. • Regulatory Program Implementation: Insure that revised strategies are consistent with and supplement pre-existing regulatory mandates. • Regional focus: Identify and classify regions according to the level of contaminants. • Directed Toxics Assessment: Identify areas of low level contamination, improve tracking and control of non-point sources. 	Continue	See Chesapeake Bay Program website for updates on nutrient reduction. http://www.chesapeakebay.net/track/health/factors Chesapeake Bay Program is monitoring levels of mercury, PCBs, PAHs, organophosphate and organochloride pesticides.
	3.4c) The jurisdictions will continue to develop, implement and monitor their tributary strategies to improve bay water quality.	2003 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

2016 Maryland FMP Report (July 2017)

Section 7. Blue Crab (*Callinectes sapidus*)

According to the 2016-2017 bay-wide winter dredge survey (WDS) the estimated abundance of spawning age females increased to a survey high of 254 million crabs, exceeding the target level of 215 million for the first time since 2010. Although spawning age female crabs increased, the overall blue crab abundance was down due to poor recruitment. Mature female harvest was at a sustainable level for the ninth consecutive year and conservative management measures will be continued based on a decline in juvenile abundance.

Status of Chesapeake Bay Blue Crab Management

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

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) decreased from 271 million in 2016 to 125 million crabs in 2017. The estimated abundance of spawning age female crabs was 254 million, an increase from 2016. The exploitation fraction was 16% in 2016, below the target (25.5%). The status of the stock from 2011-2017 based on the female-specific target and threshold is found on Table 1. A stock assessment update is pending.

In order to ensure that male abundance does not drop below a critical level relative to female abundance, the Bay jurisdictions developed conservation points of reference for male crabs. The points of reference were updated in 2014 to include a scaling factor that is consistent with the way female BRPs are calculated. The Chesapeake Bay Stock Assessment Committee (CBSAC) recommended the following conservation trigger for male crabs. If the male exploitation rate exceeds 33% the Bay jurisdictions should consider conservation measures for male crabs. The male conservation trigger is based on the second highest exploitation value in the time series of data and does not represent a biologically significant parameter. The 2016 estimate of male exploitation was 23% and management action is not recommended for male crabs at this time.¹ Estimates of male exploitation for 2017 cannot be calculated until the completion of the 2017 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 30% in 2017.

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.² 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 and are still in place. Waterfront property owners must register their crab pots in order to use them from their pier. 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://dnr.maryland.gov/fisheries/Pages/regulations/blue-crab.aspx>

In 2016 the estimated abundance of spawning females increased and was above the minimum safe threshold of 70 million crabs. With an increase in estimated abundance of spawning age females and harvest below the recommended target, the daily mature female bushel limits were increased starting July 2016 and the mature female season was extended 20 days. Due to low juvenile abundance in 2017, the mature female season will be shortened by 10 days and bushel limits decreased for November 2017.

The Fishery

As population levels change, maintaining the exploitation target may result in either an increase or a decrease in harvest. The 2016 baywide (Maryland, Virginia and Potomac River) commercial harvest was approximately 60 million lbs. (Figure 2). The percentage of females removed by harvest in 2016 was approximately 16% 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 4.2 million lbs. baywide in 2016. Adding up the harvest from each fraction of the harvesting sectors and across the entire Chesapeake Bay, the 2016 total harvest was approximately 64 million lbs.¹

Issues/Concerns

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

Since 2012 a pilot study led by an industry-based group has been testing a new way to accurately report commercial harvest data in a more timely fashion using electronic technology. This is a co-management approach between the crab harvesters and MD DNR. The electronic reporting program includes a “hail-in, hail out” protocol and random catch verification which should provide improved and timely commercial harvest data. The 2015-2016 report can be found after the implementation table.

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

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

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

Enforcement

The enforcement of commercial and recreational fishing regulations is critical to management success. There has been an initiative towards improving enforcement of blue crab conservation/management measures. In Maryland, the Natural Resource Police (NRP) hired additional officers to provide a dedicated enforcement effort for crab management. The NRP has successfully increased the total number of enforcement hours and in the past 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 2017. In preparation for the stock assessment update the jurisdictions have determined terms of reference. The state jurisdictions will take the lead on addressing topics for the stock assessment update. Although steps have been made to improve harvest accountability and reporting for both the commercial and recreational fisheries, more improvements are needed. Even though female abundance exceeded the target, the jurisdictions need to maintain

conservative management measures due to a low juvenile year class and make adjustments to ensure that harvest levels are commensurate with abundance indices.

References

¹ Chesapeake Bay Stock Assessment Committee (CBSAC). 2017 Chesapeake Bay Blue Crab Advisory Report, June 2017.

² 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

³ 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, 2011-2017

Reference Points			Stock Status						
	Target	Threshold	2011	2012	2013	2014	2015	2016	2017
Female-specific Exploitation Fraction	25.5%	34% (max)	24%	10%	23%	17%	15%	16%	TBD*
Abundance (millions of female crabs)	215	70 (min)	190	97	147	68.5	101	194	254

(2017 Chesapeake Bay Blue Crab Advisory Report)

*Exploitation fraction cannot be calculated until the 2017 harvest data is complete

Figure 1. Estimated abundance of spawning age female crabs (age 1+) in Chesapeake Bay, 1990-2017

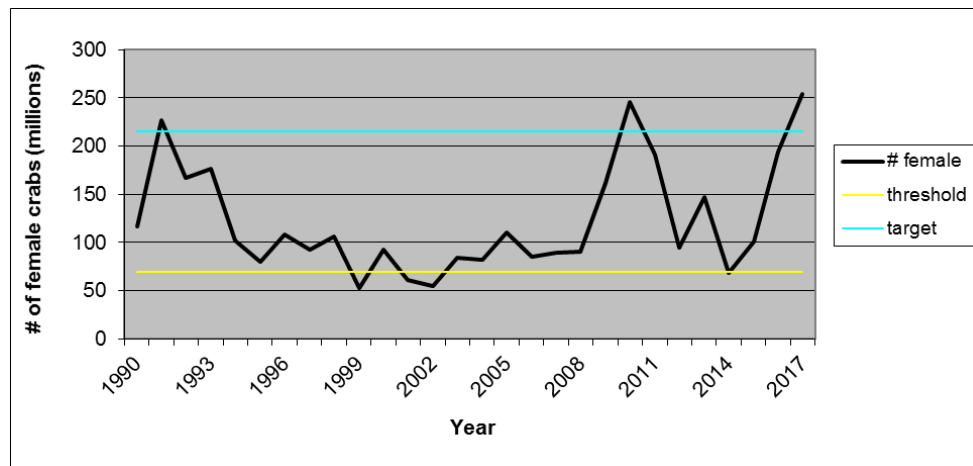
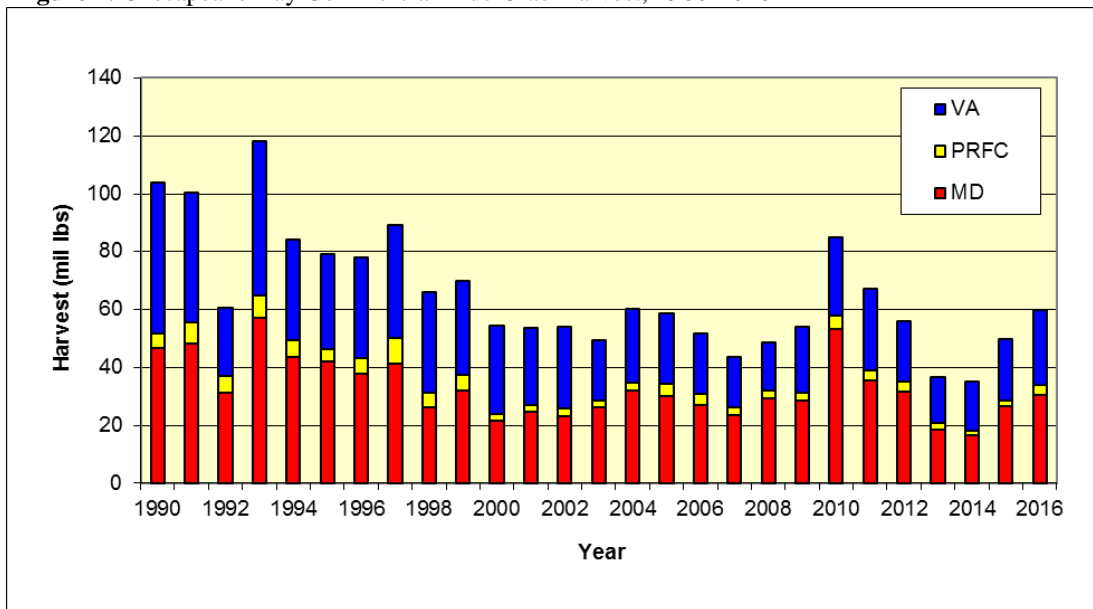


Figure 2. Chesapeake Bay Commercial Blue Crab Harvest, 1980-2016



2003 Chesapeake Bay Program Blue Crab Fishery Management Plan Amendment 1 (updated 07/2017)			
Problem Area	Action	Date	Comments
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.	2001 adopted in 2003 Continue 2011 Continue 2017	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. Female abundance (254 million crabs) is currently above the threshold level and above the target level.
	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.	2001 adopted in 2003 Continue 2016	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. The 2016 female-specific exploitation was 16%, below the target level. An exploitation fraction for 2017 cannot be calculated until the completion of the 2017 fishery (December 2017).
	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. 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.)	2003 2006 2008 2011 Continue	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. Female-specific BRPs adopted in 2011. In 2017, the blue crab stock is not depleted and overfishing is not occurring.

2003 Chesapeake Bay Program Blue Crab Fishery Management Plan Amendment 1 (updated 07/2017)

Problem Area	Action	Date	Comments
	Action 4 CBP jurisdictions will utilize the results of fishery-independent surveys to determine stock status.	Continue	Results of the 2016-2017 Winter Dredge Survey (WDS) indicated the abundance of female age 1+ crabs was 254 million crabs. Spawning-age crab abundance was above the threshold and considered not overfished.
Fishing Effort Strategy CBP jurisdictions will adjust fishing effort to achieve the adopted BRPs.	Action 5 CBP jurisdictions will reduce the exploitation rate of legal-sized blue crabs to meet the target BRPs.	2001 Continue 2011 2016 2009-2010 2017	The Bay jurisdictions implemented new regulations in 2008 & 2009 to reduce exploitation on female crabs. Harvest regulations have been adjusted as needed to meet the target exploitation rate. In 2011, exploitation rates were changed to female-specific rates. Exploitation rates have been below the target since 2010 (Table 1). The 2016 baywide harvest was approximately 64 million lbs. There is a large amount of latent effort in the blue crab fishery (latent effort = fishing effort not currently utilized). MD implemented a buy-back program for LCC (limited crab catcher) licensees. VA also implemented a buy-back program and utilized a reverse auction system. Between 2009 and 2010, MD reduced the LLC by about 700 licensees resulting in about a 35,000 pot reduction in effort Initial analyses conducted by jurisdictions show little evidence that effort changes in response to changes in blue crab abundance according to the 2017 Chesapeake Bay Blue Crab Advisory Report. http://www.chesapeakebay.net/documents/CBSAC_2017_Crab_Advisory_Report_FINAL_6-26-17.pdf
Monitoring Strategy CBP jurisdictions will collect fishery-dependent and fishery-independent data on blue crab resources.	Action 6 CBP jurisdictions will continue to monitor blue crab resources in the bay and work towards developing a baywide monitoring approach	Continue	In 2010/2011, recruitment, as measured by the abundance of age 0 crabs in the WDS, remained low and was below the average recruitment of 258 million crabs. Although the number of juveniles had declined, it was one of the largest juvenile abundance indices since 1998. In 2011/2012, recruitment was the highest on record but declined by almost 50% the following year (2012-2013). WDS results indicate

2003 Chesapeake Bay Program Blue Crab Fishery Management Plan Amendment 1 (updated 07/2017)

Problem Area	Action	Date	Comments
			that recruitment decreased from 271 million age 0 crabs in 2016 to 125 million crabs in 2017.
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	The VA blue crab spawning sanctuary (928 square miles) was redesigned into 5 areas with separate closure dates. The EBFM life history brief indicates that blue crabs occupy a wide range of estuarine habitats and utilize a series of habitats sequentially along a salinity gradient.
	Action 8 CBP jurisdictions will continue to protect SAV in potential, post-larval settlement areas.	Continue	SAV beds in near shore habitats provide essential habitat for blue crabs, especially during their post larval and juvenile stages. SAVs provide critical shelter for many key species besides crabs. SAVs help improve water clarity, add oxygen to the water, and reduce shoreline erosion.

2003 Chesapeake Bay Program Blue Crab Fishery Management Plan Amendment 1 (updated 07/2017)

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

Acronyms:

BRP- biological reference points
 CBSAC- Chesapeake Bay Stock Assessment Committee
 CBP- Chesapeake Bay Program
 EBFM - Ecosystem based fisheries management
 F – Fishing mortality

FMP- Fishery Management Plan
 MSG - Maryland Sea Grant
 QET - Quantitative Ecosystem Team
 SAV – Submerged Aquatic Vegetation
 WDS – Winter Dredge Survey

January 23, 2018

Maryland State General Assembly
90 State Circle
Annapolis, MD 21401

2015 – 2016 Summary for E-Reporting with FACTS™ Pilot Program

Code of Maryland Regulations (COMAR) allows for pilot programs to evaluate new approaches to managing fisheries (08.02.01.10). Implemented in 2012, the E-Reporting with FACTS™ pilot program is a real-time electronic commercial harvest reporting system that provides increased accountability for capturing accurate harvest data. It was initiated in response to the 2008 Federal Fisheries Disaster for Chesapeake Bay blue crabs declared by National Oceanic and Atmospheric Administration (NOAA). Led by the Blue Crab Design Team, a partnership of the department and industry, the pilot program was developed to help prevent future blue crab fishery disasters. The department continues to partner with the following vendors for the development and management of the program: Oyster Recovery Partnership, Electric Edge Systems Group, Maryland Environmental Service, and Versar.

The web-based electronic reporting system is dependent on hailing, where participants use their own mobile device (smartphone or tablet), phone or personal computer to report their daily commercial harvest activity. The default for the system is “I did not crab”, so the user only hails on days when they expect to engage in commercial harvest activity. When a harvester starts a trip in FACTS™, they are alerting the system to expect a harvest report at the end of the day. This ‘start hail’ is sent prior to leaving the dock and includes information on where and when they expect to land their harvest. The trip ‘end hail’ is their harvest report and is sent before they land their catch.

This approach to commercial harvest reporting increases accountability as it provides the department with the opportunity to verify the information provided. The use of independent roving monitors early in the program verified the accuracy of the harvest information being reported, paving the way for continued program expansion. Currently, Natural Resource Police encounter reports are used to provide additional verification of harvest. Starting in the spring of 2018, roving monitors will be funded by a NOAA grant and will return as part of the harvest verification process for the pilot program.

In 2015, the program expanded to include striped bass fishery reporting and hired an E-Reporting Outreach Coordinator. There were 173 participants in the blue crab program representing approximately three percent of Maryland’s commercially licensed crabbers. Over the course of the 2015 season, April 1 – December 15, a total of 3,271 trips were taken in FACTS™ by 91 active crabbers. These harvesters reported 28,725 bushels of hard crabs, 35,064 dozen soft shell crabs and 202,802 individual peelers.

In 2016, the program demonstrated strong growth in participation and the option to report all Chesapeake Bay finfish activity was added to the program. The number of participants in the blue crab program doubled to 346, representing approximately six percent of Maryland's commercially licensed crabbers. Over the course of the season, April 1 – December 15, a total of 7,135 trips were taken in FACTS™ by 212 active crabbers. These harvesters reported 62,014 bushels of hard crabs, 32,472 dozen soft shell crabs and 283,971 individual peelers.

Of note in 2016, was that seventy-nine percent of all yellow perch commercially harvested in Maryland, during the January 1 – March 31 season, was reported by E-Reporting with FACTS™ program participants. This high percentage afforded an exceptional opportunity to demonstrate the effectiveness of this innovative program to monitor and manage the quota. Due to the hailing component, Fishing and Boating Services leadership was able to accurately assess the daily fishing pressure. This resulted in the decision to take a less conservative approach to managing the fishery; allowing more time for watermen to harvest on weekends. Program participants were able to use their FACTS™ accounts to view the remaining quotas in real-time for all three designated harvest areas (Chester River, Upper Bay and Patuxent River).

The increased accountability inherent with this pilot program also provides opportunities to offer specific harvest flexibilities for watermen and are allowed through the pilot program regulations (COMAR 08.02.01.10). As recommended by the Blue Crab Design Team, participants in the E-Reporting with FACTS™ program are able to use a flexible day off for crabbing; rather than be constrained to the traditional declared Sunday or Monday. As the program has expanded, additional flexibilities have been added for the striped bass and yellow perch fisheries. If additional funding is secured, it is expected that the E-Reporting with FACTS™ pilot program will be expanded to include additional fisheries (e.g., Charter).

An important aspect of the E-Reporting with FACTS™ pilot program is outreach and support for our volunteer program participants. Training is provided by the E-Reporting Outreach Coordinator and, more recently, experienced program participants are mentoring new users in the use of the system. To ensure the pilot program is accessible to all commercial watermen, the system is designed to work using smartphone/computer technology and has operators staffing a 24 hour call center. Feedback is received and incorporated throughout the year and additional customer service is provided by the program's 24 hour helpline. Replacing inefficient monthly paper reports, electronic reporting is a business tool that provides participants with 24/7 access to their trip and harvest data.

In addition to commercial watermen and program managers, FACTS™ has been designed to support other users to more effectively verify, enforce and utilize the program's data. While Natural Resources Police are unable to view any harvest information which would require a subpoena, their enforcement accounts allow them to view daily trip activity and confirm remaining striped bass quota shares. For department biologists, the data analyst role has a fishery dependent sampling tool; providing information in real-time that ordinarily would take months to generate. As a result, watermen can hold the department accountable for timely management decisions.

2016 Maryland FMP Report (August 2017)

Section 8. Bluefish (*Pomatomus saltatrix*)

The most recent benchmark stock assessment of the coastal bluefish stock was conducted in 2015. Based on data through 2014, the bluefish stock is not overfished and overfishing is not occurring. The assessment provided new biological reference points and used improved catch at age data. Addendum I (2012) implemented standardized sampling and ageing practices that were successful at providing important data for the assessment.

Bluefish are a coastal, pelagic species found around the world in tropical and temperate waters. Populations inhabiting inshore and offshore waters of the Atlantic coast of the United States undergo seasonal migration from Florida to Maine. Spawning occurs multiple times as stocks move northward. Estuaries and other near shore habitats are used as nurseries by bluefish larvae and by juveniles.

Bluefish are sought after by recreational anglers for their aggressive feeding behavior and fight when hooked. Recreational and commercial harvests from the Chesapeake Bay peaked in the 1980s. Commercial harvest of bluefish occurs but their soft flesh make them a poor choice for freezing and limits their market demand.

Chesapeake Bay FMP

The Chesapeake Bay Bluefish Fishery Management Plan (CBB FMP) was adopted in 1990 and amended in 2003. The CBB FMP Amendment 1 adopted the Mid-Atlantic Fisheries Management Council (MAFMC) and the Atlantic States Marine Fisheries Commission (ASMFC) coastal overfishing definition and rebuilding schedule. The 1989 ASMFC/MAFMC FMP was initially developed to address the concerns raised by recreational fishermen about harvest by the tuna purse seine fisheries.

The coastal bluefish FMP was the first FMP to be developed jointly by an interstate commission and regional fishery management council. The MAFMC/ASMFC FMP was amended by ASMFC in 1998 to prevent recruitment overfishing, reduce fishing waste, improve cooperative management among states, maximize availability, and improve biological understanding of the species. Addendum I to Amendment 1 (2012) mandated increased collection of length at age data by states responsible for 5% or more of the coastal harvest; MD is exempt from the mandate.¹ The MAFMC has amended the FMP five times (2000, 2007, 2011, 2014 and 2015). The 2015 omnibus amendment for all MAFMC species adds various measures to improve and expand on the Standardized Bycatch Reporting Methodology. It is unclear how this amendment will affect bluefish fisheries because commercial discards are considered to be negligible in the stock assessment.

Maryland is required to submit an annual compliance report to ASMFC. The compliance report describes fishery dependent and independent monitoring, current regulations, commercial and recreational landings, and planned management actions.

Stock Status

Bluefish are managed as a single coastal stock. A benchmark stock assessment (SA) completed in 2015 projected stock status through 2018. The peer-reviewed assessment used new input data to improve the shortcomings of the previous model, which relied heavily on uncertain relationships between spawning stock biomass (SSB) and future recruitment. Catch estimates and juvenile recruitment indices were incorporated into the age-structured assessment program (ASAP) model to produce estimates of fishing mortality (F) and stock biomass.² Based on results of the SA, the National Marine Fisheries Service (NMFS) implemented specifications for the 2016-2018 bluefish fishery, including acceptable biological catch (ABC) limits of 19.46 million lbs. for 2016, 20.64 million lbs. for 2017, and 21.81 million lbs. for 2018.³

Bluefish are not overfished, i.e. SSB in 2014 (191 million lbs.) was above the SSB threshold (123 million lbs.). Overfishing is not occurring, i.e. fishing mortality (F) in 2014 (0.157) was below the threshold of 0.17. Fishing mortality has declined steadily since 2007. Coastal recruitment has historically been variable, but a period of low recruitment persisted from 2008-2012. Coastal recruitment in 2013 and 2014 was above average. Total abundance increased in 2014 to 82 million fish, while total stock biomass decreased slightly from 214 million lbs. in 2013 to 208 million lbs. in 2014.²

Current Management Measures

Annual stock assessments are used to determine total allowable landings (TAL) for commercial and recreational fisheries. Seventeen percent of the TAL is allocated to the commercial fishery and the other 83% is allocated to the recreational fishery. The FMP allows for a portion of unused recreational TAL to be transferred to the commercial sector. The commercial fishery is managed under state-specific quotas with allocations based on historical landings data from 1987-1989. The 2017 Atlantic coast recreational harvest limit is 11.58 million lbs. and the coastal commercial quota is 6.07 million lbs. Maryland receives 3% of the coastal commercial quota resulting in a 2017 quota of 256,420 lbs.⁴ These values may be adjusted when 2016 coastal harvest estimates are finalized.

The Fisheries

Maryland's commercial and recreational bluefish fisheries are open year-round with a minimum size limit of 8 inches. The recreational fishery has a daily limit of 10 fish per person per day.

Maryland's commercial harvest in 2016 was 66,720 lbs., a 27% decrease from 2015 (Figure 1). Approximately 86% of the commercial catch was harvested from the Atlantic Ocean with the remainder from the Chesapeake Bay and Coastal Bays.⁵ The Marine Recreational Information Program (MRIP) harvest estimate (A+B1) for 2016 was 112,853 fish (157,160 lbs.) in Maryland, a 32% increase from 2015 (Figure 2). Live discards (B2) decreased from 190,360 fish in 2015 to 135,708 in 2016 (Figure 2).⁶

Monitoring Programs

Bluefish data is collected by Maryland DNR's Chesapeake Bay Finfish Program (CBFP) and Coastal Bays Program. Bluefish are sampled from pound nets to assess size structure of resident bluefish. Bluefish sampled in 2016 were 289 mm (11.4 inches total length (TL)) on average. Seine surveys are conducted in the Chesapeake Bay and the Atlantic Coastal Bays to develop bluefish juvenile indices. The 2016 Chesapeake Bay bluefish juvenile index was 0.02, below the time-series average of 0.22. The 2016 Coastal Bays bluefish juvenile index was 0.21, also below the time-series average of 0.42.⁵

The Chesapeake Bay Multispecies Monitoring and Assessment Program (ChesMMAP) (2002-present) 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.²

Issues/Concerns

The 2015 benchmark SA included more robust age data from multiple east coast states as required by Addendum I to Amendment 1.^{1,2} Age-0 bluefish have a bimodal (spring and summer) recruitment pattern. The contribution of recruits from each season to the adult population is uncertain, although it has been hypothesized that the spring cohort has a greater influence on adult abundance.²

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. Recreational discard mortality is an important factor for bluefish stock assessments but data is limited. The bluefish Technical Committee conducted a thorough review of bluefish discard mortality literature for the latest stock assessment and approved an estimate of 15% for use in modeling. Commercial discard mortality is uncertain though commercial discards are considered negligible.²The MAFMC Advisory Panel suggested using single hook gear in the recreational bluefish fishery to reduce hooking damage for fish that are hooked and released. States should consider additional educational and outreach materials on how to avoid recreational hooking damage.

References

- ¹ ASMFC. 2012. Addendum I to Amendment 1 to the Bluefish Fishery Management Plan. Atlantic States Marine Fisheries Commission. Alexandria, VA.
- ² ASMFC. 2015. Bluefish Benchmark Stock Assessment for 2015. Atlantic States Marine Fisheries Commission. Alexandria, VA.
- ³ Fisheries of the Northeastern United States; Atlantic Bluefish Fishery; 2016-2018 Atlantic Bluefish Specifications. Federal Register, Vol. 81, No. 150. August 4, 2016. pp. 51370-51374.
- ⁴ Fisheries of the Northeastern United States; Atlantic Bluefish Fishery; 2017 Sector Quota Transfer Adjustment. Federal Register, Vol. 82, No. 47. March 13, 2017. pp 13402-13404.
- ⁵ Durell, E.Q. 2017. Maryland 2016 Bluefish (*Pomatomus saltatrix*) Compliance Report to the Atlantic States Marine Fisheries Commission. Maryland Department of Natural Resources.
- ⁶ Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division. May 15, 2017 query.

Figure 1. Maryland commercial bluefish landings and quota, 1950-2016.⁵

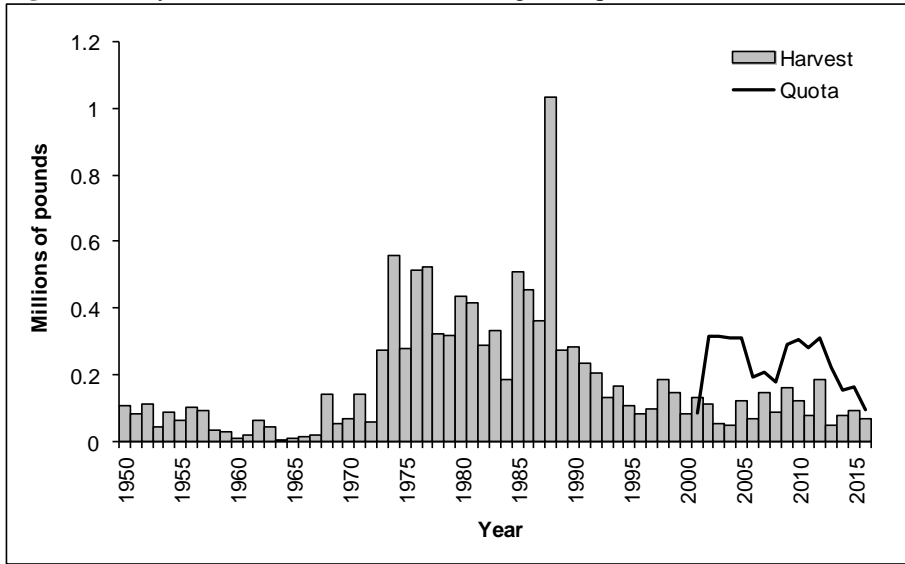
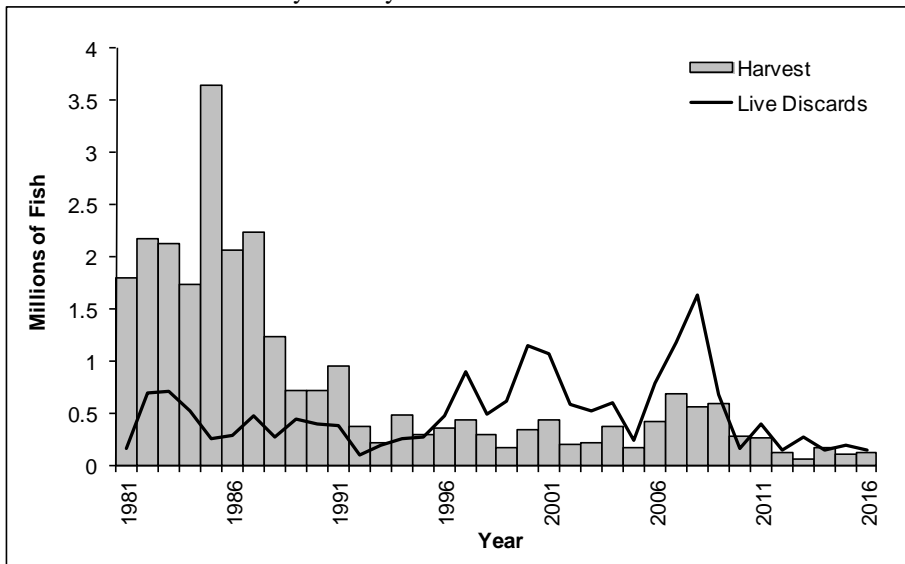


Figure 2. Estimated number of bluefish harvested and live discards by the recreational fishery in Maryland from 1981 to 2015.⁶



2003 Amendment #1 to the 1990 Chesapeake Bay Bluefish Fishery Management Plan Implementation Table (updated 08/2017)

Problem Area	Action	Date	Comments
Stock Status Management Strategy 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.	Action 1.0 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.
	Action 1.1 CBP jurisdictions will adopt the MAFMC/ASMFC overfishing definition, and adhere to the 9-year rebuilding schedule for the coast wide management of bluefish: F=0.51 (1999-2000) F=0.41 (2001-2003) F=0.31 (2004-2007).	1999 Continue 2008 2015	The 9-year rebuilding schedule reduced F: F=0.51(1999-2000) F=0.41(2001-2003) F=0.31(2004-2007) The bluefish stock is rebuilt, and overfishing is not occurring. Fishing mortality target is $F_{MSY} = 0.170$ and most recent F estimate is 0.157, below the target.
Fishery Management Strategy CBP jurisdictions will follow the coastal management measures established by the ASMFC and the MAFMC, and coordinate fishery management measures within the Chesapeake Bay.	Action 2.0 CBP jurisdictions will adhere to the commercial TAL established by the MAFM/ASMFC. Individual state-by-state TALs are based on historic landings from 1981-1989.	Continue	TAL may vary annually. NMFS revised the 2017 coastal commercial quota to 6.07 million lbs. and the coastal recreational harvest limit to 11.58 million lbs. Maryland receives 3% of the commercial quota for a total of 256,420 lbs. VA receives 11.88% or 1.01 million lbs. Maryland transferred 50,000 lbs. of its 2016 commercial quota to New York, resulting in an adjusted quota of 96,631 lbs.
	Action 2.1 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.

2003 Amendment #1 to the 1990 Chesapeake Bay Bluefish Fishery Management Plan Implementation Table (updated 08/2017)

Problem Area	Action	Date	Comments
Fishery Management Strategy cont'd	Action 2.2 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. The coastwide Recreational Harvest Level (RHL) for 2017 is 11.58 million lbs.
Research and Monitoring Strategy CBP jurisdictions will monitor the commercial and recreational fisheries and improve catch and effort data. CBP jurisdictions will also pursue studies to evaluate the social and economic aspects of the bluefish fishery in the Chesapeake Bay.	Action 3.0 CBP jurisdictions will continue to collect catch and effort data from the commercial fishery, and expand the economic data to include dollar value of the commercial fishery and the annual dockside value received for bluefish in CBP jurisdictions.	Continue Complete	Mandatory reporting is in effect in all CBP jurisdictions. Dockside value is available from NMFS. MAFMC created a RSA program which allows up to 3% of the TAC to be sold and the money used to fund research projects. The RSA program is currently suspended pending thorough review of cost, benefit, and law enforcement concerns.
	Action 3.1 CBP jurisdictions will assess methods for improving recreational and charter catch/effort data needed to evaluate biological and economic impacts.	Continue 2011 Continue	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.
	Action 3.2 CBP jurisdictions will continue to collect fishery independent data on bluefish.	2001 Continue	The ChesFIMS and ChesMMAP surveys provided data used to help manage bluefish in Chesapeake Bay. The ChesFIMS survey ended in 2006. ChesMMap continues to provide data on diet preferences. Bluefish are regularly sampled by the MDNR Fisheries Service to estimate recruitment and characterize size structure.

2003 Amendment #1 to the 1990 Chesapeake Bay Bluefish Fishery Management Plan Implementation Table (updated 08/2017)

Problem Area	Action	Date	Comments
<p>Habitat Management Strategy 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.</p>	<p>Action 4.0 CBP jurisdictions continue to set goals for water quality and habitat restoration and protection, to address commitments established under Chesapeake Bay 2000 Agreement.</p>	<p>2003</p> <p>2009</p> <p>2010</p> <p>2012</p> <p>2013</p> <p>Continue</p>	<p>Bluefish habitat was identified in Amendment 1 to the Chesapeake Bay Bluefish FMP.</p> <p>President Barack Obama’s executive order recommitted federal agencies to Bay restoration and regulatory enforcement.</p> <p>EPA established a Bay wide TMDL (aka: pollution diet). Each jurisdiction must establish 2 year milestones for progress towards meeting its TMDL.</p> <p>Legislation has been passed for restrictions on new developments using septic systems. Legislation for a stormwater fee based on impervious surface coverage was enacted.</p> <p>Chesapeake Bay Program monitors levels of mercury, PCBs, PAHs, organophosphate and organochloride pesticides. Ambient water quality criteria of DO, water clarity, and chlorophyll-a have been adopted for the Chesapeake Bay.</p> <p>See Chesapeake Bay Program website for updates on water quality criteria http://www.chesapeakebay.net/issues/issue/chemical_contaminants http://www.chesapeakebay.net/restoringwaterquality.aspx?menuitem=14728 nutrient reduction</p>
	<p>Action 4.1 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>	<p>Continue</p>	<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>

2003 Amendment #1 to the 1990 Chesapeake Bay Bluefish Fishery Management Plan Implementation Table (updated 08/2017)

Problem Area	Action	Date	Comments
Habitat Management Strategy cont'd			<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. http://www.chesapeakebay.net/track/health</p>
	<p>Action 4.2 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>Continue</p> <p>2003 Continue</p> <p>2012</p> <p>2014</p> <p>1998 Continue</p>	<p>MD developed a Blue Infrastructure that includes mapping structural habitat and SAV.</p> <p>VIMS annually surveys SAV distribution in Chesapeake Bay. The SAV goal adopted by Chesapeake Bay Program was planting 1,000 acres of SAV by 2008 and restoration of 185,000 acres of SAV by 2010.</p> <p>Planting goal was revised to 20 acres per year.</p> <p>A Chesapeake Watershed Agreement was adopted in June 2014 with interim targets of 90,000 acres by 2017 and 130,000 acres by 2025. SAV coverage in 2016 was 97,430 acres http://www.chesapeakebay.net/indicators/indicator/bay_grass_abundance_baywide.</p> <p>Regulations are in place to prohibit dredging through SAV beds. Tiered designation and prioritization of SAV beds has not been implemented. Avoidance of dredging, filling and construction impacts to SAV is strictly enforced by MDE and USACE with input from DNR, USFWS, and NMFS. MD has not established undisturbed buffers. VA has established buffer criteria.</p>
	<p>Action 4.3 CBP jurisdictions will monitor important forage species, when identified by fishery independent surveys to insure that activities such as directed</p>	<p>Continue</p>	<p>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</p>

2003 Amendment #1 to the 1990 Chesapeake Bay Bluefish Fishery Management Plan Implementation Table (updated 08/2017)

Problem Area	Action	Date	Comments
Habitat Management Strategy cont'd	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.		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.
		2012	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.
		2014	Results of the most recent stock assessment for menhaden, which considered new data, indicate that menhaden are not overfished and overfishing is not occurring.
		2015	The 2014 Chesapeake Watershed Agreement delineated a forage fish outcome and a forage workshop was held in Nov. 2014. During 2015, a forage work plan was developed for 2016/2017 http://www.chesapeakebay.net/managementstrategies/strategy/forage_fish
	Action 4.4 CBP jurisdictions will monitor the abundance of important bluefish forage species that are not managed under CBP FMPs, such as bay anchovies and Atlantic silversides	Continue	MD and VA juvenile seine surveys monitor the abundance of anchovies and silversides. Non-managed forage fish abundance is examined by an independent, CBL research project.

2003 Amendment #1 to the 1990 Chesapeake Bay Bluefish Fishery Management Plan Implementation Table (updated 08/2017)			
Problem Area	Action	Date	Comments
	Action 4.5 CBP jurisdictions will continue to identify predator/prey interactions, both inter- and intra-species competition and other interactions that might affect the management of bluefish.	Continue 2012	Data from the ChesFIMS and the ChesMAP surveys will be utilized to identify and delineate ecological relationships. Development of multispecies fishery management plans may result from this data. A multispecies predator/prey model is being developed by ASMFC that includes bluefish, menhaden, striped bass, and weakfish.

1990 Chesapeake Bay Bluefish Fishery Management Plan Implementation Table (updated 7/2017)			
Strategy	Action	Date	Comments
1 – Stock Status and Increased Fishing Pressure: In order to protect the bluefish resource in the Chesapeake Bay and along the Atlantic coast from overexploitation, stock levels and fishing rates need to be monitored. Appropriate management actions may be needed if stock levels continue to decline and harvest levels continue to increase.			
1.1.1) Since bluefish are a highly migratory species harvested along the Atlantic coast, Maryland, the Potomac River Fisheries Commission, and Virginia will cooperate with the Mid-Atlantic Fishery Management Council and the Atlantic States Marine Fisheries Commission to solve interjurisdictional problems in managing the bluefish stock	1.1.1) Maryland, the Potomac River Fisheries Commission, and Virginia will continue to participate in scientific and technical meetings for managing bluefish along the Atlantic coast and in estuarine waters.	Continue	Jurisdictions will work closely with the MAFMC, ASMFC, and other coastal states, especially to monitor the commercial catch. See Amendment #1 Action 1.0

1990 Chesapeake Bay Bluefish Fishery Management Plan Implementation Table (updated 7/2017)

Strategy	Action	Date	Comments
<p>1.1.2) Maryland, the Potomac River Fisheries Commission, and Virginia will monitor the bluefish fisheries in the Chesapeake Bay and in state coastal waters and implement conservation management measures for the fisheries as needed.</p>	<p>1.1.2.1) Maryland, the Potomac River Fisheries Commission, and Virginia will adhere to state allocations established by the MAFMC and ASMFC if the commercial harvest is projected to equal or exceed 20% of the total bluefish catch from the Atlantic coast. Commercial harvest controls will be coordinated among Bay jurisdictions and will be consistent with those established in federal waters. Options may include gear restrictions, areal closures, trip limits, and quotas.</p>	<p>Dependent on harvest trends</p>	<p>Bay jurisdictions will coordinate with each other and with federal government. May include gear, trip, area, catch, and/or other restrictions.</p> <p>See Amendment #1 Action 2.0</p>
	<p>1.1.2.2) A) Maryland, Potomac River Fisheries Commission, and Virginia will continue current licensing requirements for the commercial harvest and sale of bluefish. B) Virginia will institute a 10 fish creel limit for the commercial harvest of bluefish by hook and line and work towards establishing a commercial hook and line license.</p>	<p>1991</p>	<p>VA will require new regulation for commercial hook and line fishery.</p> <p>A) See Amendment #1 Action 2.1</p> <p>B) See Amendment #1 Action 2.2</p>
	<p>1.1.2.3) Maryland will establish a 10 fish per person per day recreational creel limit at present minimum for the Chesapeake Bay and state coastal waters. Virginia and the Potomac River Fisheries Commission established a 10 fish per person per day recreational limit in summer 1990. Upon a recommendation from the MAFMC and ASMFC, or as otherwise determined to be appropriate, jurisdictions may modify the possession limit and/or minimum size limit.</p>	<p>1991</p>	<p>Will require new regulations. Jurisdictions will coordinate creel limits and size limits.</p> <p>See Amendment #1 Action 2.2</p>
<p>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.</p>			
	<p>2.1.1) Virginia and the Potomac River established a 10 fish per person per day</p>	<p>1991</p>	<p>See Action 1.1.2.2</p>

1990 Chesapeake Bay Bluefish Fishery Management Plan Implementation Table (updated 7/2017)

Strategy	Action	Date	Comments
2.1) Efforts will be made to reduce the discard of dead bluefish in the Chesapeake 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 7/2017)			
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.	1991	Will coordinate with CBSAC, universities, other agencies. See Amendment #1 Action 3.2

1990 Chesapeake Bay Bluefish Fishery Management Plan Implementation Table (updated 7/2017)

Strategy	Action	Date	Comments
	3) Investigate the environmental parameters that 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.	4.1) The District of Columbia, Environmental Protection Agency, Maryland, Pennsylvania, the Potomac River Fisheries Commission, and Virginia will continue to set specific objectives for water quality goals and review management programs established under the 1987 Chesapeake Bay Agreement. The Agreement and documents developed pursuant to the Agreement Call for: 1) Developing habitat requirements and water quality goals for various finfish species. 2) Developing and adopting basinwide nutrient reduction strategies. 3) Developing and adopting basinwide plans for the reduction and control of toxic substances. 4) Developing and adopting basinwide management measures for conventional pollutants entering the Bay from point and non-point sources. 5) Quantifying the impacts and identifying the sources of atmospheric inputs on the Bay system. 6) Developing management strategies to protect and restore wetlands and submerged aquatic vegetation. 7) Managing population growth to minimize adverse impacts to the Bay environment.	Continue	Agencies must coordinate closely; must continue work on habitat requirements for bluefish and other water quality issues in the Bay. Chesapeake Bay Program (CBP) develops, revises, and monitors goals and strategies for agriculture, air pollution, bay grasses, chemical contaminants, climate change, development, education, forests, groundwater, nutrients, population growth, rivers and streams, sediment, stormwater runoff, wastewater, weather, and wetlands. For more information: http://www.chesapeakebay.net/issues http://www.chesapeakebay.net/issues/issue/nutrients http://www.chesapeakebay.net/issues/issue/chemical_contaminants http://www.chesapeakebay.net/issues/issue/sediment http://www.chesapeakebay.net/issues/issue/wastewater http://www.chesapeakebay.net/issues/issue/stormwater_runoff http://www.chesapeakebay.net/issues/issue/air_pollution http://www.chesapeakebay.net/issues/issue/wetlands

1990 Chesapeake Bay Bluefish Fishery Management Plan Implementation Table (updated 7/2017)			
Strategy	Action	Date	Comments
			http://www.chesapeakebay.net/issues/issue/bay_grasses http://www.chesapeakebay.net/issues/issue/dev_elopment See Amendment #1 Actions 4.0, 4.1, 4.2

Acronyms

ABC – Allowable Biological Catch
 ASMFC – Atlantic States Marine Fisheries Commission
 B_{msy} – Biomass maximum sustainable yield
 BRP – Biological Reference Point
 CBL – Chesapeake Biological Laboratory
 CBP – Chesapeake Bay Program
 CBSAC – Chesapeake Bay Stock Assessment Committee
 CHEFIMS – 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

2016 Maryland FMP Report (May 2017)

Section 9. Maryland Catfish Species

Introduction

The commercial harvest of invasive blue catfish (*Ictalurus furcatus*) and flathead catfish (*Pylodictis olivaris*) rebounded in 2016 from a short lull in 2015. The Invasive Catfish Task Force continues its efforts to educate recreational anglers on the importance of removing these aggressive species from the ecosystem and studying the population dynamics of both species.

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 19th century. 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 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 invasive species.

A Fishery Management Plan has not been written for catfish in the Chesapeake Bay but a technical report was completed in 1998. The technical report summarized catfish knowledge and recommended a survey of catfish populations to determine stock status in the Chesapeake Bay.

The Sustainable Fisheries Goal Implementation Team (GIT) of the Chesapeake Bay Program developed a policy on invasive catfish species. The policy agrees to develop and implement management strategies to reduce invasive catfish populations and mitigate their spread. An Invasive Catfish Task Force (ICTF) was established in 2012 to identify management options for addressing invasive catfish issues. The ICTF developed a report in 2014. The Invasive Species Action Plan recommends: slowing and reducing the spread of invasive catfish 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 catfish 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 2014.¹ 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. Maryland developed an Aquatic Nuisance Species Management Plan in 2016. Both blue catfish and flathead catfish were identified as high priority aquatic nuisance species. The high priority status is based on the "high potential of negative economic and/or ecological impacts."

http://dnr.maryland.gov/Invasives/Documents/Maryland_Aquatic_Nuisance_Species_Plan.pdf

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 and most recently updated in 2016.² A surplus production model was used to assess channel catfish in the Head of Bay (HOB) and Choptank River. Channel catfish status in Potomac, Patuxent and Nanticoke rivers were determined from commercial landings. The HOB surplus production model showed a population biomass decline during the 1990's after a period of population growth in the 1980's. Biomass peaked in the HOB between 2008 and 2010. Biomass declined through 2015 and the stock was considered fully exploited but not overfished. The Estuarine Juvenile Finfish Survey (EJFS) data have been used to assess juvenile production but the seine survey is not the ideal collection technique to survey young catfish, so this index has been discontinued. The upper Chesapeake Bay winter trawl survey age 1 data produces a more accurate depiction of juvenile catfish production. Channel catfish juvenile

production in HOB was at or above average in four of the last five years (Figure 2). Relative abundance data from fyke nets sampled in the Choptank River indicate that channel and white catfish relative abundance was mostly above average during 2008 – 2016 (Figures 3 and 4).³ Channel catfish stock status is less clearly defined in the Nanticoke, Patuxent, and Potomac rivers. Commercial landings indicated that channel catfish stocks are increasing in the Nanticoke River, stable in the Patuxent River, and at low levels in the Potomac River. The Potomac River channel catfish decline coincides with blue catfish expansion.

Maryland DNR began monitoring blue and flathead catfish in the Patuxent River in 2016. There is also a diet study underway. Preliminary results are expected in 2017 including DNA determination of stomach contents. Several studies are also in progress in Virginia to determine population status, distribution and diet. An Invasive Catfish Symposium is planned for fall 2017 to discuss the state of the science and the status of the invasive catfish fishery.

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 per person per 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, catfish commercial landings have been reported by species. Commercial catfish harvest in 2016 was over 1.9 million lbs. The 2016 commercial landings for blue and flathead catfish were 169,324 and 37,597 lbs., respectively, and landings for both were more than those reported in 2015. Catfish are caught in commercial fish pots, fyke nets, and pound nets. They are sold in both “dead” and “live” markets.

The ICTF has promoted the harvest of invasive catfish species to reduce their ecological impact on river systems within the Chesapeake Bay. In the last few years, flathead and blue catfishes have entered the commercial fishery and an active market exists for these invasive species. There has been a baywide increase in commercial processors, an increase in the price per pound of invasive catfish species, and the successful marketing of freshly caught blue catfish to Maryland restaurants. In Virginia, there has been an on-going study on the use of low frequency (LF) electrofishing as a commercial gear type for harvesting invasive blue catfish. The study indicates that LF electrofishing is effective at harvesting all sizes of blue

catfish with no bycatch issues. The use of this gear type has some limits based on water temperature and salinity.

In 2016, Maryland legislation expanded the types of gear that can be legally used for harvesting catfish. Legislation also expanded the use of haul seines to include the weekends. In Virginia, it is now illegal to introduce/stock or release invasive catfish into Virginia waters. Pennsylvania implemented regulations for the use of additional gear types to target flathead catfish and developed a management plan for flatheads.

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 fishing 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. Maryland DNR requests that anglers remove and kill any blue and flathead catfish they catch.

Issues of Concern

Introduced non-native 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.¹ 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.⁴

Tagging results from Virginia studies indicate that blue catfish can move both short and long distances within a river system. Their salinity tolerance is higher than most freshwater fishes so they have the potential to expand to other rivers depending on whether it is a dry or wet year. Larger blue catfish appear more tolerant of salinity than smaller blue catfish.

Diet studies from Virginia indicate that blue catfish prey on shad and herring at low levels but during spawning in the spring: a critical part of their life cycle. Blue catfish also prey on American eels in spring and fall. Predation on blue crabs are a management concern since preliminary diet data indicate they are preyed upon at higher levels than previously expected.

Catfish 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.⁵

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.

References:

¹Bilkovic, 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.

²Piavis, P. and E. Webb III. 2016. 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. Annapolis, Maryland.

³Piavis, P. and E. Webb III. 2016. 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.

⁴Viverette, 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.

⁵Pinkney, 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.

Figure 1.

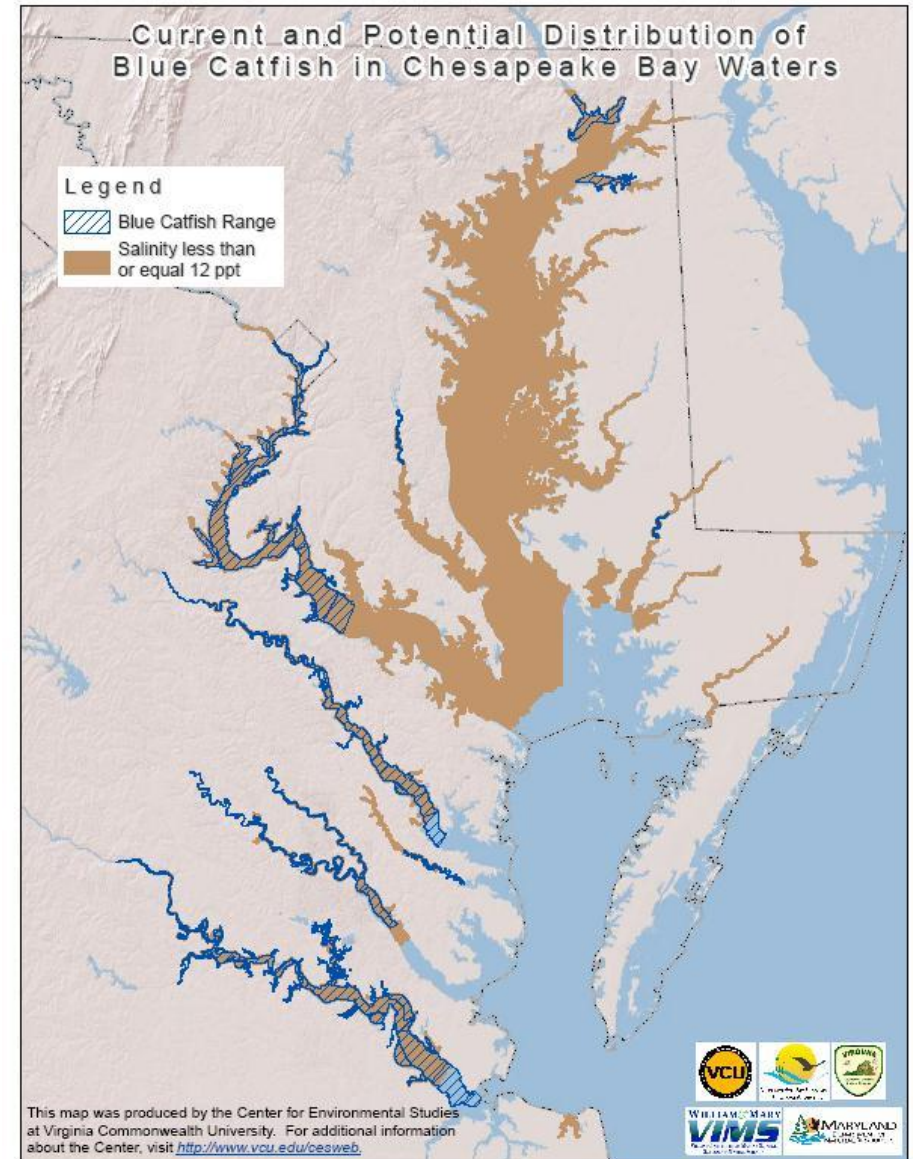


Figure 2. Channel catfish age 1 index from upper Chesapeake Bay winter trawl survey, 2000-2016.

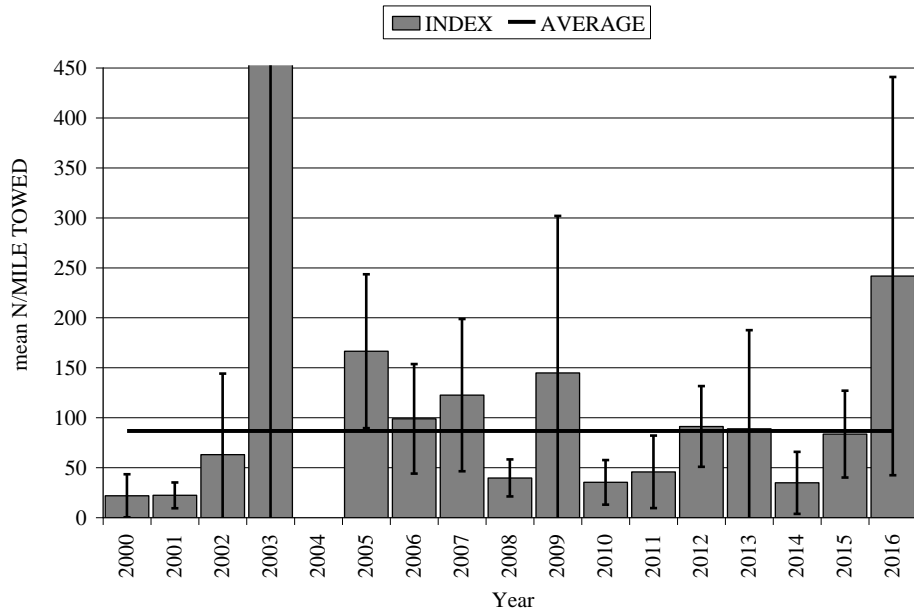


Figure 3. Channel catfish relative abundance (N/net day) from the Choptank River fyke net survey, 2000 – 2016. Horizontal line indicates time series average relative abundance.

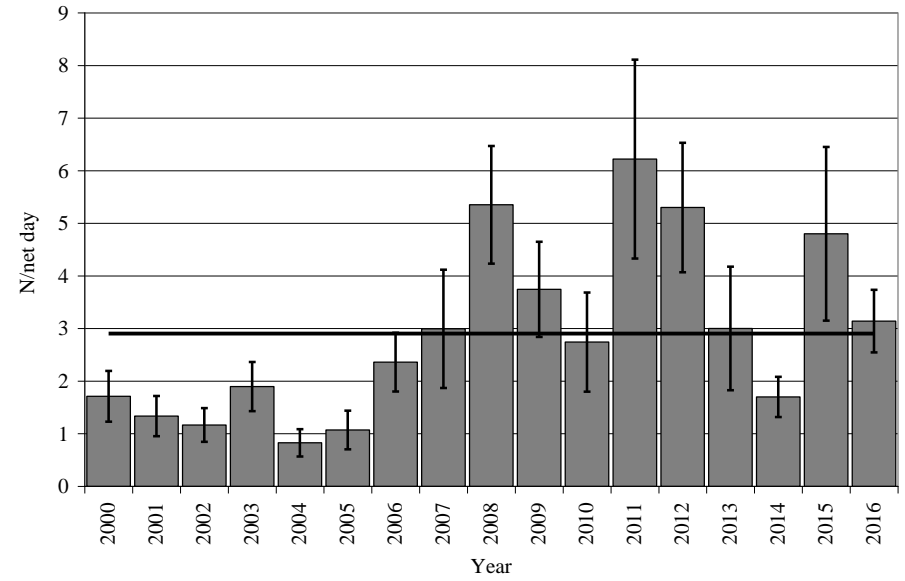


Figure 4. White catfish relative abundance (N/net day) from the Choptank River fyke net survey, 2000 – 2016. Horizontal line indicates time series average relative abundance.

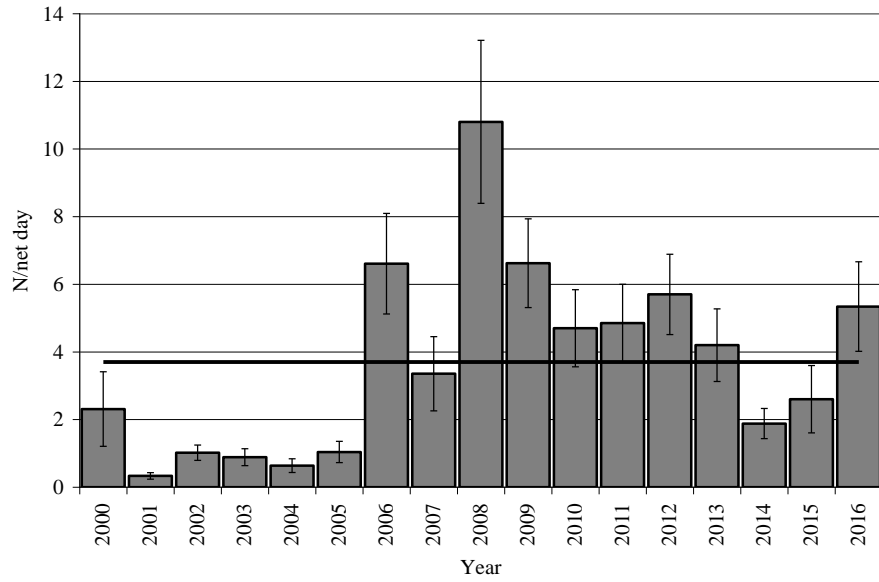
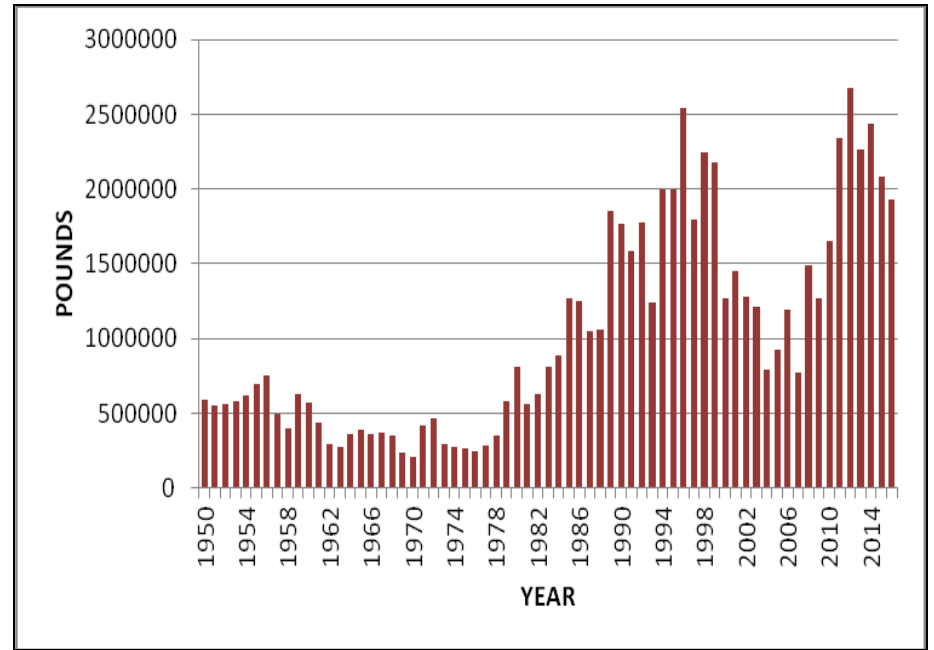


Figure 5. Maryland commercial catfish landings (MDDNR data)



2016 Maryland FMP Report (May 2016)

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

Maryland's Atlantic Coastal Bays is a unique ecosystem that is separate from the Chesapeake Bay. For this reason, the Coastal Bays blue crab fishery is managed separately under the Coastal Bays Blue Crab Fishery Management Plan (Coastal BCFMP). Developed in 2001, the Coastal BCFMP identifies management measures to conserve the coastal blue crab stock while protecting the ecological and socio-economic value of the species. During the last plan review in 2010 it was determined that the Coastal BCFMP was an appropriate framework for managing this resource.

The development of the 2001 Coastal BCFMP was triggered by the Comprehensive and Conservation Management Plan (CCMP) adopted for Maryland's Coastal Bays in 1999. The CCMP recommended that the Maryland Department of Natural Resources address fishery issues specific to Maryland's Coastal Bays. To view the entire CCMP, go to the Maryland Coastal Bays National Estuary Program website at <http://www.mdcoastalbays.org>. The CCMP is reviewed and updated on a regular basis. A comprehensive review of the CCMP was completed during 2013 and resulted in updated goals, objectives and actions. The plan was revised as the 2015-2025 Maryland Coastal Bays Comprehensive Conservation and Management Plan. The revised plan addresses water quality and environmental health of the estuaries around Ocean City and Assateague Island. The CCMP includes 4 additional plans, 15 goals, 33 challenges and 222 actions. To view the 2015 Coastal Bays Report card, go to: http://ian.umces.edu/pdfs/ian_report_card_536.pdf

Stock Status

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

Recruitment of juveniles into the Coastal Bays is largely driven by environmental and hydrologic elements of the Atlantic Ocean. Although there is evidence that some internal recruitment is occurring, it is hypothesized that most of the 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 increase in carbon dioxide. The complex factors that drive circulation patterns are non-linear. As a result, circulation patterns could change much faster than previously indicated. Changes in climate patterns could affect blue crab larval recruitment into the Coastal Bays.

Fishery Statistics

Maryland's Coastal Bays support both a commercial and recreational blue crab fishery. The preliminary 2016 commercial harvest of hard, soft and peeler crabs from the Coastal Bays is 1.5 million lbs., a decrease from 2015 (Figure 3). Annual commercial harvest of blue crabs from the Coastal Bays has ranged from 0.54 to 2.4 million lbs. with an average harvest of 1.3 million lbs. Crab pots accounted for 99.8% of the total commercial harvest in 2016. The recreational fishery is primarily a small boat fishery due to limited public shoreline/pier/bulkhead access. Recreational harvest of blue crabs in the Coastal Bays is undocumented. Estimates of recreational harvest from the Chesapeake Bay are believed to be between 8 and 11% of the commercial harvest. Whether or not this estimate is applicable to the Coastal Bays is unknown.

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

Management Measures

Maryland DNR manages the Coastal Bays commercial blue crab fishery through daily catch limits (25 bushels/boat/day), seasons (closed between Nov 1 & Mar 31), daily time restrictions, gear restrictions (no scrapes or dredges), limited entry, and other management strategies as necessary to control fishing effort. Maryland 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 seasons (closed between Jan 1 & Mar 31). No license is required. Waterfront property owners can use two crab pots off their dock/pier. The pots must be marked with the owner's name and address or MDDNR 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. In both the commercial and recreational fisheries there are minimum size limits [minimum 5" for hard crabs, 3 ½" for soft crabs and time-period size differences for peeler crabs (3¼" prior to July 15th and 3½" after July 15th)]. There is no minimum size limit on mature female crabs and the taking of sponge crabs is prohibited. Special regulations

are in place for crabbing in Worcester County and may change annually (see COMAR for a complete list of restrictions).

Concerns/Issues

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

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.

Figure 1. Maryland blue crab seine CPUE from the Coastal Bays Fisheries Investigations, 1989-2016.

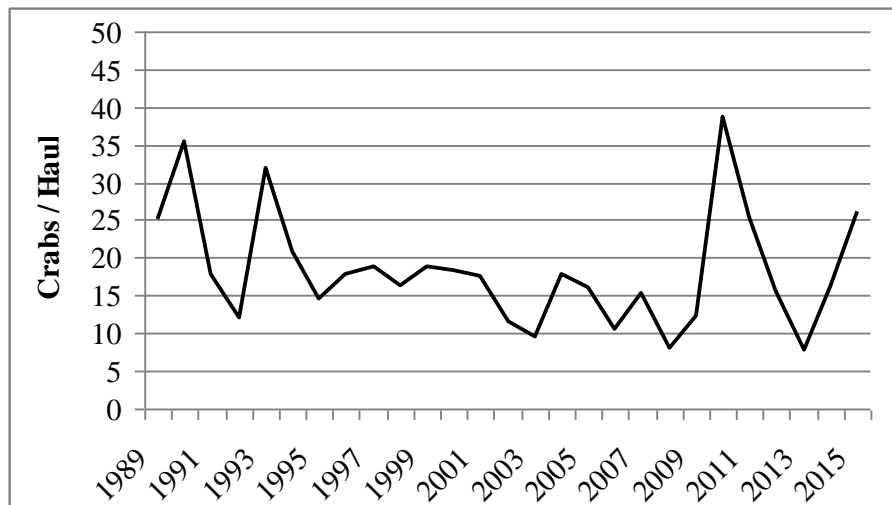


Figure 2. Maryland blue crab trawl CPUE from the Coastal Bays Fisheries Investigation, 1989-2016.

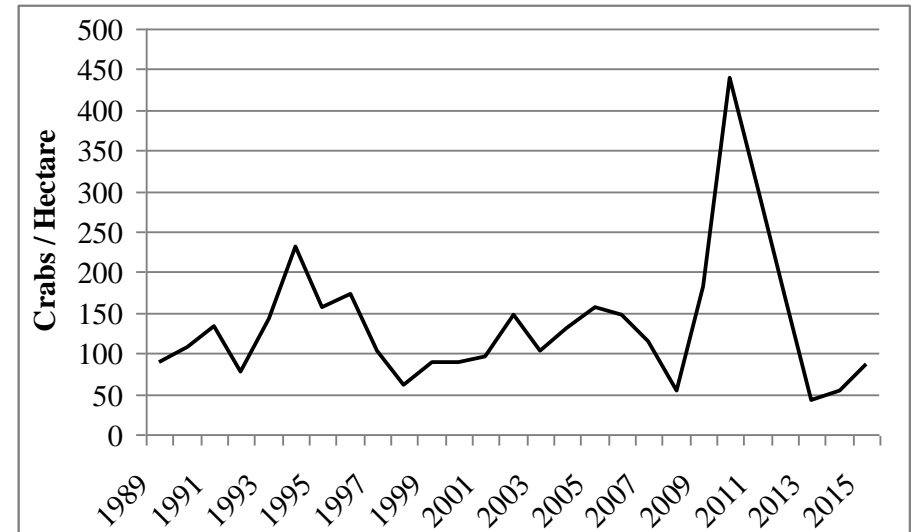
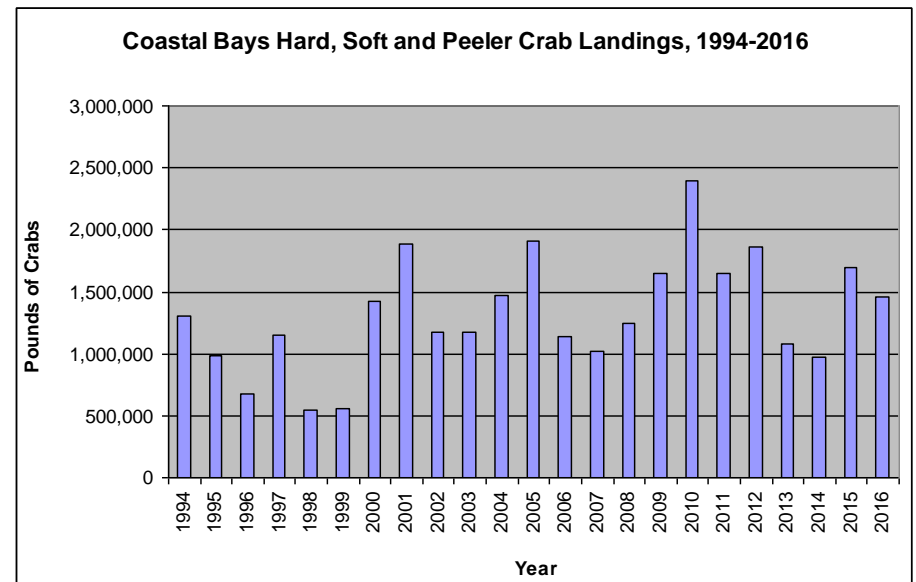


Figure 3. Total Maryland Coastal Bays Blue Crab commercial harvest in pounds, 1994-2016 (MD DNR data).



2001 Coastal Bays Blue Crab Fishery Management Plan Implementation (updated 05/2017)		
Objective/Problem	Action	Implementation
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.	1.4.1 DNR and MCBP will identify potential funding sources to support the following research and monitoring activities: a) Assess the impact of <i>Hematodinium</i> in the coastal bays blue crab population (i.e. identify what intensity of <i>Hematodinium</i> infection causes mortality, and identify other factors, environmental and/or biological, that may influence blue crab mortality from <i>Hematodinium</i>). b) Identify factors which influence <i>Hematodinium</i> proliferation, elucidating different life stages, determining the full life cycle of the parasite, and eventual production of a more specific diagnostic tool either by immunoassay or molecular assay techniques. c) Examine how crabs become infected with <i>Hematodinium</i> .	Research includes monitoring prevalence in MD coastal bays. Research is ongoing with the NOAA Oxford Cooperative. University of MD Eastern Shore, and VIMS. A 2010/2011 University of MD project found the presence of <i>Hematodinium</i> sp. in 9% of the water & sediment samples. Viruses of all types have been documented in blue crabs & likely impact population dynamics. VIMS is currently conducting a disease study on crabs from the Eastern Shore of Virginia.
	1.4.2 DNR will define the criteria under which a Marine Protected Area can be effective in assessing the impacts of <i>Hematodinium</i> on blue crabs	The Coastal Bays Fisheries Advisory Committee discussed MPAs in the past, without any specific outcome. This committee was disbanded and fishery issues are now discussed with forums two times a year and through the Maryland Coastal Bays Program http://www.mdcoastalbays.org/
Obj. 2. Improve our understanding of blue crab biology and stocks. Prob. 2.1: Stock Status	Action 2.1.1: 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. Reported landings of hard, soft and peeler crabs from the Coastal Bays was 1.5 million lbs. (2016). Average landings have been approximately 1.3 million lbs.
	2.1.2: 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 Bay Fishery Investigation

2001 Coastal Bays Blue Crab Fishery Management Plan Implementation (updated 05/2017)		
Objective/Problem	Action	Implementation
		(CBFI) trawl and seine surveys. Research needs have not been defined.
	2.1.3: 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.
	2.1.4: 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.
	2.1.5: 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.	2.2.1: DNR will establish, implement and evaluate a commercial reporting monitoring program to obtain accurate catch and effort data from anyone crabbing commercially in Worcester County consistent with recommendations of the Atlantic Coast Cooperative Statistics Program. a) Evaluate the effectiveness of the A pilot@ daily logbook reporting system implemented in 2000 for commercial crab harvesters and dealers in Worcester Co b) Consider using the Chesapeake Bay's commercial crab reporting system, but make it specific to the coastal bays, including more detailed information on location of harvest and effort data.	As a result of the pilot project, blue crab reporting went from a monthly summary to a daily logbook. The daily logbook program was expanded to the entire state in 2001. A pilot study was conducted in the Chesapeake Bay during 2012 to evaluate the use of an electronic reporting system to improve the timely reporting of catch statistics. A few crab harvesters from the Coastal Bays participated in the study during 2016.
	2.2.2: DNR will improve the enforcement of mandatory monthly reporting	A list of licensees with late reports is published online and annual reminders are sent out to licensees with missing reports. The voluntary electronic reporting

2001 Coastal Bays Blue Crab Fishery Management Plan Implementation (updated 05/2017)		
Objective/Problem	Action	Implementation
		program should also provide improved and timely commercial harvest reports.
Prob. 2.3: Recreational Catch and Effort Data.	2.3.1: 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.
	2.3.2: 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	2.4.1: 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.
	2.4.2: 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)
	2.4.3: DNR will continue to work with Maryland's Non-Indigenous Species Task Force to examine invasive species issues, and develop an Aquatic Nuisance Species Plan to become eligible for Federal funding	An Aquatic Nuisance Species Task Force developed a management plan for green crabs for the entire U.S. in 2002. The Maryland Aquatic Nuisance Species Management Plan was completed in November 2016. The European green crab was identified as a high priority species.
	2.4.4: 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 Shifting

2001 Coastal Bays Blue Crab Fishery Management Plan Implementation (updated 05/2017)		
Objective/Problem	Action	Implementation
		<u>Sands</u> (2009), a book about the Coastal Bays.
Prob. 2.5: Functional Role of Blue Crabs in the Natural Ecological Community.	2.5.1: 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.
Obj.3. Maintain an economically stable and sustainable commercial blue crab fishery.	3.1.1: DNR will improve the accuracy of effort data in the coastal bays' commercial blue crab fishery by implementing actions related to Problem 2.2 - Commercial Reporting.	See comments Action 2.2.1 and Action 2.2.2.
	3.1.2: 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) Gear Restrictions - 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) Time Restrictions - 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.08.02.03.12E) Time restrictions have been enacted. (COMAR.08.02.03.12D) Closed season enacted: November 1 to April 1. (COMAR 08.02.03.12C) For 2017, the time restrictions were changed from a fixed time to: sunrise to 8.5 hours after for April and October and 1/2hour before sunrise to 8 hours after for May-Sept.
Prob. 3.2: Harvest of Female Crabs,	3.2.1: 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) Area Closures - 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 th and 50 th Street; and 2) The Therefore site, in southern Isle of Wight Bay;	Continue.

2001 Coastal Bays Blue Crab Fishery Management Plan Implementation (updated 05/2017)		
Objective/Problem	Action	Implementation
	3) The Bridge site, just north of the Verrazano Bridge on the barrier island side. b) Catch and Size Limits - Determine if the current catch and size limits for female crabs are appropriate.	
	3.2.2: 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.	3.3.1 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).	Continue.
	3.3.2: DNR will determine if measures are necessary to reduce the bycatch mortality of crabs in the hydraulic clam dredge fishery (i.e. Action 3.2.1(a) - prohibition of hydraulic clam dredging in areas where female crabs are concentrated).	Hydraulic Clam Dredging is currently prohibited in Maryland's Coastal Bays, 2007. Natural Resource Article § 4-1002
	3.3.3: 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.	Continue. (Lukacovic et al. 2005)
	3.3.4: MCBP will coordinate an annual/seasonal volunteer effort to locate and remove derelict pots.	Continue.
Obj. 4. Improve the recreational crabbing experience. Prob. 4.1: Satisfaction of Recreational Crabbers.	4.1.1: 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.
	4.1.2: DNR will examine the effects of habitat quality on the success rates of recreational crabbing in the coastal bays.	No studies have been conducted.
	4.1.3: 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.	Continue.
	4.1.4: DNR, MCBP, Town of Ocean City and Worcester County will work towards increasing the number of land-accessible areas for recreational crabbing.	Continue.
Obj. 5. Protect, maintain and enhance	5.1.1: DNR will alleviate the impact of hydraulic clam dredging and prop scarring to SAV in the coastal bays by:	Hydraulic Clam Dredging is currently prohibited in Maryland's

2001 Coastal Bays Blue Crab Fishery Management Plan Implementation (updated 05/2017)		
Objective/Problem	Action	Implementation
blue crab habitat. Prob. 5.1: Submerged Aquatic Vegetation (SAV).	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.	Coastal Bays, 2007. Natural Resource Article § 4-1002
	5.1.2: 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.
	5.1.3: DNR and MCBP will continue to identify SAV species needing protection and activities needing restrictions.	Continue
	5.1.4: 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 increased in the Coastal Bays during 2015. The coastal bays aerial survey was not done in 2016. SAV beds in Maryland's Coastal Bays appear to be an important area of primary habitat for fish.
	5.1.5: 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) Continue. c) Completed by MGS & DNR. d) Not yet initiated.
Prob. 5.2: Overwintering Habitat.	5.2.1: 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.	5.3.1: 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	Continue. The CCMP was revised in 2015.

2001 Coastal Bays Blue Crab Fishery Management Plan Implementation (updated 05/2017)		
Objective/Problem	Action	Implementation
	actions. Refer to the CCMP for more specific information on these actions.	
Prob. 5.4: Dissolved Oxygen.	5.4.1: 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.	Continue. (Maryland Department of Natural Resources 2004).The CCMP went through a thorough review and strategies and actions were updated during 2013. It resulted in an updated CCMP (2015).
	5.4.2: DNR will identify areas which have unsuitable levels of dissolved oxygen (i.e. < 3 mg/L) for blue crabs.	Continue. (Maryland Department of Natural Resources 2004).
Prob. 5.5: Nutrient, Sediment and Chemical Inputs.	5.5.1: 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.	Continue. (Maryland Department of Natural Resources 2004).
Obj. 6. Improve enforcement of crabbing restrictions. Prob. 6.1: Enforcement of Conservation Measures.	6.1.1: 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.
	6.1.2: 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

2016 Maryland FMP Report (June 2017)

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

After completion of the 2016 Coastal Bays shellfish assessment, the boat captain who has worked on these surveys for many years announced his retirement and is selling his clamming boat, leaving some question as to the future of these surveys. With the dredging ban entering its ninth year, there are no hydraulic clamming rigs in the Coastal Bays and a rapidly diminishing pool of clambers who have experience working in these waters. The Coastal Bays are a difficult place to navigate and to work because of wide expanses of shallows, shifting shoals, locally strong currents, highly variable substrate and topography, and a great deal of recreational activity especially in the northern bays. Another difficulty is finding a captain with a well-maintained rig who is comfortable following survey protocols and accommodating contingencies that might arise during the survey. The Maryland Department of Natural Resources (MD DNR) Shellfish Division is exploring options for a replacement captain and clamming vessel.

Coastal Bays Fishery Management Plan (FMP)

Recognizing Maryland's Coastal Bays as a separate, unique ecosystem from the Chesapeake Bay, a Comprehensive Conservation Management Plan (CCMP) was adopted for Maryland's Coastal Bays in 1999. The plan recommended that the MD DNR address fishery issues specific to Maryland's Coastal Bays, including those related to hard clams, the primary molluscan shellfish resource in the region. In accordance with this plan, a Coastal Bays Hard Clam Fishery Management Plan (Coastal Clam 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 Clam FMP was reviewed by the Plan Review Team (PRT). The PRT recommended a revision of the plan because the majority of actions are no longer valid due to the ban on mechanical harvesting. A time line for revising the plan has not been developed.

Stock Status

Since 1993, the MD DNR Shellfish Division has conducted fishery-independent hard clam surveys in the Maryland Coastal Bays. During the eight years since the enactment of the dredging ban, trends in the survey findings have varied depending on geographic region. In 2016, hard clam densities in all five bays were either stable or have increased. The St. Martin River, which historically had very low hard clam densities, continued to improve and now exceeds the 1953 baseline (the first of the coastal components to do so). Recruitment has also been variable by region but overall appears to have increased slightly.

During the first two years following the elimination of hydraulic escalator dredging, the southern bays (Chincoteague and Newport) continued to experience declining hard clam densities. Hard clam densities in Chincoteague Bay fell to record low levels, a full order of magnitude below the 1952 benchmark. Since 2010 this trend has reversed, with Chincoteague Bay densities doubling to 1993 levels, where they have remained for the past five years at approximately 20% of historic densities (Figure 1). Likewise, the hard clam population has more than doubled in Sinepuxent Bay since 2012 and is now at about 69% of its 1953 level. Equally encouraging results have been seen in the northern bays (Assawoman and Isle of Wight), which have had relatively substantial increases since dredging was eliminated. Note that this population expansion began before the dredging ban went into effect with sizable recruitment to the population evidenced in 2008 that subsequently went unharvested. Particularly in Isle of Wight, which generally experiences good hard clam recruitment, the post-dredging ban average hard clam density has nearly tripled the pre-ban average (Figure 2). However, over the past six years, Isle of Wight clam densities have leveled off below their historic highs and recruitment has sharply declined. The population in Assawoman Bay has increased seven-fold from critically low densities in 2006, with a 29% increase in the last year, but is still about 62% 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 survival¹ (such as brown tide blooms) and possibly increased predation. The primary predator on juvenile hard clams is blue crabs.² Other species that prey on clams are oyster drills, moon snails, whelks, mud crab, sea stars, cownose rays, horseshoe crabs, herring gulls, waterfowl, and finfish (such as tautog, puffer, black drum, and flounder).

Current Management Measures

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

The Historical Fishery

Commercial effort and harvest has varied over the years. Harvests in the mid-1990s were below 25,000 lbs. per year. Successful recruitment during this period was followed by an increase in landings, which exceeded 100,000 lbs. in 1999 and peaked at 163,000 lbs. 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 lbs. in 2010,³ the last year for which landings are available. Information from the recreational fishery is unknown.

Aquaculture activities have been slowly expanding in recent years. In 2016, there were 18 active leases covering 141 acres. Both hard clams and oysters were being raised on these leases. Production increased from 525 bushels in 2015 to 823 bushels in 2016.

Issues and/or Concerns

Most of the strategies and actions in the 2002 Coastal Bays Clam FMP were developed to address hydraulic dredging. Since the use of hydraulic dredges is prohibited, these strategies and actions are now obsolete. Consequently, the development of a new plan has been recommended but a time line has not been developed.

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

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

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

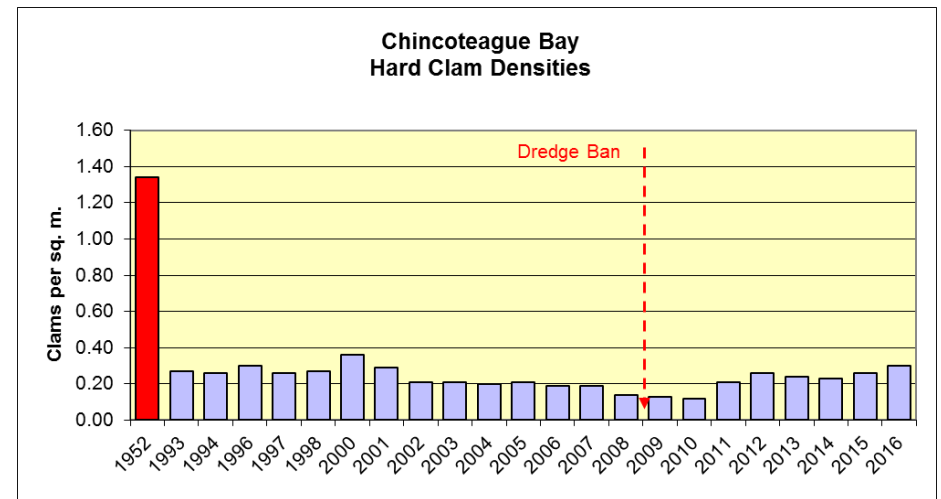
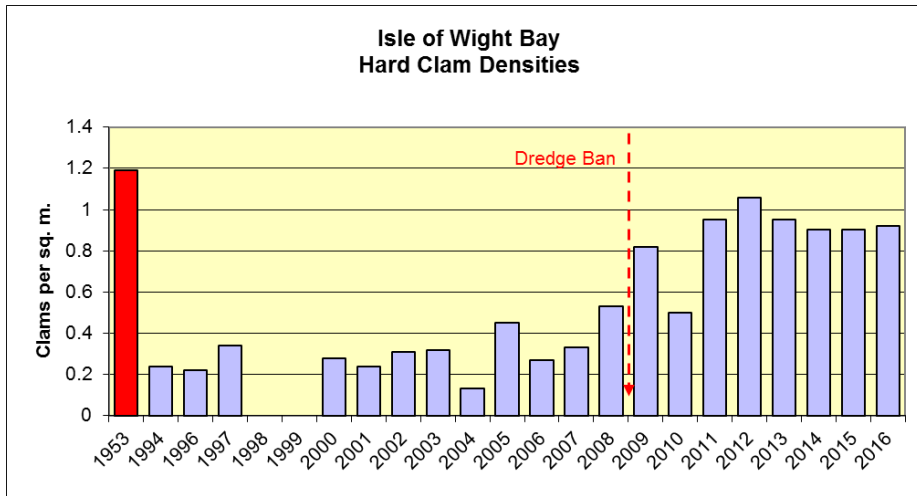


Figure 2. Isle of Wight Bay hard clam densities before and after the dredging ban and the historic benchmark density (red bar) (MD DNR data).



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
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.

2002 Coastal Bays Hard Clam Fishery Management Plan (updated 06/17)		
Objective/Problem	Action	Implementation
Obj.1. Enhance and perpetuate hard clam stocks. Prob 1.1: Mortality of Small Clams	1.1.1 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.	Continue. 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 8 seasons. Limited recreation-only harvest areas and sanctuaries are preferred alternatives to closures and moratoriums.
	1.1.2 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 8 years.
Obj.2. Manage for a viable commercial hard clam harvest to maintain an economically stable fishery. Prob. 2.1: Potential Economic Hardship to Commercial Clammers Caused by the “Boom and Bust” Nature of the Fishery	2.1.1 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.
	2.1.2 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 8 seasons. Commercial clam harvesters in all Maryland waters are required to report their daily catch of all clam species starting September 2011.
Obj. 3. Evaluate the feasibility of hard clam aquaculture opportunities. Prob 3.1: Establishing Hard Clam Aquaculture	3.1.1 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. MD DNR will be lead agency as of July 1, 2011 in permit processing. An aquaculture training conference was hosted by UMD, in cooperation with MD DNR, NOAA CBO and the Oyster Recovery Partnership. Three aquaculture open houses were held in 2010. 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.

2002 Coastal Bays Hard Clam Fishery Management Plan (updated 06/17)

Objective/Problem	Action	Implementation
Prob. 3.1 continued	Continue 3.1.1	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.
	3.1.2 Identify problems with the permitting process and make recommendations to specific agencies to solve those problems.	This was done through the above task force, reinforced with information from a range of states at the Maryland Aquaculture Development Conference held in Annapolis in August 2003. Permitting process has improved and will continue to address the myriad laws and regulations of the past 100 years which preserved wild harvest at the expense of aquaculture.
	3.1.3 Simplify the application process and designate a single point contact at DNR to assist potential applicants with aquaculture permits, questions related to the regulatory requirement, guidance through the permitting process and fulfilling of regulatory obligations, tracking permit applications, and coordinating state agency permitting activities to aquaculture permits.	<p>The leasing laws were entirely revised in 2009, including the provision for pre-approved lease areas in the coastal bays to streamline the process. Two areas have since been pre-approved: South Point Shoal and Whale Gizzard Shoal. Because these areas have been pre-screened for leasing conflicts, the application process is shorter.</p> <p>MD DNR has been designated as the lead agency for coordinating all aquaculture permitting as of 7-01-11 (SB 847 & HB 1053). MD 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>
	3.1.4 DNR will evaluate the feasibility of hard clam aquaculture in Maryland’s coastal bays by: a) Identifying potential areas and size of area for hard clam aquaculture; b) Initiating and providing funding for pilot hard clam aquaculture studies; c) Investigating the economic impact of hard clam aquaculture; and	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 producing hard clams and oysters. Pre-approved leasing areas

2002 Coastal Bays Hard Clam Fishery Management Plan (updated 06/17)		
Objective/Problem	Action	Implementation
Prob. 3.1 Continued	d) Assessing the ecological impacts associated with hard clam aquaculture	<p>have been evaluated and proposed.</p> <p>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.</p> <p>c) Ongoing - but hard clam aquaculture has revolutionized the Florida fishing industry and kept many former fishermen in business when they had few other options. It is a multi-million dollar industry in VA where the production of high quality shellfish runs ahead of MD.</p> <p>d) A study of the incidence of the clam disease QPX (MD DNR/VIMS) was completed. Continue to monitor mortality in farmed clams for disease (none reported). MD DNR 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>	4.1.1 DNR will develop and distribute a public outreach brochure illustrating recreational clamming areas, access points, methods and harvest restrictions.	This is a low priority and has not been initiated. Increased education on recreational harvest should include the responsibility and mechanism to report harvest. This may be an opportunity for Coastal Baykeeper input.
	4.1.2 DNR will work with the Town of Ocean City and Worcester County to improve access to recreational clamming areas	Boat ramps and associated facilities continue to be constructed and renovated with funding provided in full or in part by the DNR Waterway Improvement Fund, funded by boat taxes. The West Ocean City Harbor ramp, built in 1988, was renovated over four months and re-opened, June 2011. A new boat ramp in Ocean City is scheduled to be opened in 2017. Due to decreased revenues (50% since FY2006), DNR was able to fund only 19% of the state and local boating access and dredging projects ⁴ .
	4.1.3 DNR will investigate the feasibility of planting seed to establish and/or enhance areas for recreational clamming, and if feasible, develop a seeding strategy.	Low priority and most likely will not be implemented.
	4.2.1 DNR will reduce the recreational catch limit for hard clams from 1 bushel to 250 hard clams per person per day.	Effected in 2002.
Obj.5. Minimize conflicts between coastal bay user groups	5.1.1 DNR will prohibit commercial clamming in the area between the Ocean City Airport at Marker 13 northward to the Rt. 90 Bridge on Saturdays (Sundays currently closed) between September 15 through October 15, and April 15 through May 31.	Effected in 2002. Action item to be moved to history/background in new FMP which will be totally revised to include aquaculture.

2002 Coastal Bays Hard Clam Fishery Management Plan (updated 06/17)		
Objective/Problem	Action	Implementation
and commercial hard clam fishermen. Prob. 5.1: Conflict Between Recreational Fishermen and Commercial Clammers.	5.1.2 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.
	5.1.3 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.	Effected in 2002. Action item is no longer needed.
Prob. 5.2: Conflict Between Shoreline Property Owners and Commercial Clammers.	5.2.1 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.
Obsolete – Mechanical harvesting now prohibited.	5.2.2 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	Effected in 2002.
	5.2.3 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.
	5.2.4 DNR will investigate the impacts of prohibiting or restricting the written permission provision that allows an individual to catch hard shell clams with a hydraulic dredge within the shoreline setback of 300 feet.	Written permission provision eliminated in 2002.
Obj. 6. Minimize ecological impacts associated with the commercial and recreational hard clam fisheries. Prob. 6.1: Community Concern on the Ecological Effects of Commercial Hydraulic Clam Dredging.	6.1.1 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.
Obsolete – hydraulic escalator dredges now prohibited.	6.1.2 DNR will encourage studies to evaluate the ecological impacts of hydraulic clam dredging in Maryland coastal bays.	Action is obsolete.
	6.1.3 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	Legally inadvisable (see Sec. 2.1.1). Action is addressed in 2.1.1.

2002 Coastal Bays Hard Clam Fishery Management Plan (updated 06/17)		
Objective/Problem	Action	Implementation
	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.	
Prob. 6.2: Direct Impact to Submerged Aquatic Vegetation (SAV) by Commercial Hydraulic Clam Dredging	6.2.1 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.
Obsolete – hydraulic escalator dredges now prohibited.	6.2.1a 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.
	6.2.1b 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	Continue.
	6.2.2 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 significant commercial activity for the past 8 seasons. No action to date.
Prob. 6.3: Potential Impact to Overwintering Blue Crabs by Commercial Hydraulic Clam Dredging. Obsolete – hydraulic escalator dredges prohibited.	6.3.1 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 MD DNR Coastal Fisheries Program. Obsolete – hydraulic escalator dredges now prohibited.
Obj. 7. Protect, maintain and enhance important hard clam habitats. Prob. 7.1: Water Quality	7.1.1 Develop strategies to restore water quality in areas closed to harvesting hard clams because of pollution	Continue.
Prob. 7.2: Hard Bottom Habitat	7.2.1 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;	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.

2002 Coastal Bays Hard Clam Fishery Management Plan (updated 06/17)		
Objective/Problem	Action	Implementation
	b) Enhancement areas; and c) Funding sources.	
Prob. 7.3: Navigational Channel Dredging and Dredge Disposal.	7.3.1 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.	MD DNR is routinely consulted during the permitting process on projects that may impact hard clams.
Prob. 7.4: Growth of Noxious Algal Blooms.	7.4.1 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.	MD DNR 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 MD DNR.
Obj. 8: Minimize the impacts of non-indigenous invasive species. Prob. 8.1: Green Crabs.	8.1.1 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.	The green crab, Japanese shore crab and Chinese mitten crab were designated "high priority marine animals" in the Maryland Aquatic Nuisance Species Management Plan (2016). A Chinese Mitten Crab Watch has been developed to help the general public report occurrences of mitten crab.
	8.1.2 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	The Maryland Aquatic Nuisance Species Management Plan was completed and approved November 2016.
Obj. 9. Implement fisheries dependent and independent monitoring programs to obtain sufficient and accurate data for managing hard clams Prob. 9.1: Stock Assessment	9.1.1 DNR will continue to survey the hard clam resource on annual basis in Maryland's coastal bays to facilitate management decisions.	Continue. This action will be included in stock assessment discussion in a revised FMP.
Prob. 9.2: Assessment of Bottom Enhancement Activities.	9.2.1 Design and implement a program to monitor the efficacy of bottom enhancement activities.	The results of pilot studies suggest that such a program would not be cost-effective. See action 7.2.1
Prob. 9.3. Commercial Catch, Effort and Economic Data.	9.3.1 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 8 seasons.
Prob. 9.4: Recreational Catch, Effort and Economic Data.	9.4.1 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:

COMAR – Code of Maryland Regulations

DHMH - Department of Health and Mental Hygiene

FMP - Fishery Management Plan

FY – Fiscal Year

IFQs - Individual Fishing Quotas

MD DNR - Maryland Department of Natural Resources

MIPS - Maryland Industrial Partnerships

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

NRP - Natural Resource Police

QPX – Quahog Parasite Unknown

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

2016 Maryland FMP Report (June 2017)

Section 12. Horseshoe Crab (*Limulus polyphemus*)

In 2016, Maryland restricted the harvest of horseshoe crabs for bait to 'boat only' and instituted an earlier start date for this component of the horseshoe crab fishery. The commercial horseshoe crab market for bait improved in 2016 from the previous year. The Adaptive Resource Model (ARM) was first used in 2013 as a framework for setting horseshoe crab harvest levels for the Delaware Bay area. The framework takes into account both horseshoe crab and shorebird considerations. The ARM was reviewed and any considerations for changes in management were deferred until after the next stock assessment in 2018.

Horseshoe crabs are an important species to many different stakeholders. Not only do they support several important commercial fisheries and a major biomedical process, they also are a critical food source for migratory shorebirds. 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.¹ The final rule listing the red knot as threatened was published on December 12, 2014. The USFWS identified climate change induced effects such as habitat impairment and loss, asynchronous timing with food resources, and predation as principal threats. The USFWS expressed confidence that the Atlantic States Marine Fisheries Commission's (ASMFC) ARM framework was a reasonable approach to ensure sufficient egg abundance to meet the needs of both red knots and horseshoe crabs.¹ 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.

Fishery Management Plans (FMPs)

Chesapeake Bay

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

Atlantic States Marine Fisheries Commission (ASMFC)

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

Addendum IV (2006) instituted seasonal and spatial harvest restrictions in Maryland and Virginia. Harvest restrictions apply only to the bait fishery. In addition, no more than 40% of Virginia's quota can be harvested east of the COLREGS line (determined by the International Regulations for Preventing Collisions at Sea and the "rules of the road" followed by vessels at sea). They must also have a minimum male to female ratio of 2:1 if landed in Virginia. Addenda V (2008) and VI (2010) continued the Addendum IV restrictions for Maryland and Virginia. Addendum VII (2012) implemented the ARM framework in 2013 to optimize horseshoe crab harvest while conserving both shorebird and horseshoe crab abundance.

The implementation of the ARM framework included a male only harvest for the Delaware Bay states and Maryland. In 2014 the Virginia Polytechnic Institute trawl survey, critical for determining the harvest level of horseshoe crabs under the ARM model, was discontinued. In its place, the ASMFC board used a composite trend index from Delaware and New Jersey, the results of which indicated harvest at status quo.² Funding for the Virginia trawl survey was secured for 2016 and the survey was conducted. The horseshoe crab technical committee began a review of the ARM framework in 2016. Based on the review, the ASMFC decided to wait until the stock assessment in 2018 to make any changes to the ARM framework including any considerations of the bait and biomedical harvest levels.

Stock Status

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

Horseshoe crabs caught in Maryland waters include individuals from three separate spawning stocks: Maryland, Virginia, and Delaware Bay. Mean catch of horseshoe crabs from the Maryland Coastal Bays trawl survey indicates a variable but

increasing trend in catch since 2002 (Figure 1). Catch from this survey was significantly above average for the first time in 2016.

Egg density is a method used to assess abundance of horseshoe crabs as well as availability of food resources for migrating shorebirds. Peak egg density generally coincides with peak shorebird migration but not always. Egg density on Delaware Bay and New Jersey beaches has been highly variable seasonally, annually and spatially over the years.

Biomedical mortality is monitored as part of the ASMFC management plan. A 15% rate for biomedical bleeding and release mortality was assumed and used in the stock assessment.⁴ In 2011 a mortality range of 5-30% was included in the ARM assessment. Coastwide biomedical harvest has increased and estimated mortality has been above the 57,500-crab cap since 2007. The estimated biomedical mortality in 2016 was 70,223 horseshoe crabs.⁵

Current Management Measures

Maryland's commercial fishery has operated under a quota system since 1998. Beginning in 2013, the harvest of female horseshoe crabs was prohibited and the quota was set for male horseshoe crabs only. Any overages are deducted from the following year's quota. Horseshoe crab commercial bait harvest regulations in 2016 were as follows:

Quota:

- The annual total allowable landings of male horseshoe crabs for the commercial fishery was 255,980. No female harvest is permitted.

Season:

- May 2, 2016 through July 8, 2016:
A person may catch or land horseshoe crabs outside of 1 mile of the Atlantic coast.
A person may catch or land horseshoe crabs in Maryland's Coastal Bays and their tidal tributaries.
A person may not catch or land horseshoe crabs within 1 mile of the Atlantic Coast or the Chesapeake Bay and its tidal tributaries.
- July 9, 2016 through November 30, 2016: A person may catch or land horseshoe crabs from the tidal waters of the State.
- December 1, 2016 through April 30, 2017: A person may not catch or land horseshoe crabs in Maryland.

Catch Limits:

- An individual may not land more than 25 male horseshoe crabs unless they are in possession of a valid horseshoe crab landing permit.
- May 2, 2016 through July 8, 2016: A permittee may not land more than 150 male horseshoe crabs per day.

- July 9, 2016 through November 30, 2016: A permittee may not land more male horseshoe crabs than the amount specified on their permit.

There are several companies along the Atlantic Coast that process horseshoe crab blood. The scientific permits for biomedical use allow horseshoe crab collection during seasonal closures. Limulus Amoebocyte 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 accompanies all batches of horseshoe crabs.

The ARM framework identified two circumstances that affect red knot demography and annual survival: 1) horseshoe crab abundance and red knot body mass at departure from Delaware Bay, and 2) arctic snow conditions upon arrival at the breeding grounds. As a result, the ARM workgroup developed five horseshoe crab management alternatives:⁷ 1) a full harvest moratorium on both sexes; 2) a harvest limit of 250,000 males and 0 females; 3) a harvest limit of 500,000 males and 0 females; 4) a harvest limit of 280,000 males and 140,000 females; and 5) a harvest limit of 420,000 males and 210,000 females. Alternative #3 is currently in place.

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

Maryland DNR and the Maryland Coastal Bays Program (MCBP - one of the United States National Estuary Programs) have been conducting horseshoe crab spawning surveys in the Maryland Coastal Bays since 2002. Maryland DNR began assisting the program in 2006. The survey has changed over the years and currently samples from mid-May to mid-July at six sites: three sites sampled by MD DNR and three sites sampled by MCBP volunteers. The survey provides the Department with information on the timing of horseshoe crab spawning, the location of spawning areas, and the magnitude of spawning activity on certain beaches. The survey information is given to ASMFC for coastal management consideration. The survey also serves as an educational and volunteer objective for the general public and has been highlighted on Maryland Public Television.

MD DNR has worked with NJ & DE to develop horseshoe crab educational curriculum for teachers. In addition, MD DNR sponsors a program called Raising Horseshoe Crabs in the Classroom.

The Fisheries

Reported coastwide landings since 1998 show more male than female horseshoe crabs were harvested annually. Several states presently have sex-specific restrictions in place to limit the harvest of females. The American eel pot fishery prefers egg-laden female horseshoe crabs as bait, while the whelk (conch) pot fishery is less dependent on females. Unclassified landings have generally accounted for around 10% of the reported landings since 2000. The hand, trawl, and dredge fisheries typically account for over 85% of the reported commercial horseshoe crab bait landings. In 2015, these gears accounted for slightly more with 88.7% of commercial landings. Other methods that account for the remainder of the harvest include gill nets, pound nets, and traps.

Maryland's commercial horseshoe crab harvest is caught primarily by trawl nets in the Atlantic Ocean. Approximately 90% of the total 2016 catch was harvested during July and August. The harvest quota increased to 255,980 male-only horseshoe crabs for 2013 and will continue at that level through 2017. The commercial harvest of female horseshoe crabs is prohibited. Previously the quota had been 170,000 male or female horseshoe crabs (2004-2012). Landings in 2013 were 240,688 horseshoe crabs or 94% of the Maryland quota (Figure 2). Landings in 2014 declined to 148,269 horseshoe crabs or 58% of the quota. Landings in 2015 further declined to 27,494 horseshoe crabs. In 2016 the bait harvest recovered somewhat to 157,013 horseshoe crabs but commercial harvest continues to be limited by a lack of market for male horseshoe crabs.⁶

The number of crabs landed coast wide for biomedical bleeding (not bait) has been stable since 2003 (Figure 3). Horseshoe crab mortality in the biomedical sector has exceeded the 57,500 crab threshold each year since 2007. However, biomedical harvest seems to have stabilized in recent years. In 2014, the total estimated mortality on biomedical crabs was 70,223 crabs.⁵ The management board reviewed options for biomedical harvest at the ARM review presentation in 2016 and decided to wait until the completion of a stock assessment in 2018 to suggest any changes.

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.¹ In addition, genetic variability in red knot body mass thresholds may be an important factor for their annual survival. The 2015 Delaware Bay red knot surveys indicated a modest decrease in red knot abundance from the previous year, but the population has increased since 2005.

Horseshoe crabs prefer to spawn on sandy beaches in protected areas like coves and bays. Shallow water areas of the Chesapeake Bay and Maryland/Virginia Coastal Bays are important nursery areas. The ASMFC Habitat Committee has identified threats to horseshoe crab spawning habitats. These threats include coastal erosion, shoreline development and stabilization, sea level rise, contaminants, oil spills, human disturbances, and excess nitrogen. Recommendations for counteracting the threats are identify and protect spawning/nursery areas and reduce human disturbances. Activities such as beach grooming and nourishment, all-terrain vehicles (ATV) and beach watercraft, should be limited on horseshoe crab spawning beaches during the spawning season.

Continued congressional funding for the Virginia Tech benthic trawl horseshoe crab survey is uncertain and the survey was discontinued in 2014.² Data from the trawl survey is important for the ARM framework and stock assessments. These analyses are necessary to ensure that horseshoe crab spawning stock and egg production are sufficient to support migratory shorebird feeding. The ASMFC horseshoe crab ARM committee has been actively working to find an alternative to the trawl survey. A composite index-based alternative was used for harvest recommendations from 2014 through 2017. In 2016, the Virginia Tech survey was conducted and the results will be available for decision making in 2017.

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.²

A number of horseshoe crabs were impinged annually at the water intakes for Calvert Cliffs Nuclear Power Plant.⁶ 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 crab mortality due to impingement was 117 animals. In 2016 there were only four mortalities due to impingement. It appears the power plant has implemented a workable solution to the problem.

Figure 1. Geometric mean catch of horseshoe crabs per trawl from the Maryland Coastal Bays Trawl Survey: 1990 – 2016.⁶

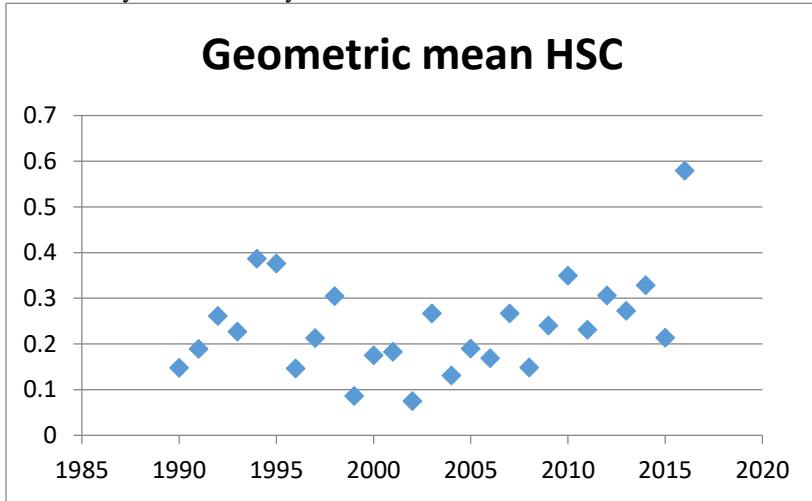


Figure 2. Maryland’s commercial horseshoe crab landings and quota: 1998-2016.⁶ The 2013-2016 quota was restricted to male horseshoe crabs.

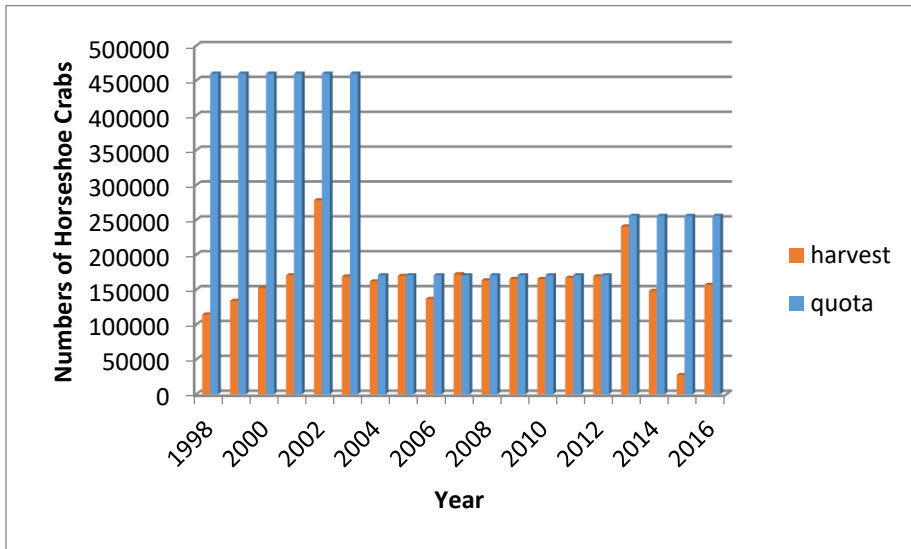
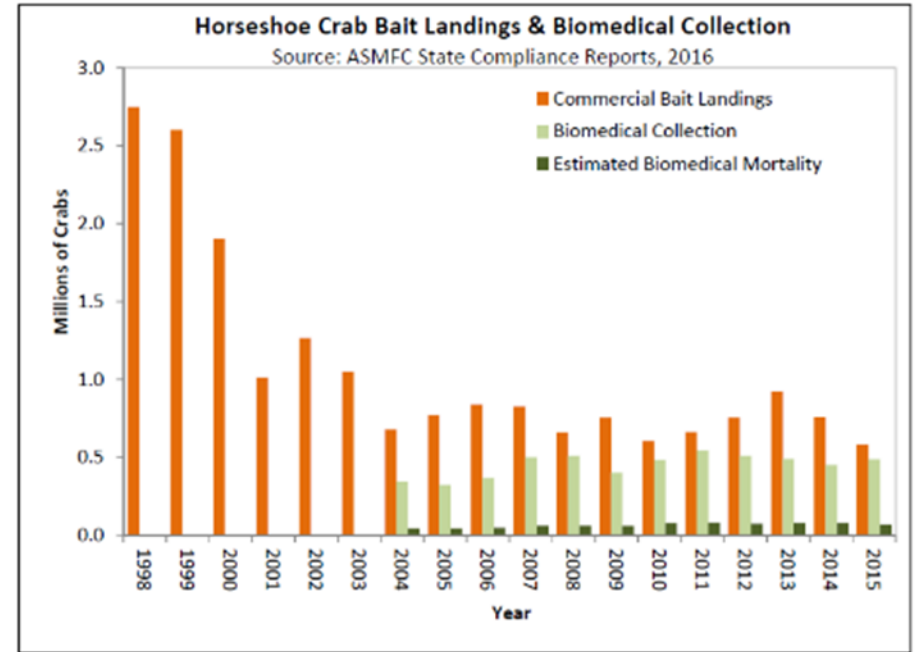


Figure 3: Number of horseshoe crabs harvested for bait and biomedical purposes, 1998 -2015.



Please note the following details regarding biomedical harvest numbers:

- * Biomedical collection numbers, which are annually reported to the Commission, include all horseshoe crabs brought to bleeding facilities except those that were harvested as bait and counted against state quotas.
- * Most of the biomedical crabs collected are returned to the water after bleeding; a 15% mortality rate is estimated for all bled crabs. This is noted in the above graph as 'Estimated Biomedical Mortality.'

References

¹ 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>

- ² ASMFC. 2017. 2016 review of the Atlantic States Marine Fisheries Commission fishery management plan for horseshoe crab (*Limulus polyphemus*): 2016 fishing year. Atlantic States Marine Fisheries Commission, Alexandria, VA.
- ³ ASMFC. 2013. Horseshoe crab stock assessment update. Atlantic States Marine Fisheries Commission, Washington, DC. August 2013.
- ⁴ ASMFC. 2009. Horseshoe crab stock assessment for peer review. Stock Assessment Report No. 09-02 (Supplement A). Atlantic States Marine Fisheries Commission, Washington, DC.
- ⁵ ASMFC. 2016. 2016 review of the Atlantic States Marine Fisheries Commission fishery management plan for horseshoe crab (*Limulus polyphemus*): 2015 fishing year. Atlantic States Marine Fisheries Commission, Alexandria, VA. <http://www.asmfc.org/species/horseshoe-crab>
- ⁵ ASMFC. 2011. 2011 review of the fishery management plan in 2010 for horseshoe crab (*Limulus polyphemus*). Atlantic States Marine Fisheries Commission, Alexandria, VA.
- ⁶ Doctor, S. 2017. Maryland's 2016 horseshoe crab (*Limulus polyphemus*) compliance report to the Atlantic States Marine Fisheries Commission. Maryland Department of Natural Resources Fisheries Service, Annapolis, MD.

1994 Chesapeake Bay and Atlantic Coast Horseshoe Crab Management Plan Implementation Table (updated 06/2017)

Problem Area	Action	Date	Comments
Strategy 1.1 Maryland and Virginia will protect the ecological role of horseshoe crabs by protecting horseshoe crab spawning areas and monitoring harvest.	1.1 Maryland and Virginia will prohibit the hand collection of horseshoe crabs from beaches during the peak time of shorebird migration, May 1-June 7.	1995	MD prohibited hand collection of HSCs between May 1 and June 7.
		1996	Based on spawning data, MD modified the restriction on hand collection of HSC to between April 1 and June 30 on Monday and Thursday only.
		1998	Since the CBP Horseshoe Crab FMP was adopted in 1994, coastal ASMFC requirements were adopted in 1998. Jurisdictions comply with all ASMFC HSC harvest restrictions.
		2001	NMFS established a HSC reserve in federal waters having a 30 mile radius from the mouth of Delaware Bay.
		2009 Continue	MD COMAR 08.02.10.01.01 states that all persons are prohibited from catching or landing HSCs in state waters from December 1 to June 7, and catching or landing HSCs from the Chesapeake Bay and its tidal tributaries, or within 1 mile of the Atlantic coast or its coastal bays shoreline from June 8 to July 12. Persons can collect crabs Monday thru Friday from July 13 to November 30. There are no recreational catch limits but a person must abide by the seasonal closures and the 25 crab/person/day if he/she doesn't have a permit.
		Continue	VA Chapter 4 VAC 20-900- restricts hand collection unless a person has a hand harvester license. 5 HSCs/person/day may be harvested for personal use without a license.
		2006 2011 2017	VA prohibits HSC harvest within 1,000 ft. of mean low water May 1 through June 7. 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. Maryland prohibits the harvest of horseshoe crabs from beaches beginning in January 2017. Horseshoe crabs must be harvested from a boat.
	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.

1994 Chesapeake Bay and Atlantic Coast Horseshoe Crab Management Plan Implementation Table (updated 06/2017)

Problem Area	Action	Date	Comments
Strategy 1.1 Continued	1.2a Continued	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 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.
		Continue	June 8 to July 10 harvest is allowed 1 mile off Maryland's Atlantic coast. Harvest is allowed in all tidal waters from July 13 to November 30. Harvest is Monday through Friday and female harvest is prohibited.
	1.2b Virginia will continue its ban on trawling within state waters.	1995	Virginia prohibits the use of trawls in Virginia's portion of the Territorial Sea.
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. The public can report sightings of horseshoe crabs spawning or report tagged crabs via the MDDNR horseshoe crab website.
		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. The process underwent an in-depth review in 2016 and resulted in a proposal to draft an addendum. The addendum has been postponed until after the completion of a stock assessment in 2018.
		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 78,798 crabs in 2014. ²

1994 Chesapeake Bay and Atlantic Coast Horseshoe Crab Management Plan Implementation Table (updated 06/2017)

Problem Area	Action	Date	Comments
Strategy 2.1 Continued	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.	Continue	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.
		Continue	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. Since 1999, over 280,000 horseshoe crabs have been tagged along the Atlantic coast.
		Continue	ASMFC coastal management actions include a mandatory monitoring program, tagging studies, spawning surveys, and egg surveys.
Strategy 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	Reporting was implemented on January 29 th , 1996. Permit system currently required and used to monitor commercial harvest.
		Continue	
		2000	ASMFC instituted a 25% reduction in horseshoe crab bait landings using 1995-1997 as the reference period.
		2004	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.
		Continue	
		2004	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.
		Continue	
		2008	MD changed the HSC harvest ratio to 2:1 male: female ratio (issued by public notice).
		2009	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.
		Continue	

1994 Chesapeake Bay and Atlantic Coast Horseshoe Crab Management Plan Implementation Table (updated 06/2017)

Problem Area	Action	Date	Comments
Strategy 3.1 Continued	3.1a Continued	2010 Continue	Spring harvest closure was extended to include April 30. A “chain of custody” must be documented for every batch of HSCs received. Harvesters are required to submit monthly catch logs. Commercial harvest reports must be submitted to MDDNR Fisheries Service within 10 days after the end of the month being reported after which the report is late. ⁷
		2011	Harvesters began importing Asian horseshoe crabs for bait market.
		2013	Maryland banned the importation of Asian horseshoe crabs.
	3.1b Maryland will determine if a special permit to harvest horseshoe crabs is necessary after evaluating the new federal reporting system and the results of the monthly reports	1995	MD requires a special HSC permit to land HSCs.
		2001 Continue	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.	
	2016	Virginia HSC harvest east of the COLREGS line is 81,331 male crabs.	
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.	
Strategy 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.	Continue	A HSC hotline and spawning beach survey was developed in 1994 to delineate spawning habitat in Maryland. MD DNR currently has a horseshoe crab webpage that invites people to help identify spawning habitat and report tagged horseshoe crabs. The webpage includes both phone numbers and email addresses for reporting information.
		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.

1994 Chesapeake Bay and Atlantic Coast Horseshoe Crab Management Plan Implementation Table (updated 06/2017)			
Problem Area	Action	Date	Comments
	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 2000 agreement was replaced with the Chesapeake Watershed Agreement in 2014. 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
 MDDNR – Maryland Department of Natural Resources
 NMFS – National Marine Fisheries Service

USFWS - US Fish and Wildlife Service
 VAC - Code of Virginia

2016 Maryland FMP Report (June 2017)

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

Spanish mackerel harvest in 2015 in Maryland and Virginia was 44,470 lbs.: about 1.5% of the Atlantic Coast 3,015,000 lb. harvest. In 2016, recreational fisherman in Maryland and Virginia landed an estimated 16,820 and 71,869 lbs., respectively. The recreational landings comprise most of MD and VA harvest. King mackerel are rarely caught in Maryland, since they are a coastal pelagic fish that are only found seasonally in the lower reaches of the Chesapeake Bay. The two species are currently not overfished or experiencing overfishing based on the South Atlantic coastal stock assessments.^{1,2}

Chesapeake and Atlantic Coast FMP

The Chesapeake Bay and Atlantic Coast King and Spanish Mackerel Fishery Management Plan (CBK/SM FMP) was adopted in 1994. The plan follows the coastal management requirements. The CBK/SM FMP was reviewed in 2014 and was determined to be an appropriate framework for managing mackerel in Maryland. The two species are managed jointly under the Atlantic States Marine Fisheries Commission's (ASMFC) 1990 FMP for Spanish Mackerel and the federal Coastal Migratory Pelagics (CMP) FMP adopted in 1983 by the South Atlantic Fishery Management Council (SAFMC). Since 1985, amendments have been adopted by the SAFMC making changes to the allocation of commercial quotas, changes to at-sea transfer rules and changes that increase the total allowable catch of Spanish mackerel. Amendment 2 (August 2015) establishes a trip limit in the southern zones but does not affect Maryland or Virginia. Amendment 26 went into effect on May 11, 2017. Amendment 26 impacts the Gulf of Mexico and southern Atlantic regions causing a change in allocations, stock boundaries and sale provisions for king mackerel. There is no change in Maryland and Virginia. 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 (2011) and Addendum I to the Omnibus Amendment (2013) by implementing creel limits, size limits and seasonal closures that closely mirror the SAFMC CMP FMP requirements. To view ASMFC FMP documents, go to: <http://www.asafc.org/species/spanish-mackerel>.

Stock Status

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

Atlantic stock is not overfished and overfishing is not occurring. The coastal stock was overfished in the 1980's and early 1990's, which led to harvest control regulations. Management measures have been successful at rebuilding the Spanish mackerel stock. The ratio of biomass to biomass at maximum sustainable yield (Bmsy) has been increasing.³

A stock assessment for the Atlantic king mackerel migratory group was completed in 2014 (SEDAR 38) and concluded that the stock is not overfished and overfishing is not occurring. However, there is some concern over low recruitment and possible northward shifts in distribution.²

Current Management Measures

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

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

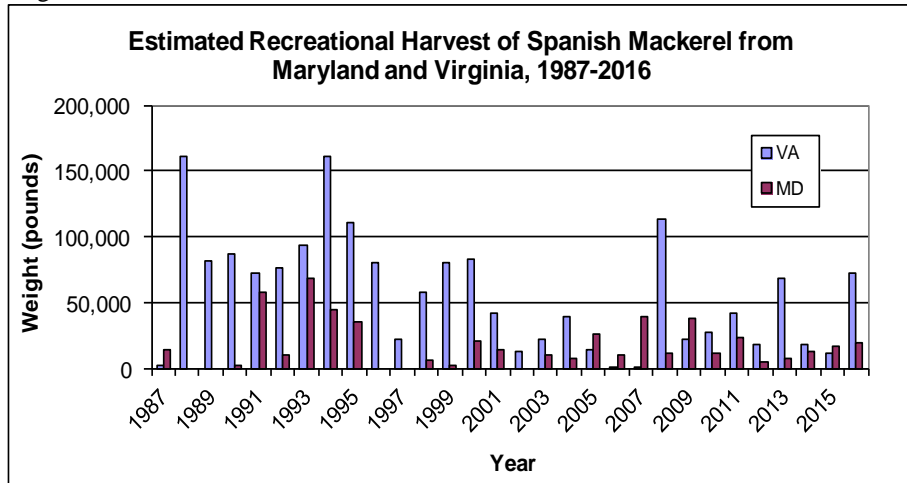
Following public hearings, ASMFC approved an omnibus amendment for spot, seatrout and Spanish mackerel in August, 2011. The amendment includes an update to the coastal plan and includes commercial and recreational management measures and recommendations, adaptive management options, *de minimis* thresholds and exemptions, monitoring recommendations and requires each jurisdiction to submit an implementation plan and annual compliance report.^{4,5} The amendment also requires

recreational fishermen to land their catch with the head and fins intact. Maryland changed its regulations in 2012 to comply with the omnibus amendment.

The Fisheries

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

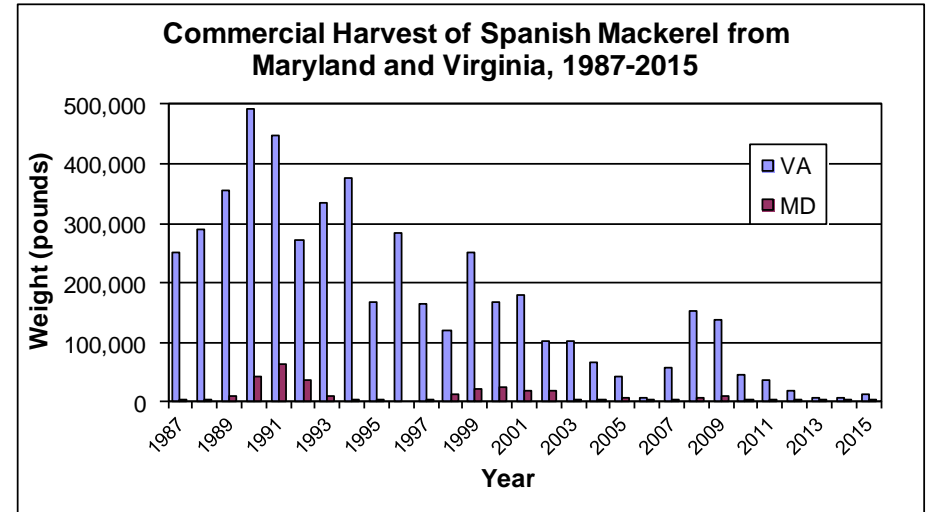
Figure 1. Estimated recreational harvest of Spanish mackerel from Maryland and Virginia, 1987-2016.



Issues/Concerns

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

Figure 2. Commercial harvest of Spanish mackerel from Maryland and Virginia, 1987-2015.



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1994 Chesapeake and Atlantic Coast King and Spanish Mackerel Management Plan Implementation Table (update 06/17)			
Section	Action	Date	Comments
Stock Status	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 lb. commercial limit in 2012. Spanish mackerel must be landed with head and fins intact.
	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 lbs. Spanish mackerel per vessel per day. MD implemented a 3500 lb. commercial limit in 2012. Spanish mackerel must be landed with head and fins intact.
	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.
	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.
	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.
	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 SAFMC recommendations.
Monitoring catch and quotas, and research needs.	2.1.1. Virginia and Maryland will require mandatory reporting of commercial landings	Continue	Both states are in compliance with reporting requirements.
	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)
	2.1.3. Jurisdictions will support stock assessment research for mackerel stocks.	Continue	VA samples Spanish mackerel for length and weight. The ASMFC omnibus amendment was approved in 2011 and was implemented July 1, 2012. The amendment includes monitoring and management recommendations. The most recent stock assessment for the south Atlantic stock of Spanish mackerel was completed in December of 2012 and revised in 2013. A new King Mackerel Stock Assessment Report was completed in August 2014 for South Atlantic and Gulf of Mexico.

1994 Chesapeake and Atlantic Coast King and Spanish Mackerel Management Plan Implementation Table (update 06/17)			
Section	Action	Date	Comments
Waste/sublegal bycatch and hook and release mortalities	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.
	3.1.2. Jurisdictions will support angler educational programs.	Continue	In 2008, Project FishSmart was organized by UMCES to develop a process for developing a consensus position on fisheries management options by a stakeholder group comprised of biologists, environmental organizations, tackle shop owners, charter boat operators, anglers, commercial fishermen, and tournament organizers. The pilot project species was King Mackerel and the goal of the project was to prevent overfishing and preserve a year-round fishery, with recommendations being adopted Nov 7, 2008. A report was submitted to the South Atlantic Fishery Management Council that recommended three options for consideration (UMCES, 2008), which were in its public scoping document. No new efforts have been focused on mackerel but the Bay jurisdictions continue angler education whenever possible.
	3.1.3. Virginia will monitor bycatch sold as crab bait from the pound net and haul seine fisheries.	1995	
Habitat Issues	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 2015	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 http://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignatures-Hires.pdf The Agreement has fish habitat, forage fish, SAV and water quality outcomes that when reached will enhance habitat and prey availability for adult Spanish mackerel. During 2015, bay jurisdictions developed two-year (2016-2017) work plans for each outcome.

Acronyms:

ACL - Annual Catch Limit

ASMFC - Atlantic States Marine Fisheries Commission

CMP - Coastal Migratory Pelagics

CBP - Chesapeake Bay Program

EEZ - Exclusive Economic Zone

MRIP - Marine Recreational Information Program

NOAA - National Oceanic and Atmospheric Administration

PRFC - Potomac River Fisheries Commission

SAFMC - South Atlantic Fisheries Management Council

SAV - Submerged Aquatic Vegetation

SEDAR - South East Data, Assessment, and Review Process

UMCES - University of Maryland Center for Environmental Studies

2016 Maryland FMP Report (June 2017)

Section 14. Eastern Oyster (*Crassostrea virginica*)

Maryland's Five-Year Oyster Review Report was released in 2016¹. This 945-page document comprehensively reviewed the sanctuary, public fishery, and aquaculture objectives from the 2010 regulation. All objectives were either determined to be met or are in progress. The report also reviewed the biology, replenishment and restoration, habitat, and harvest information (where applicable) for each of the 51 sanctuaries and 39 public fishery areas since 1990.

Maryland remains committed to restoring five oyster tributaries to meet the 2014 Chesapeake Watershed Agreement (CWA) oyster outcome. Restoration work continued in the three restoration partnership sanctuaries: Harris Creek, Little Choptank, and Tred Avon rivers. In 2016, 61.3 million hatchery spat-on-shell were planted on reefs previously constructed in Harris Creek, 592 million hatchery spat-on-shell were planted on 132 acres of Little Choptank, and 143 million hatchery spat-on-shell were planted on 32 acres in Tred Avon. In 2017, the proposed restoration work will consist of planting 18 acres of substrate in Tred Avon, and 643 million hatchery spat-on-shell on 143 acres in Tred Avon and Little Choptank. Continued reef construction in Little Choptank is on hold pending the Board of Public Work's approval of a shallow water construction permit. Also, in 2017, a light planting of hatchery spat-on-shell (102 million spat-on-shell on 105 acres) will occur on Harris Creek reefs constructed in 2012 and 2013 to ensure multiple age classes on the restored reefs. The Oyster Advisory Commission (OAC) has been reviewing and discussing the selection of the two remaining areas to meet the goal of the CWA oyster outcome.

Chesapeake Bay Oyster Management

The Chesapeake Bay Oyster Management Plan (OMP) was adopted in 1989 and revised in 1994 and 2004. The 2004 management plan provides both a general framework and specific guidance for implementing a strategic, coordinated, multi-partner management effort for oysters in the Bay.² 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 bay-wide database to track restoration projects. The 2004 OMP was reviewed and amended in 2010. Amendment 1 allows aquaculture and clamming within sanctuaries, the use of new enforcement measures to protect sanctuary areas, and the implementation of sanitation guidelines.³

In 2010, a major initiative within the framework of the OMP was developed. The Maryland 10-point Oyster Restoration and Aquaculture Development Plan increased the network of oyster sanctuaries from 9% of available habitat to 24%, identified

areas for oyster aquaculture with a streamlined permitting process, and recommended a more targeted, scientifically managed, sustainable public fishery. The sanctuary expansion leaves 176,035 acres of natural oyster bar available for the public oyster fishery.

Coincident with the expansion of the Maryland sanctuary network, an oyster workgroup was established by the Sustainable Fisheries Goal Implementation Team of the Chesapeake Bay Program to develop quantitative oyster restoration metrics, to define sampling protocols, and to provide assessment techniques for sanctuary reefs. The group completed a consensus document (December 2011) describing a minimum suite of goals and metrics.⁴ 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.²

Oyster sanctuaries figured prominently in the CWA adopted by the Chesapeake Bay Program (2014).⁵ A management strategy and a biennial work plan (2016-17) were completed that detail necessary actions to reach the baywide oyster outcome: the restoration of oyster reefs in 10 tributaries by 2025.⁶ 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, TC, and CBF),* and consulting scientists (University of Maryland, VIMS, SERC, and Morgan State University).*

The Maryland Oyster Advisory Committee (OAC) originally was established in 2007 and new commissioners were appointed in 2016 to make recommendations to MD DNR on management issues. The Secretary of MDDNR assigned the OAC three tasks pertaining to sanctuaries: to recommend whether to proceed with oyster restoration in the Tred Avon River, to recommend two additional tributaries for large-scale oyster restoration, and to suggest adjustments to oyster sanctuary and public fishery areas if warranted.

As a result of these recent initiatives, an evaluation of the Oyster Management Plan by the multi-agency Plan Review Team concluded that the framework for managing oysters was still appropriate but that the strategies and actions had changed considerably, and therefore recommended a complete revision of the Oyster Management Plan. Revision of the Plan was placed on hold until the Maryland OAC had a chance to review the Department's Five-Year Report released in July 2016.¹ The OAC reviewed the report and was making recommendations to DNR when the State Legislature passed HB 924 prohibiting the change of any sanctuary boundaries until after a stock assessment has been completed. A stock assessment was also mandated by an earlier legislative act which was passed by the Maryland General Assembly in 2016. The Sustainable Oyster Population and Fishery Act requires MD DNR, in conjunction with the University of Maryland Center for Environmental

Science (UMCES), to conduct a stock assessment and develop biological reference points for management of the oyster fishery. Maryland DNR convened a team to develop the terms of reference for the stock assessment and is in the process of compiling data and developing an assessment model. A revision of the Oyster Management Plan will be considered once the stock assessment is completed in December 2018.

Stock Status

The 2016 Fall Oyster Survey was conducted from 11 October to 28 November throughout the Maryland portion of the Chesapeake Bay and its tributaries, including the Potomac River. A total of 327 samples were collected from 272 oyster bars. Sites monitored included natural oyster bars, oyster seed production areas, seed and shell plantings, and sanctuaries. The sampling results indicated that although the spatfall index was above the long-term median for the second consecutive year, increasing disease and observed mortality levels associated with continued elevated salinities are cause for concern.

The Spatfall Intensity Index of 30.9 was almost 50% higher than the 32-year median value (Figure 1). Although slightly lower than the 2015 Index, this year's spatset was more widely distributed with twice as many 2016 Index bars showing gains than losses. As in past years, the better spatset was observed from the Choptank region and down-bay, although a light spatset occurred as far north as the Eastern Bay region. No spat were found along the mid-Western Shore and upper part of the bay. The highest spatset (586 spat/bu) was observed on the Susquehanna bar in the Little Choptank River where Florida fossil shell had been planted in 2014. In contrast to 2015, the strong recruitment event that occurred in the lower Potomac was not repeated in 2016, but a rare, light spatset was observed in the middle and upper reaches of the oyster growing areas in that river.

Dermo disease remained widely distributed throughout the oyster-growing waters of Maryland. Oysters at all the standard disease monitoring sites were infected with *Perkinsus marinus*, the parasite which causes dermo disease. The mean prevalence increased slightly from the previous year but continued to be below the long-term average, extending a trend that began in 2003. The mean infection intensity for dermo disease rose above the long-term average for the first time since 2007. The number of oyster populations with elevated intensities increased threefold from 2015, especially on bars from the Choptank River and south. *Haplosporidium nelsoni* (MSX) disease had an upsurge in prevalence for the third consecutive year, substantially increasing on several bars in the Choptank River and lower Western Shore. MSX maintained its expanded range up-bay, reaching as far north as the Eastern Bay and the Miles River.

Despite a slight increase in oyster mortalities, the Maryland-wide Mortality Index of 16% remained below the 32-year mean. However, it has steadily risen over the past

three years to double that of 2013. Mortalities were highly variable among bars within some of the regions (e.g. within the St. Mary's River observed mortalities ranged from 14% to 64%). The highest regional mortalities were on the north shore of the lower Potomac, averaging 36%. The highest Index bar mortalities were observed on Cook Point in the lower Choptank River (48%) and Ragged Point in the Little Choptank River (45%).

The 2016 Maryland Oyster Biomass Index continued to decrease from the record high of 2013. The 2016 Biomass Index of 1.41 was the sixth highest in the 24-year time series, reflecting the declining numbers of the strong 2010 and 2012 year classes and mediocre spatsets in many of the regions since then (Figure 2).

The major oyster sanctuaries were sampled during the 2016 Fall Survey. Recruitment was generally consistent with non-sanctuary areas except in the Manokin and Little Choptank sanctuaries, which averaged among the highest regional spatsets in the bay. Rabbit Island in the Harris Creek sanctuary had the highest spatset of the entire Choptank region. Harris Creek Sanctuary had a similar spatset average to neighboring Broad Creek, an open harvest area. For the first time in three years of testing, MSX disease was found in the Harris Creek sanctuary at a low prevalence but was not detected in the Tred Avon River sanctuary. Mortality rates in sanctuaries continued to be well below the long-term average. Overall, those sanctuaries that received strong spatfalls in 2010 and 2012 and those receiving supplemental oyster seed plantings appeared to be in good condition.

With reported harvests of 384,000 bushels during the 2015-16 season, commercial oyster landings were slightly lower than the previous year (Figure 3), yet the dockside value of \$14.9 million was the second highest since 1987. Power dredging accounted for 32% of the landings, primarily from the Lower Eastern Shore and Choptank regions. Patent tongs were the second dominant gear type, harvesting 27% of the landings. Tangier Sound was the leading production area with 24% of the Maryland landings, followed by Broad Creek with 18%.

Stock assessment methodology studies were conducted in 2009-2010.⁸ The studies included a spatial analysis to determine the appropriate scale for oyster population processes and the development of two oyster stock assessment models. The models were fitted to harvest data from the fishery and relative density data from the fall dredge survey. The models estimated mortality rates and abundance. Both approaches found a substantial decrease in oyster abundance during the study periods. Recommendations were made to improve data collection from the fishery and the fall survey. 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 Watershed Agreement (2014) to restore oysters to 10 tributaries by 2025 (5 each in Maryland and Virginia). Harris Creek was selected as Maryland's first restoration area. Initial restoration efforts (reef construction and seeding or seeding only on suitable bottom) in Harris Creek were completed in 2015 with 350.9 acres planted with oyster seed or substrate with oyster seed. Three years after planting, the first 12 reefs to be restored within the creek all meet the minimum restoration density of 15 oysters/m² over 30% of the reef area.⁹ The Little Choptank River was selected as Maryland's second priority area for targeted oyster restoration with a goal of 440 acres. As of 2015, 127.5 acres of reef have been constructed in the Little Choptank River and initial restoration is complete on 45.8 acres. The Tred Avon has been selected as Maryland's third area for oyster restoration with a goal of 147 acres. As of 2015, USACE has constructed 16 acres of reef and initial restoration efforts (substrate and seed) are complete on 2.6 acres. After a delay in restoration efforts to await the results of the oyster review (July 2016), the USACE has resumed the construction of oyster reefs in the Tred Avon.

Maryland's oyster harvest has been approximately 100,000 bushels annually since 2002. Historically, the annual harvest averaged 2.5 million bushels (1920-1969) and 1.3 million bushels (1970-2002) (Figure 3). The harvest for the 2015-2016 season was 383,534 bushels and the preliminary harvest estimate for the 2016-2017 season is currently 202,716 bushels. The decrease in harvest is mainly due to the depletion of the strong 2010 and 2012 year classes in that have been for multiple seasons and poor recruitment in the following years. 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 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 (NSSP) to protect human health by allowing any contaminated shellfish to be traced to a specific harvest area.

Oyster legislation passed in 2011 included the expansion of lease areas, authority for MD DNR to revoke commercial licenses for poaching violations, transfer of the Seafood Marketing and Aquaculture Program from the Department of Agriculture to the MD 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 including a series of training publications and the sponsorship of two statewide aquaculture conferences. Through a partnership with ORP, MD 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 are required to submit monthly harvest reports. Oyster aquaculture continues to expand in Maryland. In 2016, 53 lease applications were received and 39 leases were issued. As of May 15, 2017, there are 387 leases totaling 6,242 acres in use for growing shellfish. The preliminary harvest estimate from leases in 2016 was 64,609 bushels

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

The Potomac River Fisheries Commission (PRFC) instituted a cooperative aquaculture program in 2013 where those who pay a fee may harvest oysters planted on a managed reserve. In 2016, the program planted 5,790 bushels of triploid spat on 21 acres on the Cobb Island Bar. Watermen harvested 880 bushels of market-sized triploid oysters from an 11-acre reserve planted in 2014 on the Ragged Point Bar.

Citizen Involvement

The Marylanders Grow Oysters (<http://www.oysters.maryland.gov>) program engages waterfront property owners in growing young oysters in cages suspended from private piers. The young oysters are protected during their first year and then planted on local sanctuaries. The program has planted about 10 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 2016. The program includes approximately 3,000 growers on 31 tributaries. Additionally, over 2,000 school students through educational programs are involved in oyster gardening as part of their curriculum.

Issues/Concerns

A major issue for oyster recovery is the continued degradation and loss of habitat. It has been estimated, but not definitively confirmed, that approximately 70% of oyster habitat has been lost between 1980 and 2009.¹⁰ 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, MD DNR directs most fresh shell to the Horn Point hatchery because in most areas of the bay it is more cost effective to put fresh shell with spat on the bottom rather than relying on natural spat set.

The shortage of shells has led to the use of alternative substrates to restore oyster reefs. In 2013 and 2014, MD DNR used 90,127 cubic yards of fossil oyster shell from Florida and 133,471 cubic yards of Maryland stone to construct oyster reefs in

Harris Creek and the Little Choptank River. To encourage recycling of oyster shells, the ORP has developed the Shell Recycling Alliance, a group of 300 restaurant owners, caterers, seafood distributors and citizens, as a mechanism for collecting shells for habitat and seed. Since the inception of the program in 2010, 108,500 bushels of shell have been recycled with an additional 30,200 bushels in 2016. Since July 2013, residents and businesses can receive a tax credit per bushel of recycled oyster shell up to \$750 per year. This year MD DNR applied for an application to dredge shell from Man O' War Shoal to acquire shell for enhancement of oyster habitat. A decision from USACE is pending.

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

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*Acronyms

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

Figure 1. Maryland spatfall intensity index (spat per bushel) from "key bars" including rankings of statistically similar indices, 1985-2016 (MDDNR Fall Survey Report, 2016). 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.⁷

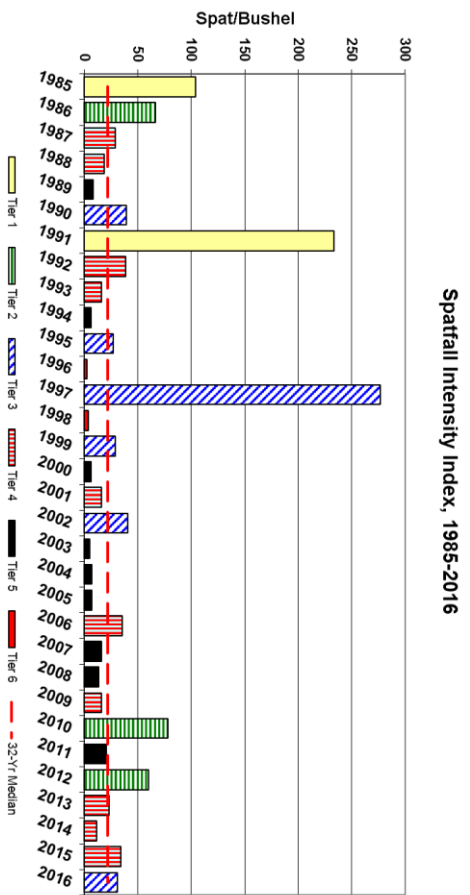


Figure 3. Maryland commercial oyster harvest, 1976–2016.

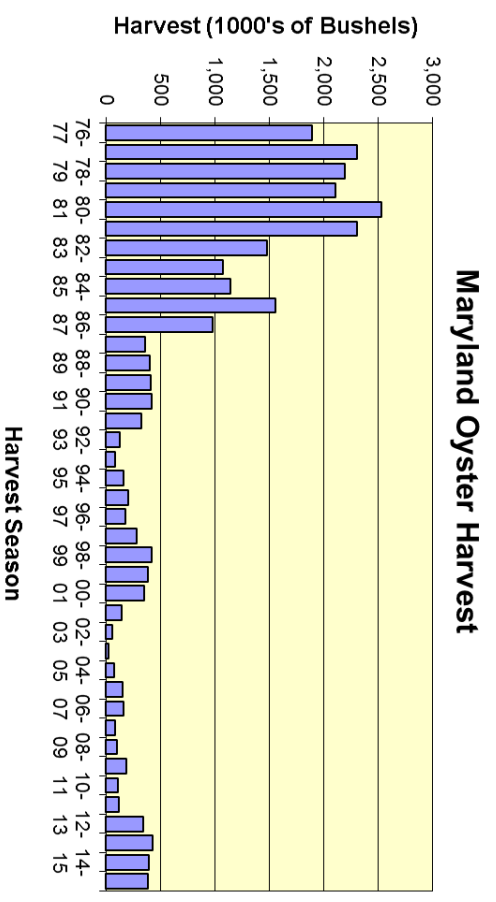
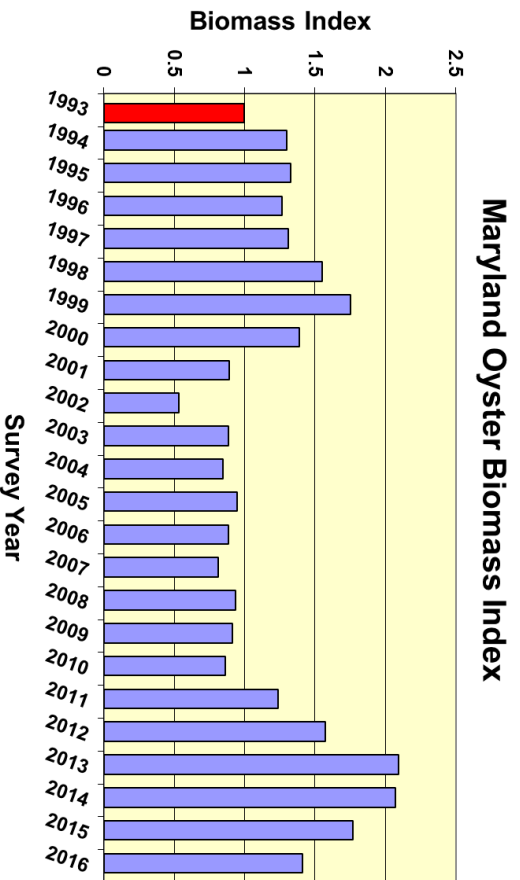


Figure 2. Maryland oyster biomass index, a measure of relative oyster abundance and weight, 1993 - 2016. Values are relative to 1993 biomass, which was set at a value of 1.⁷



2004 Oyster Management Plan (OMP) Implementation Table (updated 07/2017)			
Section	Action	Date/ Responsible agencies	Comments
<p>Disease Strategy</p> <p>3.1A. Utilize disease management in all aspects of restoration & harvest to minimize spreading disease</p> <p>3.1B. Develop & 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, MDDNR, and VMRC.	Modeling and assessment frameworks were utilized through the PEIS process to evaluate the benefits of disease management strategies. They included developing and testing of disease tolerant strains for aquaculture; implementing geographically distinct, large-scale oyster restoration (VIMS/NOAA funding); and producing disease-free spat on shell (ORP/UMCES). Scientific research results indicate the need for a cautionary approach to using disease resistant strains for restoration (see Action 6.3.1). Maryland has adopted a new approach for managing against oyster disease. Maryland will use a targeted restoration approach to facilitate the evolution of natural disease resistance, while managing against the spread of disease. Sanctuaries located in areas with salinities >14 ppt will encourage the development of disease resistance through natural selection. However, the supply of larvae from low-salinity disease refuges may slow the development of disease resistance.
	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, MDDNR, aquaculture industry	Additional State and Federal funding has resulted in an increase in hatchery production from 38 million spat in 2000 to over 1.2 billion in 2013. Over the years hatchery production has increased: 750 million spat (2009); ~450 million spat (2010); over 600 million spat (2011); over 800 million spat (2012), 1.2 billion spat (2013), 972 million spat (2014) and 945 million (2015). The hatchery produced 1.1 billion spat in 2016. 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 (MDDNR/NOAA funding).
	3.3 Establish broodstock sanctuaries in heavily infected areas to possibly produce disease resistant seed. (See Chapter IV Sanctuaries for more details).	Continue MDDNR, 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 were evaluated in 2016 and the Maryland Oyster Advisory Commission was formulating recommendations on changes to sanctuary areas, based on submissions from industry and environmental groups, until HB 924 was approved and stopped any changes to sanctuary boundaries until a stock assessment is completed in December 2018.
	3.4 Develop, implement and maintain a seed policy to reduce and minimize disease impacts.	2004 2007 Continue	MDDNR 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.	Continue	MDDNR funded an UMCES project to develop spatially-explicit assessment tools for the oyster stock in Chesapeake Bay. The project evaluated current data collection, recommended improvements to data collection and evaluated the feasibility of including environmental factors into assessment models. Maryland has addressed some of the recommendations by requiring more accurate harvest data and increasing the number of fall survey samples in which all oysters are measured. MDDNR/ MGS & NOAA are continuing to coordinate field operations to characterize benthic habitat. MDDNR is surveying oyster sanctuaries to obtain population estimates. In 2016, the Maryland General Assembly passed the Sustainable Oyster Population and Fishery Act, requiring MDDNR, in conjunction with the UMCES, to conduct a stock assessment and develop biological reference points for management of the oyster fishery. MDNR and UMCES convened a team to develop the terms of reference for the stock assessment and is in the process of compiling data and developing an assessment model.
<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 Commission)	2004 2009 Continue	MDDNR supported a study to determine the best productive oyster bars within Maryland and used the results to develop a 10-point Oyster Restoration and Aquaculture Development Plan. Based on this study, new sanctuaries were established in 2010. The Maryland OAC was considering changes to the Maryland sanctuaries based on the 2016 review of sanctuary performance and submissions from industry and environmental groups, when the approval of HB 924 delayed any actions until a stock assessment is completed in Dec. 2018. 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. Initial restoration has been completed in Harris Creek and continues in the remaining five tributaries. The final two tributaries in Maryland will be selected by the Department in 2017 based on the input received from the OAC.
	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.	2005 2008/2009 Continue	Protocols have been developed to delineate and mark sanctuary areas. Bay jurisdictions continue to track restoration progress. Maryland oyster sanctuaries are marked with buoys; locations are shown on maps provided to watermen. Restoration progress is tracked using a geo-database.
	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.	Continue	A study on alternative cultch material in MD was conducted in various salinities & the report is on file with MDDNR. 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. MDDNR 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. MDDNR has applied for a permit to dredge shell from Man o' War Shoal and is awaiting a decision from the USACE.

Strategy 4.2. Continued.	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 Continue	MD obtained a permit for a reclamation program that will provide up to 25 million bushels of shell. The MDDNR/MGS and NCBO bottom survey program provided information to prioritize areas and facilitated decisions on shell reclamation techniques. In 2012, 550,850 bushels of previously-planted shells were reclaimed; 370,900 bushels were placed on fishery bars and 179,950 bushels were purchased by leaseholders. ORP started a Shell Recycling Alliance and collected approximately 15,000 bushels of shell in 2012 and has collected 108,500 bushels since inception. Beginning in 2013, a tax credit up to \$750 is allowed for recycling oyster shell.
	4.2.5 Increase hatchery production to support restoration needs. Current seed levels are too low to effectively stock sanctuaries (see Chapter VI Hatchery and Aquaculture).	2005	See comment for Action 3.2. The question: “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.	Continue MDDNR, VIMS	The 2016 Maryland Oyster Biomass Index continued to slightly decrease from the record high of 2013. The 2016 Biomass Index of 1.41 was the sixth highest in the 24-year time series, reflecting the declining 2010 and 2012 strong year classes and mediocre spatsets in many of the regions. Maryland’s biomass estimate is based on the annual fall survey data and an estimate of available oyster habitat. Documentation for MD’s methodology for calculating biomass estimates is available in the PEIS. There is a need to improve the data, especially the habitat estimates that support the biomass calculations. MGS and NOAA are using sonar to refine habitat estimates. 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). The first reefs constructed and seeded in Harris Creek meet the minimum density goal of 15 oysters/m ² over 30% of the bottom.
Sanctuaries (cont’d) Strategy 4.3 Management actions within sanctuaries are primarily based on salinity zones and focus on three key factors: growth, reproduction and disease. The zonal approach to management provides general guidelines for selecting project objectives and anticipating project results in each area.	Strategy 4.3.A: Zone 1 (5ppt to <12ppt) Increase biomass & enhance reef habitat. Enhance reef/ bottom habitat to increase oyster biomass and promote the development of living oyster reefs with broad size/age class structure that supports a diverse reef community Action 4.3.A.1 Identify priority areas in Zone 1 that would have the most success at reaching the defined project objectives Action 4.3.A.2 Rehabilitate and maintain oyster bottom habitat to provide planting substrate for seed oysters and optimal conditions for larval settlement Action 4.3.A.3 Plant hatchery produced SPF seed, if necessary, over several years to establish an oyster population with a diverse age class structure	2005 Continue	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. The first three tributaries chosen for large-scale oyster restoration are located in Zone 2 to balance good reproduction with lower disease pressure.

<p>Strategy 4.3. Continued.</p>	<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> <hr/> <p>Strategy 4.3.C (>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>Continue</p>	
<p>Strategy 4.4 The jurisdictions will establish oyster sanctuaries to promote maximum ecological value</p>	<p>Action 4.4.1 Identify areas of special interest throughout the Bay, especially areas that may retain larvae (maybe auto-recruiting), and protect them using the sanctuary status</p>	<p>Continue</p>	<p>The Great Wicomico, Lynnhaven, Piankatank, Lower York 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. UMCES developed a model to predict where oyster larvae will be transported throughout Harris Creek and surroundings. This research will help identify locations for restoration activities that may result in larval retention and supply of larvae to areas outside the sanctuary. The USACE Master Plan for Native Oyster Restoration contains estimates of flushing time for many tributaries, a parameter contributing to larval retention.</p>
<p>Strategy 4.5 Implement the actions described in chapter III to address disease problems.</p>	<p>Action 4.5.1 Utilize only SPF hatchery seed in sanctuaries designated for oyster biomass accumulation, Zone 1 and Zone 2.</p>	<p>Continue</p>	<p>Two workshops held in 2007 provided guidance on the role of hatchery-based oysters used for restoration. Using domesticated strains has not improved survival or resulted in higher recruitment. Preserving local wild stocks is preferred since data suggest some level of natural disease</p>

In addition, the jurisdictions will take further action to minimize the spread of disease	Action 4.5.2 Place hatchery seed on newly created sanctuary bottom and not on top of infected oyster populations in order to prevent rapid infection of the disease-free seed		resistance is occurring (VIMS). In 2016, Maryland dermo disease prevalence increased slightly but was still below the long-term average. MSX prevalence increased for the third straight year and the parasite's range continued to expand up-bay. Although mortality remains low, it is difficult to separate the effects of environmental conditions, especially temperature and salinity, from improved survival due to disease resistance.
	Action 4.5.3 Continue to prohibit the movement of infected oysters from higher salinity waters onto newly or previously created sanctuaries in Zone 1		
Sanctuaries (cont'd) Strategy 4.6 To facilitate the enforcement of closed areas, especially sanctuaries, implement the following actions:	Action 4.6.1 Sanctuaries will be placed in geographically distinct areas with enough space to create a buffer zone between harvest and sanctuary areas to enable enforcement	2003 Continue	State agencies are responsible for marking sanctuary areas but sanctuaries continue to experience enforcement problems. New enforcement strategies have been developed to address this issue. See strategy 5.4. During 2009, MDDNR provided educational materials to the court system and implemented a pilot program in Anne Arundel County to establish a Natural Resource Day in court. This system has proven successful and more than half of Maryland counties attempt to group natural resources cases. MDDNR 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. Sanctuaries are marked with buoys and the locations marked in closure books distributed to all watermen.
	Action 4.6.2 Sanctuaries will be buoyed and marked		
	Action 4.6.3 The public and judiciary will be notified about sanctuary areas through educational initiatives, public announcements and stakeholder meetings		
	Action 4.6.4 New enforcement measures will be identified and implemented. Additional manpower will be recommended if necessary		
Managing Harvest Strategy 5.1 Establish sanctuaries & special management areas thereby reducing F & develop appropriate biological reference pts.	Action 5.1.1 Establish a network of sanctuaries (refer to Section 1.IV for details) and special management areas throughout the Bay to limit harvest and increase oyster production	Continue	In 2008, 4% of quality oyster habitat was in sanctuaries. 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. The Maryland OAC had been reviewing the sanctuary and fishery areas and was ready to recommend some changes when HB 924 was approved and delayed any changes until the completion of a stock assessment in Dec. 2018. 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 Continue	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. Harvester tagging regulations have yielded data on bar-specific exploitation rates and serve as a check on dealer reports. These data are being compiled for the stock assessment and the development of BRPs. MDDNR and UMCES have developed the terms of reference for the stock assessment and will be working on the development of assessment models in 2017 and 2018.
	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 Continue	The guidelines are being used.

	Action 5.1.4 Control oyster harvest to reach an appropriate F determined by the Oyster Scientific Committee.	2007/2008 Continue	Oyster harvest is controlled through many regulations by MDDNR & VMRC. If BRPs are determined, a target and threshold F will be defined. Virginia has initiated an effort to reduce the number of oyster harvesters by freezing and then lowering the number of Oyster All Gear User Fee holders. PRFC has instituted a cooperative aquaculture program in which people may pay a fee to harvest oysters planted in a managed reserve.
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 Continue	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 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.
	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 Continue	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. The OAC is currently reviewing sanctuary and public fishery areas and may recommend changes. Any recommended changes to sanctuary boundaries will be deferred until after the stock assessment has been completed in Dec 2018.
	Action 5.2.4 Identify and implement regulatory & legislative changes needed for managing open & closed harvest areas.	2006 Continue	MDNR opens and closes areas via public notice or the regulatory process, including scoping and public comment. Harvest reserves are opened by public notice. 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 Continue	Monitoring is underway and evaluation is on-going. Models are lending insight into the conditions under which rotational harvest is sustainable. Counties proposed rotational harvest schemes which were reviewed by the OAC.
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 Continue	MDDNR no longer implements a repletion program. 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.

	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.	2010 Continue	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.	Continue	
Hatchery and Aquaculture Considerations Strategy 6.1 Utilize hatchery-produced seed to augment natural reproduction reduce disease effects & increase biomass.	Action 6.1.1 Develop an inter-lab certification program for oyster diseases. Utilize the molecular diagnostic protocols for certifying SPF oyster seed developed by the VIMS Shellfish Pathology Laboratory.	2005 Continue	Program was completed and currently used by VIMS, UMCES, and MDNR.
	Action 6.1.2 MD will increase hatchery production of SPF seed to support the 10-fold increase in oyster biomass: a) Increase & maintain as necessary the operating funds for each MD hatchery facility; b) Evaluate & optimize the efficiency of each facility in order to ensure maximum production of spat.	Continue	States are focusing on restoring targeted tributaries: Harris Creek, Little Choptank River, and the Tred Avon River (MD) and the Lynnhaven, Lafayette, Great Wicomico, Lower York 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
	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	Implemented and continuing.
	Action 6.1.4 The U.S. Army Corps of Engineers (USACE) will conduct an analysis of hatchery project production in relationship to environmental benefits as part of its long-term restoration planning, and determine whether augmenting or building new hatchery (ies) is warranted	2008 Continue USACE	The master plan examines and evaluates the problems and opportunities related to oyster restoration and formulates a plan for implementing large-scale bay-wide restoration. This action was expected to be addressed as part of the Native Oyster Master Plan (2012) by the USACE. However, the plan establishes guidelines for restoration and not specific actions. Work is closely coordinated with MD and VA.
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	Continue 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.	TBD MDDNR, VMRC	There is some concern about reduced genetic variability of selectively bred oysters compared to wild oysters. In 2007, oyster disease experts recommended to discontinue transplanting infected natural seed; to discontinue bar cleaning for disease; to use hatchery-produced seed for augmenting natural stocks; to create sanctuaries and enforce a harvest moratorium; and consider larval dispersal mechanisms when creating oyster sanctuaries.

<p>Strategy 6.3 Develop recommendations for using disease resistant strains of native oysters for restoration. Selectively bred oyster strains should be used for restoration only in areas where native oysters are locally depleted.</p>	<p>Action 6.3.1 Assess and evaluate the use of disease resistant stocks as a tool for increasing disease resistance in the native oyster population in the Bay.</p>	<p>2007</p>	<p>The participants at the 2007 OMP Workshop concluded that the development of alternative strains for use in restoration should not be pursued thereby preserving the natural ability of oysters to develop disease resistance. There was also consensus that domesticated disease-resistant strains were acceptable for aquaculture endeavors.</p>
	<p>Action 6.3.2 Monitor restoration activities to clarify the interaction between selectively bred strains and wild stocks of oysters.</p>	<p>2005 UMCES, ORP, VMRC</p>	<p>Carlsson et al (2008) evaluated the contribution of a selectively bred, domesticated oyster strain to recruitment in the Great Wicomico, Lynnhaven, York, and Elizabeth Rivers from 2002 to 2006. They were unable to detect a significant contribution of the domestic strain to wild-produced spat.</p>
<p>Strategy 6.4 The members of the OMP drafting team will review the MD task force report & recommend changes to the OMP as appropriate regarding aquaculture strategies & actions</p>	<p>Action 6.4.1 Amend the OMP as necessary to incorporate new strategies and actions regarding aquaculture.</p>	<p>2009 2010 2019</p>	<p>The vision of the new Maryland 10-Point Oyster Plan is “to establish a private aquaculture industry that emerges as a major economic contributor to the State of Maryland while maintaining a more targeted and scientifically managed wild oyster fishery that is sustainable.” Chapter 173 of the Legislative Acts of 2009 passed new aquaculture leasing statutes that completely changes how Maryland regulates, administers, and manages aquaculture and leasing of shellfish. Grants have been secured to help people with start-up and operational costs for new oyster farms. The federal and state permitting processes have been streamlined. The first Aquaculture Enterprise Zone (AEZ) was established by regulation in October 2009 in the Patuxent River near Broomes Island. The AEZ has not yet been permitted by USACE, so leases there are not yet available. 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. Results from Maryland’s 2016 evaluation of sanctuaries, harvest areas, and aquaculture areas will be used to develop any new management strategies and actions. Changes to the OMP will be considered after the completion of a stock assessment in 2018.</p>
<p>Monitoring and Information Management Strategy 7.1 A) Utilize the results of the oyster stock assessment as an estimate of oyster abundance in the Bay; B) Use the 1994 biomass value as a baseline to track progress towards the 10-fold objective.</p>	<p>Action 7.1.1 Conduct monitoring programs that are consistent in terms of sampling procedure, timing of sampling, types of data collected, and analysis and provide the results to a central database or databases.</p>	<p>Continue</p>	<p>Monitoring programs have been reviewed. UMCES has provided recommendations on how to improve existing fishery-independent and fishery-dependent data collection methodology. MDNR Shellfish Program has taken the recommendations under consideration. 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.</p>

	Action 7.1.2 Establish a Technical Committee to develop data management guidelines for handling oyster data.	2005	Original committee meeting did not result in specific guidelines.
	Action 7.1.3 Develop and maintain a database to track oyster restoration projects and provide web-based access.	2007 MDDNR, VMRC, NOAA Continue	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	2007	An Oyster Workshop was convened in December 2007. Oyster restoration is a regular agenda topic for the CBP's Sustainable Fisheries Goal Implementation Team. An Oyster Summit was held in February 2016 to provide a forum to discuss oyster issues in the Chesapeake Bay. The summit report can be found at https://www.chesapeakebay.net/channel_files/23465/summit_report_3-13_final_3-18_correction.pdf
	Action 7.1.5 Promote the research recommendations listed in Section 2.	2005 2009	All oyster partners. New research recommendations will be developed during the OMP revision process.

Acronyms:

BRPs - Biological Reference Points
CBF – Chesapeake Bay Foundation
CBP - Chesapeake Bay Program
HB – House Bill
MGS - Maryland Geological Survey
MDDNR - Maryland Department of Natural Resources
MLEIN - Maritime Law Enforcement Information Network
NCBO - NOAA Chesapeake Bay Office
NFWF – National Fish and Wildlife Foundation
NOAA - National Oceanographic and Atmospheric Administration
NRP - Natural Resources Police
OAC - Oyster Advisory Commission
OMP - Oyster Management Plan
ORP - Oyster Recovery Partnership
PEIS - Programmatic Environmental Impact Statement
PPT – Parts per Thousand
PRT- Plan Review Team
SERC – Smithsonian Environmental Research Center
SPF - Specific Pathogen Free
STAC - Scientific and Technical Advisory Committee
TBD – To Be Determined
TNC – The Nature Conservancy
UMCEES - University of Maryland Center for Environmental & Estuarine Studies
UMCES - University of Maryland Center for Environmental Studies
USACE - U.S. Army Corps of Engineers
VIMS - Virginia Institute of Marine Science
VMRC - Virginia Marine Resources Commission

2016 Maryland FMP Report (June 2017)

Section 15. Red Drum (*Sciaenops ocellatus*)

The Atlantic States Marine Fisheries Commission's (ASMFC) South Atlantic State/Federal Management Board (Board) began the benchmark stock assessment process for red drum in 2015. During the process the Board expressed some concerns with the model, Stock Synthesis 3 (SS3), used in the stock assessment, and, therefore, requested the Red Drum Stock Assessment Subcommittee develop Statistical Catch at Age (SCA) models similar to what was used in the 2009 stock assessment. The SCA models were developed in 2016 and will be peer reviewed in 2017. Following the review, the Board will determine if the models are appropriate for management use.

Fishery Management Plans (FMPs)

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

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

Stock Status

Status of the red drum stock is derived from the Atlantic coast stock assessment. In the 1980s and 1990s, the coastal red drum stock was overfished and management measures were implemented to reduce fishing mortality (F) and rebuild the stock. Two management units were defined: the northern stock (NC to NJ) and the southern stock (FL to SC). The 2009 ASMFC stock assessment found that the stocks were relatively stable as far as could be determined with data limitations, and that overfishing was likely not occurring.¹ The threshold and target are based on an escapement rate that provide a 30% and 40% static spawning potential ratio (sSPR), respectively. The sSPR is based on female biomass and egg production. An sSPR below 30% indicates that overfishing is occurring. The average sSPR has exceeded the overfishing threshold since 1994 with one exception in 2002 and the northern stock has been above the target since 1996.²

An Atlantic coastwide benchmark stock assessment was conducted in 2015 by ASMFC and was reviewed by the Southeast Data, Assessment, and Review (SEDAR) team. This assessment used a new model, SS3, to assess coastal red drum stocks. Due to some concerns the Board had with the new model, they requested the Red Drum Stock Assessment Subcommittee to develop SCA models similar to what was used in the 2009 stock assessment. These models will be peer reviewed by the Center for Independent Experts (CIE) in the winter of 2017. Following review the Board will determine if the models are appropriate for management use.

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. Red drum are more frequently reported from Virginia waters, where salinities are higher. Schools of red drum below the minimum size limit 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.² 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 recreational fishermen and a slot limit of 18"-25" and a creel limit of 5 fish per day for commercial fishermen. The Potomac River Fisheries Commission (PRFC) has a slot limit of 18"-25" and a possession limit of 5 fish per day for recreational and commercial fishermen. There are no closed seasons for the recreational or commercial fisheries.

The Fisheries

Commercial harvest from the Chesapeake Bay has averaged 7,600 lbs. since 2000 (Figure 1). It makes up a small proportion (10-20%) of the total commercial catch from the Atlantic coast. The majority of the commercial catch from the Atlantic coast is from North Carolina. Three southern states have given red drum game fish status and prohibit commercial harvest (FL, GA, & SC). Coastal commercial landings have declined since the 1980s.²

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

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

The Maryland Sport Fisheries Advisory Commission asked MD 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 1 to Amendment 2 to the Red Drum Fishery Management Plan.³ Addendum 1 revised the habitat section to include the most current science on red drum habitat requirements for all life history stages. Habitat identification and description, habitats of concern, and potential threats to recovery and sustainability were also defined.

References:

- 1 SEDAR. 2009. SEDAR 18: Stock Assessment Report Atlantic Red Drum. Southeast Data, Assessment, and Review. North Charleston, South Carolina. <http://sedarweb.org/sedar-18>
- 2 2016 Review of the Atlantic States Marine Fisheries Commission Fishery Management Plan for Red Drum (*Sciaenops ocellatus*) 2015 Fishing Year. 22p. Addendum 1 to Amendment 2 to the red drum fishery management plan: *Habitat Needs & Concerns*. Approved August, 2013. 24p
- 4 Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division, June 19, 2017. <http://www.st.nmfs.noaa.gov/commercial-fisheries/index>
- 5 Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division, June 19, 2017. <http://www.st.nmfs.noaa.gov/stl/recreational/index.html>

Figure 1. Commercial red drum landings reported to NMFS by Maryland and Virginia: 1982-2015.⁴ Maryland's 2016 commercial red drum landings are preliminary and Virginia's 2016 commercial red drum landings are not yet available.

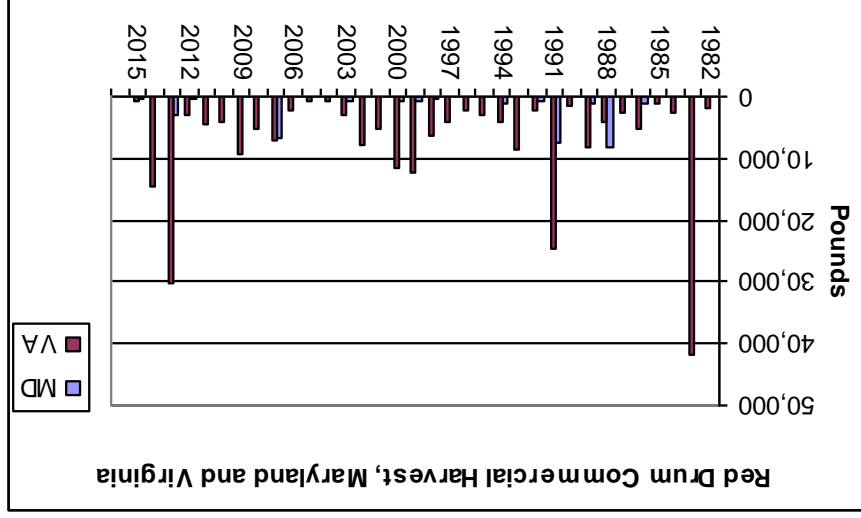
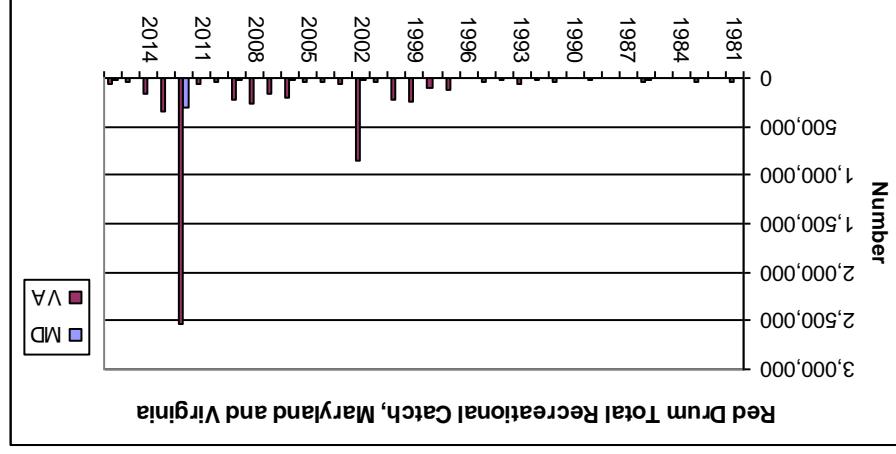


Figure 2. Total recreational red drum MRIP catch estimate for Maryland and Virginia, all modes combined, 1982-2016.⁵ (Includes fish caught and released)



1993 Chesapeake Bay and Atlantic Coast Red Drum Management Plan Implementation Table (updated 06/17)			
Section	Action	Date	Comments
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 2003 2009 2015 Continue	In compliance with coastal recommendations. VA has adopted a slot limit and now allows harvest of 18-26" red drum. A new possession limit of 3 fish has been adopted for both recreational and commercial harvest. The 2009 peer reviewed ASMFC stock assessment found the resource to be relatively stable with overfishing not occurring. Next coastal stock assessment is scheduled for 2015. Effective January 1, 2015, VA will allow recreational fishermen 3 fish per day between 18"-26" and commercial fishermen 5 fish per day between 18"-25".
	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 2003 Continue	In compliance with coastal recommendations. MD has a recreational size limit for red drum of 18-27" and a commercial size limit of 18-25". The possession limit is 1 fish/day for the recreational fishery and 5 fish/day for the commercial fishery. PRFC has a size limit of 18-25" and a possession limit of 5 fish for both recreational and commercial harvest.
	1.2a Jurisdictions will investigate the potential for using bycatch reduction devices in nonselective fisheries	1992 Continue	The bycatch of immature red drum has not been a problem in Chesapeake Bay fisheries because small fish are infrequently encountered. Bycatch reduction devices that are currently in place should increase the escapement of juvenile red drum.
	1.2b Virginia and Maryland will work with the South Atlantic Fishery Management Council (SAFMC) and ASMFC to develop and require more efficient gear to reduce bycatch and/or discards.	1992 Continue	MD and VA appointed representatives to the ASMFC/SAFMC Red Drum Advisory Panel. MD and VA have representatives on the ASMFC technical committee. MD does not currently have a representative on the Red Drum Advisory Panel.

1993 Chesapeake Bay and Atlantic Coast Red Drum Management Plan Implementation Table (updated 06/17)			
Section	Action	Date	Comments
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 lbs. of red drum harvested in 2013, the largest since 1983. Preliminary commercial landings for 2016 are 141 lbs. (MD)
	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.

1993 Chesapeake Bay and Atlantic Coast Red Drum Management Plan Implementation Table (updated 06/17)			
Section	Action	Date	Comments
	2.3c Virginia and Maryland will continue to supplement the Marine Recreational Statistics Program	Continue	<p>In 2016, VA anglers received citations for 819 red drum over 46” in length that were caught and released which represented 22% of all tournament entries.</p> <p>MD anglers submitted 28 red drum in 2016 to the catch and release tournament award citation program. MD charter boat logs reported 55 red drum caught in 2016, 19 of which were harvested.</p> <p>The Marine Recreational Information Program (MRIP) has replaced MRFSS with refined estimates of recreational harvest and total catch. Proportional standard errors (PSE) have dropped below 50 in the past five years for VA, indicating that recreational red drum harvest estimates were more precise in VA’s waters, the same is not true for MD.</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 2011.⁸ 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. No red drum were encountered by this survey in 2016.</p>

1993 Chesapeake Bay and Atlantic Coast Red Drum Management Plan Implementation Table (updated 06/17)

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	2000 2014 Continue	<p>New water quality and SAV goals were adopted by the Chesapeake Bay Program signatory states in 2014 as part of the Chesapeake Watershed Agreement, for more information a summary of the agreement can be viewed at the following link http://www.chesapeakebay.net/documents/ChesapeakeBayWatershedAgreementFINAL.pdf</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. In 2016, there were an estimated 97,433 acres of SAVs in the Chesapeake Bay. This estimate surpasses the 2017 restoration target and puts progress ahead of schedule to meet the 185,000-acre SAV restoration goal. The next target is 130,000 acres by 2025.⁶</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 2012⁷. The 2013 SAV estimate was 10,872 acres. Due to turbid conditions in 2014 not all regions could be mapped and only partial totals were reported.</p>

Acronyms:

ASMFC - Atlantic States Marine Fisheries Commission
Board - South Atlantic State/Federal Fisheries Management Board
CBRD FMP - Chesapeake Bay Red Drum Fisheries Management Plan
CIE - Center for Environmental Experts
EPA - US Environmental Protection Agency
F - fishing mortality
FMP - Fishery Management Plan
MRFSS - Marine Recreational Fisheries Statistics Survey
MRIP - Marine Recreational Information Program
PFRC - Potomac River Fisheries Commission

SAV - Submerged Aquatic Vegetation
SAFMC - South Atlantic Fisheries Management Council
SCA - Statistical Catch at Age
SEDAR - Southeast Data Assessment and Review
SS3 - Stock Synthesis 3
sSPR - static spawning potential ratio
NMFS - National Marine Fisheries Service
VIMS - Virginia Institute of Marine Science
VMRC - Virginia Marine Resource Commission

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Section 16. Scup (*Stenotomus chrysops*)

The big change in scup management in Maryland in 2017 was an increase in the mesh size for offshore trawlers from 4.5 inches to 5.0 inches. This was a regulatory requirement that had been in place but somehow had been missed. Scup commercial harvest in Maryland was minimal in 2016 and has been highly variable since the late 1960's through 2012 compared to other Atlantic Coast states. There were no recreational scup landings reported which continued a zero trend for the last few years. Scup are rarely caught by Maryland recreational anglers from either offshore or inshore areas. 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 comes from its designation as a species In Need of Conservation which was established in 1994.¹

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. Addendum XXIX (May 2017) allows better utilization of the commercial quota by shortening the summer period and extending the winter period. 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.²

Stock Status

The Scup Benchmark Stock Assessment Report was completed in August 2015. The ASMFC 2015 scup stock assessment determined that as of 2014, scup are not overfished and overfishing is not occurring relative to the revised biological reference points (BRPs).³ The fishing mortality rate (F) was estimated to be 0.049 in 2014, below the fishing mortality threshold reference point = $F_{MSY} = F_{40\%} = 0.177$. Spawning Stock Biomass (SSB) was estimated to be 219,066 metric tons (MT) = 483 million lbs, in 2014, above the biomass target reference point = $SSB_{MSY} = SSB_{40\%} = 92,044$ MT = 203 million lbs.³ New reference points were defined in the assessment <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.³ Maryland's commercial fishery is open all year with a minimum size limit of 9" in state waters and 9" in Federal waters.⁴ 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.⁵ Winter II landings were set at 18,000 pounds per trip.⁶ The summer fishery in state waters is managed by quota; Maryland's allocation is 0.012%.^{7, 8} 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.⁶ 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 315,400 pounds in 2013, 527,953 pounds in 2014, 25,869 pounds in 2015, and 37,620 pounds in 2016 (Figure 1). 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 2015⁹ (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. Recreational management measures are being maintained in federal waters (e.g., 9-inch minimum size, 50 fish possession limit, and year-round open season). States will continue to use a regional management approach. The ASMFC Technical Committee will conduct an analysis on the potential impacts of lowering the size limit for northern region state waters on the 2018 coastwide harvest.

Figure 1. The commercial harvest of scup in Maryland since 1950.⁹ Harvest data is not available for the years 1996, 2001-2003, and 2006-2008.

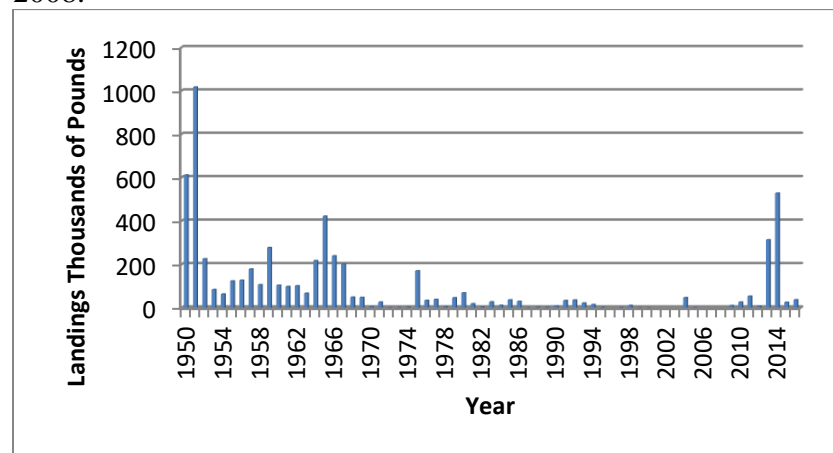
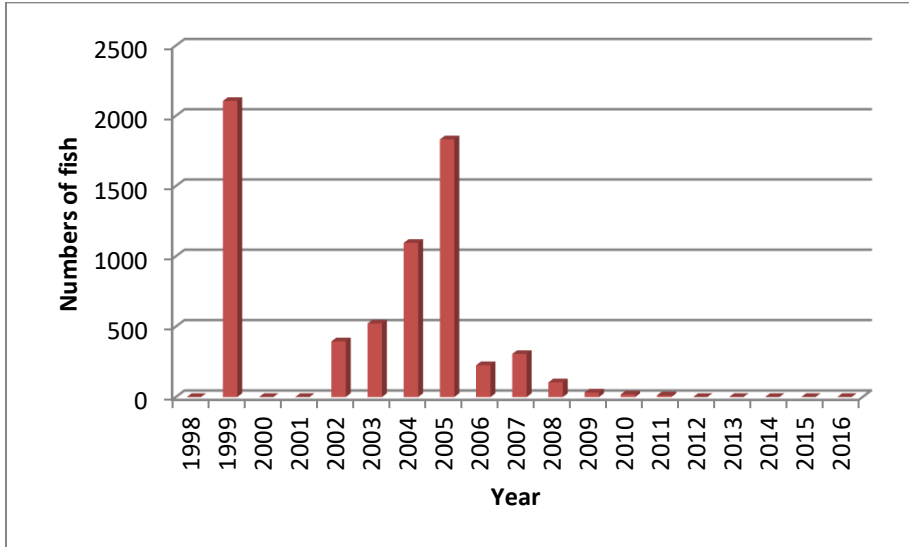


Figure 2. The recreational scup harvest in Maryland since 1998.¹⁰



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- ¹Maryland Office of the Secretary of the State. COMAR 08.02.12.03. Retrieved March 09, 2017: <http://www.dsd.state.md.us/comar/comarhtml/08/08.02.12.03.htm>
- ²Mid-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
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- ⁴ Doctor, S. 2017. Maryland's 2016 annual compliance report for scup. Maryland Department of Natural Resources. Stevensville, MD.
- ⁵ 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>
- ⁶Department 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)).
- ⁷ 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.
- ⁸ 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.
- ⁹ Personal communication from the NOAA Fisheries, Northeast Regional Office. March 09, 2017. http://www.nero.noaa.gov/ro/fso/reports/reports_frame.htm
- ¹⁰ Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division. March 09, 2017 <http://www.st.nmfs.noaa.gov/recreational-fisheries/index>.

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Section 17. Striped Bass (*Morone saxatilis*)

In 2016, the Atlantic States Marine Fisheries Commission (ASMFC) Striped Bass Technical Committee updated the stock assessment and concluded that the resource is not overfished and overfishing is not occurring. Fishing mortality (F) was below threshold and target levels, and female spawning stock biomass (SSB) was below the target level but above the threshold level. The 2016 Maryland striped bass fishery was managed under the ASMFC's Addendum IV to Amendment 6. Recreational and coastal migrant harvests were higher in 2016 than the previous six years, driven by the large 2011 year-class. The 2016 juvenile abundance index was well below average. Addendum IV harvest restrictions will remain in place through 2017. The ASMFC Striped Bass Technical Committee (SBTC) will conduct the next benchmark stock assessment in 2018. In preparation for the 2018 stock assessment, the SBTC will explore new biological reference points (BRPs).

Fishery Management Plans (FMPs)

In 1989 the Chesapeake Bay Program developed the Chesapeake Bay Striped Bass Fishery Management Plan (CBSB FMP) to coordinate management among Bay jurisdictions and to comply with ASMFC FMP requirements. The CBSB FMP was amended in 1998. Amendment 1 formally adopted ASMFC's Amendment 5 management framework for the Chesapeake Bay. Amendment 5 (1995) to the ASMFC FMP required an annual juvenile abundance survey in Maryland and Virginia to monitor recruitment. Maryland's Juvenile Abundance Index (JAI) began in 1954 and Virginia's survey began 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 adjust 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 (2014) reduced the Atlantic coast F rate in 2015 and 2016 to a level at or below the target. In Maryland, harvest reductions include a 25% reduction in the Atlantic and Chesapeake Bay trophy fisheries from 2013 harvest and a 20.5% reduction in the

summer/fall and winter fisheries from 2012 harvest levels (<http://www.asmfc.org/species/atlantic-stripped-bass>).

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

Stock Status

Although the striped bass stock is not overfished and overfishing is not occurring, model projections indicate that SSB could fall below the threshold in the future. Striped bass are managed under BRPs for F and SSB. The BRPs were updated in the ASMFC's 2013 Benchmark Stock Assessment Report for Atlantic Striped Bass and most recently in 2015 and 2016. The current target F for striped bass in coastal waters is 0.18 and the $F_{\text{threshold}}$ is 0.22. Separate BRPs for Chesapeake Bay were not developed in the 2013 Stock Assessment report but the Technical Committee will continue to work on developing Chesapeake Bay reference points.² In the meantime, the Chesapeake Bay stock will be assessed under the coastwide reference points.

The 2015 estimate of F from the 2016 stock assessment update ($F=0.16$) was below the F threshold and F target levels. The current target female SSB was 72,032 MT (159 million lbs.) with the $SSB_{\text{threshold}}$ at 57,626 MT (127 million lbs.). The 2015 coastwide SSB from the 2016 stock assessment update was 58,853 MT (129 million lbs.) which is above the threshold but below the target.¹ The 2017 season will be managed under Addendum IV. A benchmark stock assessment will be completed in 2018. The most recent ASMFC Atlantic Striped Bass Stock Assessment Update (2016) can be found at: http://www.asmfc.org/uploads/file/581ba8f5AtlStripedBassTC_Report2016AssmtUpdate_Oct2016.pdf

Maryland DNR has conducted the Estuarine Juvenile Finfish Survey since 1954 to measure young of year (YOY) striped bass abundance and to calculate a juvenile abundance index (JAI), presented as a geometric mean. 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.⁴ The 2016 JAI was well below average (4.27) at 1.25. The 2015 JAI was well above average at 10.67 and the 2014 JAI was near average at 4.065 (Figure 1). The Maryland JAI is one of six indices that are calculated for

different regions of the Atlantic coast including Maine, New York, New Jersey, Virginia, and North Carolina.⁴

Current Management Measures

Addendum IV established management measures to achieve mandatory reductions in recreational and commercial removals for the 2016 season. The Chesapeake Bay is managed under a separate commercial quota that is allocated among the Bay jurisdictions. Maryland's 2016 Chesapeake Bay striped bass commercial quota was 1.47 million lbs., the same as 2015 (Figure 2).⁶ The 2016 commercial quota allocated to the common pool fisheries was 19,439 lbs. for hook and line and 29,159 lbs. for drift gill net. The remaining quota was allocated to the individual transferable quota (ITQ) fishery with no gear-specific restrictions.⁶ The Maryland Atlantic commercial quota was 90,727 lbs. and could be harvested with drift gill net or otter trawl. The recreational (including charter) fishery in Chesapeake Bay attained reductions in the trophy and summer/fall harvests through changes in size limits (Figure 3).⁶ Regulations for striped bass in Maryland 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 individual transferable quota (ITQ) management framework. The common pool fishery has a single quota shared among all participants. An ITQ guarantees each participating waterman a portion of the commercial quota. Quota allocation is based on a waterman's historical landings record through February 29, 2012. Watermen can transfer quota to other watermen with an ITQ.

Commercial fisheries are managed using quotas and seasonal restrictions by gear type: pound net, haul seine, hook and line, and drift gill net. In 2015, the quota was decreased by 20.5% for Chesapeake Bay and by 25% for Atlantic Ocean commercial fisheries to meet Addendum IV compliance requirements. These reductions continued for the 2016 seasons. 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 – December 31. The pound net fishery was open from Monday – Saturday and the haul seine fishery was open from Monday – Friday. The hook and line ITQ sector was open from Monday – Thursday while open days for the common pool sector varied during the fishing season. The drift gill net fishery was open from January 1 – February 29 and December 1-31. The ITQ sector operated from Monday – Friday while open days for the common pool sector varied during the fishing season. The Atlantic Ocean drift gill net and otter trawl fisheries had a 24" total length minimum size limit. Atlantic coast fisheries were open from Monday – Friday on January 1 – May 31 and October 1 – December 31.

Striped bass caught by the commercial fishery must be individually tagged and landed at a certified check station prior to sale.⁴ Each fish is counted and weighed. Check

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

Recreational harvest is managed with seasonal and spatial restrictions. No recreational harvest of striped bass is allowed in the Chesapeake Bay and Potomac River during the January 1 – February 29 catch and release fishery. Regulations to control recreational catch and release effort during the pre-spawn period (March 1 - the third Friday in April) were implemented in 2010. During this time, anglers are prohibited from using stinger hooks, required to use barbless hooks when trolling, required to use circle hooks or J hooks with a gap < ½" when using bait, and allowed up to six lines per boat when trolling. Fishing is allowed in the mainstem Chesapeake Bay below Brewerton Channel (Patapsco River), Tangier and Pocomoke sounds, and tributaries except those identified as striped bass spawning rivers. The 2016 spring trophy season took place from April 16 – May 15, but harvest was restricted to the Chesapeake Bay mainstem south of Brewerton Channel (Baltimore) down to the MD/VA line, Pocomoke Sound, and Tangier Sound. The regulations changed for the 2016 trophy season due to implementation of Addendum IV. Anglers could keep one fish 35 inches or greater.

Allowable fishing locations were less restrictive from May 16 – 31: Chesapeake Bay mainstem from Hart-Miller Island (Baltimore) to the MD/VA border; the lower five miles of the Chester, Choptank, and Patuxent rivers; Pocomoke Sound, and Tangier Sound. All Chesapeake Bay and tributary waters are open to striped bass fishing from June 1 – December 20. The 2016 creel and size limits from May 16 – December 20 were two fish per person per day 20-28 inches, or one fish per person per day 20-28 inches and one fish per person per day over 28 inches. The fishery transitions to catch and release only on December 21 and continues thru December 31. The use of eel as bait is prohibited from December 21 – May 31 to prevent deep hooking which increases mortality.

Spring recreational regulations differ somewhat for upper Chesapeake Bay waters including the Susquehanna Flats. The striped bass fishery is catch and release only from December 21 – May 3. The fishery is closed from May 4 – 15. The 2016 fishery reopened with a 1 fish per person per day creel at 20 – 26 inches from May 16 – 31.

The 2016 Atlantic coast recreational fishery regulations started with 1 fish per person per day of 28 inches or greater. A public notice was issued on May 24, 2016 to change the regulations to 2 fish per person per day from 28 to 38 inches or greater than 44 inches effective June 1, 2016. The US Secretary of Commerce enacted a moratorium on striped bass harvest in federal waters (Exclusive Economic Zone or EEZ) in 1990. The moratorium remains in effect.

The 2017 spring trophy season regulations, the summer/fall recreational regulations, and the Atlantic recreational fishery will all be the same as 2016.

Maps of closed, catch and release, and harvest areas can be found at

<http://dnr.maryland.gov/fisheries/pages/striped-bass-maps.aspx>.

An overview of commercial regulations can be found at

<http://dnrweb.dnr.state.md.us/fisheries/regulations/table.asp?c=commercial> and recreational regulations at <http://www.eregulations.com/maryland/fishing/striped-bass/>.

The complete list of commercial and recreational harvest restrictions is printed in the Code of Maryland Regulations (COMAR).

The Fisheries

The 2016 Maryland commercial fishery in Chesapeake Bay harvested an estimated 1.45 million lbs.; 660,148 lbs. from the winter gill net fishery and 765, 313 lbs. from the summer/fall fishery (Figure 2).⁶ Atlantic coast landings were estimated at 19,675 lbs.⁵

The NOAA Marine Recreational Information Program (MRIP) estimated recreational harvest in Maryland for 2015 was 4.31 million lbs. (Figure 3).⁶ Of the 2016 Chesapeake Bay harvest, 74,139 spring migratory fish (1,752,227 lbs.) were harvested by the trophy fishery (Figure 4).⁶ The estimated discard mortality for striped bass is 9%, equal to approximately 405,698 fish or 782,550 lbs. in 2016.⁶

Issues/Concerns

The striped bass stock has been undergoing a decline in SSB and an increase in F. Although projections from the 2016 stock assessment update indicated that SSB could fall below its threshold, F was below target and threshold levels.

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 mycobacteriosis⁸ or other factors affecting health. Nutritional status of striped bass has been discussed as a possible health index. Nutrition-based reference points were proposed by Jacobs et al. (2013).⁹ Further studies of mycobacteriosis infections in striped bass and its relation to M are 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. ASMFC considered developing Addendum V to relax coastwide commercial and recreational regulations and bring the current F closer to the target level (based on the 2016 stock assessment update). The Chesapeake Bay jurisdictions had raised concerns about the economic hardships imposed since Addendum IV. Prior to Addendum IV, the Chesapeake Bay jurisdictions and other producer areas along the coast were managed under a lower target F than the coastal stock. In May 2017, the Striped Bass Board decided to delay any management changes until the completion of the 2018 benchmark stock assessment.

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

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

Figure 1. Striped bass juvenile abundance index geometric mean values: 1957 – 2016.^{5,6} The red line represents the recruitment failure definition (1.60) and the black line defines the target period average (1959-1972) of stable recruitment. The moratorium was in place from 1985 to 1989.

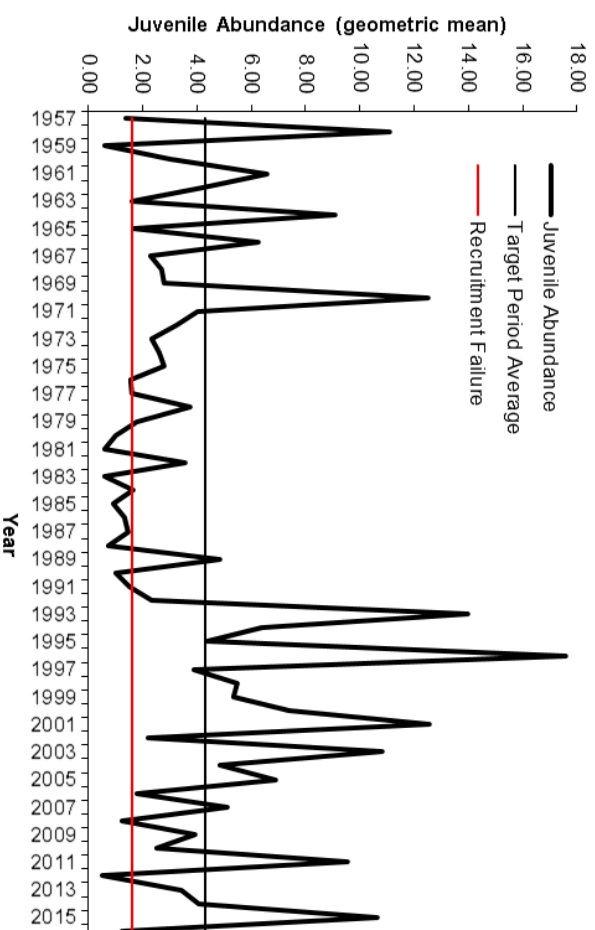


Figure 2. Total commercial striped bass landings (Atlantic and Chesapeake Bay) ⁶ and Chesapeake Bay landings ⁶ in Maryland from 1982 to 2016. Total and Chesapeake Bay quota are shown for 2003-2016. Striped bass harvest moratorium was in effect from 1985 to 1989. (<http://www.asmfc.org/species/atlantic-striped-bass>).

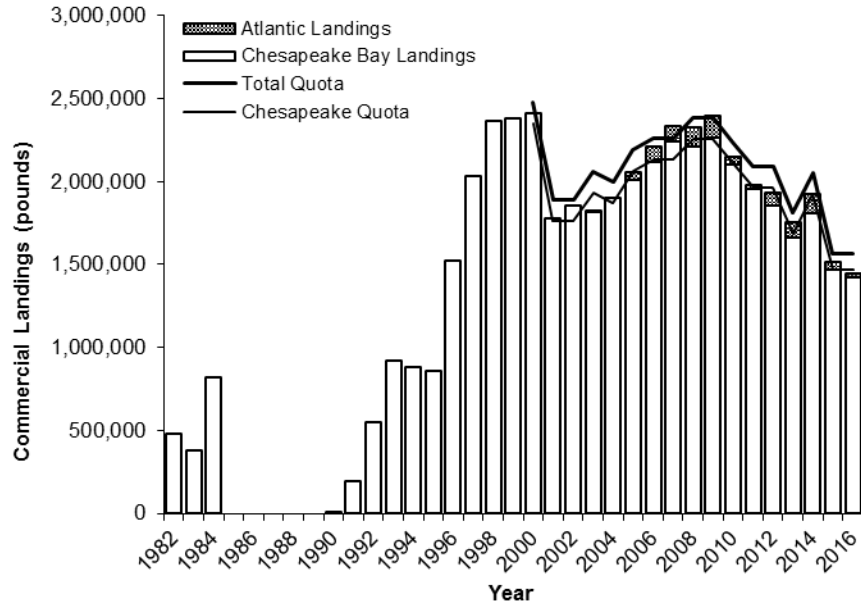


Figure 3. Maryland recreational (including charters) striped bass landings from 1981-2016.^{6,7} Striped bass harvest moratorium was in effect from 1985 to 1989.

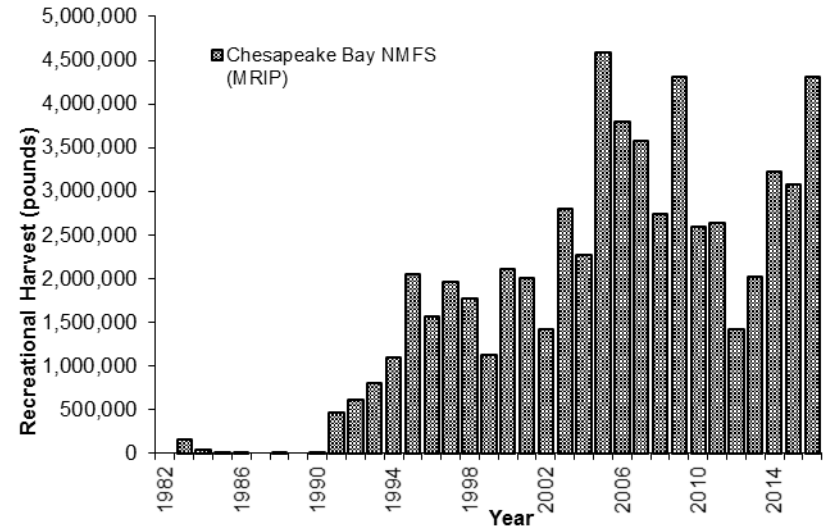
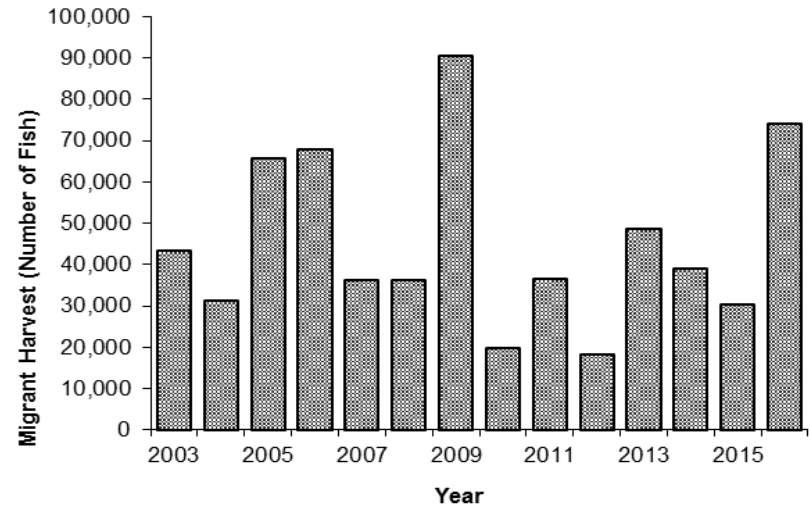


Figure 4. Maryland striped bass migrant harvest from 2003 to 2016.⁶ Trophy migrant harvest data submitted as an appendix to the ASMFC annual compliance reporting.



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- ⁹ 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 06/2017)

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 Continue	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, 2011, and 2015 year=classes
		2014	Addendum IV approved to implement management measures to reduce F and to increase SSB.
		2015 2016 Continue	New regulations implemented as required by Addendum IV. Trophy season regulations adjusted, but still implemented as required by Addendum IV.
<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 transition fishery and a rate of 0.5 (equivalent to about 32% of the legal sized fish being harvested) during a recovered 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} .
		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.
		Continue	Bay jurisdictions are in compliance with ASMFC guidelines. CB F remains below the target of 0.27. See Strategy 1.2 comments for size limits and

1989 Chesapeake Bay Striped Bass Management Plan Implementation Table (updated 06/2017)

Strategy	Action	Date	Comments
Continue 1.1.1	Continue 1.1.1	2013 Continue	Strategy 2.4.1 comments for seasons and time restrictions. BRPs were changed in the update to the 2013 ASMFC Coastal Stock Assessment. New BRPs are a target F=0.18 and threshold F=0.22.
	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.	Continue	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	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.
		2016	Addendum IV requires the recreational minimum size limit for striped bass to be 20 inches. The trophy season regulations are changed from a slot limit to a 35-inch minimum size limit.
	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.	Continue	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.

1989 Chesapeake Bay Striped Bass Management Plan Implementation Table (updated 06/2017)

Strategy	Action	Date	Comments
Continue 1.2	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.	Continue Continue	DC, MD, PRFC, and VA recreational fisheries are managed with a combination of the 20" – 28" slot limit and a 28" minimum size limit: 2 fish 20" - 28", or 1 fish 20" - 28" and 1 fish ≥28". Spring trophy season size limits for MD and PRFC are 1 fish ≥28" and VA allows 1 fish ≥32". There is not a spring trophy season in DC. Commercial fishery size limits: MD is 18" – 36" for all gear and seasons; PRFC is 18" – 36" from February 15 – March25 and ≥ 18" from June 1 – December 15, and for gill net ≥ 18" from November 12 – February 14; VA minimum size is 18" all season with a 28" maximum from March 26 – June 15. Commercial fishing is prohibited in DC.
1.3 Fishing mortality rates will be set to ensure a viable female spawning stock of age VIII and older females, and stocks will continue to be enhanced with hatchery production.	1.3.1 During a transition fishery, mortality will be controlled to protect age VIII or older females until they comprise at least a certain percentage (as determined by the ASMFC) of the female spawning population.	2011	Female fish ages 8+ have increased in abundance. Minimum percent of age 8+ females has not been specified by ASMFC.
	1.3.2 A fishery on a recovered stock will be controlled so that females age VIII or older continue to comprise at least a certain percentage (as determined by the ASMFC) of the female spawning stock.	Discontinued 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, $SSB_{\text{threshold}} = 66.2$ million lbs. and $SSB_{\text{target}} = 82.7$ 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 &	Magothy - 1982 Patuxent - 1984 Pennsylvania – 1990	MD, PA, and USFWS discontinued stocking hybrid striped bass.

1989 Chesapeake Bay Striped Bass Management Plan Implementation Table (updated 06/2017)

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

1989 Chesapeake Bay Striped Bass Management Plan Implementation Table (updated 06/2017)

Strategy	Action	Date	Comments
Continue 2.3	striped bass.		
	2.3.1 C) The sale of striped bass caught by recreational or charter boat fishermen will be prohibited.	Continue	CB jurisdictions are in compliance.
	2.3.2 Maryland and Virginia will establish a weekly reporting system for licensed commercial fishermen and a daily reporting system for buyers during the commercial season. Maryland and Virginia will provide the Potomac River Fisheries Commission with information obtained through their mandatory buyer reporting provisions. The Potomac River Fisheries Commission will reduce the time period required for the finfish reporting system from monthly to weekly.	2006 2009	Electronic reporting was established for check stations and fishermen.
		2010	Commercial Harvest Reports must be submitted to MDNR Fisheries Service within 10 days after the end of the month being reported. After 10 days the report is late. Watermen having late reports will be identified on the MDNR commercial webpage and in the Maryland Watermen's Gazette. Official violations are recorded for a license if a harvest report is not received within 50 days after the due date. Two or more reporting violations may result in license suspension.
		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).		
2.4.1 Fishing seasons will be established for the recreational, charter boat and commercial fisheries. The length of the season may be adjusted as needed, including when quotas are reached (see Action 2.1.2), by opening and closing areas to fishing, or with other actions as appropriate. Seasons will be consistent among jurisdictions to the extent possible.	2.4.1 A) The District of Columbia will establish a recreational fishing season within the period June through December.	Completed	The season opens in May and concludes at the end of December.
	2.4.1 B) Maryland will establish fishing seasons within the following periods: o The commercial gill net season will be within the period November through	Continue	Fishing season dates are annually reviewed by ASMFC. Chesapeake Bay pound net, haul seine and

1989 Chesapeake Bay Striped Bass Management Plan Implementation Table (updated 06/2017)

Strategy	Action	Date	Comments
	parity with the coastal states.		
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 2014	Weekend and evening/night fishing have been prohibited. Saturday fishing was allowed in the pound net sector.
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 Continue	Area closures are regulated. Jurisdictions follow ASMFC harvest restrictions.
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.	Continue	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.	Continue	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"> o Utilize daily trip tickets for commercial and charter fishermen. o Conduct port sampling of commercial vessels. o Conduct onboard sampling of commercial catches. o Utilize check-in station sampling to characterize exploited stocks. o Require dealer logs o Maintain Natural Resource Police activity reports. o Utilize aerial overflights to estimate recreational effort. o Conduct port and onboard sampling of recreational vessels. o Conduct telephone surveys to estimate 	1995 - 2003 Continue 2007	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. 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. Data collected from Federal waters is coordinated with NOAA Fisheries. Addendum I to Amendment 6 of the ASMFC FMP requires commercial and recreational

1989 Chesapeake Bay Striped Bass Management Plan Implementation Table (updated 06/2017)

Strategy	Action	Date	Comments
Continue 2.5	recreational participation. ○ Utilize mail surveys to estimate recreational catch and effort. ○ Utilize an enhanced National Marine Fisheries Service survey and/or Chesapeake Bay Stock Assessment Committee recreational monitoring data.	2008 2011 Continue	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. 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 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.	Continue	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 Continue	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.	Continue 2011 2011 Continue	ASMFC's Law Enforcement Committee develops minimum enforcement policies. 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,

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Strategy	Action	Date	Comments
Continue 2.6.1	Continue 2.6.2		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.
<p>3 - Stock Assessment and Research Needs: The Chesapeake Bay Stock Assessment Committee (CBSAC) will continue to improve the coordination of stock assessment pursuant to the Chesapeake Bay Stock Assessment Plan. Stock identification studies should be expanded, especially for the Chesapeake & Delaware Canal and along the coast, to provide information on stock mixing. The contribution of hybrids and hatchery produced fish to the wild population needs to be determined. A review of hooking mortality and other by-catch mortality rates would allow greater precision in establishing fishing mortality controls. Studies on larval survival and growth in relation to environmental variables would provide a better understanding of the factors affecting year class strength.</p>		<p>Continue</p> <p>Completed</p> <p>2009</p> <p>2008 – 2011</p> <p>2012-2013</p> <p>2014</p> <p>2015</p> <p>2016</p>	<p>MD and VA have instituted tagging programs to estimate migration and mortality rates.</p> <p>Gillnet survey is used to collect population data.</p> <p>Studies demonstrating the effectiveness of circle hooks for reduced gut hooking and release mortality have been completed.</p> <p>Research has linked striped bass recruitment with climate cycles. Wood & Austin, 2009, Synchronous multidecadal fish recruitment patterns in Chesapeake Bay, USA.</p> <p>SARC determined stock is not overfished is not undergoing overfishing.</p> <p>A benchmark stock assessment was completed in 2013.</p> <p>An update to the benchmark stock assessment was completed and the stock was not overfished and overfishing was not occurring, but management triggers were met and lead to approval of Addendum IV</p> <p>An update to the stock assessment was completed in October 2015 (using data through 2014) The stock was not overfished and overfishing was not occurring, however, SSB was projected to fall below the threshold level and harvest reductions were triggered.</p> <p>An update to the stock assessment was completed in October 2016 (using data</p>

1989 Chesapeake Bay Striped Bass Management Plan Implementation Table (updated 06/2017)

Strategy	Action	Date	Comments
			through 2015). The stock was not overfished and overfishing was not occurring. Fishing mortality was 0.16, below the target of F=0.18.
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.	Continue Continue	MD has a gill net survey to monitor the spring spawning stock. MD and VA tag fish for the USFWS Cooperative Coastal Striped Bass Tagging Program to monitor migratory and resident striped bass population dynamics. ASMFC does not require DC to tag fish.
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 2009 Continue Continue	Addendum I to Amendment 6 of the ASMFC FMP requires states to implement angler education about catch and release best practices. Tagging data indicates striped bass natural mortality (M) may be increasing unless CB emigration has increased. Increased M may reflect an increased incidence of mycobacteriosis, decreased prey availability, or poor water quality. Tagging study design and implementation requirements are coordinated with ASMFC. Tag return data provide information on migration rates and mortality. The data is then used to improve management measures.
4 – Declining Water Quality: Adequate spawning and nursery areas with good water quality are critical for striped bass survival. Although causes for the decline in reproduction may differ between years and between spawning areas, several water quality aspects are identified as reducing survival of young. State and Federal studies will continue to examine the effects of environmental contaminants on striped bass. 4.1 Identify those water quality factors, both natural and man-induced, which affect striped bass reproduction and survival, and focus on the control of those factors.	4.1 The first four action items are commitments under the 1987 Chesapeake Bay Agreement. The DCFM, MDNR, PRFC and VMRC are not the agencies responsible for carrying out the actual commitments but are involved in setting the objectives of the programs to fulfill the commitments. The achievement of these commitments will lead to improved water quality and enhanced biological production that can only benefit striped bass populations. The DCFM, MDNR, PRFC and VMRC fully support these commitments.	1990 Continue 2010 2014	Water quality issues are also addressed in the Chesapeake 2000 Agreement and most recently in the 2009 Executive Order. US EPA established a Chesapeake Bay TMDL “pollution diet” mandating nutrient and sediment reductions for compliance with the Clean Water Act. Chesapeake Bay jurisdictions adopted a new Chesapeake Bay Watershed Agreement which outlines new goals and outcomes for protecting and restoring the Bay. The document is available at http://www.chesapeakebay.net/chesapeakeba

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Strategy	Action	Date	Comments
Continue 4.1	Continue 4.1		ywatershedagreement/page The forage outcome and work plan are particularly important for striped bass.
	<p>1 - The first commitment adopted under the 1987 Chesapeake Bay Agreement was a report titled, “Habitat Requirements for Chesapeake Bay Living Resources”. This document listed the habitat requirements for selected target species including striped bass. The report is being revised and updated by a workgroup of the Living Resources Subcommittee. When complete in May 1990, the habitat requirements contained in the report will be used to aid managers in improving water quality:</p> <p>a) Assist in the revision of water quality standards and criteria as needed, b) Develop a Habitat Requirements Use Report which will detail resource needs by river segment, c) Assist in the 1991 Nutrient Re-evaluation by providing living resource habitat requirement for use in the 3-D Model (The model will compare existing water quality with the habitat requirements and project whether the requirements would be met under various nutrient removal scenarios), and d) Assist in the implementation of the nutrient, toxics and conventional pollutant control strategies by identifying critical habitat needs.</p>	<p>1991</p> <p>2001</p> <p>2007 Completed</p> <p>1990 Continue</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: http://www.chesapeakebay.net/issues/issue/blue_crabs http://www.chesapeakebay.net/issues/issue/menhaden http://www.chesapeakebay.net/issues/issue/oysters http://www.chesapeakebay.net/issues/issue/shad http://www.chesapeakebay.net/issues/issue/striped_bass</p>
	<p>4.1 2 –Development and adoption of a basinwide plan that will achieve a reduction of nutrients entering the Chesapeake Bay:</p> <p>a) Construct public and private sewage facilities. b) Reduce the discharge of untreated or inadequately treated sewage. c) Establish and enforce nutrient and conventional pollutant limitations in regulated discharges. d) Reduce levels of nutrients and other conventional pollutants in runoff from agricultural and forested lands. e) Reduce levels of nutrients and other</p>	<p>1990</p> <p>Continue</p>	<p>Currently addressed through the Chesapeake Bay Program’s 2-year milestones towards reaching the 2025 water quality goals.</p> <p>Chesapeake Bay Program develops, revises, and monitors goals and strategies for nutrient reduction. For more information: http://www.chesapeakebay.net/issues/issue/nutrients</p>

1989 Chesapeake Bay Striped Bass Management Plan Implementation Table (updated 06/2017)

Strategy	Action	Date	Comments
Continue 4.1	conventional pollutants in urban runoff. 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 Continue	Chesapeake Bay Program develops, revises, and monitors goals and strategies for chemical contaminants. For more information: http://www.chesapeakebay.net/issues/issue/chemical_contaminants
	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 Continue	Chesapeake Bay Program develops, revises, and monitors goals and strategies for sediment, wastewater, stormwater runoff, and agriculture. For more information: http://www.chesapeakebay.net/issues/issue/sediment http://www.chesapeakebay.net/issues/issue/wastewater http://www.chesapeakebay.net/issues/issue/sediment http://www.chesapeakebay.net/issues/issue/stormwater_runoff
	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): a) Determine the relative contributions to acid	1990 Continue	Chesapeake Bay Program develops, revises, and monitors goals and strategies for air pollution. For more information: http://www.chesapeakebay.net/issues/issue/air_pollution

1989 Chesapeake Bay Striped Bass Management Plan Implementation Table (updated 06/2017)			
Strategy	Action	Date	Comments
Continue 4.1	deposition from various sources of acid deposition precursor emissions and identify any regional variability. b) Assess the consequences of the environmental impacts of acid deposition on water quality. c) Identify and evaluate the effectiveness and economic costs of technologies and mitigative techniques that are feasible to control acid deposition into the Chesapeake Bay.		

Acronyms

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

VMRC – Virginia Marine Resources Commission
 VPA – Virtual Population Assessment
 YOY – Young of Year

2016 Maryland FMP Report (March 2017)

Section 18. Summer Flounder (*Paralichthys dentatus*)

Regional abundance of summer flounder seems to have shifted to an increase in larger fish further north.¹ As a result, a regional rather than state-by-state, conservation equivalency approach was implemented for summer flounder in 2016. Maryland's region includes Virginia and Delaware. All states within a region have the same size limit, possession limit, and season.²

The most recent stock assessment update (June 2016) indicated that the summer flounder stock is not overfished but overfishing is occurring. Coastal stock abundance peaked in 2010 and has declined since then but remains above the threshold. Poor recruitment has resulted in six years of below average year classes and has contributed to the declining stock abundance. Consequently, management measures for 2017 include a 30% reduction in the harvest limit for the coastal states. This will result in a decreased commercial quota as well as increased recreational size limits,

Fishery Management Plans (FMPs)

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

The Plan Review Team concluded that the CBSF FMP and amendment were appropriate for managing the resource and recommended another review after the development of the MAFMC/ASMFC amendment.

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

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

In 2014, the MAFMC began a comprehensive strategic planning process to reevaluate the management of summer flounder that will ultimately result in the development of a new amendment. During 2015, the MAFMC conducted meetings and a special workshop to develop new goals and objectives. Beginning in 2016 and continuing in 2017, the working group will be developing a range of management alternatives and drafting an Environmental Impact Statement for consideration.

Stock Status

Summer flounder inhabit coastal waters from the North Carolina/South Carolina border north to the US/Canadian border and are managed as a single stock. A benchmark stock assessment was completed in 2013³ with an update to the assessment in 2015⁴ and 2016.⁵ Based on the 2016 update (data through 2015), the summer flounder stock is not overfished but overfishing is occurring. The 2016 update provides continued evidence that fishing mortality (F) has been underestimated and spawning stock biomass (SSB) has been overestimated since 2011. Tracking of recent assessment estimates and projections of catch, F, and SSB indicate that although catches have not substantially exceeded the Acceptable Biological Catch (ABC), projected F has been exceeded and projected SSB has not been achieved.

Since 2007, the fishing mortality rate has increased to 0.390 in 2015, 26% above the 2013 SAW 57 F_{MSY} proxy = $F_{35\%}$ = 0.309. SSB was estimated to be 36,240 MT in 2015, 58% of the 2013 SAW 57 SSB_{MSY} proxy = $SSB_{35\%}$ = 62,394 MT. Average recruitment from 1982 to 2015 has been 41 million fish. However, since 2010, the average recruitment has been 26 million fish.

Management Measures

The National Marine Fisheries Service (NMFS), in conjunction with the 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.⁶ 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.

For the Maryland/Delaware/Virginia (MDV) region, the minimum recreational size was 16" with a 4 fish per person per day limit, and the fishery was open year round. The proposed requirements for the 2017 MDV region is a minimum size of 17" with a 4 fish per person per day limit, year round.

Maryland monitors summer flounder abundance, size, and age with an annual Coastal Bays trawl survey, beach seine survey, and commercial trawl survey from near-shore Atlantic waters. The results from these three surveys are used by ASMFC, MAFMC, and Maryland to develop regulations for the following year's summer flounder fisheries.

The Fisheries

The commercial quota for Maryland in 2016 was 165,657 lbs. The Maryland commercial harvest in 2016 was 144,018 lbs. (Figure 1. MD DNR data). The 2016 recreational catch of summer flounder was estimated at 23,042 fish with an estimated total weight of 82,016 lbs.

(Figure 2. National Marine Fisheries Service, Fisheries Statistics and Economics Division, Personal Communication, accessed March 09, 2017).⁷

Figure 1. Maryland commercial summer flounder harvest in pounds, 1958-2016.

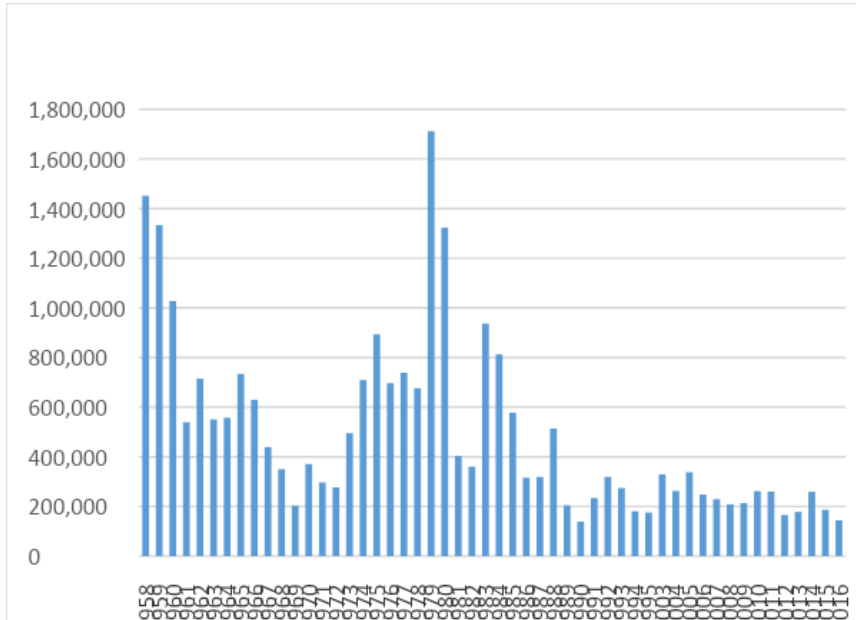
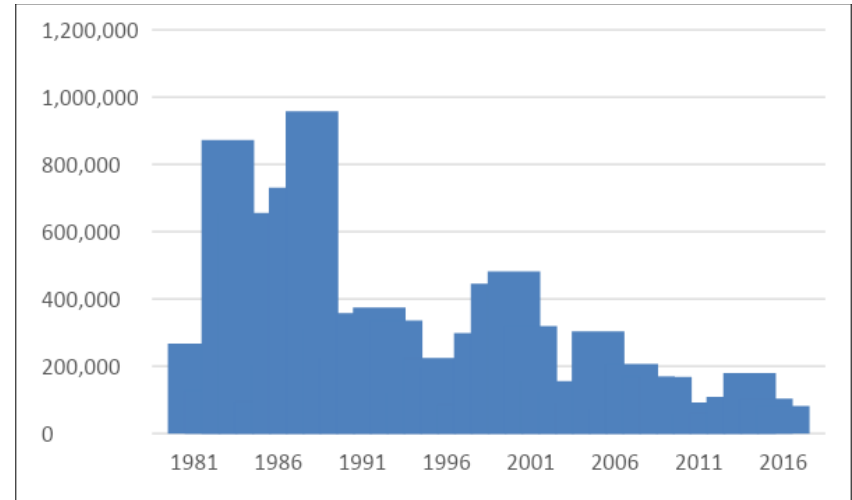


Figure 2. Estimated recreational summer flounder harvest in pounds, 1981-2016 (MRIP).



Issues/Concerns

Commercial harvesters from the lower mid-Atlantic are beginning to travel further 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 could possibly be a reallocation of state commercial quotas.

A poleward expansion of summer flounder distribution has been evident since 2009.⁸ The poleward expansion of summer flounder may be a response to warming water temperature 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.⁹ As a result of changes in distribution and concerns about management, the ASMFC and MAFMC will take the change under consideration during their comprehensive review of the summer flounder management framework.

References

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- ² 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.
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- ⁴ Terceiro M. 2015. Stock assessment update of summer flounder for 2015. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 15-13; 18 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at <http://www.nefsc.noaa.gov/publications/>
- ⁵ Terceiro M. 2016. Stock Assessment of Summer Flounder for 2016. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 16-15; 117 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at <http://www.nefsc.noaa.gov/publications/>
- ⁶ Doctor, S. 2017. Maryland's 2016 summer flounder (*Paralichthys dentatus*) compliance report to the Atlantic States Marine Fisheries Commission. Maryland Department of Natural Resources. Annapolis, Maryland.
- ⁷ Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division. <http://www.st.nmfs.noaa.gov/index>. Accessed March 09, 2017.
- ⁸ 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
- ⁹ 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

1.1)Continued	1.1a) Continued	2014-2015	Allocation 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. 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".
		2016	MD's commercial hook & line minimum size limit 16". Minimum size limit for all other commercial gear was 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.
		2015 Continue	Regional management in effect. MD/DE/VA all have the same minimum size limit, creel limit for the recreational fishery.
	1.1c) Maryland and Virginia will maintain the traditional commercial fishery by	1998 2003	MD has implemented a summer flounder catch share system. The catch share allocation equitably

1.1)Continue	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.	Continue 2005 Continue	distributes the quota among harvesters based on past harvest. IFQ allows fishermen to manage harvest for best economic yield. VA issues permits for vessels and dealers.
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1991 Chesapeake Bay Summer Flounder Fishery Management Plan Implementation Table (03/2017)			
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.
	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	1998	See Amendment #1, Strategy 1.1, Action 1.1a

1.1)Continue	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.		
	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, 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.	1993 1995 1998 2012 2013 2014 Continue	ASMFC State allocations changed. ASMFC capped coastwide quota & adjusted stock rebuilding schedule. ASMFC revised overfishing definition. See Amendment #1, Strategy 1.1, Action 1.1a 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. 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. The MAFMC began a major review of the summer flounder component of their management framework.
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	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.	Completed Continue	Mesh size restrictions have been implemented.
Management agencies will urge	1.2b) Virginia and Maryland will work	Continue	Mesh size restrictions have been implemented.

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.	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.	2014 Continue	MAFMC has begun a major review of their management framework for summer flounder.
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.	Continue	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.	Continue	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.	Continue	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	2.1) The jurisdictions will continue to support stock identification research, particularly stock composition tagging studies being conducted at Virginia's	1995 Continue	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

research to determine the extent of stock mixing in the Chesapeake Bay flounder population.	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.	2014 Continue	the fish they catch. More information is available at: http://www.vims.edu/research/units/centerspartners/map/recfish/index.php MD does not have a summer flounder tagging program. Regional stock management was implemented for 2014 and continues into 2016.
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.	Continue	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)Continue	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.	Continue 2006	Data collection is required by ASMFC and MAFMC. FISHMAP program was discontinued.
2.4) Maryland and Virginia will	2.4) Maryland and Virginia will continue	1977	MD DNR conducts a summer blue crab trawl survey.

<p>continue their joint and individual efforts in providing the information needed to determine the relationship between abundances of adult and juvenile flounder.</p> <p>2.4)Continue</p>	<p>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 cooperative sampling of trawl fisheries.</p> <p>2.4)Continue</p>	<p>Continue</p> <p>1989 Continue</p> <p>2001 2006</p> <p>2002 Continue</p> <p>2006 Continue</p> <p>Continue</p>	<p>VIMS and MD DNR collaboratively conduct a winter dredge survey of blue crabs.</p> <p>University of Maryland Center for Environmental Science Chesapeake Biological Laboratory, University of Maryland - College Park, and the Maryland Department of Natural Resources co-operatively conduct the Chesapeake Bay Fishery-Independent Multispecies Survey (ChesFIMS). More information is available at: http://hjort.cbl.umces.edu/chesfims.html</p> <p>VIMS conducts the Chesapeake Bay Multispecies Monitoring and Assessment Program (ChesMMAP, a subset of ChesFIMS sites) with funding from the VMRC. The trawl survey samples juvenile and adult fishes from the upper Chesapeake Bay to the mouth of the Bay.</p> <p>Northeast Area Monitoring and Assessment Program (NEAMAP) is a near shore trawl survey that samples from Cape Hatteras north to Cape Cod that also implemented. More information is available at: http://www.vims.edu/research/departments/fisheries/programs/multispecies_fisheries_research/interaction/fish_food_habits/index.php</p> <p>Summer flounder juvenile surveys are required by ASMFC.</p>
<p>3.1) The District of Columbia, Environmental Protection Agency, Maryland,</p>	<p>3.1) The District of Columbia, Environmental Protection Agency, Maryland, Pennsylvania, the Potomac</p>	<p>1990 Continue</p>	<p>Chesapeake Bay Program (CBP) develops, revises, and monitors goals and strategies for agriculture, air pollution, bay grasses, blue crabs, chemical</p>

<p>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>	<p>River Fisheries Commission, and Virginia will continue to set specific objectives for water quality goals and review management programs established under the 1987 Chesapeake Bay Agreement. The Agreement and documents developed pursuant to the Agreement call for: 1) Developing habitat requirements and water quality goals for various finfish species.</p>	<p>2014</p>	<p>contaminants, climate change, development, education, forests, groundwater, invasive species, menhaden, nutrients, oysters, population growth, rivers and streams, sediment, shad, stormwater runoff, striped bass, wastewater, weather, and wetlands. For more information: http://www.chesapeakebay.net/issues</p> <p>The CBP has developed a Chesapeake Watershed Agreement (2014) with fisheries and habitat outcomes. Summer flounder is not a focal species. However, diet analysis indicates summer flounder in the Chesapeake Bay are eating mysids, Bay anchovies, sand shrimp and mantis shrimp.</p>
<p>3.1)Continue</p>	<p>3.1 2) Developing and adopting basinwide nutrient reduction strategies.</p>	<p>1990 Continue</p>	<p>Chesapeake Bay Program develops, revises, and monitors goals and strategies for nutrient reduction. For more information: http://www.chesapeakebay.net/issues/issue/nutrients</p>
	<p>3.1 3) Developing and adopting basinwide plans for the reduction and control of toxic substances.</p>	<p>1990 Continue</p>	<p>Chesapeake Bay Program develops, revises, and monitors goals and strategies for chemical contaminants. For more information: http://www.chesapeakebay.net/issues/issue/chemical_contaminants</p>
	<p>3.1 4) Developing and adopting basinwide management measures for conventional pollutants entering the Bay from point and nonpoint sources.</p> <p>3.1 4)Continue</p>	<p>1990 Continue</p>	<p>Chesapeake Bay Program develops, revises, and monitors goals and strategies for sediment, wastewater, stormwater runoff, and agriculture. For more information: http://www.chesapeakebay.net/issues/issue/sediment http://www.chesapeakebay.net/issues/issue/wastewater http://www.chesapeakebay.net/issues/issue/stormwater_runoff</p>
	<p>3.1 5) Quantifying the impacts and identifying the sources of atmospheric</p>	<p>1990 Continue</p>	<p>Chesapeake Bay Program develops, revises, and monitors goals and strategies for air pollution. For</p>

	inputs on the Bay system.		more information: http://www.chesapeakebay.net/issues/issue/air_pollution
	3.1 6) Developing management strategies to protect and restore wetlands and submerged aquatic vegetation.	1990 Continue	Chesapeake Bay Program develops, revises, and monitors goals and strategies for wetland and submerged aquatic vegetation restoration. For more information: http://www.chesapeakebay.net/issues/issue/wetlands http://www.chesapeakebay.net/issues/issue/bay_grasses
	3.1 7) Managing population growth to minimize adverse impacts to the Bay.	1990 Continue	Chesapeake Bay Program develops, revises, and monitors goals and strategies for land development. For more information: http://www.chesapeakebay.net/issues/issue/development

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

2016 Maryland FMP Report (June 2017)

Section 19. Tautog (*Tautoga onitis*)

Tautog are a long-lived, slow-growing species. They prefer nearshore coastal waters, especially rocky reef areas, and are found in low numbers in the Chesapeake Bay. They are predominately a recreational game fish in Maryland but there is a small commercial fishery managed under the same regulatory framework as the recreational fishery, i.e., the same season, size limit and creel limit. Tautog size at age varies. Males tend to grow faster than the females and both sexes can live a long time. The oldest tautog recorded by Maryland Fishing and Boating Service (FABS) was 28-years old.

Tautog have been managed by the Atlantic States Marine Fisheries Commission (ASMFC) on a coastwide basis from Massachusetts to Virginia since 1996. However, tagging data suggest strong site fidelity across years with limited north-south movement and some seasonal inshore-offshore migrations. In the northern part of their range, adult tautog move from offshore wintering grounds in the spring to nearshore spawning and feeding areas where they remain until late fall. As water temperatures decrease, the reverse migration occurs. Populations in the southern region may undergo shorter distance seasonal migrations, while in the southern-most part of the range they may not undergo seasonal migrations at all.¹ The ASMFC is developing a regional approach to managing tautog. Maryland will be part of the Delaware-Maryland-Virginia (Delmarva) region.

Fishery Management Plans (FMPs)

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

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_{target} . Addendum III (2002) revised the F_{target} reference point to 0.21 and a biological reference point of 40% spawning stock biomass (SSB, 0.29). Overfishing was defined as $F_{\text{threshold}} = 0.29$. Addendum IV (January 2007) established biological reference points to determine if tautog are overfished: $SSB_{\text{target}} = 59$ million lbs. and $SSB_{\text{threshold}} = 44$ million lbs. Tautog biomass was below average for 8 years and a rebuilding F_{target} of 0.20 was

implemented. The addendum specified 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_{target} to 0.15: a 53% coastwide reduction in harvest. Following the Technical Committee recommendations, the 53% coastwide harvest reduction was revised to 39% in early 2012.² Maryland implemented regulations in 2013 to achieve the required reduction. Maryland is required to submit an annual compliance report to ASMFC.

Stock Status

Over the years, the ASMFC has conducted benchmark (full) stock assessments for tautog (1999, 2005, 2014) and updates in 2002, 2011 (revised in 2012) and 2016. The 2014 stock assessment (2015) utilized data through 2013. This assessment conducted analyses for the coastwide stock unit, and also assessed multiple regions as discrete stock populations. Based on the 2014 (2015) stock assessment, all regions were overfished with overfishing occurring in the northern region (Massachusetts-Rhode Island).³ In 2016, two new regional stocks were assessed and peer-reviewed. While the three-region approach of the 2014-2015 benchmark stock assessment was still applicable, there was interest in assessing and managing Long Island Sound as a discrete area. This regional assessment analyzed two additional regions (Long Island Sound and New Jersey/New York Bight) to comprise a four-region management scenario. The two regions were found to be overfished and experiencing overfishing. Following this analysis, all regions in the four-region management scenario (Massachusetts/Rhode Island, Long Island Sound, New Jersey/New York Bight, and Delaware/Maryland/Virginia) were updated with landings and index data through 2015. All regions were overfished in 2015. Fishing mortality was at the target level for the Delmarva region.⁴ Short term projections to determine the level of harvest required to have a 50% and 70% probability of achieving the fishing mortality target for each region, as well as the probability of being at or above the SSB threshold, by 2020 were also conducted.

With the four-region approach fully vetted through the Commission's stock assessment process, the Tautog Board initiated the development of Draft Amendment 1 to consider the use of regional management areas and evaluate the illegal harvest of undersized and unreported tautog, which has become an increasingly pervasive issue. Draft Amendment 1 development is underway with an expected 2018 implementation date. The Delaware/Maryland/Virginia (Delmarva) status is that overfishing is not occurring, but our stock size is estimated to be about 8% below the proposed SSB threshold of 1,600 MT and 30% below the proposed SSB target of 2,000 MT.

Current Management Measures

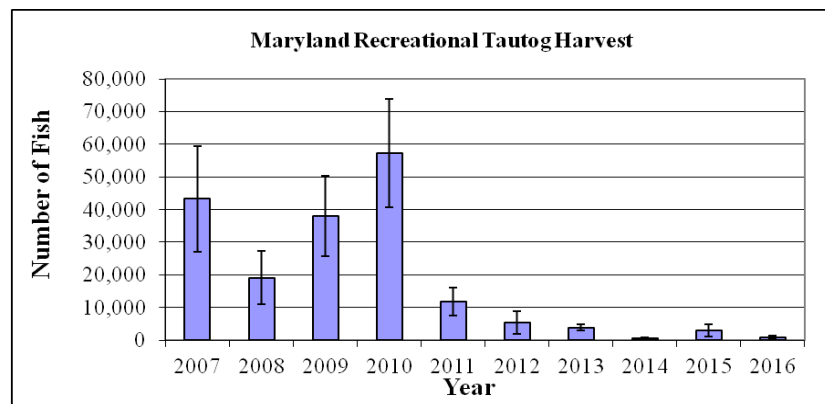
Maryland's tautog regulations have not changed since 2013. Both commercial and recreational fisheries have a minimum size limit of 16". Fisheries in tidal and coastal waters are limited to 4 fish per person per day during January 1 – May 15 and during November 1 – 26. Harvest is reduced to 2 fish per 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 recreational and commercial tautog harvests are minor components of the total coastwide landings. Preliminary estimates from the Marine Recreational Information Program (MRIP) determined a total recreational harvest of 882 (PSE 70.6) tautog in Maryland during the 2016 fishing season (Figure 1). The recreational harvest was comprised of 70% private/rental boat fishing 3 miles or less from shore (PSE 90) and 30% private/rental boat inland (PSE 102.8).⁵ Tautog are not well-sampled by the MRIP program, resulting in higher percent standard errors (PSEs) and large year-to-year swings in catch estimates, often driven by small numbers of intercepts.¹

Maryland commercial landings have remained at low levels⁶ since 2007 due to the limited possession allowance. The state is considered *de minimis* by the ASMFC and the landings data are confidential.⁶

Figure 1. Maryland recreational tautog harvest (A + B1; number of fish): 2007-2016 as estimated by Marine Recreational Information Program.



Issues/Concerns

Adult tautog are dependent on hard bottom structure such as reefs, ship wrecks, stones or artificial structures. Juveniles require submerged aquatic vegetation (SAV) beds and protected coastal embayments for development. In 2016, there were an estimated 97,433 acres of SAV in the Bay. While SAV has increased in the Chesapeake Bay and surpassed its interim acreage goal, Maryland Coastal Bays have experienced a decrease in SAV beds. In 2015, the total area of SAVs was 8,743 acres. The 2015 is an improvement from 2013 when the abundance of SAVs was the lowest in two decades. Submerged aquatic vegetation is an important and essential habitat for a sustainable population.

Tautog is considered a delicious meal, and illegal live markets are a concern to management and law enforcement. A coastal commercial tagging program is currently in development by ASMFC specifically aimed at reducing the illegal live market north of Delmarva.

References

- ¹Atlantic States Marine Fisheries Commission. 2017. 2016 Annual Report of the Atlantic States Marine Fisheries Commission to the Congress of the United States and to the Governors and Legislators of the Fifteen Compacting States. 1050 N. Highland Street, Suite 200, Arlington, Virginia 22201
- ²Maryland Department of Natural Resources. 2017. Maryland's 2016 Tautog (*Tautoga onitis*) compliance report to the Atlantic States Marine Fisheries Commission. Maryland Department of Natural Resources, Fisheries Service. Annapolis, Maryland.
- ³Atlantic States Marine Fisheries Commission. 2015. Tautog Benchmark Stock Assessment and Peer Review Reports. Arlington, Virginia 22201
- ⁴Atlantic States Marine Fisheries Commission. 2017. The 2016 Tautog Stock Assessment Update. Arlington, Virginia 22201
- ⁵Marine Recreational Information Program (MRIP), National Marine Fisheries Service, 2017, Fisheries Statistics Division.
- ⁶The Atlantic Coastal Cooperative Statistics Program (ACCSP), 2017.

1998 Chesapeake and Atlantic Coast Tautog Fishery Management Plan Implementation Table (06/2017)

Strategy	Action	Date	Comments
<p>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.</p>	<p>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.</p>	<p>1998 2003 2005 Continue</p>	<p>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.</p>
	<p>1.2) VA, MD and PRFC will reduce fishing mortality to interim and target rates, as defined by ASMFC, through a combination of possession limits, gear, seasons, and/or other restrictions. Target rates may be changed and management measures adjusted as more data becomes available to manage the stock. Due to differences in F between MD and VA, different management strategies may be necessary to reach the target F set by ASFMFC. The jurisdictions will continue to work towards a unified, Baywide management strategy.</p>	<p>1999 2005 2011 2011 2012 2014 2015 2016</p>	<p>A benchmark coastal stock assessments and stock assessment updates have been completed over the years. The stock assessment completed in 2005 (using data from 1981-2004) indicated that F declined from 0.71 to 0.299.</p> <p>Overfishing was redefined as $F_{40\%SSB}=0.29$. The 3-year average ($F=0.389$) exceeds 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 were overfished.</p> <p>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%.</p> <p>Based on the 2014 (2015) tautog benchmark stock assessment, the stock is overfished and overfishing is occurring.¹ Besides assessing tautog as one unit stock along the coast, a regional stock assessment approach was evaluated.</p> <p>A stock assessment update was completed in 2016. All regions are considered overfished but overfishing is not occurring in the Delmarva region.</p> <p>ASMFC has initiated the development of an amendment for a regional approach to management with region-specific reference points and scheduled</p>

1998 Chesapeake and Atlantic Coast Tautog Fishery Management Plan Implementation Table (06/2017)

Strategy	Action	Date	Comments
1) Continue	1.2) Continue	Continue	for completion in 2017 with implementation in 2018.
	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"> • Untreated hemp, jute, or cotton string of 3/16" (0.48 mm) or smaller • Magnesium alloy, timed float releases (pop-up devices) or similar magnesium alloy fasteners • Ungalvanized or uncoated iron wire of 0.09" (2.39 mm) or smaller. 	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.
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.	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 was conducted to determine if there is genetic separation in the coastal stock. Maryland is participating in this study, results pending publication.
	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 tautog 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 2011 Continue 2011 Continue	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

1998 Chesapeake and Atlantic Coast Tautog Fishery Management Plan Implementation Table (06/2017)

Strategy	Action	Date	Comments
2.1) Continue	2.1 C) Continue	2016	robust data base to estimate recreational harvest. The Marine Recreational Information Program (MRIP) determined a total observed and reported recreational harvest (A + B1) of tautog in Maryland during the 2016 fishing season was 882 fish.
	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 in localized tautog populations. As reliance of this species on structure for both food and shelter may limit populations in the Chesapeake Bay area, studies designed to determine the relationship between population size and available shelter and food sources should likewise be encourages.	2.2) Research on migration of tautog between areas is encouraged. Tagging experiments to provide data on tautog migration may be funded from sales of saltwater fishing licenses. The Virginia Game Fish Tagging Program will be continued.	Continue 2007 Continue Continue	A study on the seasonal occurrence of tautog in the lower CB indicates that most fish tagged and released in inshore waters remain inshore for the winter rather than move offshore (Arendt, Lucy and Munroe, 2001). VA initiated Marine Sportfish Collection Project to collect sex, length, and age data. Freezers were set up for recreational anglers to donate whole fish or carcasses. VA initiated Saltwater Fisherman's Journal where anglers log their fishing experiences and anecdotal information.
3.1.1) Restoration of aquatic reefs could lead to increased habitat for tautog. Jurisdictions will continue to expand and improve their current oyster restoration programs with periodic program evaluations to ensure maximum success.	3.1.1A) MD and VA will continue the implementation of the 1994 Oyster FMP which combines the recommendations of both the Virginia Holton Plan and the Maryland Roundtable Action Plan. Strategies in both VA & MD have taken a new focus as the programs intensify efforts to manage around the devastating oyster diseases, Dermo and MSX, currently infecting Chesapeake Bay oysters.	Continue 2004 2008 2009 - 2010	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. MD DNR has expanded the oyster sanctuary network from 9% to 25% (app. 9,000 acres) of the available oyster

1998 Chesapeake and Atlantic Coast Tautog Fishery Management Plan Implementation Table (06/2017)

Strategy	Action	Date	Comments
3.1.1) Continue	3.1.1A) Continue	2012 Continue	<p>habitat. Both recreational and commercial fish species will benefit from improved/protected oyster bar habitat.</p> <p>Oyster aquaculture is increasing the acres of active aquaculture have been permitted since 2011.</p>
	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 Continue 2016	<p>Maryland's Artificial Reef Management Plan was created and several reefs have been built in the Bay.</p> <p>Reefs are qualitatively monitored with underwater video. There is no set sampling schedule or protocol.</p> <p>ARC and MARI have begun support for shallow water (<20 ft.) reef projects.</p> <p>The 10-yr permit with the USACE was renewed and materials were deployed at 5 reefs sites.</p>
3.1.2) The creation of new artificial reefs and the expansion and improvement of preexisting reefs will provide additional habitat for the tautog population.	3.1.2A) Jurisdictions will continue to maintain, expand, and improve their artificial reef programs. Since 1995, VA has developed 3 new reef sites within the Bay and expanded several existing sites, deploying more than 6,000 designed structures (concrete tetrahedrons) and over 5,000 tons of concrete rubble. MD has designated 3 sites as oyster sanctuaries where harvest is not allowed: Plum Point, lower Severn River and Cambridge. MD will also be examining the efficacy of small hill sanctuaries at 3 sites: Tangier, Choptank and Strong Bay (Chester R.).	1996-2006 2007 Continue Continue 2008 2011 Continue	<p>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).</p> <p>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.</p> <p>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.</p> <p>44 NY subway cars were deployed off Ocean City.</p> <p>USN Destroyer <i>Radford</i> was reefed on August 10, 2011. The vessel has since broken into 3 pieces but remains upright.</p> <p>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</p>

1998 Chesapeake and Atlantic Coast Tautog Fishery Management Plan Implementation Table (06/2017)

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

1998 Chesapeake and Atlantic Coast Tautog Fishery Management Plan Implementation Table (06/2017)

Strategy	Action	Date	Comments
3.2.1) Continue		2015 2016	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. Total area of SAVs in the Coastal Bays (2015) was 8,743 acres. Total area of SAVs in the Chesapeake Bay (2016) was 97,433 acres.
	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. http://www.chesapeakebay.net/restoringwaterquality.aspx?menuitem=14728 .
	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 (http://www.chesapeakebay.net/indicators/indicator/planting_bay_grasses). 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 SAVs by 2025 VIMS annually surveys SAV distribution in Chesapeake Bay. 2013 SAV acreage was 59,711; 2014 estimated acreage was 75,835; 2015 was 92,315 acres; and 2016 estimate was 99,619 acres.
3.2.2) The jurisdictions will use The Submerged Aquatic Vegetation Habitat Requirements and Restoration Targets: A Technical Synthesis as a guide to set quantitative levels of relevant water quality parameters necessary to support continued survival, propagation and restoration of SAV, as well as established the regional SAV restoration target goals defined earlier in this section.	3.2.2) When choices must be made in selecting SAV restoration projects, to fund and support under the Chesapeake Bay SAV Policy Implementation Plan, specific attention should be given to action items that lead to the protection and restoration of SAV found within the juvenile tautog habitat range.	Continue	More emphasis is being placed on multispecies benefits when considering restoration projects. Long-term survival of SAV plantings has been limited. STAC reviewed the SAV restoration projects and concluded they were operationally successful but functionally unsuccessful. SAV aerial surveys continue.
3.3) In 1998, the Chesapeake Executive Council adopted the Chesapeake Bay Wetlands Policy in recognition of the ecological and economic importance that wetlands play in the Chesapeake Bay. The Wetlands Policy	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	1991 Continue	Wonders of Wetlands (WOW) curriculum was developed. GIS mapping activities are underway to target protection and restoration of habitat resources. Habitats are not

1998 Chesapeake and Atlantic Coast Tautog Fishery Management Plan Implementation Table (06/2017)

Strategy	Action	Date	Comments
<p>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.”</p>	<p>b) protect existing wetlands c) rehabilitate, restore and create wetlands d) improve education e) further research.</p>	<p>2006 Continue</p> <p>2009 Continue</p> <p>2011 Continue</p> <p>2014 Continue</p>	<p>targeted to benefit a specific species.</p> <p>MD is developed a Blue Infrastructure that includes mapping structural habitat and SAV.</p> <p>Wetland mosquito ditches from the 1930s-1940s are being modified to reduce tidal flow and restore wetland hydrology and function.</p> <p>Between 2010 and 2011, 3,775 acres of wetlands were established or re-established and 107,239 acres were enhanced or rehabilitated.</p> <p>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.</p>
<p>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.</p>	<p>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.</p>	<p>Continue</p> <p>2009</p> <p>2009</p> <p>2010</p> <p>2012</p> <p>2013</p> <p>2014 Continue</p>	<p>Maps that indicate regions of concern for living resources have been developed.</p> <p>See Chesapeake Bay Program website for updates on nutrient reduction. http://www.chesapeakebay.net/status_reducingpollution.aspx?menuitem=19859.</p> <p>President Barack Obama’s executive order recommitted federal agencies to Bay restoration and regulatory enforcement.</p> <p>EPA established a Bay wide TMDL (aka: pollution diet). Each jurisdiction must establish 2-year milestones for progress towards meeting its TMDL.</p> <p>Legislation has been passed for restrictions on new developments using septic systems.</p> <p>Legislation for a stormwater fee based on impervious surface coverage was enacted.</p> <p>2014 Chesapeake Watershed Agreement outcome is to achieve a 60% reduction of nutrient and sediment</p>

1998 Chesapeake and Atlantic Coast Tautog Fishery Management Plan Implementation Table (06/2017)			
Strategy	Action	Date	Comments
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.	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
 EPA – Environmental Protection Agency
 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
 MRFSS – Marine Recreational Fisheries Statistics Survey
 MRIP – Marine Recreational Information Program
 NMFS – National Marine Fisheries Service
 NY – New York
 OCRF - Ocean City Reef Foundation
 PAH – Polycyclic Aromatic Hydrocarbon
 PCB – Polychlorinated Biphenyl
 PRFC –Potomac River Fishery Commission
 PSE – Percent Standard Error
 SAV – Submerged Aquatic Vegetation
 TMDL – Total Maximum Daily Load
 USACE – United States Army Corps of Engineer
 USFWS – United States Fish and Wildlife Service
 USN – United States Navy
 VIMS – Virginia Institute of Marine Science

2016 Maryland FMP Report (June 2017)

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

Commercial and recreational landings of weakfish remain low for Chesapeake states, and throughout the Atlantic coast. The coastwide stock is depleted and, therefore, conservative harvest restrictions are in place. No change in management is expected until total mortality decreases and results in increased spawning stock biomass. For the first time in 13 years, stock assessment results indicated total mortality was below the threshold in 2014, but still above the target. However, spawning stock biomass (SSB) remains very low. Maryland juvenile indices in 2015 and 2016 have remained below average, and weakfish sampled in Maryland still exhibit a truncated age structure.

Fishery Management Plans (FMPs)

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

The CBP plan was reviewed by the Maryland Department of Natural Resources (MDDNR) Fisheries Service (Fishing and Boating Service or FABS since 2016) plan review team (PRT) in 2012/2013. A report was presented to the Tidal Fisheries Advisory Committee and Sport Fisheries Advisory Committee as part of the plan review process. The PRT recommended no changes to spotted seatrout or weakfish allocation but noted a need for additional socioeconomic data.

Stock Status

A coastwide benchmark stock assessment was prepared in 2015, peer reviewed and accepted for management by ASMFC in 2016. The Atlantic weakfish stock is considered depleted, and has been since 2002. The term "depleted" is used when factors other than fishing mortality have contributed to a decline in biomass. A Bayesian statistical catch at age model was used to examine time varying natural mortality in addition to fishing mortality and recruitment. New biological reference

points (BRPs) based on total mortality were adopted with the threshold set at 30% and the target set at 20%. In the early 2000s, natural mortality increased significantly then stabilized at a high level which led to an increase in total mortality. Fishing mortality (F) from 2011 to 2014 was low, but total mortality remained high enough to preclude stock recovery. The 2014 total mortality was below the threshold but above the target, indicating a sustainable level of mortality in the terminal year of the model. This was the first time in 13 years that total mortality was below the threshold and there was a slight increase in SSB and total abundance. However, SSB still remains very low. More years of data will be necessary to determine if the improvement seen in 2014 is accurate and persists into the future. Maryland's fishery dependent and independent monitoring has shown both a decrease in mean adult age and low juvenile abundance. Despite current restrictive management measures, the depleted weakfish stock is unlikely to recover quickly without a decrease in natural mortality.¹ Prevailing theories for the increase in natural mortality are predation, competition and changes in climate, but no definitive cause has been determined.

Current Management Measures

Management measures implemented by ASMFC's Addendum IV required states to implement a 1 fish recreational creel limit and a 100 pound commercial trip bycatch limit, which translates to a 60% reduction in commercial and recreational exploitation. The Chesapeake Bay jurisdictions implemented new restrictions in 2010 to meet or exceed the ASMFC requirements on harvest and bycatch. In Maryland, the recreational creel limit was decreased to one fish and commercial bycatch limits were implemented. These restrictions continued through 2016.

Maryland DNR FABS conducts fishery dependent and fishery independent monitoring for important recreational and commercial fish species. Adult weakfish are sampled from pound nets. Maryland is required to provide biological data to ASMFC from the commercial catch based on per metric ton of commercial landings. Based on preliminary landings, Maryland was required to provide 2 lengths and 2 age samples for 2015 (and met the requirement). Juvenile fish are sampled from Maryland's Chesapeake Bay and Coastal Bays. Juvenile weakfish mean catch per unit of effort was higher in the 1990s and reached lows in 2008 and 2012. There was an increase in juvenile weakfish production in both the Bay and Coastal Bays in 2013 and 2014 but index values remained below the long-term mean. In 2015, the Coastal Bays trawl relative abundance index was well below the long term mean, but the Chesapeake Bay index remained just below the long term mean. In 2016, this trend reversed, with the Chesapeake Bay index declining and the Coastal index increasing to near 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 2016 were 1,013 fish in Maryland and 11,448 fish in Virginia.³ Many of the recent yearly values for both states have had high proportional standard errors, indicating these estimates are imprecise. The declining commercial landings trend began in 1999. Maryland and Virginia's 2016 commercial landings were 1,397 and 17,882 lbs., respectively.⁴ Landings values for the past eight years are the lowest on record for both states for the entire NMFS time series (1950-2015).⁴

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.¹

The ASMFC weakfish plan review team has reported its recommendations for management, biological research, social and economic research, and habitat studies.² 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 monitoring weakfish diet over a broad regional scale.

Figure 1. Maryland and Virginia estimated recreational weakfish harvest in numbers, 1982-2016.³

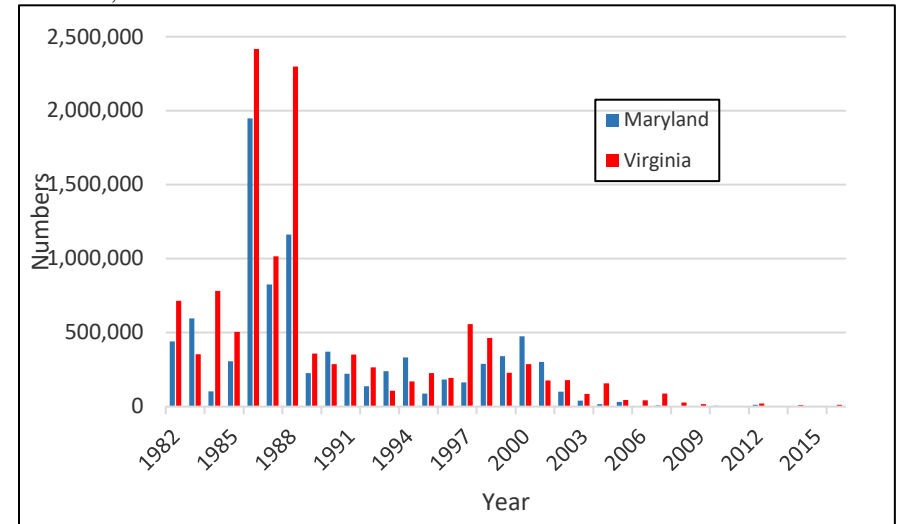
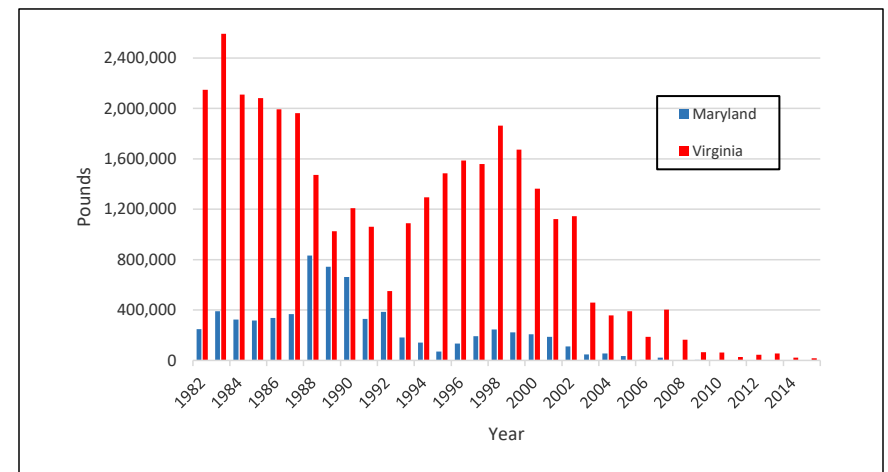


Figure 2. Maryland and Virginia commercial weakfish landings, 1981-2015.⁴



References

¹ ASMFC 2016. Weakfish Benchmark Stock Assessment and Peer Review Report. Arlington, VA 270p.

http://www.asafc.org/uploads/file/5751b3db2016WeakfishStockAssessment_PeerReviewReport_May2016.pdf

² ASMFC. 2015. 2014 Review of the Atlantic States Marine Fisheries Commission Fishery Management Plan for Weakfish (*Cynoscion regalis*) 2014 Fishing Year. Arlington, VA 21p.

<http://www.asafc.org/uploads/file/564116d22015weakfishfmpreview.pdf>

³ Personal communication from the National Marine Fisheries Service, Marine Recreational Information Program, Fisheries Statistics Division June 8, 2017.

⁴ Personal communication from the National Marine Fisheries Service, Commercial Fisheries Statistics, Fisheries Statistics Division June 8, 2017.

2003 Chesapeake Bay Program Weakfish Fishery Management Plan Implementation (updated 07/17)			
Strategy/ Problem	Action	Date	Comments
<p>Stock Status Management Strategy: CBP jurisdictions will adopt biological reference points (BRPs) that reflect the most current status of the weakfish stock. As data becomes available on multi-species interactions and ecological considerations such as species interactions, food webs, bycatch, biodiversity and habitat, the BRPs should be modified accordingly.</p>	<p>1.1_MD, PRFC (Potomac River Fisheries Commission) and VA will adopt the Atlantic States Marine Fisheries Commission's (ASMFC) recommendations for the coast wide management of weakfish</p>	<p>2003 Annually reviewed and adjusted if necessary</p>	<p>The ASMFC conducted a peer reviewed stock assessment in 2015 that indicated the stock is depleted and has been since 2002. The biomass decline is the result of increasing natural mortality while F remains low. Size and age structure of the stock has decreased. New total mortality-based BRPs were approved (May 2016). Total mortality was between the target and threshold in 2014 (the terminal year of the model) after being above both for 13 years. Stock biomass is still very low and will require several years of low total mortality to recover.</p>
	<p>1.2 In order to achieve the fishing target rates defined by the adopted BRPs, CBP jurisdictions will utilize a combination of size limits and possession limits, and/or seasons or areas to manage the commercial and recreational fishery in state waters.</p>	<p>2003 Annually</p>	<p>ASMFC Addendum IV to Amendment 4 of the weakfish FMP requires that the recreational creel does not exceed 1 fish/person/day in the CBP jurisdictions. Commercial landings must be limited to 100 pounds per vessel per 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 requirements have remained in effect since 2010. The CBP jurisdictions are in compliance; all met the recreational harvest restrictions and met or exceeded the commercial harvest restrictions.</p>
<p>The Fishery Management Strategy: The CBP jurisdictions will regulate the commercial and recreational fishery based on the most recent status of the stock and the established fishing targets.</p>	<p>2.1 The CBP jurisdictions will consider regional differences when determining state allocation issues and regulations.</p>	<p>2003 As necessary</p>	<p>The Maryland Sport Fish Advisory Commission recommended a weakfish moratorium but no action was taken. Fishing mortality has been decreased over the years but there remains a significant amount of non-fishing mortality,</p>
	<p>2.2_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.</p>	<p>2003 Dependent on the availability of economic data</p>	<p>Collection of economic data for the commercial fishery should include dockside values, the number of commercial vessels, the number of commercial fishermen, and the economic returns from the commercial fishery. Data collection for the recreational fishery 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.</p>
	<p>2.3 The CBP jurisdictions continue to support the use of BRDs in non-directed fisheries and the appropriate</p>	<p>2007 Annually</p>	<p>ASMFC Addendum III to Amendment 4 of the weakfish FMP aligns BRD certification requirements between state and federal waters</p>

2003 Chesapeake Bay Program Weakfish Fishery Management Plan Implementation (updated 07/17)			
Strategy/ Problem	Action	Date	Comments
Fishery Management Strategy Continued	mesh sizes in directed fisheries, to reduce the fishing mortality on small weakfish.		along with the SAFMC shrimp bycatch reduction device requirements.
<p>The Fishery</p> <p>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.</p>	3.1 The CBP jurisdictions will continue fishery dependent sampling and improve catch data. Economic information from the recreational and commercial fisheries will also be reviewed.	2005 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. In 2016, otoliths were removed from 63 weakfish during the MD pound net sampling in Chesapeake Bay, and only ages 1 and 2 were present.
	3.2 The CBP jurisdictions will conduct fishery independent sampling and collect data on abundance, age structure and recruitment.	Continue	Weakfish juvenile abundance from the Maryland Blue Crab Trawl Survey in Pocomoke and Tangier sounds generally increased from 1989 to 1996, remained at relatively high levels through 2001, then generally decreased from 2003 to 2008, and have remained moderate to low. The Chesapeake Bay juvenile geometric mean in 2016 decreased to the 3rd lowest value of the 28 year time series. A second JI index s generated from the Coastal Bay Trawl survey. The geometric mean from this survey increased in 2016 but was still below the long term mean.
	3.3 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.
	3.4 The CBP jurisdictions will begin to collect and examine stomach contents data and examine the effects of environmental variables upon weakfish growth rates.	Continue	Data from the ChesMMAF Survey, CHESFIMS (2001-2006) projects 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 07/17)			
Strategy/ Problem	Action	Date	Comments
<p>Habitat</p> <p>Management Strategy: CBP jurisdictions will monitor and regulate activities which may be harmful to weakfish habitat.</p>	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.	2000	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.
		2014	The CBP developed a Watershed Agreement (2014) with new and updated habitat outcomes. For more information see: http://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignatures-Hires.pdf
	4.1 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.
	4.2 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 Continue	Data from the ChesMMA, CHESFIMS (2001-2006), and the MD Winter Trawl Survey will provide data on important forage species for weakfish. The CHESFIMS survey was discontinued after 2005 and a modified year in 2006 due to lack of funding. The CBP developed a Watershed Agreement (2104) with new forage species outcome. For more information see: http://www.chesapeakebay.net/documents/FINAL_Ches_Bay_Watershed_Agreement.withsignatures-Hires.pdf
4.3 The CBP jurisdictions will monitor the abundance of weakfish forage species that are not managed under CBP FMPs, such as bay anchovies, and	Continue	The MD Estuarine Juvenile Finfish Survey and VIMS Juvenile Abundance Monitoring Surveys (formerly known as the VIMS Trawl Survey and the VIMS Juvenile Seine Survey) will continue to monitor the abundance of important, non-managed forage species in the Chesapeake Bay.	

2003 Chesapeake Bay Program Weakfish Fishery Management Plan Implementation (updated 07/17)			
Strategy/ Problem	Action	Date	Comments
Continue Habitat Strategy	Atlantic silversides, using on-going monitoring and surveys.		
	4.4 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.	Continue 2014 Continue	Data from the ChesMMAAP, CHESFIMS (2001-2006), and the MD Winter Trawl Survey will be collected and analyzed by CBP jurisdictions to identify possible inter-and intra-species relationships. ASMFC weakfish TC incorporated a striped bass predator function into the 2006 weakfish stock assessment to model the weakfish stock decline since 1998. No new recommendations have been developed. The CB Watershed Agreement (2014) has a forage species outcome that will evaluate predator/prey interactions. A forage management strategy was developed in 2014/2015 and a biennial work plan was developed for 2016 and 2017. The work plan includes actions to identify important forage species, evaluate a process for developing indicators and develop a process to manage for key predators.

Acronyms:

ACCSP – Atlantic Coast Cooperative Statistics Program

ASMFC - Atlantic States Marine Fisheries Commission

BRD - bycatch reduction device

BRPs - biological reference points

CHESFIMS - Chesapeake Bay Fishery Independent Multispecies Fisheries Survey

ChesMMAAP - Chesapeake Bay Multispecies Monitoring and Assessment Program

CBP - Chesapeake Bay Program

F - Mortality due to fishing

FMP - Fishery Management Plan

PRFC - Potomac River Fisheries Commission

PSE - Proportional Standard Error

SAFMC - South Atlantic Fishery Management Council

SSB - spawning stock biomass

TC - Technical Committee

VIMS - Virginia Institute of Marine Science

YOY - young of the year fish

b) Spotted Seatrout Notes:

The Atlantic States Marine Fisheries Commission (ASMFC) adopted the Fishery Management Plan (FMP) for Spotted Seatrout in 1984 for states from Maryland to Florida. An Omnibus Amendment (2011) was developed to bring spotted seatrout under the authority of the Atlantic Coastal Fisheries Cooperative Management Act (1993) and the ASMFC charter (1995). A corrected version of the omnibus amendment with Technical Addendum 1a was adopted on February 9, 2012.¹ 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 Services (beginning in 2016 Fishing and Boating Service, FABS) Plan Review Team (PRT) in 2012/2013. A report was presented to the Sport Fisheries and Tidal Fisheries Advisory Commissions. The Tidal Fisheries Advisory Commission recommended no action but the Sport Fisheries Advisory Commission recommended that the Maryland DNR FABS consider raising the minimum size limit and decreasing the creel limit. Maryland increased the commercial size limits, decreased the recreational creel limit and instituted a daily commercial catch limit in 2013.

Stock Status

A coastwide 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 (VA, NC, SC, GA, FL) with state-by-state variability and no regional trend. A peer-reviewed stock assessment was completed for Virginia in 2014. Based on the results, it appears that the stock is not overfished and overfishing is not occurring. 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.

Management Objectives and Measures:

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

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

Fisheries

The Marine Recreational Information Program (MRIP) estimated that Maryland recreational harvest has ranged from zero to 7,933 fish from 2005 to 2016, with higher catches occurring in the late 1980s and mid 1990s (Figure 3). Most estimates have a high proportional standard error (PSE) value which indicates the estimates are highly uncertain in most years. Catch-and-release estimates in the past 10 years have ranged from 2,331 to 107,017 fish per year, but have been highly variable with no trend and very

high PSE values. The Virginia recreational harvest estimates have been consistently higher than Maryland's with lower PSE values and ranged from 8,880 to 247,736 fish per year from 2005 to 2015, and 2015 was the lowest value of the time series. The 2016 estimated harvest for Virginia increased to 66,559 fish. Release estimates for Virginia over the same time period have ranged from 82,935 to 1,653,352 fish per year with the highest value occurring in 2016. Maryland commercial landings since 1982 have been less than 2,000 lbs. most years, except for a peak in landings from 1996 to 2002 when landings averaged 20,515 lbs. per year (Figure 4). Virginia's commercial landings have averaged 23,094 lbs. per year since 1982, but experienced an unusually large peak in 2012 with 116,768 lbs. reported.

Figure 3. Estimated recreational harvest for spotted seatrout from Maryland and Virginia, 1986-2016.³ (MRIP data)

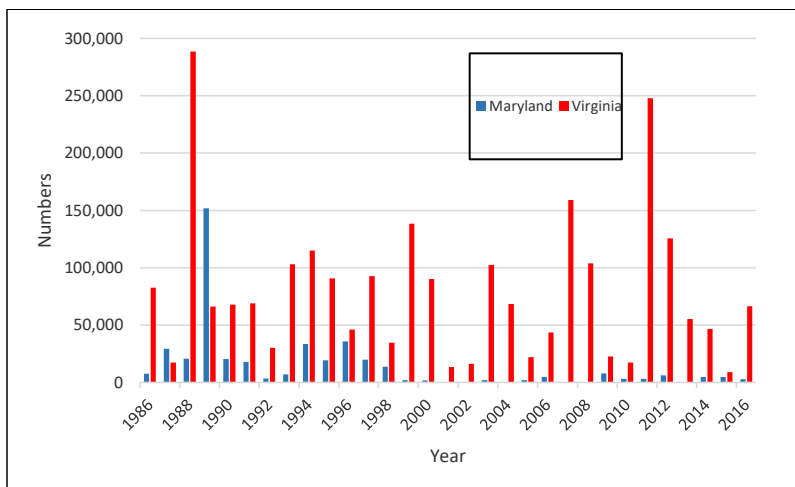
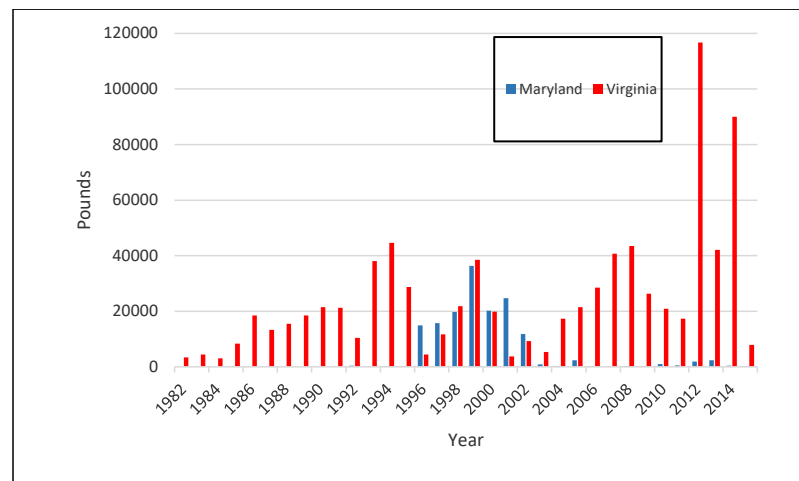


Figure 4. Commercial spotted seatrout landings from Maryland and Virginia, 1982-2015.² (NMFS data)



Issues and Concerns

Spotted seatrout are generally found within their natal estuary. The species is comprised of unique spatial populations and very little mixing occurs outside of adjacent estuaries.⁴ There are distinct genetic differences among populations along the Atlantic coast that supports the idea of limited mixing of subpopulation. Seasonal movements out of the Chesapeake Bay is currently the only example of spotted seatrout migration.

References:

- ¹ 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.
- ² Personal communication from the National Marine Fisheries Service, Commercial Fisheries Statistics, Fisheries Statistics Division June 9, 2017.

³ Personal communication from the National Marine Fisheries Service, Marine Recreational Information Program, Fisheries Statistics Division June 9, 2017.

⁴ Odell, J., D. H. Adams, B. Boutin, W. Collier II, A. Deary, L. N. Havel, J. A. Johnson Jr., S. R. Midway, J. Murray, K. Smith, K. M. Wilke, and M. W. Yuen. 2017. Atlantic Sciaenid Habitats: A Review of Utilization, Threats, and Recommendations for Conservation, Management, and Research. Atlantic States Marine Fisheries Commission Habitat Management Series No. 14, Arlington, VA.

2016 Maryland FMP Report (May 2017)

Section 21. White Perch (*Morone americana*)

White perch are one of the top species encountered by anglers fishing in Maryland. The 2016 recreational harvest of 868,954 lbs. was more than twice that of 2015. A new state record of a 1.65-pound white perch in the Atlantic division was set by 10-year-old Ryan Timmons of Berlin, Maryland (August 2016). A new non-tidal record of 1.9-pound white perch was established by George Venker of Baltimore (April 2017). White perch continue to rank in the top five of commercially harvested finfish in Maryland.

Maryland Fishery Management Plan (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 (F) was lower than necessary to maintain stock abundance. The assessment cautiously noted that some indices of commercial catch-per-unit-effort (CPUE) were trending lower while recreational CPUE trended higher. The 2009 stock assessment used a surplus production model for the Maryland portion of the Chesapeake Bay and a Catch Survey Analysis (CSA) in the Choptank River.² 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 three years of additional data (2012-2014). Models indicated that populations in the Upper Bay were near time series highs and F was low. In the Choptank River, populations were at average levels and F was at close to fully exploited levels.

Age 1 white perch relative abundance in the Upper Bay trawl survey was near average in 2013, below average in 2014, and decidedly above average in 2015 and 2016 (Figure 1). There is less available data to assess Lower Bay white perch populations. For those areas, both fishery-dependent and fishery-independent indices

were examined.² Although biological reference points (BRPs) have not been formally established, a target of $F_{\text{target}}=0.60$ was suggested. Between 2000 and 2013, F has not exceeded the F_{target} .³ 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 intermittently strong year-class production. Very strong year-classes were produced in 2011, 2014 and 2015 (Figure 2). 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 caught using some of the same commercial gear types such as drift gill nets. In addition, fyke nets are 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 lbs. with an estimated value of 1.32 million dollars (Figure 3).¹ Maryland commercial landings for white perch were 1.5 million lbs. in 2014 with an estimated value of \$1.04 million dollars and 787,643 lbs. in 2015 with an estimated value of 1 million dollars. The estimated commercial harvest in 2016 was 1.85 million lbs. with an estimated value of 1.4 million dollars. Recreational harvest of 305,182 lbs. in 2015 was below the long-term average of 587,130 lbs. (1981-2015) (Figure 4). The 2016 recreational harvest of 868,954 lbs. was well above the long term average.

Issues/Concerns

White perch harvests have recently rebounded from a period of lower reports in the mid-2000's (Figure 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.² The FABS (formerly 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.

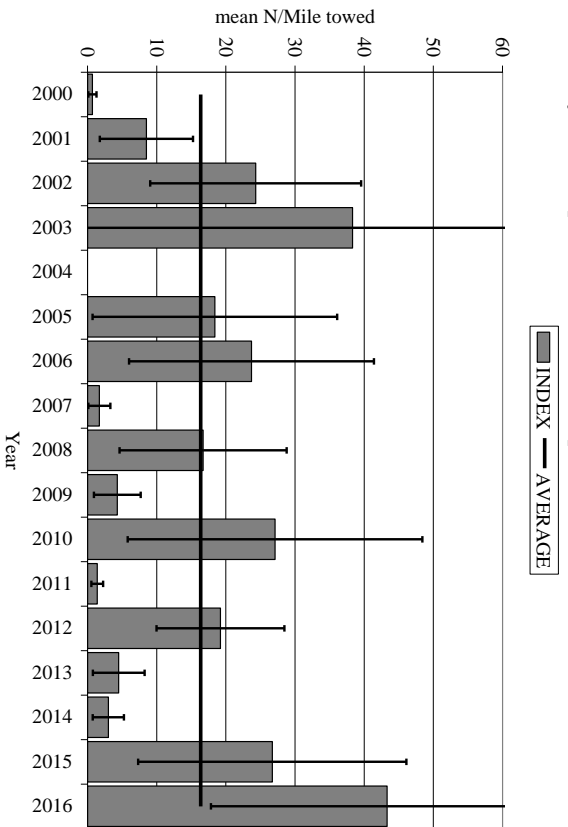


Figure 2. Maryland young-of-year geometric mean catch per haul for white perch, 1962 – 2016. Horizontal line= time series average. (EJFS data)

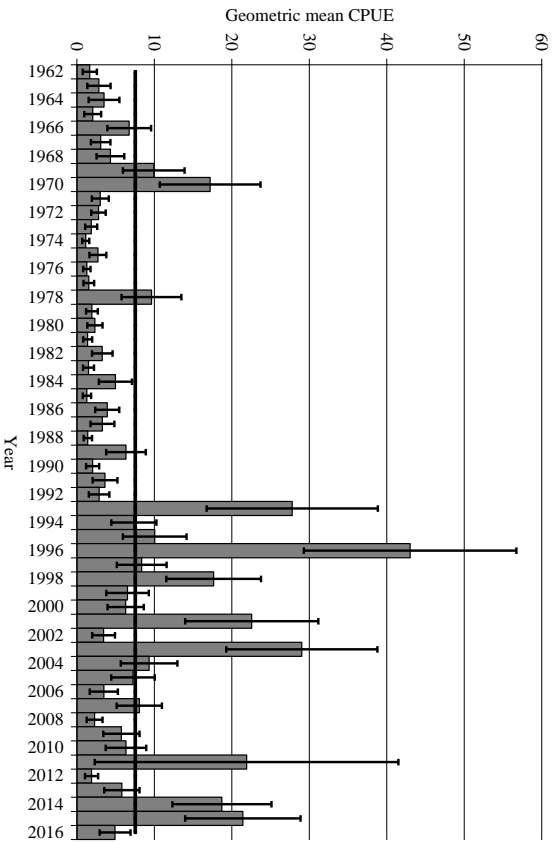


Figure 3. Commercial landings of white perch from Maryland, 1981-2016.

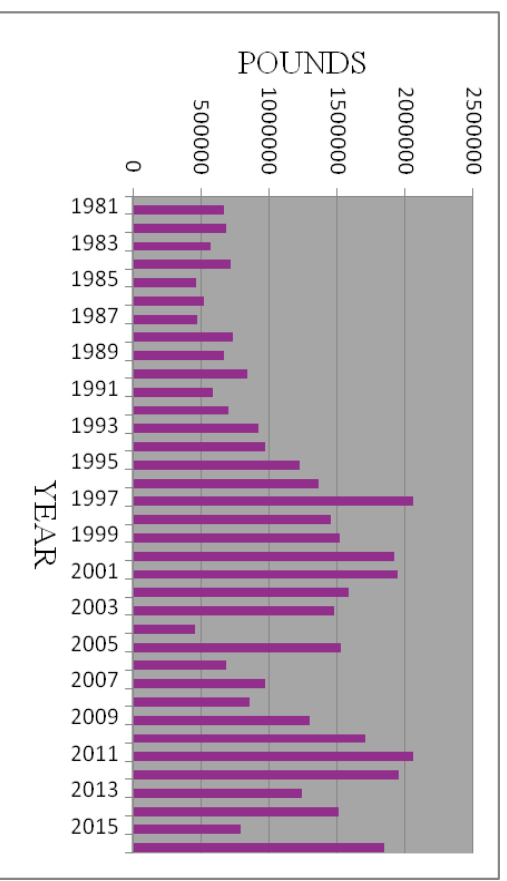
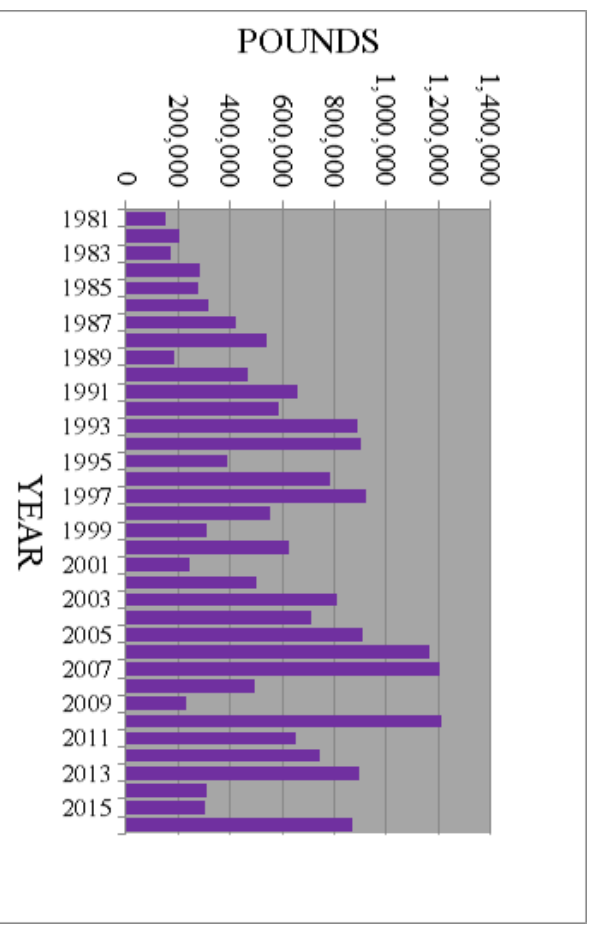


Figure 4. Estimated recreational white perch harvest from Maryland, 1981-2016.



References:

¹ Personal communication from the National Marine Fisheries Service, Fisheries Statistics Division, Commercial Fisheries. May 10, 2017.

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

³ Piavis, P.G. and E. Webb III. 2016. Population vital rates of resident finfish in selected tidal areas of Maryland's Chesapeake Bay. Maryland Department of Natural Resources, Fisheries Service Report F-61-R-9. Annapolis, Maryland.

Draft 1990 White Perch Fishery Management Plan Implementation Table (updated 05/17)

Problem Area	Action	Date	Comments
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.	2009 Continue	<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 $F=0.60$ and the population has increased. Total upper Bay population abundance has been variable from 11 million fish (2001) to 4.4 million (2007.)⁴ 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 $F_{target} = 0.60$. However, formal BRPs have not been adopted.</p>

<p>Habitat Issues 4.1. Water quality impacts distribution and abundance of finfish species in Chesapeake Bay.</p>	<p>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.</p>	<p>Continue</p>	<p>Watershed indicators for aquatic systems include water quality as well as components of aquatic systems, biological diversity, hydrologic, and terrestrial system. http://www.dnr.state.md.us/watersheds/surf/indic/md/md_indic.html This Maryland Integrated Watershed Data and Information System is a cooperative effort between the MD 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: http://www.chesapeakebay.net/track/tools</p>
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Acronyms:

BRPs - Biological Reference Points

CSA - Catch Survey Analysis

CPUE - Catch per Unit Effort

EJFS – Estuarine Juvenile Finfish Survey

F - Fishing Mortality

H & L - Hook and Line

MD DNR – Maryland Department of Natural Resources

YOY – Young of Year

2016 Maryland FMP Report (July 2017)

Section 22. Yellow Perch (*Perca flavescens*)

In 2017, sixty one permits were purchased by commercial fishermen to participate in the yellow perch commercial fishery. Of the 61 issued, 22 were participants in the pilot program which allows fishermen to tag boxes of fish rather than tag individual fish. There were 9 fishermen that opted to tag individual fish, however, only 6 of them actively fished and reported any harvest. The remaining 30 fishermen never requested their permit cards or tags.

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.¹ 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. An amendment was drafted in 2016 to meet the recommendations. It revises the management plan objectives, incorporates the status of the stock, and presents the current management approach.

Stock Status

Yellow perch stocks are not overfished and overfishing is not occurring. Yellow perch stock assessments have been conducted every two years up to 2005 and annually since 2007 for the Upper Chesapeake Bay (includes the Bay and tributaries north of the Bay Bridge except the Chester River). The biological reference points (BRPs also known as targets and thresholds) were updated using a spawning stock biomass per recruit model. The yellow perch assessment model was refined by adding six more years of data (2011-2016), re-examining fishery independent indices and weightings, and expanding the range of ages.² The revised Upper Bay population estimate (2011-2016) has varied over time from 1.2 million (2011) to 2.2 million (2016) but was as high as 3.0 million (1998) when the assessment began. (Figure 1). A biomass estimate of 200,000 kilograms was calculated for 2013 and was estimated at 212,000 kilograms in 2016 (Figure 2). Total instantaneous fishing mortality ($F=0.23$) remains under the target F of 0.53 (Figure 3). Recruitment to the population at age 1 has increased from an

estimated 207,000 in 2011 to 800,000 in 2016² (Figure 4). Estimated recruitment in 2013 and 2014 was well below the long term average while 2015 and 2016 were nearly twice 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 F 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, 0.12 in 2014, and 0.24 in 2015. 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 or box of fish is tagged for accountability depending on whether or not the fisherman is enrolled in the pilot program. The commercial fishery has a slot limit of 8.5 to 11.0 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 lbs. for the Upper Bay; 6,770 lbs. for the Chester River; and 2,500 lbs. for the Patuxent River. The Upper Bay harvest was under its quota by 1,757 lbs. while the remaining quota for the Chester and Patuxent Rivers were 1,252 and 1,213 lbs., 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 lbs. for the Upper Bay; 5,175 lbs. for the Chester River; and 2,500 lbs. 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 lbs. for the Upper Bay and 4,725 lbs. 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 lbs. was harvested within eight days once the ice cleared. When the quota was predicted to be met the season was closed. However, harvest exceeded the quota in both the Chester River and Upper Bay by 27 and 3,990 lbs., respectively (Figure 8). The Patuxent River quota of 2,500 lbs. was under harvested by 1,389 lbs.

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

The subtraction of the overages from the 2016 season resulted in quotas of 10,558 and 45,976 lbs. for the Chester River and the Upper Bay, respectively, for the 2017 season. The Upper Bay fishery was closed on March 13, 2017, when the quota was expected to be met. However, at that time harvest was around 4,500 lbs. away from the quota and the season was reopened on March 20, 2017. It remained open until the mandated closure on March 31. The harvest for 2017 in the Upper Bay, Chester River and Patuxent River was 44,426 lbs., 6,381 lbs., and 0 lbs., respectively (Figure 10).

Issues and Concerns

Some areas, such as the Severn River, continue to experience poor egg survivorship.³ Abnormalities in yellow perch ovaries and testes have been documented and may contribute to poor egg and larval viability. Studies have suggested that the abnormalities maybe associated with environmental contaminants.

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

References

- ¹ 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.
- ² Piavis, P.G. and E. Webb, III. 2016. 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.
- ³ 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. Upper Chesapeake Bay yellow perch abundance estimates (N, ages 2+), 1998 – 2016.

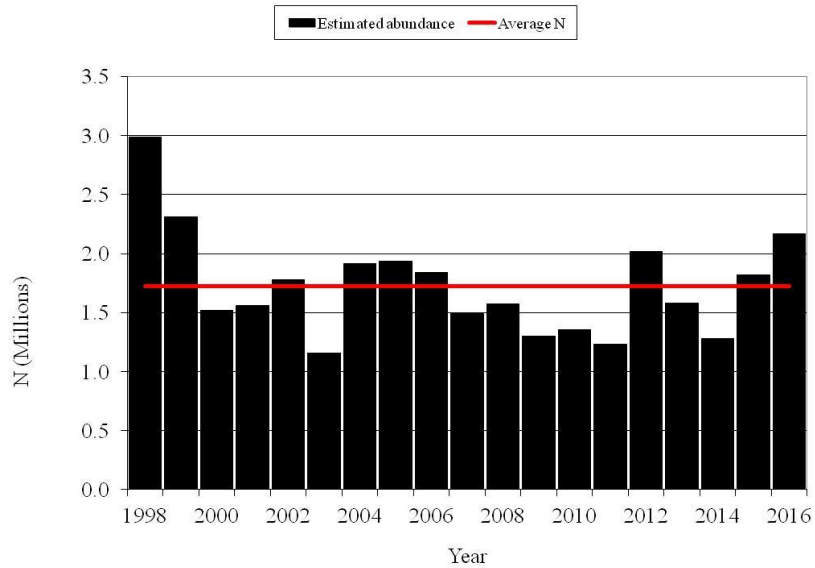


Figure 2. Upper Chesapeake Bay yellow perch biomass (kg, ages 2+) estimates, 1998 – 2016.

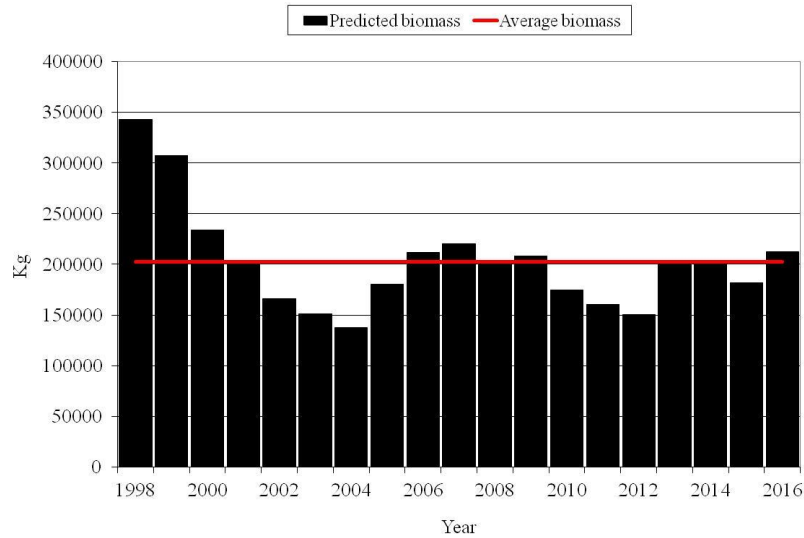


Figure 3. Upper Chesapeake Bay yellow perch fully recruited instantaneous fishing mortality (F) estimates, 1998 – 2016.

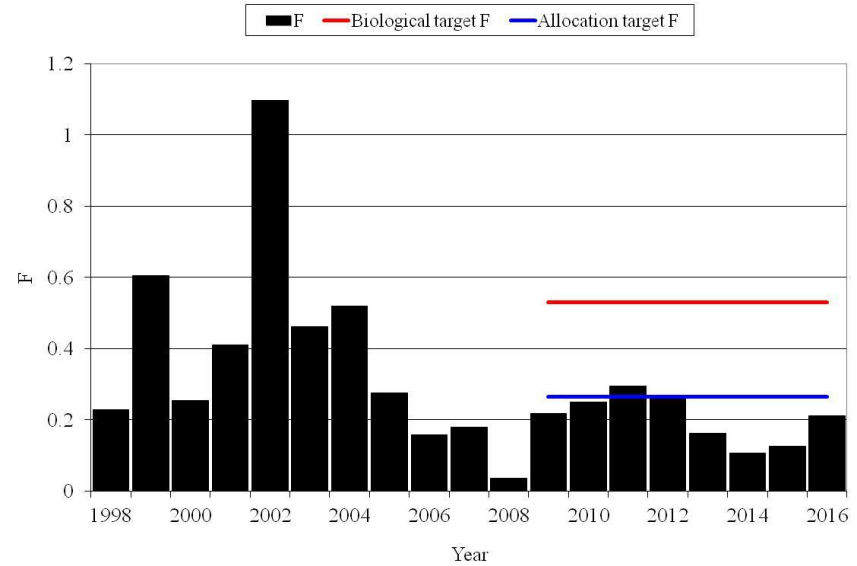


Figure 4. Upper Chesapeake Bay yellow perch recruitment (R, age 1) estimates, 1998 – 2016. Horizontal line indicates time series average.

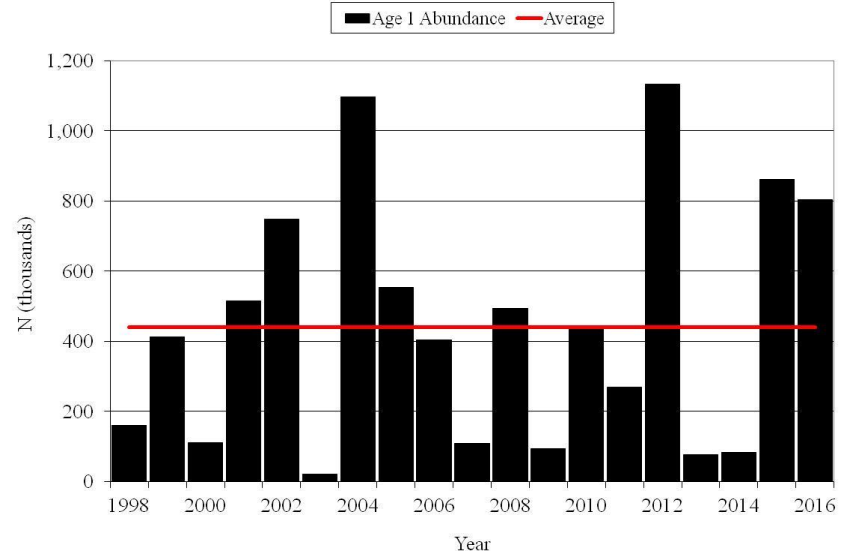


Figure 5. Maryland commercial yellow perch harvest by region, 2012

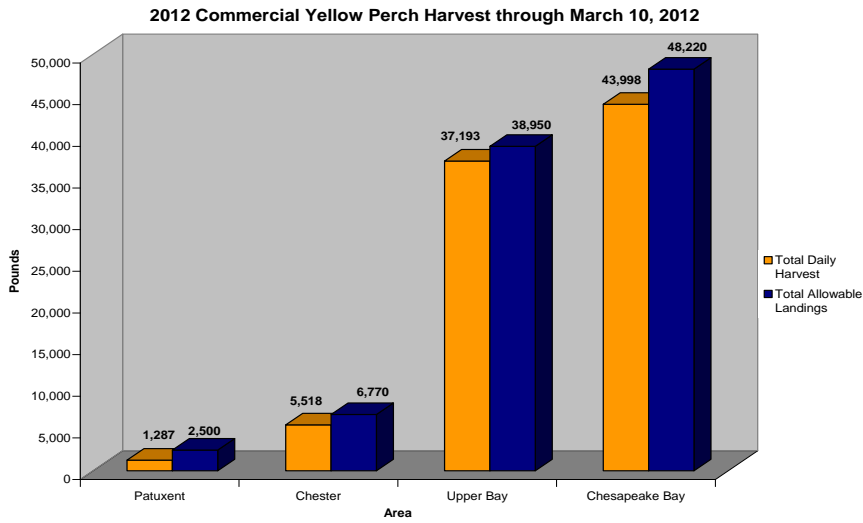


Figure 7. Maryland Commercial Yellow Perch Harvest by Region, 2014

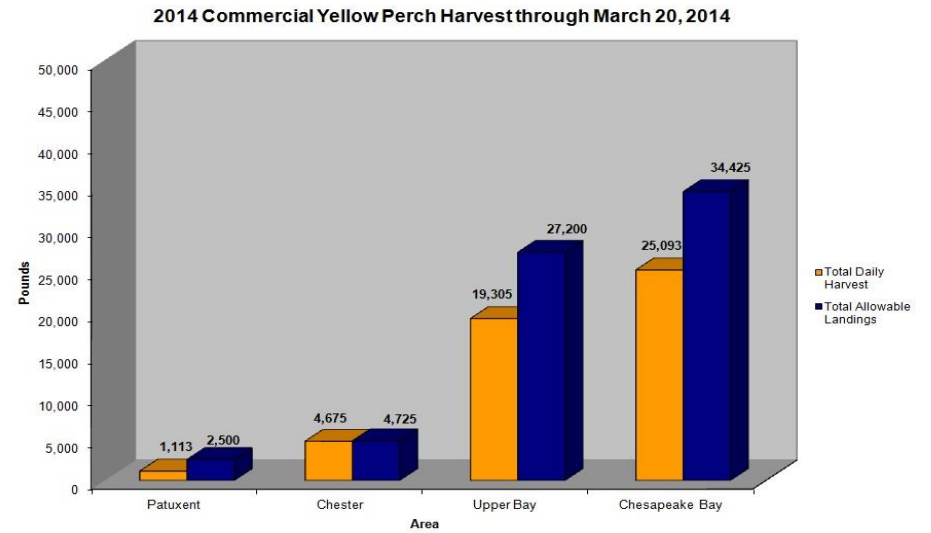


Figure 6. Maryland commercial yellow perch harvest by region, 2013

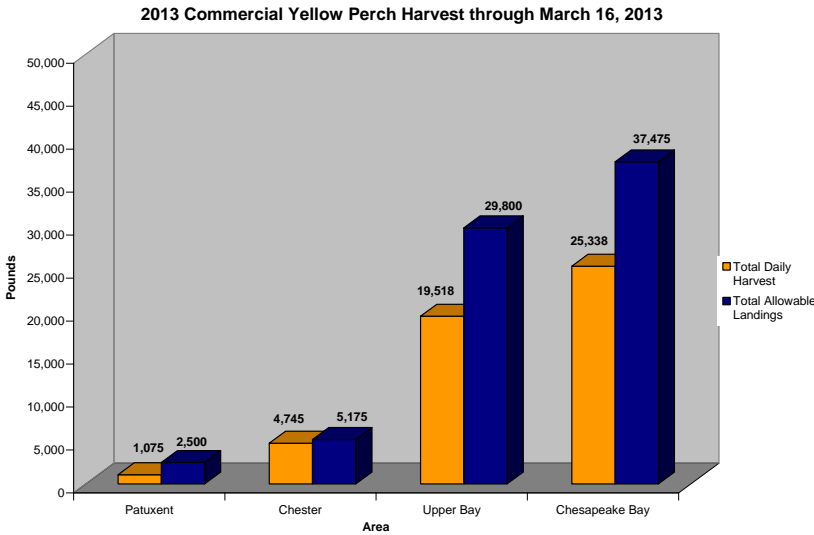


Figure 8. Maryland Commercial Yellow Perch Harvest by Region, 2015

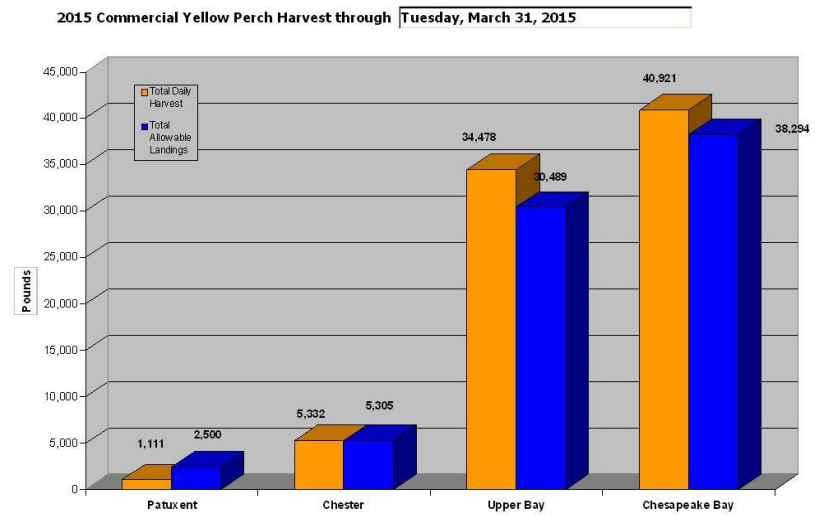


Figure 9. Maryland Commercial Yellow Perch Harvest by Region, 2016

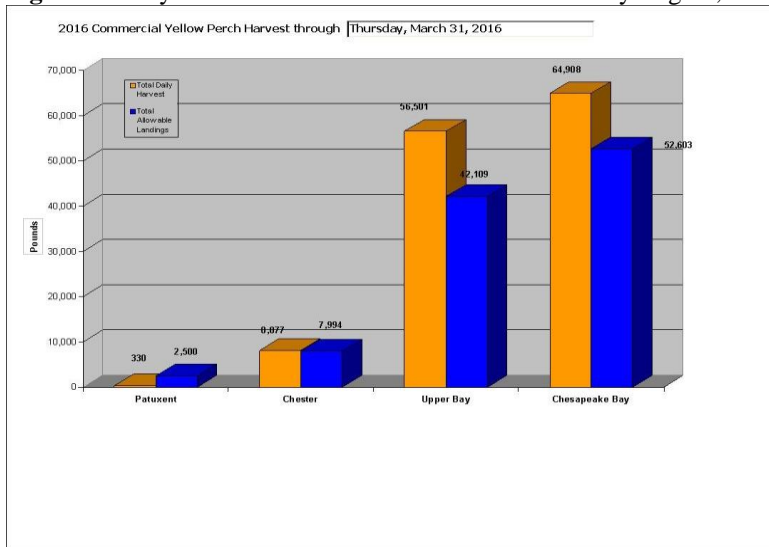
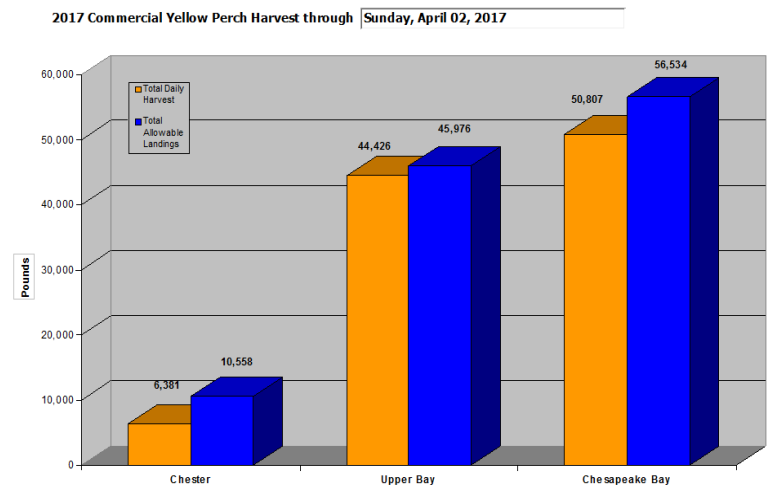


Figure 10. Maryland Commercial Yellow Perch Harvest by Region, 2017



2002 Maryland Tidewater Yellow Perch Fishery Management Plan Implementation Table (updated 07/2017)

Section	Action	Date	Comments
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.	Continue	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 Resources (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.	Continue	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.	Continue	Coordinate with DNR Environmental Review Program (ERP). The ERP typically reviews 2,500 to 3,000 projects per year. During FY’06 over 800 projects were considered for yellow perch impacts. The ERP 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, ERP 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.	Continue	Maryland 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.	2006 Discontinued	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.	Continue	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 degraded habitat on stock abundance.	2001 2005	DNR completed field work in 2005. The field results indicated low juvenile survival, low DO and high salinity. Volunteers have been enlisted to monitor yellow perch larvae in the Severn River. These data are incorporated into impervious surface analyses. Severn River habitat has been monitored by the Riverkeeper program (http://www.severnriverkeeper.org)
	3) Use the Yellow Perch FMP as a model for the application of ecosystem-based fishery management	Continue	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

Section	Action	Date	Comments
	principles and develop new methods of application/implementation.		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.	Discontinued	The table was updated but a more general watershed management approach is necessary. There should be an emphasis on preserving habitat especially in more pristine areas. Blue infrastructure may aid in determining priority areas for preservation and restoration. The Fish Passage Program continues to collect ichthyoplankton in some historical yellow perch spawning streams. Results are compared with historical yellow perch ichthyoplankton data. The table is no longer used.
	5) Designate the currently closed rivers as yellow perch areas of particular concern, so if resources and funding become available, they can be directed to these areas.	2002 2009	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.
	7) Identify essential fish habitat (EFH) for utilizing progressively more detailed information.	Continue	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.	Continue	Working with tributary teams and local riverkeepers but the scope of work should be broadened. Maryland DNR will continue to coordinate habitat activities.
Control Fishing Mortality by	9) Adopt BRPs of $F_{35\%}$ and $F_{25\%}$ as a threshold for the yellow perch	2002 Continue	Continuing analysis indicates current BRPs are appropriate. The Maryland Yellow Perch Stakeholder Committee (YPSC) presented recommendations (2007) to evaluate triggers for

Section	Action	Date	Comments
establishing biological reference points (BRPs) that describe the targets and thresholds (limits) for yellow perch stocks.	resource. As more data becomes available, the BRPs may be changed to reflect the most current status of the resource.		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. The BRPs were updated using a spawning stock biomass per recruit model. The assessment model was refined by adding six more years of data (2011-2016), re-examining fishery independent indices and weightings, and expanding the range of ages.
	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 2016 Chesapeake Bay TAC of 52,603 lbs. was calculated. This was an increase from the 2015 TAC of 38,295 lbs. The calculated 2016 quota for the Upper Bay commercial fishery was 42,109 lbs. The Chester River quota was 7,994 lbs. and the Patuxent River quota was 2,500 lbs. Improved catch reporting included daily call-ins, verified by tagging. These measures were implemented in 2009 to improve accountability and have continued through 2016.
	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.	Periodically Updated 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.
	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.
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: http://dnr2.maryland.gov/Fisheries/Pages/survey/index.aspx
Identify any	16) MD DNR has implemented a	2003	Fixed gear restrictions are county specific. DNR has done unofficial counts of fyke nets and

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problems and recommend solutions.	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.		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.	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 MD DNR will monitor yellow perch stocks in representative areas of the Chesapeake Bay in order to assess yellow perch stock status.	19) Continue to sample commercial and recreational harvest of yellow perch and collect basic biological data. Additional biological data may indicate changes in the status of the stocks and require additional management measures.	Continue	Chesapeake Finfish Program (previously FS Multispecies Project) collects yellow perch data from commercial and experimental fyke nets, seine and trawl surveys and uses data to periodically assess stocks. Estimated Upper Chesapeake Bay population abundance was 2.2 million fish in 2016. Recruitment has increased from estimated 207,000 (2011) to 800,000 (2016). Recruitment was well below the long term average in 2013 and 2014. It was nearly twice the long term average in 2015 and 2016.
	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. A YOY index is calculated for the Choptank, Nanticoke, Potomac and Patuxent rivers and the Head of Bay.
	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,	Continue	Current estimates of stock status are based on data from the Upper Bay and Choptank.

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	such as the trawl survey in the upper Bay.		
	23) Review and evaluate yellow perch monitoring efforts biannually. Recommend changes in monitoring and protocol necessary to implement the yellow perch FMP.	2002 Continue	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 (currently Fishing and Boating Services) conducts fishery 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 non-fishing communities in stewardship of the yellow perch resource in tributary basins.	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 Project. Explore the use of volunteer recreational survey using the web similar to the recreational survey implemented for striped bass.	Continue	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. Access to the survey and summaries from 2010, 2012 and 2016 can be viewed at: http://dnr.maryland.gov/fisheries/Pages/survey/yellow-perch.aspx
	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.	Continue	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
	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.	Discontinued	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.
	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	Continue	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.

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	information on their occurrence and distribution: cooperative efforts with the Team program; and volunteer monitoring opportunities.		

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
 ERP - Environmental Review Program
 F - Fishing mortality
 FMP - Fishery Management Plan
 FS - Fisheries Service (currently Fishing and Boating Services FABS)
 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 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

2016 Maryland FMP Report (June 2017)
Section 23. Brook Trout (*Salvelinus fontinalis*)

Introduction

Brook trout is the only native salmonid in Maryland. Like the lake and bull trout, brook trout are members of a group of fish known as charr - the English name given to all members of this genus. Brook trout have become a catalyst in the eastern United States for the conservation and restoration of native coldwater fishery resources specifically, and a poster child for fishery and water resources conservation in general. In Maryland, this movement began in 2006 with the development of our statewide Brook Trout Fisheries Management plan (BTFMP); http://dnr.maryland.gov/fisheries/Documents/MD_Brook_Trout_management_plan.pdf. The plan helps direct conservation and management activities for Maryland brook trout and has been annually updated and was formally reviewed in 2010 and 2013/2014.

The development of the BTFMP coincided with the creation of the Eastern Brook Trout Joint Venture (EBTJV), a multi-partner effort of state and federal government agencies, academic institutions, and non-profit angling and conservation groups to increase awareness and promote conservation and restoration of brook trout in their native eastern United States range (<http://easternbrooktrout.org/>). This was followed in 2014 by the addition of a specific brook trout outcome in the Chesapeake Watershed Agreement (<http://www.chesapeakebay.net/chesapeakebaywatershedagreement/page>), an important step in raising the profile of brook trout conservation in the Chesapeake Bay watershed.

Brook trout are typically found in Maryland's more pristine and remote areas because of their habitat and life history requirements (Heft et al. 2006). They are considered an indicator species, representative of a whole suite of unique aquatic and terrestrial organisms that occupy and share the same habitat. An iconic symbol of clean water and healthy aquatic systems, brook trout are the aquatic

“canary in the coal mine.” If water quality and habitat are degraded brook trout will quickly be extirpated. The decline of brook trout populations in Maryland has been significant. It is estimated that brook trout have been eliminated from 62% of their historic habitat in Maryland, and the majority of remaining populations are considered greatly reduced, occupying less than 10% of their historic range (Hudy et al. 2008). 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. Most habitat is located on private land or on a mix of private/public lands. Wild brook trout populations are generally relegated to headwater streams, where human disturbance is minimal and forest cover is still prevalent.

While important from a conservation and aesthetic standpoint, brook trout are also an important recreational resource managed by the Maryland Department of Natural Resources (MD DNR) Freshwater Fisheries Division. Trout fishing in Maryland is a popular recreational activity, with a variety of options available to anglers. The options include fishing opportunities supported by the stocking of rainbow and brown trout, introduced trout species that have been successfully domesticated for hatchery production. There is a large and passionate group of anglers who prefer to pursue only native trout where it still occurs in its historic habitat statewide.

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 are present in >50% of the streams), 542 (38%) were classified as *Reduced* (brook trout are 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). 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 only 103 *Intact* subwatersheds and 43 *Reduced* subwatersheds that are assigned high priority scores (≥ 0.79) for potential restoration, only one of which is in Maryland. In Maryland specifically, a 2015 update to the initial 2006 assessment focused at a finer geographic scale (Mark Hudy, personal communication) showed that 72% of historic brook trout populations are *Extirpated*, 27% persist at a *Reduced* level, and only 1% are considered *Intact*. Maryland's only *Intact* watershed is the Upper Savage River (USR) system and is one of the best brook trout systems in the mid-Atlantic region.

A finer scale assessment of brook trout populations in the Chesapeake Bay watershed was completed (2012 - 2014) 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), which was used to identify brook trout patches (Whiteley et al. 2013). A "patch" is defined as a group of contiguous catchments occupied by wild brook trout; patches are not connected physically (i.e., they are separated by a dam, unoccupied warm water habitat, downstream invasive species, etc.) and are generally assumed to be genetically isolated. The assessment found that there were 3,608 "Wild Brook Trout Only" patches in the Chesapeake Bay watershed and only 166 patches in Maryland (4.5%).

In 2007, a first of its kind in Maryland special restrictive angling regulation, was implemented in the USR watershed to reduce angling related harvest and mortality within the system and strengthen the conservation value of the resource. All brook trout caught must be released immediately and bait fishing is not allowed. Annual population monitoring throughout the watershed has been done over the last decade. Some of the highlights of what we have learned from our efforts over the past 10 years include how the system functions and

its future potential. We have observed that the USR brook trout population has recovered from its lower level and now appears to be stable and possibly increasing. Prior to monitoring, we had limited information about how the USR population behaved. We now know that reproductive success is the main factor influencing the USR population under the current regulation. A very dry autumn followed by a very wet spring results in almost no successful reproduction because the low flows in the fall limit the availability and quality of spawning sites. High flows in spring tend to scour and displace the eggs and very young fish. One year of poor reproduction can be seen in lower numbers of adults 1 - 3 years later, and back-to-back years (or more) of poor reproduction can reduce the adult population to less than half of what normally is observed. This highlights the fishery management value of protecting the older and larger fish in the population. Larger brook trout produce more and healthier eggs and choose the best spawning sites, increasing the likelihood of reproductive success. Protecting and keeping these large fish in the system ensures that there will be a greater chance of a strong spawning stock during and following those years with adverse environmental conditions. This also keeps larger fish available for anglers to enjoy a quality recreational fishery even during poor recruitment years.

Our long term monitoring has shown that while the adult population numbers have recovered, the biggest fish in the tributary streams in general have not gotten bigger. This suggests that the small streams we monitor either cannot support or cannot grow larger fish, despite substantially larger fish often sighted and caught in the mainstem of the USR. A possible reason for this is a lack of suitable habitat (such as woody debris) as a result of past land use practices. Forested land at the catchment scale was one of the most important factors affecting brook trout occurrence in Connecticut headwater streams (Kanno et al. 2015). However, the lack of growth in Maryland tributary streams remains unknown and needs to be investigated. One surprising finding was that while historic fisheries studies on Appalachian streams suggested that the brook trout life span was typically 2 - 3 years, we found age 7 brook trout in the USR system. This is a vital piece of information for fisheries management and

conservation. Finally, even though there has been some improvement at the easy angler access sections (areas closest to access points) since the regulation was implemented, our long-term monitoring work shows that these areas continue to have fewer adults and lower reproduction than adult fish in less accessible sections (where a long hike is necessary). This remains a strong concern because it impacts angling opportunity, long term conservation potential, and suggests a direct connection between angler access and resource quality. While we do not have definitive answers why this is occurring, possible reasons include angler related mortality from the effects of higher angling pressure; habitat differences; physical disturbance to the stream bed, particularly damage to redds (nests) being stepped on; and behavioral responses of fish to leave areas that have frequent disturbances. Determining why areas with easy access are not as productive is a vital research need. As human populations encroach on brook trout habitat, this will likely become an even more common management challenge.

Anthropogenic impacts have been identified as the primary reason for the documented declines in brook trout. Increasing urbanization, deforestation, exotic species, and mining have been identified as a few of Maryland's most imminent threats. Likewise, the future of Maryland's brook trout populations remains uncertain in the face of increasing water temperatures in response to climate change.

Status of the Fishery

The brook trout daily limit (in areas that are not put-and-take or special management areas) is two trout with no minimum size and no closed season, except in special trout management and put-and-take areas. 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. These areas are described in the annually published Maryland Fishing Guide. Maryland's premier brook trout fishery occurs in Garrett County in the USR mainstem and tributaries

upstream of the Savage reservoir dam. This system supports the highest population densities and largest brook trout in the state, and the streams are managed under catch and release rules with angling restricted to artificial lures only. Intensive monitoring of this fishery by MD DNR's Freshwater Fisheries Division has been ongoing annually since 2006 and has shown progress towards meeting four delineated management objectives (Hilderbrand 2017). Figure 1 shows the watersheds where brook trout historically occurred in Maryland and Figure 2 shows the current distribution as of 2016.

Brook Trout FMP Work Effort Status

A focus area from the 2013/2014 BTFMP review was the development and implementation of a comprehensive statewide sampling schedule, as described in Action 11.1.1 of the FMP (*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 three-year rotation was not feasible, so a five-year rotation (2014 - 2018) was developed and initiated in 2014 and will continue through 2018. Sampling was conducted by Freshwater Fisheries Regional Division and Brook Trout Program staff in 2016. Eighty six of 95 streams scheduled to be sampled were completed and the remaining streams were moved to the 2017 and 2018 schedule. From 2014 through 2016, 235 of 266 (88.0%) scheduled stream samples have been completed. Brook trout were present in 191 (81.3%) of these streams. Table 1 lists by river basin the number of streams sampled from 2014 through 2016.

A second recommended focus area 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: Maryland Biological Stream Survey (MBSS) water quality and habitat data collection components; establishment of permanent sampling stations; number of stations per stream length; and fish collection methodology*). The Maryland Brook Trout Program Field Sampling Manual (Sell and Heft 2014) was completed prior to the 2014

sampling season and was used in 2015 and 2016 by all Freshwater Fisheries Division staff involved with brook trout sampling efforts and by all Resource Assessment Services (RAS) staff that conducted brook trout sampling efforts for the Freshwater Fisheries Division.

The third recommended focus area from the 2014 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 and Boating Service (FABS) website. The page provides information on statewide brook trout work and research. It also links to numerous other state and national organizations involved with brook trout work. For 2016 updates were added to the webpage and will be done annually in the future.

Focus areas for future (2017 - 2019) work efforts from the BTFMP Implementation Table will include: 1) **Strategy 1.2.** Investigate angler use and exploitation on Maryland brook trout populations statewide through creel surveys, and relate harvest and incidental angling mortality to brook trout length frequency structure and maximum fish size; 2) **Strategy 7.1.** Develop statewide restoration guidelines for restoring extirpated brook trout populations; 3) **Action 9.1.1.** Utilize the Maryland Sport Fisheries Advisory Commission (SFAC), DNR Regional Teams, and other appropriate state agencies to solicit input on brook trout conservation measures; 4) **Strategy 4.4.** Identify adverse summer water temperature impact areas (impoundments, etc.) and develop strategies to alleviate the impacts; and 5) **Strategy 11.1.** Develop a consistent, coordinated monitoring program to: 1) assess and track population abundance and viability; 2) monitor and detect environmental changes from anthropogenic (acidification, sedimentation, development/urbanization, AMD, etc.) and natural causes (floods, drought); 3) monitor and detect exotic species encroachment and impacts; and 4) monitor/detect water flow and temperature changes.

Current Management and Restoration Efforts

As part of the 2014 Chesapeake Watershed Agreement, brook trout restoration was included as a specific outcome for the Vital Habitats goal. The outcome is to *Restore and sustain naturally reproducing Brook Trout populations in Chesapeake headwater streams with an eight percent increase in occupied habitat by 2025.* Brook Trout Program staff worked with the Bay Program's Habitat Goal Implementation Team (GIT) group to complete the relevant work projects described in the two-year work plan for this outcome (Table 2). This work plan helps guide restoration efforts in the Bay watershed to meet the Watershed Agreement's Brook Trout Outcome and includes specific research designed to develop a metric that will track progress towards the goal of increased habitat and is compatible with Maryland's BTFMP. During 2016, Brook Trout Program staff cooperated and assisted in work efforts towards completing Key Actions 1, 2, 7 and 10 as delineated in the two-year work plan. Staff also provided input for the Bay management boards annual progress update meeting. Partners in this effort include: Maryland Department of Natural Resources, New York State Department of Environmental Conservation, Pennsylvania Fish and Boat Commission, Virginia Department of Game and Inland Fisheries, West Virginia Department of Natural Resources, United States Fish and Wildlife Service, United States Geological Survey, Trout Unlimited, and the Eastern Brook Trout Joint Venture.

Brook Trout Program staff lead the effort to conduct the statewide Wild Trout Angler Preference survey. The survey was initiated by MD DNR Freshwater Fisheries Program primarily to gather data on angler attitudes and preferences towards brook trout angling and management in the upper Savage River system (USR). Also, several questions were included to assess angler attitudes towards statewide wild trout fishing in general. This survey was initiated to address the social information needed to obtain and quantify statewide angler opinions towards the USR brook trout angling regulation, its effect on the quality of the fishing, and angler use of the resource. The results of the survey showed that statewide, Maryland wild trout anglers are generalists as to their angling method,

and the vast majority target wild trout and stocked trout. Support for the USR brook trout special management regulation is unequivocal, and anglers responded that they believe the USR fishery has improved since the regulation was implemented. Support for more conservative brook trout regulations statewide is also extremely strong. Anglers favor more restrictive regulations including catch and release only, tackle restrictions for statewide brook trout management regulation options, and a majority of anglers support not stocking for put and take use where wild brook trout occur. The option to harvest brook trout is the least important aspect of what anglers value about brook trout fishing, further supporting that anglers view the value of the brook trout resource as non-consumptive.

Brook Trout Program staff organized and hosted the first annual youth brook trout fishing clinic at Big Run State Park, Garrett County, Maryland. Twenty-six young anglers attended the event, which was focused on helping them learn about a variety of topics with the intent to make them better brook trout anglers (and anglers in general). Topics covered included: what brook trout eat, knot tying, catch and release techniques, and casting lessons for spin fishing and fly fishing. Volunteers from Bill's Outdoor Center, Early Rise Fly Shop, and the Nemaquin Chapter of Trout Unlimited were on hand to assist in making the day a success. Freshwater Fisheries staff handled instruction at the stations and helped to prepare food, register kids, and answer any questions. Overall, the day was successful with numerous participants thanking us and sharing stories of the fish they caught. Several children indicated they had caught their first brook trout.

Brook Trout Program staff attended the Southern Division of the American Fisheries Societies' Annual Trout Committee meeting (<http://sdafs.org/trout/annual-meetings-and-minutes>) at Oglebay Conference center in Wheeling, West Virginia (2016). Several new initiatives were discussed, and a particular area of concern was the issue of invasive fish diseases in wild trout populations and in hatchery systems and the vectors for arrival. The committee agreed to develop a sub-committee to create a document to describe the problem and suggest methods to address these concerns, and staff agreed to

participate in this effort. Staff have been active members of the Trout Committee for many years, serving as past committee chairs in 2010 and 2013 and hosting the meeting at New Germany State Park in 2012. The Trout Committee is the longest active serving committee in the Southern Division and the 2017 meeting will be the 50th consecutive meeting. Participating state and federal agencies represented at the 2016 meeting included the National Park Service, National Forest Service, United States Geological Survey, and staff from state natural resource agencies of Maryland, Virginia, West Virginia, North Carolina, Tennessee, Arkansas, Missouri, and Kentucky. Non-governmental participants included staff from the Eastern Brook Trout Joint Venture, Trout Unlimited, and the developer of the MicroFish software package.

Brook Trout Program staff continued to work with Trout Unlimited representatives, MD DNR Inland Fisheries staff, Carroll and Baltimore County natural resources staff, and National Aquarium staff to develop and implement a brook trout restoration effort on a watershed scale for the upper Gunpowder River (UGR) watershed (upstream of the Prettyboy reservoir). This watershed has been identified as having a high likelihood of success for brook trout habitat restoration and reintroduction, and at a larger scale than has been attempted before in Maryland. This will be a long-term effort with the potential to provide a significant increase in the amount of habitat occupied by brook trout by 2025. Work completed in 2016 included assisting with the publication and distribution of a brochure for public dissemination that describes the plan and restoration goals, placement of water temperature logging devices in tributaries, and radio tracking of 15 adult brook trout collected in the mainstem of the UGR.

Brook Trout Program staff continued working with the Maryland Department of the Environment's Abandoned Mine Lands Division on a watershed scale restoration effort within the Casselman River 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. Water quality and brook trout monitoring was done at these sites and will continue annually.

Brook trout population monitoring was done following the completion of a large scale streambank restoration and brook trout habitat enhancement project was completed in the Upper Savage River (USR) mainstem. The project was spearheaded by the Canaan Valley Institute, and included as partners Maryland DNR Freshwater Fisheries Division, the Savage River Watershed Association, and Trout Unlimited. Total project cost from grants was \$274,175 and funding was provided by the National Fish and Wildlife Foundation (NFWF), the Chesapeake Bay Trust (CBT), and the Exelon Corporation. In-kind match funds were provided by the Canaan Valley Institute and the MD DNR's Inland Fisheries Division. Approximately 1,000 feet of streambank were restored and protected. Fish habitat structures were created in-stream to benefit the brook trout population. Work was completed in fall of 2015 and brook trout were observed using the newly created habitat within weeks of completion. Fish and invertebrate population monitoring will be done annually to measure the success of the restoration. Fish monitoring results from 2016 showed substantial numbers of adult brook trout, up to 14" in length, inhabiting the new fish habitat areas.

Issues of Concern

Increased salinity levels in streams from runoff of road salt holding areas and salt use on roads in the winter has been observed. Impacts on freshwater aquatic organisms can occur as a result of this, and of particular concern is the potential impact on brook trout populations. Laboratory studies in partnership with the United States Geological Service(USGS) and Frostburg State University are being initiated to determine if brook trout eggs and fry stages are affected by increased salinity levels, thereby, simulating increases that have been observed in streams.

Initial statewide brook trout population sampling completed in 2014 and continuing work in 2015 and 2016 revealed a substantial loss of historically occupied brook trout habitat in the Central region of Maryland. While not unexpected, this trend will likely continue as the

five-year sampling rotation is completed. Two major factors are likely responsible for the decline, increasing human development and competition with invasive brown trout. Additional restoration work in the Gunpowder River system is planned (upper Gunpowder River mainstem) and research related to brook trout movement within the watershed.

The recent discovery of gill lice *Salmincola edwardsii* in North Carolina brook trout populations is a potential concern for Maryland brook trout populations. This copepod is endemic to brook trout populations in the northern portion of their native range but has not been seen south of New England and Great Lakes states. Typically, infestations are not considered significant at a population level but recent increases in parasite loads in Wisconsin and Minnesota are contributing to population declines (Mitro et al. 2014). Brook Trout Program staff applied for grant funding through the State Wildlife Grant (SWG) program in 2014 and received funding in 2015 to investigate if gill lice are present in Maryland brook trout populations. Sampling will be done in 2017 and 2018. 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, and energy extraction and development issues (gas and wind). Angler and citizen input and volunteer effort will be vital for brook trout conservation as land use and development issues are the determining factors for habitat loss and continued brook trout survival. Participating in citizen watershed associations and angler advocacy groups can provide valuable and needed input to assist municipalities and counties with brook trout conservation. The Maryland Brook Trout webpage lists sites and names of state and national groups that are working for brook trout conservation (<http://dnr2.maryland.gov/fisheries/Pages/brook-trout/index.aspx>).

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Table 1. 2014, 2015, and 2016 statewide brook trout sampling effort by river basin, as per the Maryland Department of Natural Resources Brook Trout Fisheries Management Plan.

River Basin	# Streams Sampled 2014	# Streams Sampled 2015	# Streams Sampled 2016
GU	5	19	20
PA	10	-	2
MP	3	3	6
UNB	24	24	44
UP	2	-	2
WC	1	-	1
YG	26	31	12

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

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

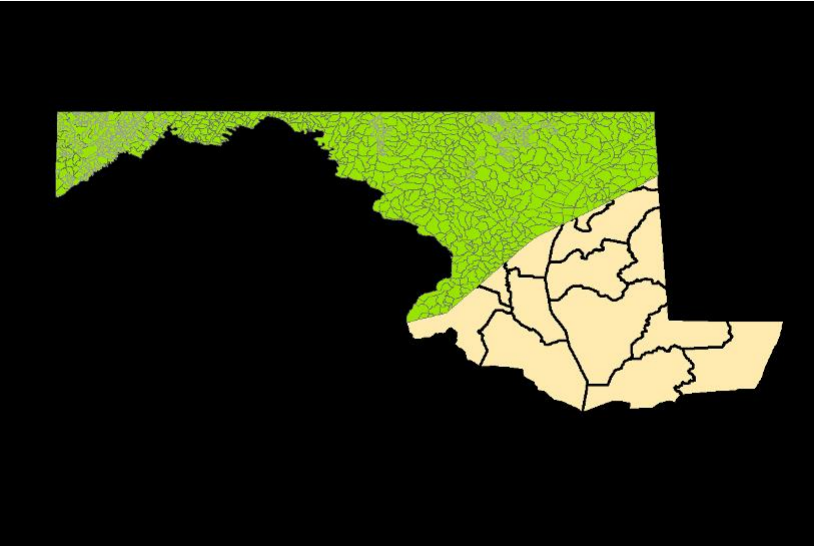


Figure 2. Current (2015) Distribution of Brook Trout in Maryland, by Subwatersheds (green is currently occupied).

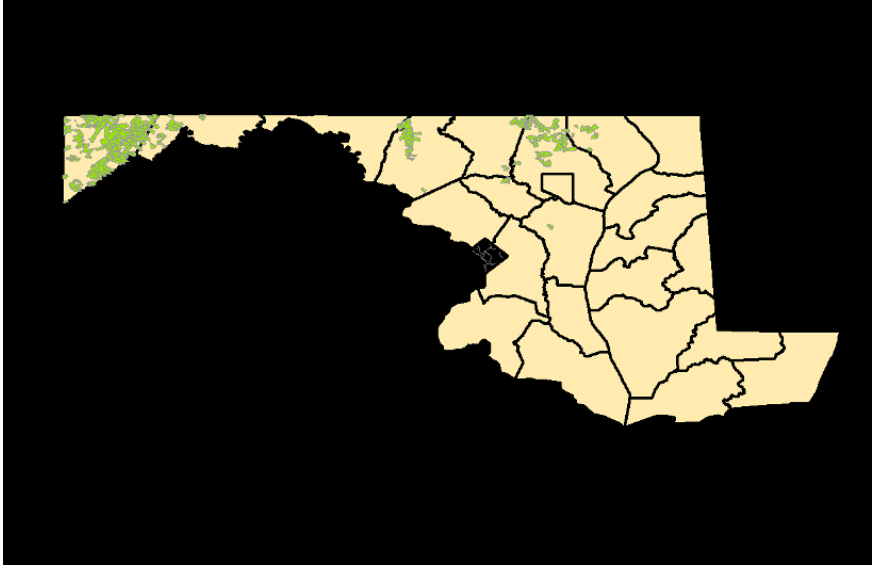


Figure 3. Two-year brook trout Work Plan (page 1) developed by the Multi-State and Federal Brook Trout Action Team as part of the Brook Trout Outcome in the 2014 Chesapeake Bay Agreement.

Outcome: Brook Trout					
Goal: Restore, enhance, and protect a network of land and water habitats to support fish and wildlife, and to afford other public benefits, including water					
Outcome: Restore and sustain naturally reproducing Brook Trout populations in Chesapeake Bay headwater streams, with an eight percent increase in					
Long term Target:		Pending analysis in Action Item 2			
2 year Target:		Pending analysis in Action Item 2			
Management Approach 1: Identify and Communicate Priority Focal Areas for Brook Trout Conservation					
Key Action** <i>Description of work/project. Define each major action step on its own row. Identify specific program that will be used to achieve action</i>	Performance Target(s) <i>Identify incremental steps to achieve Key Action.</i>	Participating Entity <i>Identify responsible partner for each step.</i>	Geographic Location	Timeline <i>Identify completion date (month & year) for each step</i>	Factors Influencing and/or Gap <i>Identify related factor or gap in Management Strategy</i>
1. Target and conserve wild brook trout populations in subwatersheds that have best potential for sustaining resiliency	Identify 10 "Priority Level One" patches (2 in each of 5 states) to conserve by 2017	Eastern Brook Trout Joint Venture with assistance from MD DNR, VA DGIF, WV DNR, NY DNR, and PA FB	MD, VA, PA, NY, WV and National Parks within the watershed	Spring 2016	Stream temperature (lack of riparian forest buffer)
	Utilize the Eastern Brook Trout Conservation Portfolio Project to deliver a fine scale assessment of priorities within historical focal areas.	Trout Unlimited	Headwater regions of the Chesapeake Bay	2017	
2. Communicate "best of the best" patches in context of local conservation planning	Map overlay with 'healthy watersheds map' and accompanying 'story map' that highlights successful local watershed efforts	CBP GIS team, Local Government Advisory Committee, Maintain Healthy Watersheds GIT, Upper Gunpowder Watershed Conservancy	MD, VA, PA, NY, WV	Summer 2016	Decision-maker awareness
Management Approach 2: Consider Climate Change and Emerging Stressors in Determining Restoration Priorities					
Key Action** <i>Description of work/project. Define each major action step on its own row. Identify specific program that will be used to achieve action</i>	Performance Target(s) <i>Identify incremental steps to achieve Key Action.</i>	Participating Entity <i>Identify responsible partner for each step.</i>	Geographic Location	Timeline <i>Identify completion date (month & year) for each step</i>	Factors Influencing and/or Gap <i>Identify related factor or gap in Management Strategy</i>
3. Add predictive layer for acid mine drainage-impacted streams and unconventional oil and gas development	Obtain needed data from states; CBP contract to create overlay to refine existing pilot model (Downstream Strategies)	Faulkner (USGS) and Petty (WVU); Habitat GIT seek funding to create overlay	MD, VA, PA, NY, WV and National Parks within the watershed	12/16 - Contractor selected; 12/17 - information provided to contractor	Declining coal production, losses in bond/severance tax revenues, State/Federal regulations
4. Consider impact of invasive species on brook trout habitat to better influence management of habitats and surrounding watersheds	Review invasive species portion of USGS study (Snyder et. al. 2015) and other relevant literature	USGS, Mid-Atlantic Panel on Aquatic Invasive Species, Habitat GIT	MD, VA, PA, NY, WV	2017	Invasive species, specifically Rainbow and Brown Trout

Figure 3. Two-year brook trout Work Plan (page 2) developed by the Multi-State and Federal Brook Trout Action Team as part of the Brook Trout Outcome in the 2014 Chesapeake Bay Agreement.

5. Implement Trout Unlimited's Home River Initiatives (Potomac Headwaters, Shenandoah, and Upper James River), which focus riparian and in-stream restoration efforts on cold water streams.	Restore and re-connect fragmented brook trout patches, with an emphasis on re-connecting intact fisheries or high quality patches. Continue to work with partners to reconnect and restore large Brook Trout patches with limestone influence. Restore reduced brook trout populations and extirpated patches.	Trout Unlimited	South Branch and Cacapon River Watersheds in WV. Shenandoah and James River Headwaters in Virginia.	2017	Adaptation
Management Approach 3: Refine and Apply Decision Support Tools					
Key Action** <i>Description of work/project. Define each major action step on its own row. Identify specific program that will be used to achieve action.</i>	Performance Target(s) <i>Identify incremental steps to achieve Key Action.</i>	Participating Entity <i>Identify responsible partner for each step.</i>	Geographic Location	Timeline <i>Identify completion date (month & year) for each step)</i>	Factors Influencing and/or Gap <i>Identify related factor or gap in Management Strategy</i>
6. Apply pilot decision support tools to target stream restoration projects for brook trout, including habitats vulnerable to fragmentation and groundwater influences	Apply Riparian Forest Buffer Mapper tool to "Priority Level 2" Wild Brook Trout Only patches Run the Brook Trout Patch Vulnerability analysis on any extirpated spring creeks in the Bay watershed to identify those with the greatest likelihood of persisting as suitable habitat	USDA Forest Service, Climate Change Workgroup, USGS (Hitt and Snyder), Stream Health Workgroup	MD, VA, PA, NY, WV and Shenandoah National Park	Fall 2016	Stream temperature (lack of riparian forest buffer) and Development
7. Host dialogue on varied brook trout angling regulations across states and in National Parks	Survey each state and NP regulatory agencies as to specific BKT regulations, create a summary document by end of 2017	Brook Trout Action Team with facilitation assistance from Eastern Brook Trout Joint Venture (Invitees: NPS, MD DNR, VA DGIF, WV DNR, NY DNR, PA FBC)	MD, VA, PA, NY, WV and National Parks within the watershed	12/16 - Information provided from states and NPS; 12/17 - summary document completed	Brook Trout fishery quality, angler use/opportunity

Figure 3. Two-year brook trout Work Plan (page 3) developed by the Multi-State and Federal Brook Trout Action Team as part of the Brook Trout Outcome in the 2014 Chesapeake Bay Agreement.

<p>8. The Chesapeake Bay Commission will work collaboratively with the Bay Program partners to identify legislative, budgetary and policy needs to advance the goals of the Chesapeake Watershed Agreement. We will, in turn, pursue action within our member state General Assemblies and the United States Congress. See CBC Resolution #14-1 for additional information on the CBC's participation in the management strategies.</p>		CBC	Chesapeake Bay Watershed	ongoing	
Management Approach 4: Continue and Expand Brook Trout monitoring efforts					
Key Action** <i>Description of work/project. Define each major action step on its own row. Identify specific program that will be used to achieve action.</i>	Performance Target(s) <i>Identify incremental steps to achieve Key Action.</i>	Participating Entity <i>Identify responsible partner for each step.</i>	Geographic Location	Timeline <i>Identify completion date (month & year) for each step</i>	Factors Influencing and/or Gap <i>Identify related factor or gap in Management Strategy</i>
<p>9. Continue assistance to states in monitoring brook trout occupancy and develop indicator using this data</p>	<p>Lead contacts in each state report Ches Bay patch occupancy information to Technical Lead; develop indicator by release of 2016 Bay Barometer</p>	<p>Ches Bay State reps on Eastern Brook Trout Joint Venture's Science and Data Committee, CBP STAR assist on indicator development</p>	<p>MD, VA, PA, NY, WV</p>	<p>annual monitoring</p>	<p>Trend data for presence/absence</p>
	<p>Work with TU's Potomac Headwaters Home River Initiative and Pennsylvania Coldwater Habitat Restoration Program with collecting and compiling Brook Trout patch and genetic sampling data.</p>	<p>Trout Unlimited</p>	<p>WV, PA</p>	<p>Ongoing</p>	
<p>10. Collect genetic information as potential census method for determining population viability and long-term restoration success</p>	<p>Genetic samples from 5 patches per state provided annually</p>	<p>U-Mass Amherst (Jason Coombs et al)</p>	<p>Five sites in each of five states</p>	<p>annual monitoring</p>	<p>Interbreeding with brown trout</p>

2006 Maryland Brook Trout Fishery Management Plan Implementation Table.

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

Strategy	Action	Date	Comments
Strategy 1.1 Investigate the life history characteristics, i.e. mortality, longevity, fecundity, growth rate, of Maryland brook trout populations statewide.	Action 1.1.1 Identify and pursue additional funding sources to accomplish the needed work.	2009 - 2013 Continue Projected completion 2015	Joint research project with UMCES Appalachian Laboratory (AL) and MD DNR Fisheries. Funds included a SWG grant. Initiated study of brook trout life history study in the Savage River. This was the number 1 priority action in 2010. Field work completed in 2013. Modeling and report completion is planned for 2015.
Strategy 1.2 Investigate angler use and exploitation on Maryland brook trout populations statewide through creel surveys, and relate harvest and incidental angling mortality to brook trout length frequency structure and maximum fish size.	Action 1.2.1 Identify and pursue additional funding sources to accomplish the needed work.	2012-2013 Statewide Pending, possible initiation in 2018	This is the number 1 priority. Upper Savage River creel survey completed. Statewide creel survey will be based on Upper Savage River creel survey. Funding necessary to expand survey statewide has not been identified. Earliest a statewide creel survey would be initiated is 2018.
Strategy 2.1 Develop a GEP index for brook trout populations in the state of Maryland.	Action 2.1.1 Submit a proposal for funding a GEP index research project to the Maryland DNR State Wildlife Grant program for FY07.	2007-2009 Completed	A SWG project report was completed in 2009. Report directs watershed associations and regional managers where to target conservation efforts.
Strategy 2.2 Utilize the index to categorize the status of brook trout populations in Maryland and create a priority list of those most at risk, and those for which conservation efforts would have long term		2009 Continue	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 2018 – 2019.

potential for long term restoration.			
Strategy 3.1 Identify and protect at- risk brook trout populations.	Action 3.1.1 Determine at- risk populations by statewide fisheries region using current data, and then by using GEP index information once it becomes available.	In progress Projected completion 2019	This was the number 2 priority action (along with Action 13.1.3) in 2010. Developing a GIS layer to identify and prioritize at-risk populations based on GEP and other risk factors. Additional resources are needed to continue project.
	Action 3.1.2 Develop a priority list of populations to be protected, incorporating the GEP index value, land ownership (private versus public), upstream watershed size and land use, public resource access, connectivity to other brook trout populations, and recreational value.	Pending	Requires completion of 3.1.1. The priority list will be generated when the GEP map has been developed.
Strategy 4.1 Develop a brook trout management plan for the Savage River watershed upstream of the Savage River dam. This plan will be used as a blueprint for developing plans in other brook trout watersheds.	Action 4.1.1 Develop a comprehensive Geographic Information System (GIS) database detailing land ownership and usage within the upper Savage River watershed, incorporating summer water temperatures and brook trout population abundance from the Maryland DNR's Inland Fisheries and MBSS databases.	2007 Continue	GIS project underway as a joint effort of MD DNR, Savage River Watershed Association, and the Izaak Walton League. Final report is being drafted. GIS database has been completed, water budget work will be initiated in 2017.
	Action 4.1.2 Utilizing the GIS analysis, identify areas within the USR watershed that are impacting brook trout populations and water quality and develop a priority list of restoration/conservation activities.	2007 Continue	Requires completion of 4.1.1. Final report is being drafted. Report will include prioritized list of impacted brook trout populations.
	Action 4.1.3 Identify areas within the Savage River that need additional conservation.	2007 Continue	Requires completion of 4.1.1. Final report is being drafted. Report will identify focal conservation areas for watershed associations.
Strategy 4.2 Present the information and			No action was formulated in the BTFMP.

recommendations in the BTFMP to the MD DNR Western Regional Team to solicit input and support.		2007 Discontinued	MD DNR Western Regional team was disbanded in 2007. Strategy is no longer practicable and is not being pursued.
Strategy 4.3 Develop a watershed-wide strategy for protecting habitat, Especially buffer protection and restoration in impacted headwater streams.		Pending	No action was formulated in the BTFMP. Action: Create a stream buffer and land use/land cover map to locate areas of concern. Threshold for negative impacts is 2% impervious surface. The map will incorporate existing state and federal land preservation and buffer strip restoration programs. Development of a GIS layer is being explored. Anticipated to begin in 2017.
Strategy 4.4 Identify adverse summer water temperature impact areas (impoundments, etc.) and develop strategies to alleviate the impacts.		2007 Continue	This is the umber 4 priority action. No action was formulated in the BTFMP. Action: Create a network of temperature loggers to monitor thermal impacts to streams. Obtain existing water temperature data and develop a GIS layer within the BKT database.
Strategy 4.5 Designate the upper Savage River watershed a fisheries “Habitat Area of Particular Concern” (HAPC). This designation will allow the development of regulations and monitoring programs to protect the resource on a watershed specific basis. It will also help to develop and foster the public and resource users’ support for the management	Action 4.5.1 Institute angling regulations to provide for maximum protection of brook trout while still ensuring angler use of the resource, i.e. no closed season, no harvest, single hook barbless lures only, no bait.	2007 2007 – 2013 Continue	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. Results indicate that the regulation has been effective in meeting management objectives to increase the number of fish >200 mm, reduce angler related mortality, and protect the only intact brook trout system in MD (upper Savage River) while optimizing

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.			angling use. Restoration of trout population densities has been partially successful. Plans for long term continued monitoring will be developed in winter 2014 and implemented in summer 2015.
Strategy 4.6 Promote and encourage the development of a citizen-based Savage River watershed advocacy organization. MD DNR will provide technical support as needed.		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.
Objective (Strategy) 5 Encourage riparian buffer habitat preservation and restoration.	Action 5.1.1 Develop a list of target watersheds in Maryland that could benefit from the CREP program, rank each system based on brook trout population status (best to worst), headwater agricultural impact, and size and connectedness of the system.	Pending	Implementation requires completion of Strategy 4.3. Implementation will aid with at-risk population targeting.
	Action 5.1.1 Using the list generated from Action 5.1.1, actively recruit and enroll farmers from the targeted watersheds into the CREP program.	Pending	Dependent on the completion of Action 5.1.1
	Action 5.1.2 Create a list of the Federal, state, and NGO conservation and restoration programs that are available to landowners; inform Regional Fisheries managers and biologists of these programs so they can work with private landowners to improve land use and water quality.	Pending	No progress to date.

<p>Strategy 6.1 The information that is needed by regulators and developers to appropriately consider and plan activities so they do not adversely impact brook trout populations is available. Developing an outreach strategy to convey this information will provide key agencies and developers with the understanding necessary to make appropriate decisions.</p>	<p>Action 6.1.1 Develop a series of PowerPoint presentations that illustrate the life history needs of brook trout and the adverse impacts that can occur from anthropogenic activities. Provide an ecosystem perspective by including a description of how brook trout serve as indicators of overall stream health; and what a healthy brook trout population means to the health of a watershed and the lives of those who reside there.</p>	<p>2011 Completed</p>	<p>This is the number 4 priority action.</p> <p>Eastern Brook Trout Joint Venture (EBTJV) developed educational and outreach materials such as videos, webinars, maps, and reports with a national perspective. More information is available at http://easternbrooktrout.org/</p> <p>Information from brook trout research and similar efforts is now available to fully develop communication and education tools for protection of brook trout and their habitat in MD. Action 6.1.1 is scheduled for completion in 2016 – 2017.</p>
	<p>Action 6.1.2 Meet with county and local government officials/agencies and commercial developers to present the information and to establish a dialog on the issues relating to the conservation and value of Maryland’s native brook trout.</p>	<p>Pending</p>	<p>Requires completion of 6.1.1.</p>
	<p>Action 6.1.3 Make presentations available to the general public through appropriate pathways, i.e. website, libraries, etc.</p>	<p>Pending</p>	<p>Requires completion of 6.1.1.</p>
	<p>Action 6.1.4 Work cooperatively with other state agencies to insure adherence to state water quality standards.</p>	<p>2007 Continue</p>	<p>Better communication fostered between MDE and DNR. DNR environmental review expanded to include teams that address specific water quality issues. Direct negotiations between Inland Fisheries and MDE focused primarily on stream classification.</p>
<p>Strategy 7.1 Develop statewide restoration guidelines for restoring extirpated brook trout populations.</p>	<p>Action 7.1.1 Adopt and modify the guidelines developed for brook trout restoration by the American Fisheries Society’s Southern Division Trout Committee.</p>	<p>Pending</p>	<p>This is the number 2 priority action.</p> <p>Implementation is pending information from the life history and genetic research projects (Actions 1.1.1 and 7.1.2) and review of the Southern Division of the American Fisheries Society Technical Committee’s (SDAFS TC) guidelines for brook trout restoration. Work is</p>

			scheduled for 2015 – 2016. This work is now scheduled for 2018-2019.
	Action 7.1.2 Incorporate a genetic component into the guidelines to direct brood fish selection location.	2010 - 2013 2014 Continue	UMCES Appalachian Lab has collected and inventoried brook trout genetics in all watersheds. Laboratory work and analysis will continue through 2018.
Objective (Strategy) 8 Complete genetic inventory of discrete brook trout populations.	Action 8.1 Secure funding (an estimated \$10,000) to complete the statewide brook trout genetic inventory. The USFWS State Wildlife Grant Program and EBTJV are two possible funding sources for completing this work.	Pending	Funds are being sought to complete the genetic inventory. Partially completed for the USR in 2014, SWG funding secured in 2016, samples will be collected in 2017, and a report generated in 2018-2019.
Strategy 9.1 Establish pathways to inform the general public about brook trout conservation and protection.	Action 9.1.1 Utilize the Maryland Sport Fisheries Advisory Commission (SFAC), DNR Regional Teams, and other appropriate state agencies to solicit input on brook trout conservation measures.	Continue	This is the number 3 priority. Strategy 9.1 aligns with Strategy 6.1. Inland Fisheries advised the MD Taskforce on Fisheries Management and regularly updates the SFAC as new research, monitoring, and regulation information becomes available.
	Action 9.1.2 Post the BTFMP on the DNR Fisheries Service webpage and request on-line comments on conservation measures as part of the regular review of the BTFMP.	2006 Continue Completed	Strategy 9.1 aligns with Strategy 6.1. BTFMP posted on line. Trout fishing information is available on the DNR Fisheries Service web site. A DNR Brook Trout webpage has been completed, and provides program information such as management updates, research highlights, and habitat needs. The webpage includes an interactive public comment interface allowing DNR to solicit public input, opinions, and observations regarding current

			and proposed conservation and management actions.
Strategy 10.1 Encourage public participation in fishery management through informational and regulatory meetings and the development of organized watershed advocacy groups. Current federal efforts are directed at assisting the formation of advocacy groups by funding startup and operational costs.	Action 10.1 Develop a list of watershed advocacy organizations in Maryland with current contact information. Evaluate the need for additional groups. Create a list of federal agency contacts that can assist with citizen advocacy groups.	2009 Completed	A list of watershed groups and advocacy organizations has been created. These organizations have developed their own lists of federal agency contacts.
Strategy 11.1 Develop a consistent, coordinated monitoring program to: 1) assess and track population abundance and viability; 2) monitor and detect environmental changes from anthropogenic (acidification, sedimentation, development/urbanization, AMD, etc.) and natural causes (floods, drought); 3) monitor and detect exotic species encroachment and impacts; and 4) monitor/detect water flow and temperature changes.	Action 11.1.1 Develop a monitoring schedule to insure that all brook trout populations statewide are sampled at least once every 3 years.	2008-2009 Completed 2009 Continue 2012-2013	This is the number 5 priority. Monitoring plan is a Federal Aid requirement. Comments from the MD Task Force on Fisheries Management and SFAC were incorporated in the plan. Streams will be monitored on a five year rotation from 2014- 2018. Brook trout in the upper Savage River were tagged and tracked via radio telemetry. Seasonal distribution was documented and tributary connectivity will be important for effective population management. A manuscript was drafted and study results are not yet available pending publication.
	Action 11.1.2 Coordinate brook trout sampling efforts between Inland Fisheries and the MBSS to maximize efficiency. Where possible, reduce the number of sites Inland Fisheries needs to monitor. Fisheries should focus on monitoring streams for recreational	Began 2006 Formalized 2010 Continue	Inland Fisheries and MBSS have increased sampling coordination. Action will continue annually.

	fisheries, MBSS on sampling headwater, privately owned streams.		
Strategy 12.1 Develop a standardized sampling protocol for monitoring brook trout populations that includes: MBSS water quality and habitat data collection components; establishment of permanent sampling stations; number of stations per stream length; and fish collection methodology.	Action 12.1.1 Create a sampling standardization committee with members from Inland Fisheries and MBSS to develop the sampling methodology.	2006 2011 Pending	MBSS sampling protocol informally adopted for portions of the Savage River. MBSS sampling protocol requires more discussion before being implemented statewide. Integration of a multi-layer sampling protocol is being considered as a modification to the MBSS sampling protocol.
	Action 12.1.2 Conduct training with Inland Fisheries staff to implement the standardized methodology.	2011	Completion of Action 12.1.1 is required. Some informal training has been done to date.
	Action 12.1.3 Collect summer water temperatures with in-stream temperature.	2007 Continue	Strategy 12.1 aligns with Strategy 4.4. Includes Inland Fisheries efforts and data from MBSS.
Strategy 13.1 Develop a database that incorporates, and where possible, standardizes, the historic and current statewide brook trout information available from the Inland Fisheries, the MBSS, and the University of Maryland monitoring programs.	Action 13.1.1 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 Continue as needed	Action 13.1.1 is the number 2 priority (along with Action 3.1.3). Informal data management group has been established and convenes as needed.
	Action 13.1.2 Identify other sources of brook trout data, such as MD Bureau of Mines, additional academic institutions, and Federal agencies, and incorporate the data into the statewide format.	Completed	Requires completion of Action 13.1.1.

	Action 13.1.3 Develop a GIS database describing BT population boundaries, population information, habitat variable information, and water temperature data.	<p style="text-align: center;">2009 Continue</p>	<p>Action 13.1.3 was the number 2 priority (along with Action 3.1.1) in 2010.</p> <p>GIS database was completed and functional in 2013. It will be updated annually.</p>
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Acronyms

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

2016 Maryland FMP Report (July 2017)

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

During 2016, the Sport Fisheries Advisory Commission (SFAC) recommended the formation of a Black Bass Advisory Subcommittee (BBAS) to address management issues for the recovery of black bass in the Upper Bay and Potomac River. Prior to the new subcommittee, the Maryland Department of Natural Resources, Fishing and Boating Services, (MD DNR, FABS) hosted informal meetings as needed to discuss black bass issues. The BBAS met several times in 2016. Members have been discussing a range of topics and have presented information to the SFAC for consideration. Discussion topics and subsequent actions can be found on the BBAS web page <http://dnr.maryland.gov/fisheries/Pages/mgmt-committees/bbas-index.aspx>.

Largemouth bass has 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 now illegal in Maryland and the recreational fishery includes pass-time fishing, live-release competitive sportfishing (or tournaments), and charter boat guiding. Fishing pressure is an important consideration for the largemouth bass fishery even though it is primarily a catch-and-release fishery. Harvest, catch-and-release mortality and a daily possession of bass during tournaments can affect survival of adults and contribute to fishing mortality. Aside from fishing mortality, natural mortality and reproduction are affected by habitat quality. Habitat conditions may be influenced by pollution, invasive species, and climate change. Because of the roles of both fishing pressure and habitat quality on structuring largemouth bass populations, strategies and actions were developed to manage largemouth bass in Maryland's tidal waters.

Strategies and management actions are described in the Fishery Management Plan (MDLB FMP) for Largemouth Bass in Maryland Tidewater (January 2014). The goal of the MDLB FMP is to describe objective reference points and provide management targets for populations in tidal freshwater habitats of the Maryland portion of the Chesapeake Bay watershed. Largemouth bass populations occur throughout Maryland's tidal freshwater. Populations differ in size and size structure, as well as productivity because of differing habitat quality and fishing pressure. In some locations it has become necessary to take management actions to help conserve the population by minimizing the negative impacts of intense fishing pressure and poor habitat quality. Actions have also been taken to identify 'at risk' populations so that resources may be effectively appropriated. At risk populations are identified using a suite of indices calculated, in part, from surveys described in the Standard Operating Procedure (SOP) for the Tidal Bass Program (TBP). Other indices are calculated from tournament reporting. The methodology within the SOP has undergone external peer-review for at least 3 cases and results are reported annually within the Federal Aid Report (for federal and technical audiences) and Black Bass Annual Review (for the general public). The FMP, SOP, short reports and fishery related data are posted on the TBP website:

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

Stock Status

Stock status for largemouth bass in 2016 was determined using survey data from fishery independent and dependent surveys. Assessments were conducted for each riverine population, indices were compared with reference points (Table 1), and general conclusions were drawn based upon the suite of indices and their relationships to reference points.

Catch in the upper Chesapeake Bay was below average, but annual survivorship for the population was above the 75th percentile.

Reproduction and recruitment appear to have improved over previous years. In order to increase the number of adult bass, current projects are aimed at ensuring survival of adults in the population. These projects include increasing awareness of catch-and-release strategies, improving infrastructure for tournaments, and developing an improved stocking policy.

The Potomac River population is naturally improving because of better annual survivorship, reproduction and recruitment. However, the average catch of age 1+ fish remains below the reference point. Projects aimed at improving survival of young bass and old bass are underway so that catch of age 1+ fish should increase in the future. Current projects to meet that objective include: increasing awareness of catch-and-release strategies, improving infrastructure for tournaments, and developing an improved stocking policy.

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

The population from Marshyhope Creek represents a small fraction of fish that may be caught in the Nanticoke River drainage. The population in Marshyhope Creek is actively fished. While total catch levels were lower in 2016 than prior years, the catch rate (i.e., number electrofished per hour) was similar to other eastern shore rivers. Average catch of juveniles was similar to previous years catch suggesting that recruitment has not appreciably changed. Continued

monitoring of fish larger than 381 mm for proportion of sample, disease, translocation and survival appear warranted.

The Pocomoke River population survey yielded results that were similar to previous years, reflecting a small but sustainable population. The fishery appears to be in good shape and perhaps benefits from the strong year class in 2014. As suggested in earlier federal aid reports (MD DNR 2016), the 2014-year class have likely recruited into the fishery and were collected during the 2016 survey when the fish were vulnerable to capture by the survey gear. To provide a robust stock assessment for this population, a complete 10-year time series of data will be available in 2019 with population specific reference points available in 2020.

The Gunpowder River population is challenged by a habitat that severely limits its natural growth potential. High levels of salinity and sedimentation, in addition to urbanized development and nutrient runoff, create a challenging environment. It is also a difficult environment to survey with electrofishing gear, which may have negatively biased the survey results. Additional forms of surveys (e.g., creel surveys) have been recommended. Despite the sampling bias, observations of environment and available electrofishing data suggest that the population size is likely to be naturally small. Juveniles have not yet been collected in Gunpowder River. Attention paid to the Gunpowder River bass population by bass anglers is likely owed to access, the density of people, and popular fishing launches for bass anglers (e.g., Gunpowder State Park). Therefore, prioritizing this area as a sport fishery appears warranted. Management actions to improve the fishery, however, may be limited to promoting awareness about reducing pollution and stocking fish rather than restricting fishing opportunities. Fishing mortality appears to be naturally restricted by the small population size of largemouth bass.

Current Management Measures/The Fishery

The number of largemouth bass caught, weighed, and released by tournament anglers is reported by permitted tournament directors. Not all tournaments are permitted, particularly those without a staged weigh-in area or those with less than 10 boats. There are no protocols in place to measure the number of largemouth bass caught and released by pass-time anglers or charter boat guide clients. A creel survey was begun in May 2017 to measure fishing effort in tidal waters of Potomac River and Upper Chesapeake Bay. These data will improve the Department's ability to objectively assess the quality of the fishery from the perspective of the angler.

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

Focus Areas for 2017-18

The TBP will focus on the following actions:

- 1) Continue the Tidal Bass Survey so that at least a 10-year baseline of data is established for targeted tidewater areas and populations are monitored at least bi-annually. Continue surveys as specified in the Tidal Bass Program's [Standard Operating Procedure](#) during fall as funded with federal and state money.
- 2) Recalculate reference points, as needed, and correct growth rate reference points.
- 3) 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.
- 4) Develop measures to determine angler satisfaction and relate those measures to fishery-independent and fishery-dependent indices. Angler satisfaction will be determined using two methods: a) statewide creel surveys and angler preference surveys conducted annually or semi-annually; and b) spatial analysis of historically valued tidal fishing areas and the habitats associated with those areas using data from *Fishing in Maryland*.
- 5) Determine economic impact of the fishery using statewide angler creel surveys and determine the economic impact of tournaments.
- 6) Proactively provide outreach information regarding handling bass, the use of additives, mechanisms to assure adequate live well maintenance, and factors that improve post-release survival of captured bass.
- 7) Support responsible growth of bass tournaments at Elk Neck State Park.
- 8) Begin monitoring state's first artificial reef for tidal black bass.

Table 1. Stock assessment of largemouth bass populations in 2016 for targeted drainages of the Chesapeake Bay watershed using indices and metrics reflecting changes in population biology. When a metric falls below the 25th percentile computed for available data for that river, the ▼ symbol is given. When a metric falls above the 75th percentile computed for available data for that river, then the ▲ symbol is given. nc = value falls within the 25th and 75th percentiles. For tidal rivers where 25th and 75th 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 at the bottom of the table. NA = Not Available

River	N	CPUE	Cor-CPUE	CPUE, 1+	PSD ₃₀₅	PSD ₃₈₁	-Z	GR-EXPrise	GR-VBGF	LW-Slope	W _r	K _n	JuvCPUE	JUVPSD	JUV%OCC
Upper Bay	30	40.53 ▼	12.81	18.12 ▼	0.73	0.39	-0.39 ▼	66.91	67.25	3.23	1.01	1.00	34.53	0.61 ▼	0.90 ▲
Potomac	51	73.65	49.03 ▲	25.63 ▼	0.63	0.36 ▲	-0.64	64.92	65.23	3.19	1.01	1.00	46.65	0.71 ▲	0.88 ▲
Patuxent ¹	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Choptank ¹	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Wicomico	25	20.52	15.49	17.00	0.60	0.37	-0.46	63.70	63.83	3.31	1.01	1.00	24.33	0.23	0.82
Marshyhope	25	14.80	8.79	8.40	0.54	0.09 ☹	NA	59.60 ☹	59.88 ☹	3.26	1.02	1.00	17.58	0.25	0.53
Pocomoke	28	16.69	9.71	15.47	0.71 ☺	0.21	-0.53	62.13	62.46	3.27	1.01	1.00	22.23	0.12	0.60
Gunpowder	20	3.98	3.02	7.27	0.83 ☺	0.75 ☺	NA	53.71 ☹	53.64 ☹	3.27	1.01	1.00	0.00	0.00	0.00

¹Not sampled in 2016.

N – Number of sites surveyed

Cor-CPUE - Catch per unit effort standardized for variation in site-measured, water clarity and dissolved oxygen

CPUE – Catch per unit effort

PSD₃₀₅ - Proportional size distribution for stock size fish that were 305 mm or greater

PSD₃₈₁ – Proportional size distribution for stock size fish that were 381 mm or greater

Z – Total annual mortality

GR – Growth rate determined from a two-parameter, isometric growth model

GR_{VBGF} – Growth rate for von Bertalanffy growth models

LW – the slope of the length-weight regression

W_r – relative weight

K_n – relative body condition

JUVPSD - Proportion of juveniles (≤ 200 mm) in sample

JUV%OCC – Proportional occurrence of juveniles among prime quality sampled sites

2014 Fishery Management Plan for Largemouth Bass in Maryland Tidewater Implementation Table (06/2017)

Strategy	Action	Date	Comment
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.	2017 Continue	Similar to previous years, survey completed for 2016 (see Table 1 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.	2017 Continue	Similar to previous years, Black Bass Annual Review completed and online http://dnr.maryland.gov/fisheries/Pages/bass/reports.aspx Two one page outreach reports distributed among over 30,000 black bass anglers. Also 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 changes in the indices.	2016 - 2017	Presented data at Potomac River Fisheries Commission annual meeting on Potomac River bass population . Presented results for Black Bass Advisory Subcommittee that reports to Sport Fisheries Advisory Commission. Presented survey results for upper bay black bass tournament directors.
	1.1.5 Improve sharing of data with other Department biologists and programs, such as the Blue Infrastructure Initiative and GIFS.	2016 - 2017	Critiqued GIFS; improved data sharing with GIFS by updating fish health information. Inland Fisheries website was developed and linked to the Tidal Bass Program page to provide greater cross-referencing with other inland fisheries. Spatial layers added to the online database include those related to fish forage and catch from the surveys.
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	2016 Continue	Coefficients of variation (CV) for indices computed to assess evaluates and determine if any were too high to yield productive indices; CVs ranged between 2% to 65%, with the most variable for catch indices; none varied beyond reasonable expectations (i.e., greater than 100%).

Strategy	Action	Date	Comment
Continue 1.2	is considerably lower than the average point estimate.		
	1.2.3 Allow internal and external peer-review of data collection and analysis to refine methods based on expert opinions.	2015 - 2016	Two papers were published in 2014-2015. One article was published in 2017 and describes problems with the Potomac River bass fishery. The methodology of the publication contained analyses and data collection methods that were critiqued and improved by reviewer comments. Methods were described during stakeholder meetings to encourage feedback. Some suggested fall surveys were inferior to spring surveys.
	1.2.4 Deliver technical reports to regional managers, other internal reviewers, and reviewers of refereed journals for review of methods and data analysis.	2016 Continue	Federal Aid Report and the Black Bass Annual Review were provided to regional managers and senior staff for internal review.
	1.2.5 Assess and/or improve sampling equipment for efficiency.	2015- 2016	QA/QC checks were performed on dataset after they were entered into the GIFS database. Regional managers and Tidal Bass Program discussed and decided upon a routine maintenance schedule for boat electrofishers. Additionally, an oscilloscope was used to detect power output for eastern region vessels, which was also done in southern region in 2014-2015, to ensure there was sufficient power output. New data collection boards (iPads) and software (Numbers) are being used to collect data during the survey. The data entry tabs include automatic QA/QC checks and provide easier import to GIFS, thereby reducing data entry mistakes.
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.	2017	Reference points were re-evaluated and readjusted in the 2014 Tidal Bass FMP and for the 2017 Tidal Bass FMP. Reference points were updated for Choptank River, Patuxent River, Marshyhope Creek, Potomac River, and the upper Chesapeake Bay.

Strategy	Action	Date	Comment
Continue 2.1	2.1.2 Obtain additional data for populations surveyed less than 10 years and develop reference points.	2016 Continue	Data were collected from Patuxent River and Marshyhope Creek to create a 10-year baseline and provide reference points. Populations in Wicomico River, Pocomoke River, and Gunpowder River were surveyed to obtain data for populations with less than 10 years of data.
	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.	2017	Reference points from the peer reviewed literature were used to assess populations without a 10-year reference dataset.
	2.1.4 Adjust reference points as additional data are required for inter-correlations and importance in reflecting the status of populations.	2017	Reference points were developed for Marshyhope Creek and revised for other rivers based on 10 years of surveys beginning in 1999; because of declines in relative abundance in Potomac and upper Bay, data for the past 5 years cannot be included in the reference point calculations.
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.	2016 Continue	For the annual population assessment 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.	2016-2017 Continue	Management actions were evaluated to help improve the Potomac River fishery and the upper Chesapeake Bay fishery. Public input was received on various action options. Catch and return areas were not deemed valuable by the Black Bass Advisory Subcommittee. Additional strategies such as targeting black bass anglers with conservation materials and developing reef habitat in the Potomac River occurred. Additionally, the

Strategy	Action	Date	Comment
Continue 2.2			department stipulated additional requirements on permits issued during warm water weather.
	2.2.3 Conduct population modeling to determine if and how management actions will influence indices and the population.		Spatial modeling was conducted in 2014 to determine how catch-and-return areas would influence populations of largemouth bass in the Potomac River and upper Chesapeake Bay. Assessments were conducted to evaluate existing spring-time regulations in tidal and non-tidal water and the expectations on their expansion to improve the fishery. No work was done on this in 2016/2017.
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.	2017	Emails and phone calls were directed to directors who did not report findings so that we obtained nearly an 80% reporting rate. As more tournament directors become aware of the permitting process, continued outreach on reporting is necessary and time consuming. A letter was issued to directors who have not reported by the Director. In the future continued effort to demonstrate the value of reporting is needed.
	2.3.2 Promote registration and activity reporting of tournament directors, for communication and compliance of permit restrictions.	2017	A letter was issued to past and current tournament directors that reminded them of the obligation to get a free permit and the requirements of the permit (i.e., reporting requirements, no leaking bags).
	2.3.3 Report results during an annual or semi-annual bass roundtable meeting that includes participants from tournaments and the recreational angling community.	2017 Continue	Results were presented at Black Bass Advisory Subcommittee, via webinar to upper bay tournament directors, and the Potomac River Fisheries Commission joint meeting on the status of the Potomac River fishery.
	2.3.4 Perform angler creel surveys, as necessary, to determine angler satisfaction, catch, and harvest rates by recreational anglers.	2016 - 2017 Continue	A statewide creel survey was developed as an on-line Volunteer Angler Survey; anglers who take this survey may win a raffle; licensed anglers are sent an email encouraging them to take the survey and every angler who submits to the MDDNR Angler's Log is encouraged to take the survey; additional datasets were evaluated for their utility (USFWS; Chesapeake Catch, Angler's

Strategy	Action	Date	Comment
Continue 2.3			Log, MRFS), but most of these cannot be used for tidal freshwater habitats; an intercept survey was developed to provide angler creel data that is comparable to past survey data from the 1980's and 1990's; this survey is being carried out.
	2.3.5 Produce studies and provide guidance on live well operating procedures to reduce mortality of largemouth bass.	2015 - 2016	Reviewed and updated guidelines on live release and handling tips in the Maryland Fishing Guide. Additional work was done to obtain information from B.A.S.S. Bass conservation videos were put online, advertised in the fishing guide, and advertised through email lists. Outreach was generated from research on keeping adult largemouth bass alive in live wells at Mississippi State University. Clarified requirements on existing permits for tournament directors that help reduce handling stress on adults. Began studies on the effects of piercing culling devices on bass.
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.	2016 - 2017	Spatial data on watershed quality were obtained from MD DNR Fisheries Habitat and Ecosystem Program. These data were loaded to an on-line spatial database of suitable areas for largemouth bass. This database is accessed at: http://dnr2.maryland.gov/fisheries/Pages/bass/recreational.aspx.
	3.1.2 Ensure that the most informative variables are being measured during the Tidal Bass Survey by conferring with MD DNR Fisheries Habitat and Ecosystem Program.	2017	The datasheet was submitted to Resource Assessment Services and the Fisheries Habitat and Ecosystem Program for internal review.
	3.1.3 Use a habitat suitability index and consult anglers and regional managers to identify habitats important for the spawning success and growth of largemouth bass.	2015	Suitability of spawning coves were identified for several tidal rivers; an ArcGIS shapefile was created to illustrate the coves; the work was written up and will be published in fall 2015 by American Midland Naturalist. It conveys how coves were ranked according to their ability to support largemouth bass reproduction.
	3.1.4 Consult published literature and experts to help	2016 - 2017	Published literature on spawning habitat for largemouth bass was summarized for stakeholders who are evaluating whether catch-and-

Strategy	Action	Date	Comment
Continue 3.1	identify valuable habitat for spawning success and growth of largemouth bass.		return areas are viable options for promoting reproduction. Literature was reviewed and processed, presented to the Black Bass Advisory Subcommittee. This information is available online.
	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.
	3.1.6 Consider the effects of climate change on largemouth bass habitat and develop adaptive management to address possible changes.	2017	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. A spatial layer of spawning coves and potential impact by sea level rise was added to the Tidal Bass Program's website. Water temperature change in tidal Chesapeake Bay was examined and changes in the distribution of fishing areas for bass anglers will be examined for the past 50 years using fishery-dependent data published in <i>Fishing in Maryland</i>. No work has been done to address adaptive management.
	3.1.7 Utilize the proposed Climate Sensitive Areas for use in land-use planning and increased protection of vulnerable habitats especially in regards to largemouth bass habitat.		No work was done on this action.
	3.1.8 Provide comments during permit review via MD DNR Environmental Review to help minimize ecological impacts on	2015 - 2016 Continue	Tidal Bass Program worked with Environmental Review to review consequences and draft a letter regarding the Department's position on coal ash discharge to Potomac River from a Virginia business, Dominion Power; Provided comments regarding construction projects proposed or conducted in upper Choptank, Pocomoke and

Strategy	Action	Date	Comment
Continue 3.1	populations from tidewater of the Chesapeake Bay watershed and largemouth bass habitat.		Wicomico Rivers. Comments were provided regarding a large-scale bridge project in lower Susquehanna River.
	3.1.9 Write letters on official letterhead to stakeholders or on behalf of stakeholders to acknowledge and promote the significance of the fishery.	2017	Official letters were written to tournament directors, those who target black bass in Maryland.
	3.1.10 Promote a level of imperviousness that is lower than 10% of the drainage	2016	A map indicating watershed health, in part based on imperviousness levels, was added to an on-line spatial database of important bass habitats.
	3.1.11 Ensure that natural variability in stream discharge is maintained by encouraging "smart growth" and limiting channelization.		No work was done on this action.
	3.1.12 Encourage lower levels of nitrogen and phosphorus waste from entering waterways via non-point and point sources.	2015-2016 Continue	Letters were written in 2014 regarding eutrophication of Wicomico Rivers. In 2015-2016, reviewed grant proposals for nutrient and sediment reduction from public and private lands. Provided comments on removal of nutrients from storm water for 2 State Highway projects on Route 40 at the Gunpowder/Little Gunpowder.
	3.1.13 Proactively work through a comprehensive plan renewal process to identify and protect important habitat features.	2015-2016	Reviewed and commented on the proposed Mallows Bay National Marine Sanctuary. The focus was to ensure that angler access to Mallows Bay would not be negatively impacted by the "Sanctuary" classification. We were ensured that anglers would retain full access to the water.
	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	2016 - 2017 Continue	Data for invasive snakeheads were collected as part of the Tidal Bass Survey, which is on-going; these monitoring data were presented at a USFWS interagency taskforce to discuss impacts of snakeheads in January. Blue and flathead catfish are also considered invasive species. The commercial harvest of blue catfish has helped lower the biomass of blue catfish in some regions of the

Strategy	Action	Date	Comment
	changes would affect the largemouth bass fishery.		watershed. Studies on expansion and impacts of invasive species on largemouth bass were discussed during taskforce meetings and meetings with stakeholders. Reviews that address impacts were generated as publications for external review and a report to a concerned citizen via Secretary Belton.
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.	2016	Public awareness on the importance of SAV for productivity of largemouth bass was discussed at the Potomac River Fishery Commission's inter-agency meeting in November 2015. A comprehensive review of existing spring-time and year-round possession restrictions was conducted, and that information was used to generate several internal reports. One such report was presented to the Black Bass Advisory Subcommittee. The subcommittee decided that there was not enough evidence to support closures or catch-and-return areas as tools to protect black bass populations.
	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.
	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.	2016 - 2017	An artificial reef ball project was partially completed for Smoots Bay (National Harbor). Permits from Maryland have been obtained and should be obtained from Army Corps of Engineers. The collaboration with MARI will help ensure that future projects have a framework that details the process of artificial reef placement from design to implementation.
	3.2.4 Develop innovative storm water management techniques, promote storm water management retrofits		No work was done on this action.

Strategy	Action	Date	Comment
Continue 3.2	where applicable, creation of wet marshy conditions throughout watersheds, and reconnect streams to riparian areas.		
	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.
	3.2.6 Promote low sedimentation of streams.	2016 - 2017	Reviewed and commented on several projects that promoted low sedimentation of streams.
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.	2016 - 2017	Similar to that in previous years, public meetings were held with PRFC . A webinar meeting was held for upper bay tournament directors. Meetings in Annapolis included six meetings of the Black Bass Advisory Subcommittee and one meeting with the public.
	4.1.2 Evaluate the adequacy of current regulations in supporting the sustainability and quality of the fishery.	2016 - 2017	Catch and return areas were evaluated in 2014 and early 2015. Current possession regulations were also evaluated by MDDNR staff to determine what changes may be made to improve the sustainability of the Potomac River and upper Chesapeake Bay fisheries. These possession restrictions included fishable slots, catch-and-release areas, and closed areas. Past regulations such as a 15" limit during spring were evaluated for effectiveness.
	4.1.3 Establish relationships between fishery independent data, angler catch, and angler satisfaction.		No work was done on this action.
4.2 Enhance fish populations by releasing hatchery raised largemouth bass, when natural reproduction or recruitment is deemed	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	2017 Continue	Stocking is a routine annual event. In June, largemouth bass were released to the Potomac River, where populations have suffered recruitment declines.

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insufficient for sustaining a fishery.	fishery without stocking efforts.		
	4.2.2 Generate a stocking strategy with an objective to either support or improve the fishery	2016	In accordance with the stocking policy (2015), key areas were identified for stocking and include Potomac River, Middle River, and the upper Chesapeake Bay. An objective method of prioritizing stocking areas was appended to the stocking policy in 2016. Money was requested from federal aid to purchase largemouth bass juveniles when stocking to an environment from which brood stock are not obtained.
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.	2016	Permitted tournaments in Potomac River and upper Chesapeake Bay were provided either the option to limit creel of large older fish, or to implement strategies that better secure their safety. Most directors selected the latter option. However, some directors have voluntarily lowered creel limits during July and August (warm weather months), as measured by a directors' selection of best management practices when filing for a permit.
	4.3.2 Improve and promote angler awareness that increases survivorship of largemouth bass during catch-and-release fishing.	2016 - 2017	Provided funding and in-kind support for research on keeping adult largemouth bass alive in live-wells at Mississippi State University. Black bass anglers were targeted with current information on reducing handling stress of bass that anglers intend to keep alive in February and June.
	4.3.3 Engage in meaningful studies that benefit the angling community by informing them on methods to improve survivorship.	2017	Began study to examine the effects of piercing culling devices on largemouth bass feeding and infection susceptibility.
	4.3.4 Enforce restrictions on holding more than 5 bass/angler/day by specially permitted release boat captains.	2016 - 2017 Continue	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. Staff developed a datasheet to record oxygen and temperature routinely throughout the day; the

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Continue 4.3			max and min are provided the tournament director at the end of the day to aid in their data reporting.
	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.	2016	Limiting redistribution of fish from distant streams was encouraged as a best management practice in the permitting system for most black bass tournaments in Maryland.
4.4 Protect, enhance and improve important angler access points to the tidewater largemouth bass fishery.	4.4.1 As part of the Chesapeake Bay Watershed Access Plan, 300 public access sites will be developed in the watershed and important angler access points to the tidewater largemouth bass fishery should be provided.	2016 - 2017	An angler access map describes fishing spots for anglers in Maryland. It was referenced in phone calls and conversations with stakeholders throughout the year. Mallows Bay is considered as a national marine sanctuary and if approved, will be advertised as a valuable access point to the tidewater largemouth bass fishery on Potomac River. Hallowing Point, Cedar Point, and a new free fishing area in Federalsburg (see Action 4.4.4) will be added or edited in the angler access map.
	4.4.2 Determine crowding of angler access points and mitigate, when possible.		No work was done on this action between June 2016 and June 2017.
	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 2016 and June 2017.
	4.4.4 Create and/or advertise new angler access points to the tidewater largemouth bass fishery.	2015 - 2016	<p>The Angler Access map, which is available on-line, was noted in correspondence with several anglers who were interested in fishing in Maryland; also, a map of approved release sites for tournaments is available on-line, advertised to directors, and is used to highlight access points for competitive sport fishing.</p> <p>Reviewed and commented on two Project Open Space (POS) projects with the potential to increase angler access to tidal bass waters. Hallowing Point on the Calvert County side of the Benedict</p>

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Continue 4.4			Bridge is being expanded to include additional boat launches, shoreline fishing and, possibly, a fishing pier. Cedar Point Wildlife Management Area will expand waterfowl access to hunter in southern Charles County, but there will be ample shoreline access for anglers as well.
	4.4.5 Promote small craft and shore-based angler access.		Worked with the Town of Federalsburg to create a new "free fishing area" along Marshyhope Creek. See Section 4.4.4. for additional boat access at Hallowing Point. Additionally, all POS submissions that are received in the Southern Region office are reviewed with additional angler and boat access being the primary point of interest.
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.	2016 - 2017	Incentive programs, such as the statewide invasive species record, were promoted to help control and manage invasive species (Northern snakehead). A fishing derby aimed at raising awareness of northern snakehead was held in partnership with National Park Service and U.S. Fish and Wildlife Service in C&O Historical Park. Studies into the impacts of blue catfish as a predator of largemouth bass during winter were planned to begin in winter of 2018 to underscore justification of controlling the biomass of blue catfish.
	5.1.2 Monitor, protect or enhance the availability of prey for largemouth bass by partnering with other agencies or other programs within MD DNR.	2015	A monitoring strategy was implemented within the Tidal Bass Program for documenting the availability of prey. Availability of forage was investigated for Middle River by developing a fish forage index, which was computed from Tidal Bass Program data in select streams and spatially referenced on-line using ArcGIS.
	5.1.3 Control or limit pollution sources to impaired waterways in order to improve the sustainability of largemouth bass populations.	2017	A habitat subgroup of the Black Bass Advisory Subcommittee was formed to work with the department and identify potential projects or legislation that should be supported or commented on by the black bass fishery.
5.2 Maintain important aspects of ecosystem	5.2.1 Identify components of ecosystem function essential	2016 - 2017	A macroinvertebrate index of biotic integrity was developed and compared between Vallisneria (eelgrass) dominated habitats

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function to maintain habitat for largemouth bass. Continue 5.2	for the sustainability of largemouth bass populations.		and Hydrilla dominated habitats. This index reflects the diversity of the macroinvertebrate community that may be reflective of habitat quality. Additional components of spawning areas have been examined and published on-line and in the primary literature. Work to identify such components for the fishery are underway to determine whether fishery-dependent data can be used to describe components needed for the fishery.
	5.2.2 Identify possible threats to the maintenance and function essential for the sustainability of largemouth bass.	2016 - 2017	Ecosystem threats to the fishery in the Potomac River and upper Chesapeake Bay were largely identified as ones related to loss of SAV or submerged structure in tidal rivers. Threats to the sustainability of largemouth bass from coastal plain rivers of eastern shore and urbanized areas (e.g., Middle River) are not well-described, but could include road development, eutrophication and invasive species. None-the-less stocking has been identified as a method of maintaining the sustainability of largemouth bass. Additional work to understand fish kills and the role of plankton in those kills are underway for Middle River and Gunpowder River
	5.2.3 Preserve ecosystem components that are essential and potentially threatened.		No work was done on this action between June 2016 and June 2017.

Acronyms:

- C&O – Chesapeake and Ohio
- GIFS - Geographic Inland Fisheries Survey System
- MARI – Maryland Artificial Reef Initiative
- MDDNR - Maryland Department of Natural Resources
- POS – Program Open Space
- PRFC – Potomac River Fisheries Commission
- QA/QC - quality assurance/quality control
- SAV - Submerged Aquatic Vegetation
- USFWS – United States Fish & Wildlife Service