

2015 Maryland FMP Report (August 2016)

Section 12. Horseshoe Crab (*Limulus polyphemus*)

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

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

Horseshoe crabs and migratory shorebirds, particularly the red knot (*Calidris canutus rufa*), have a unique ecological relationship. Red knot rely on horseshoe crab eggs as food during their spring migration from South America to their Arctic breeding grounds. In September, 2013, the U.S. Fish and Wildlife Service (USFWS) published a proposed rule in the Federal Register to list the red knot as a threatened species.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

Fishery Management Plans (FMPs)

Chesapeake Bay

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

ASMFC

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

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

Stock Status

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

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

Reported biomedical mortality from harvest to release was 1.3% in 2012. However, a 15% rate for bleeding and release mortality was assumed and used in the stock assessment.⁴ In 2011, a mortality range of 5-30% was included in the ARM assessment. Estimated annual mortality has averaged 75,346 crabs from 2008 – 2014.² Coastwide biomedical harvest has increased and has been above the 57,500 crab cap since 2007. The estimated biomedical use was 524,103 crabs in 2014 a slight decline from the average of 554,737 (2008-2014).²

Current Management Measures

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

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

The ARM framework identified two circumstances that affect red knot demography and annual survival: 1) horseshoe crab abundance and red knot body mass at departure from Delaware Bay and 2) arctic snow conditions upon arrival at the breeding grounds. As a result, the ARM workgroup developed five horseshoe crab management alternatives: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 ARM framework underwent a review in 2016.

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

The Fisheries

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

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

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 2014 Delaware Bay red knot surveys indicated a modest increase in red knot abundance.

The Virginia Tech benthic trawl horseshoe crab survey has provided important data for the ARM framework and stock assessments. These analyses are necessary to ensure that horseshoe crab spawning stock and egg production are sufficient to support migratory shorebird feeding. The biomedical industry was able to provide partial funding for the 2012 trawl survey but Congressional funding was discontinued in 2014.² and. The trawl survey is relatively inexpensive (\$200,000)³ and the ASMFC horseshoe crab ARM committee has been actively working to find an alternative to the trawl survey. A composite index based alternative was used in 2015.

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

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

The bait industry has been importing three Asian horseshoe crab species to supply the bait market and take advantage of increased bait prices. Two concerns associated with importation of this non-native species are the introduction of non-native parasites and pathogens; and possible human health risks from the neurotoxin tetrodotoxin found in one of the Asian species.³ ASMFC approved Resolution 13-01 to ban the import and use of the Asian horseshoe crab as bait (<http://www.asmfc.org/species/horseshoe-crab>) and has encouraged member states to ban importation of Asian horseshoe crabs. Maryland banned the import of Asian horseshoe crabs in 2013.⁸

A substantial 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 crabs mortality due to impingement was 117 animals. The 2015 data is not yet available.

Figure 1. Geometric mean catch of horseshoe crabs per trawl from the Maryland Coastal Bays Trawl Survey: 1990 – 2015.⁶

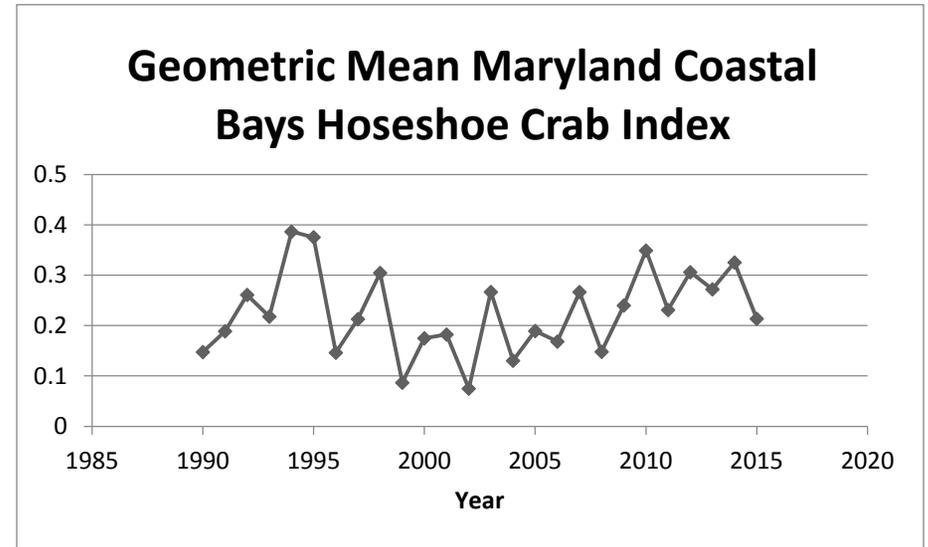


Figure 2. Maryland's commercial horseshoe crab landings and quota: 1998-2015.⁶ The 2013-2015 quota was restricted to male horseshoe crabs.

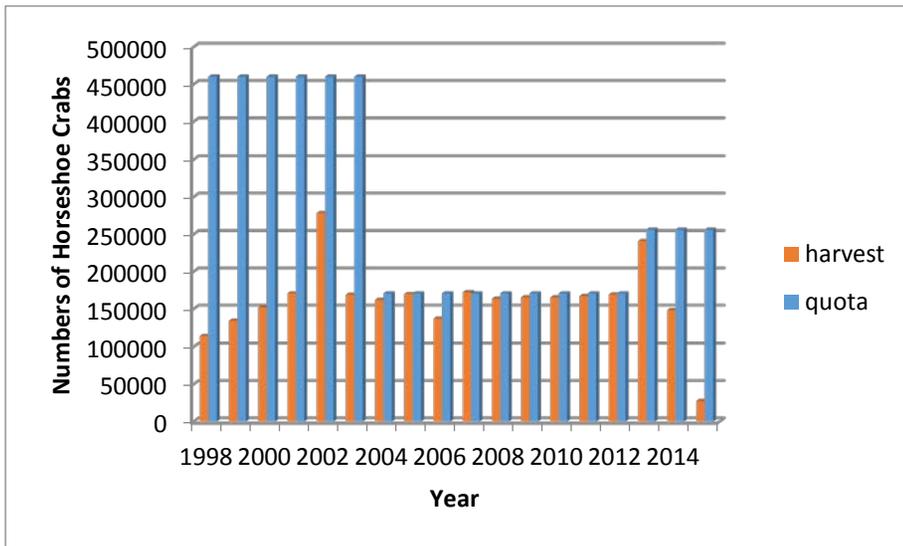
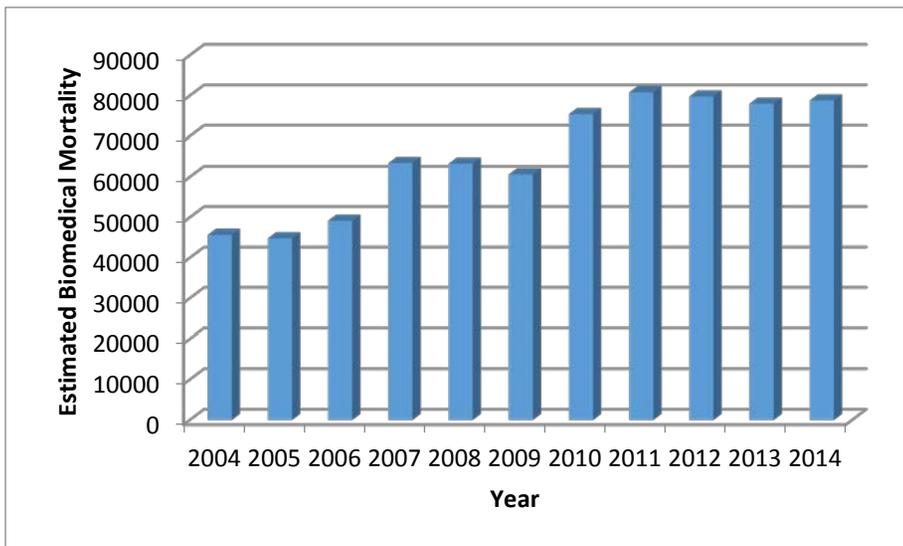


Figure 3. Estimated mortalities of horseshoe crabs bled for the biomedical industry: 2004-2014.³ The 2015 mortality estimate was not available at the time of this report. Mortality does not include crabs returned to the bait industry. Threshold is 57,500.



References

- 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. 2015. 2015 review of the Atlantic States Marine Fisheries Commission fishery management plan for horseshoe crab (*Limulus polyphemus*): 2014 fishing year. Atlantic States Marine Fisheries Commission, Alexandria, VA.
- 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.
- ⁴ ASMFC. 2010. 2010 review of the fishery management plan in 2009 for horseshoe crab (*Limulus polyphemus*). Atlantic States Marine Fisheries Commission, Alexandria, VA.
- 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. 2016. Maryland's 2015 horseshoe crab (*Limulus polyphemus*) compliance report to the Atlantic States Marine Fisheries Commission. Maryland Department of Natural Resources Fisheries Service, Annapolis, MD.
- ⁷ Eyler, S., S. Michels, and D. Brzezinski. 2011. 2011 review of the fishery management plan in 2010 for horseshoe crab (*Limulus polyphemus*). Atlantic States Marine Fisheries Commission, Washington, DC.
- ⁸ Classification of Nonnative Aquatic Organisms. Annotated Code of Maryland § 08.02.19.04 (2013).

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

| 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 | 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. |
| | 1.2a Maryland will prohibit the scraping, trawling or dredging of horseshoe crabs between May 1 and June 7 within the Chesapeake Bay, coastal bay areas, and 1 mile of the Atlantic Coast. | 1995 | The time period recommended to prohibit the scraping, trawling, and dredging of HSCs within the Chesapeake Bay, Coastal Bays, and within 1 mile of the Atlantic coast was changed from May 1 and June 7 to April 1 and June 30 based upon MD spawning survey data |
| | | 2004 | Crabs harvested from the bait industry can be bled by the biomedical industry. These crabs must be returned to the bait harvester after being bled. |
| | | 2009 Continue | April catch or harvest restriction was added to the spring fishery. MD COMAR 08.02.10.01.01 states that HSCs cannot be caught or landed in MD state waters from December 1 to June 7. This restriction includes a May 1 to June 7 closure. Scientific collection permits (including biomedical bleeding) allow HSC |

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

| Problem Area | Action | Date | Comments |
|--|---|--|--|
| | | On-going | <p>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.</p> <p>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.</p> |
| | 1.2b Virginia will continue its ban on trawling within state waters. | 1995 | Virginia prohibits the use of trawls in Virginia’s portion of the Territorial Sea. |
| | 1.3 Virginia will prohibit a directed horseshoe crab fishery between May 1 and June 7, continue mandatory reporting in the conch dredge fishery and monitor bycatch of horseshoe crabs. | 1995 | An ASMFC HSC FMP was adopted in 1998. Since then, additional harvest restrictions have been implemented as needed. |
| Strategy 2.1 Maryland and Virginia will coordinate with Delaware and begin to develop a spawning stock census of horseshoe crabs that will serve as the basis for determining management recommendations as appropriate. | 2.1 Maryland and Virginia will coordinate and implement a horseshoe crab spawning stock census in Chesapeake Bay, coastal bays, and along the Atlantic coast. | <p>1995</p> <p>2002 Continue</p> <p>2007 Continue</p> <p>2008 Continue</p> | <p>An annual spawning stock survey was initiated from 1994 to 2000 in MD. The Delaware spawning survey provides data on assessing the status of the spawning population. MD’s spawning survey is only in the Coastal Bays (not the Chesapeake Bay). The MD Coastal Bays HSC trawl survey has been conducted since 1990.</p> <p>Maryland Coastal Bays program began a volunteer spawning survey. Public reports of HSC spawning in Chesapeake Bay are kept on file.</p> <p>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 will undergo an in-depth review in 2016 and has resulted in the development of an ASMFC addendum.</p> <p>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</p> |
| | 2.2 Maryland and Virginia will promote and encourage research on horseshoe crab estimates of population abundance, age and size composition, mortality estimates and migration. | Open | Continue to participate in the annual HSC meeting of regional biologists and managers. A University of Maryland Eastern Shore project to determine if a spawning stock survey could be used to provide a statistically significant index of abundance was partially funded. CPUE data is collected from MD’s offshore and coastal bay trawl survey, and blue crab summer trawl survey within the Chesapeake Bay. Sex data is collected from MD’s spawning beach survey. A tagging program was initiated in 1995 to determine migratory patterns, identify stocks, and increase our understanding of the HSCs spawning behavior. USFWS currently directs the effort. |

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

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

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

Acronyms

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

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

