

ATLANTIC STATES MARINE FISHERIES COMMISSION

REVIEW OF THE INTERSTATE FISHERY MANAGEMENT PLAN

FOR HORSESHOE CRAB
(Limulus polyphemus)

2018 FISHING YEAR



Prepared by the Plan Review Team

Approved by the Horseshoe Crab Management Board
October 2019

Table of Contents

I.	Status of the Fishery Management Plan	1
II.	Status of the Stock and Assessment Advice	3
III.	Status of the Fishery.....	4
IV.	Status of Research and Monitoring.....	8
V.	Status of Management Measures and Issues	10
VI.	Research Needs/PRT Recommendations.....	25

I. Status of the Fishery Management Plan

<u>Date of FMP Approval:</u>	December 1998
<u>Amendments</u>	None
<u>Addenda</u>	Addendum I (April 2000) Addendum II (May 2001) Addendum III (May 2004) Addendum IV (June 2006) Addendum V (September 2008) Addendum VI (August 2010) Addendum VII (February 2012)
<u>Management Unit:</u>	Entire coastwide distribution of the resource from the estuaries eastward to the inshore boundary of the EEZ
<u>States with Declared Interest:</u>	Massachusetts - Florida
<u>Active Boards/Committees:</u>	Horseshoe Crab Management Board, Advisory Panel, Technical Committee, and Plan Review Team; Delaware Bay Ecosystem Technical Committee

Goals and Objectives

The Interstate Fishery Management Plan for Horseshoe Crabs (FMP) established the following goals and objectives.

2.0. Goals and Objectives

The goal of this Plan is to conserve and protect the horseshoe crab resource to maintain sustainable levels of spawning stock biomass to ensure its continued role in the ecology of the coastal ecosystem, while providing for continued use over time. Specifically, the goal includes management of horseshoe crab populations for continued use by:

- 1. current and future generations of the fishing and non-fishing public (including the biomedical industry, scientific and educational research);*
- 2. migrating shorebirds; and,*
- 3. other dependent fish and wildlife, including federally listed (threatened) sea turtles.*

To achieve this goal, the following objectives must be met:

- (a) prevent overfishing and establish a sustainable population;*
- (b) achieve compatible and equitable management measures among jurisdictions throughout the fishery management unit;*
- (c) establish the appropriate target mortality rates that prevent overfishing and maintain adequate spawning stocks to supply the needs of migratory shorebirds;*

- (d) coordinate and promote cooperative interstate research, monitoring, and law enforcement;*
- (e) identify and protect, to the extent practicable, critical habitats and environmental factors that limit long-term productivity of horseshoe crabs;*
- (f) adopt and promote standards of environmental quality necessary for the long-term maintenance and productivity of horseshoe crabs throughout their range; and,*
- (g) establish standards and procedures for implementing the Plan and criteria for determining compliance with Plan provisions.*

Fishery Management Plan Summary

The framework for managing horseshoe crabs along the Atlantic coast was approved in October 1998 with the adoption of the Interstate Fishery Management Plan for Horseshoe Crabs (FMP). The goal of this plan is to conserve and protect the horseshoe crab resource to maintain sustainable levels of spawning stock biomass to ensure its continued role in the ecology of coastal ecosystems, while providing for continued use over time.

In 2000, the Horseshoe Crab Management Board approved Addendum I to the FMP. Addendum I established a state-by-state cap on horseshoe crab bait landings at 25 percent below the reference period landings (RPL's), and *de minimis* criteria for those states with a limited horseshoe crab fishery. Those states with more restrictive harvest levels (Maryland and New Jersey) were encouraged to maintain those restrictions to provide further protection to the Delaware Bay horseshoe crab population, recognizing its importance to migratory shorebirds. Addendum I also recommended that the National Marine Fisheries Service (NMFS) prohibit the harvest of horseshoe crabs in federal waters (3-200 miles offshore) within a 30 nautical mile radius of the mouth of Delaware Bay, as well as prohibit the transfer of horseshoe crabs in federal waters. A horseshoe crab reserve was established on March 7, 2001 by NMFS in the area recommended by ASMFC. This area is now known as the Carl N. Shuster Jr. Horseshoe Crab Reserve.

In 2001, the Horseshoe Crab Management Board approved Addendum II to the FMP. The purpose of Addendum II was to provide for the voluntary transfer of harvest quotas between states to alleviate concerns over potential bait shortages on a biologically responsible basis. Voluntary quota transfers require Technical Committee review and Management Board approval.

In 2004, the Board approved Addendum III to the FMP. The addendum sought to further the conservation of horseshoe crab and migratory shorebird populations in and around the Delaware Bay. It reduced harvest quotas and implemented seasonal bait harvest closures in New Jersey, Delaware, and Maryland, and revised monitoring components for all jurisdictions.

Addendum IV was approved in 2006. It further limited bait harvest in New Jersey and Delaware to 100,000 crabs (male only) and required a delayed harvest in Maryland and Virginia. Addendum V, adopted in 2008, extends the provisions of Addendum IV through October 31, 2010. In early 2010, the Board initiated Draft Addendum VI to consider management options

that would follow expiration of Addendum V. The Board voted in August 2010 to extend the Addendum V provisions, via Addendum VI, through April 30, 2013. The Board also chose to include language, allowing them to replace Addendum VI with another Addendum during that time, in anticipation of implementing an Adaptive Resource Management (ARM) Framework.

The Board approved Addendum VII in February 2012. This addendum implemented an ARM framework for use during the 2013 fishing season. The framework considers the abundance levels of horseshoe crabs and shorebirds in determining the optimized bait harvest level for the Delaware Bay states of New Jersey, Delaware, Maryland, and Virginia (east of the COLREGS).

II. Status of the Stock and Assessment Advice

A benchmark stock assessment was completed and approved for management use in 2019 (available at:

http://www.asmfcr.org/uploads/file/5cd5d6f1HSCAssessment_PeerReviewReport_May2019.pdf).

This assessment was the first to successfully apply a stock assessment model to a component of the horseshoe crab stock. A Catch Multiple Survey Analysis model, a stage-based model that tracks progression of crab abundances from pre-recruits to full recruits to the fishery, was applied to female crabs in the Delaware (DE) Bay region (New Jersey-Virginia). This model estimated regional female crab abundance using relative abundance information from the Virginia Tech Benthic Trawl Survey, New Jersey Ocean Trawl Survey, and Delaware Adult Trawl Survey, and estimates of mortality including natural mortality, commercial bait harvest, commercial discard mortality, and mortality associated with biomedical use. While reference points were not approved to determine stock status, the CMSA population estimates were recommended as the best estimates for female horseshoe crab abundance in the DE Bay region.

The base CMSA model population estimates show an increase in the number of female crabs in the DE Bay region since 2012, when the ARM Framework was established via Addendum VII. This increasing trend is supported by positive trends in regional fishery-independent surveys during this time period. Population estimates from the base model are not publicly viewable due to the inclusion of confidential biomedical data. However, a sensitivity run assuming no biomedical mortality is publicly viewable, and these estimates are not significantly different from the base run. Estimates of discard mortality from the Northeast Fisheries Observer Program (NEFOP) were also included in the base CMSA model and indicate that discard mortality could be significant, of similar or greater magnitude than mortality due to bait harvest. Population estimates from the CMSA are currently being considered for incorporation into the ARM Framework, which is run annually to specify bait harvest quotas for the DE Bay region.

Autoregressive Integrated Moving Average (ARIMA) models, similar to those used in previous assessments, were applied to all regions. ARIMA models were fit to fishery-independent survey

indices trends of abundance in each of the regional horseshoe crab populations: Northeast (Massachusetts-Rhode Island), New York (Connecticut-New York), DE Bay, and Southeast (North Carolina-Florida). No definitions for overfishing or overfished status have been adopted by the Management Board. However, the assessment characterized the status of each regional and the coastwide population based on the percentage of surveys within a region (or coastwide) having a >50% probability of the final year being below the ARIMA reference point. The ARIMA reference point was the 1998 index for each survey. “Poor” status was >66% of surveys meeting this criterion, “Good” status was <33% of surveys, and “Neutral” status was 34 – 65% of surveys. Based on this criteria, stock status for the Northeast region was neutral; the New York region was poor; the Delaware Bay region was neutral; and the Southeast region was good. Coastwide, abundance has fluctuated through time with many surveys decreasing after 1998 but increasing in recent years. The coastwide status includes surveys from all regions and indicates a neutral trend, likely due to positive and negative trends being combined.

III. Status of the Fishery

Bait Fishery

For most states, the bait fishery is open year round. However, because of seasonal horseshoe crab movements (to the beaches in the spring; deeper waters and offshore in the winter), the fishery operates at different times. New Jersey has prohibited commercial harvest of horseshoe crabs in state waters since 2006. State waters of Delaware are closed to horseshoe crab harvest and landing from January 1st through June 7th each year, and other state horseshoe crab fisheries are regulated with various seasonal/area closures.

Reported coastwide bait landings in 2018 remained well below the coastwide quota (Table 1, Figure 1). Bait landings decreased 35% from the previous year, due primarily to landings decreases in Maryland (72% decrease from 2017), Delaware (37%), and New York (29%), although significant decreases were evident in almost all states. Delaware harvested 2,925 crabs above their adjusted quota over a two-week period in 2018, and reduced their quota for 2019 from their allocated 162,136 male crabs to 159,211 male crabs.

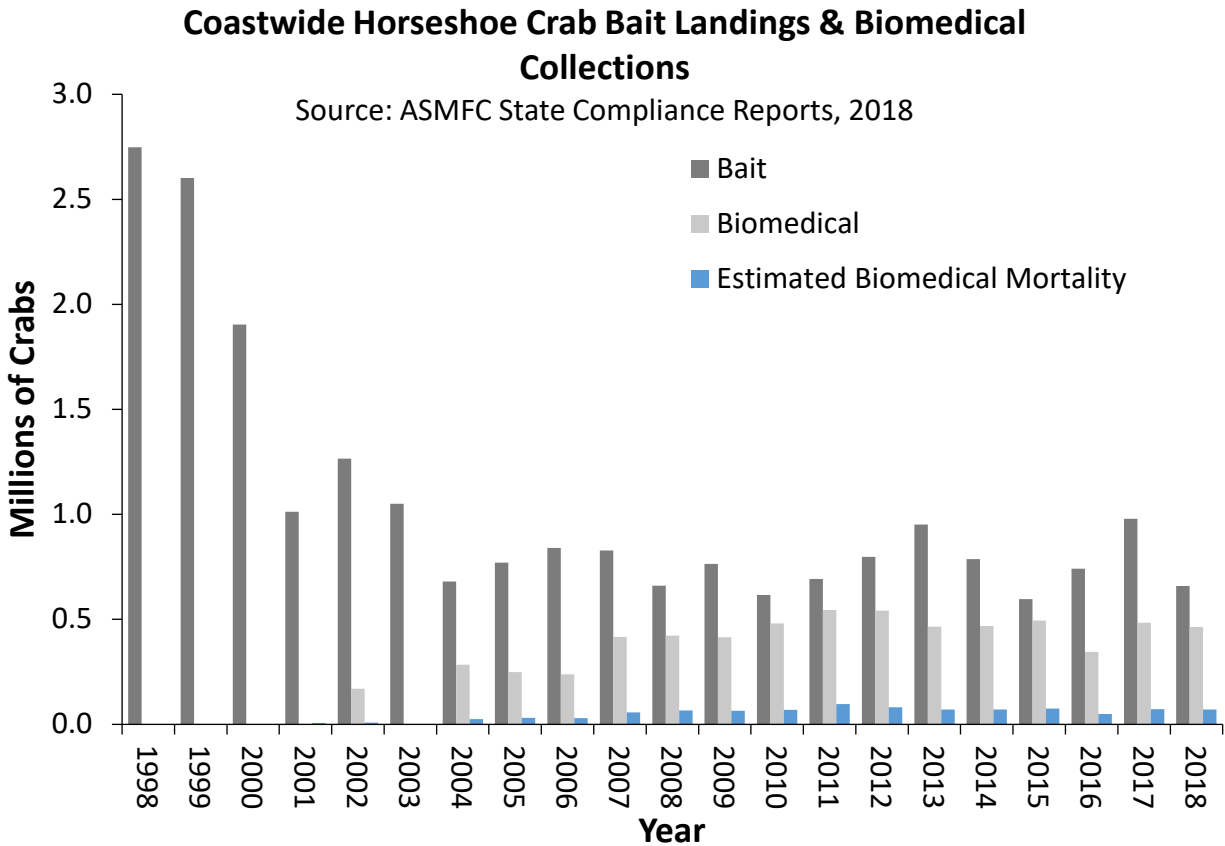
Table 1. Reported commercial horseshoe crab bait landings by jurisdiction. Note: Landings from 2017 and earlier were updated to numbers validated by all jurisdictions for use in the 2019 benchmark stock assessment.

Jurisdiction	ASMFC Quota 2018	State Quota 2018	2018	2017	2016	2015	2014
MA	330,377	165,000	159,002	134,707	110,399	117,611	130,316
RI	26,053	8,398	1,889	3,415	20,676	7,867	13,841
CT	48,689	48,689	15,181	19,778	12,135	19,632	20,634
NY	366,272	150,000	138,223	195,717	176,632	145,324	134,370
NJ*	162,136	0	0	0	0	0	0
DE*	162,136	123,140	126,065	201,132	109,836	151,262	168,044
MD*	255,980	255,980	66,647	237,146	157,013	27,494	148,269
PRFC	0	-	0	0	0	0	0
DC	0	-	0	0	0	0	0
VA**	172,828	172,828	140,584	160,331	128,848	102,235	145,266
NC***	24,036	24,036	10,998	25,161	25,197	24,839	24,557
SC	0	0	0	0	0	0	0
GA	29,312	29,312	0	0	0	0	0
FL****	9,455	9,455	C	1,394	689	264	2,046
TOTAL	1,587,274	986,838	658,589	978,781	741,425	596,528	787,342

*Male-only harvest

**Virginia harvest east of the COLREGS line is limited to 81,331 male-only crabs under the ARM harvest package #3. Virginia data shown are preliminary. Virginia harvest east of the COLREGS in 2018 was 65,692 crabs. The total above represents harvest on both sides of the COLREGS line.

Figure 1: Number of horseshoe crabs harvested for bait and used for biomedical purposes, 1998-2018.



*** 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 assumed for all bled crabs that are released. This number plus observed mortality reported annually by bleeding facilities via state compliance reports is noted in the above graph as 'Estimated Biomedical Mortality.'**

Reported coastwide landings since 1998 show more male than female horseshoe crabs were harvested annually. Several states presently have sex-specific restrictions in place which limit or ban 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. States with greater than 5% of coastal landings are required to report sex for at least a portion of their bait harvest, and within these states, 16.6% of landings were unclassified in 2018.

The hand, trawl, and dredge fisheries typically account for the majority of reported commercial horseshoe crab bait landings. Other gears that account for the remainder of the harvest include rakes, hoes, and tongs, fixed nets, and gill nets.

Biomedical Use

The horseshoe crab is an important resource for research and manufacture of materials used for human health. There are five companies along the Atlantic Coast that process horseshoe crab blood for use in manufacturing Limulus Amebocyte Lysate (LAL): Associates of Cape Cod, Massachusetts; Lonza (formerly Cambrex Bioscience), Limuli Laboratories, New Jersey; Wako Chemicals, Virginia; and Charles River Endosafe, South Carolina. Addendum III requires states where horseshoe crabs are collected for biomedical bleeding to collect and report total collection numbers, crabs rejected, crabs bled (by sex) and to characterize mortality.

The Plan Review Team annually calculates total coastwide collections and estimates mortality associated with biomedical use. In 2018, 464,482 crabs coastwide were collected for biomedical for bleeding (Table 2). This does not include bait crabs that were counted against state quotas and bled. This represents a 4% decline from 2017. Males accounted for 40% of total biomedical collections, females comprised 25%, and 32% of collections were of unknown sex. Crabs were rejected prior to bleeding due to mortality, injuries, slow movement, and size (mortality observed while crabs were going through the biomedical process is included in Row D below). Approximately 1% of crabs collected solely for biomedical purposes were observed and reported as dead from the time of collection up to the point of bleeding.

During the 2019 benchmark stock assessment, literature estimates were analyzed to estimate post-bleeding mortality. Although many of these studies did not implement biomedical best practices, these values are the only available estimates of mortality experienced after bleeding. Post-bleeding mortality was estimated at 15%. Tagging data was used in the assessment to compare survivorship between crabs that were and were not bled. These results indicated some decrease in short-term survivorship, but greater long-term survivorship for bled crabs. These results are likely attributable to the culling process used by biomedical facilities to select healthy crabs for bleeding.

Post-bleeding mortality, calculated as 15% of the number of bled biomedical (non-bait) crabs, for 2018 was estimated as 65,319. Total mortality of biomedical crabs for 2018 was estimated as 70,881 crabs. This represents approximately 10% of the 2018 total directed use mortality (729,470 crabs), which includes removals from both bait and biomedical uses of horseshoe crabs.

Table 2. Numbers of horseshoe crabs collected, bled, and estimated mortality for the biomedical industry. Numbers shown are for crabs collected solely for biomedical use. Mortality of bled crabs that later enter the bait industry is included in bait harvest.

Year	Crabs Collected	Crabs Bled	Post-Bleeding Mortality	Observed Mortality	Total Mortality
2009	414,959	386,118	57,918	6,318	64,236
2010	480,914	412,781	61,917	6,829	68,746
2011	545,164	486,850	73,028	24,139	97,167
2012	541,956	497,956	74,693	7,370	82,063
2013	464,657	440,402	66,060	5,447	71,507
2014	467,897	432,340	64,851	5,658	70,509
2015	494,123	464,506	69,676	5,362	75,038
2016*	344,495	318,523	47,778	1,004	48,782
2017	483,245	444,115	66,617	6,056	72,673
2018	464,482	435,463	65,319	5,562	70,881

***Some biomedical collections were reduced in 2016 due to temporary changes in production.**

The 1998 FMP establishes a mortality threshold of 57,500 crabs that, if exceeded, requires the Board to consider management action. Based on an estimated total mortality of 70,881 crabs, this threshold was exceeded in 2018, as it has been for 11 of the last 12 years. Estimated mortality from biomedical use in 2018 is a larger percentage of total directed use mortality but smaller in number than in 2017. Results of the 2019 Benchmark Stock Assessment indicate that current levels of biomedical mortality, which have been relatively consistent for the last six years (with the exception of 2016), have not had a significant effect on horseshoe crab population estimates or fishing mortality in the Delaware Bay region.

IV. Status of Research and Monitoring

The Horseshoe Crab FMP set forth an ambitious research and monitoring strategy in 1999 and again in 2004 to facilitate future management decisions. Despite limited time and funding there are many accomplishments since 1999. These accomplishments were largely made possible by forming partnerships between state, federal and private organizations, and the support of hundreds of public volunteers.

Addendum III Monitoring Program

Addendum III requires affected states to carry out three monitoring components:

All states who do not qualify for *de minimis* status report monthly harvest numbers and subsample a portion of the catch for sex and harvest method. In addition, those states with annual landings above 5% of the coastwide harvest report all landings by sex and harvest method. Although states with annual landings less than 5% of annual coastwide harvest are not required to report landings by sex, the PRT recommends all states require gender reporting for horseshoe crab harvest.

States with biomedical collections are required to monitor and report collection numbers and mortality associated with the transportation and bleeding of the crabs.

States must identify spawning and nursery habitat along their coasts. All states have completed this requirement, and a few continue active monitoring programs.

Virginia Tech Research Projects

The Virginia Tech Horseshoe Crab Trawl Survey (VT Survey) was not conducted in 2013 - 2015, due to a lack of funding, but was conducted in 2016-2018, and is in progress for 2019. The 2018 survey results indicate increases from 2017 in mature, newly mature, and juvenile females and newly mature and juvenile males but a decreases in mature males. Mature male and female crabs have shown increasing trends across the time series (2002-2018). The Adaptive Resource Management (ARM) Working Group will use the indices from this survey to estimate horseshoe crab abundance for the ARM model, which specifies harvest limits for the upcoming year. The VT Survey for 2019 is currently in progress and is funded for 2020. Funding sources beyond 2020 continue to be explored.

Spawning Surveys

The redesigned Delaware Bay spawning survey was completed for the 20th year in 2018. No trend was detected in the baywide indices of spawning activity (both male and female) for the time series; though the slope was slightly negative. Trends in male spawning exhibited a slightly positive slope in both states, and the trend in New Jersey was significant. The trend from the index of female spawning activity in both states exhibited a slightly negative slope, and the trend in Delaware was significant. Female spawning activity in 2018 peaked during the third lunar period sampled (May 27 – May 31). The annual baywide sex ratio was 5.6:1 (Male: Female) equaling the highest ratio in the time series. The range of annual observed sex ratios on the Delaware Bay spawning beaches over the time series has ranged as low as 3.1:1.

Tagging Studies

The USFWS continues to maintain a toll-free telephone number as well as a website for reporting horseshoe crab tag returns and assists interested parties in obtaining tags. Tagging work continues to be conducted by biomedical companies, research organizations, and other parties involved in outreach and spawning surveys. Beginning with the 2013 tagging season, additional efforts were implemented to ensure that current tagging programs are providing data that benefits the management of the coast-wide horseshoe crab population. All existing and new tagging programs are required to submit an annual application to be considered for the tagging program and all participants must submit an annual report along with their tagging and resight data to indicate how their tagging program addresses at least one of the following objectives: determine horseshoe crab sub-population structure, estimate horseshoe crab movement and migration rates, and/or estimate survival and mortality of horseshoe crabs. The PRT recommends all tagging programs approved by the states coordinate with the USFWS tagging program, in order to ensure a consistent coastwide program for providing management input.

Since 1999, over 340,000 crabs have been tagged and released through the USFWS tagging program along the Atlantic coast. Crabs have been tagged and released from every state on the Atlantic Coast from Florida to New Hampshire. In the early years of the program, tagging was centered around Delaware Bay; however, in recent years, tagging has expanded and increased in the Long Island Sound and Southeast. Tagging information from this database has been used in the 2019 Benchmark Stock Assessment to define stock structure, estimate total mortality, and characterize impacts of biomedical use on crab mortality.

New York Region Monitoring

Following the 2019 Benchmark Stock Assessment, which characterized the status of the horseshoe crab population in the New York region as “Poor”, the Board directed the Plan Review Team to monitor fishery-independent surveys in this area to track progress of state management actions toward improving this regional population. During the assessment, five surveys were included in the ARIMA model to characterize this population. One of these, the NorthEast Area Monitoring and Assessment Program (NEAMAP), includes sample areas outside of the New York region, making it too data-intensive to specify the regional index on an annual basis. The most recent information from the state-conducted surveys used in the assessment is summarized below, but can be viewed in greater detail in the Connecticut and New York state compliance reports. The Western Long Island (WLI) Little Neck Bay and Manhasset Bay seine surveys were combined in the assessment to form a single index, but are shown below separately.

Connecticut

- Long Island Sound Trawl (Fall) – 2017 index = 0.95 kg/tow, increase from 2016, 2nd consecutive year of increase

New York

- Peconic Trawl – 2018 index = 0.19 (delta distribution average catch per unit effort [CPUE]), increase from 2017, below 2009-18 average (0.27)
- WLI Jamaica Bay Seine (all horseshoe crabs) – 2018 index = 0.43 (geometric mean), increase from 2017, above 2009-18 average (0.35)
- WLI Little Neck Bay Seine (all) – 2018 index = 0.93 (geometric mean), increase from 2017, below 2009-2018 average (1.15)
- WLI Manhasset Bay Seine (all) – 2018 index = 0.68 (geometric mean), increase from 2017, above 2009-18 average (0.64)

V. Status of Management Measures and Issues

ASMFC

Initial state-by-state harvest quotas were established through Addendum I. Addendum III outlined the monitoring requirements and recommendations for the states. Addendum IV set harvest closures and quotas, and other restrictions for New Jersey, Delaware, Maryland, and Virginia, which were continued in Addendums V and VI.

The Board approved Addendum VII, implementation of the ARM Framework, in February 2012 for implementation in 2013. Addendum VII includes an allocation mechanism to divide the Delaware Bay optimized harvest output from the ARM Framework among the four Delaware Bay states (New Jersey, Delaware, Maryland, and Virginia east of the COLREGS). Season closures and restrictions, present within Addendum VI, remain in effect as part of Addendum VII.

Included in this report are state-by-state charts outlining compliance and monitoring measures. The PRT recommends all jurisdictions were in compliance with the FMP and subsequent Addenda in 2018.

MASSACHUSETTS		
	2018 Compliance	2019 Management Proposal
<i>De minimis status</i>	Did not qualify for <i>de minimis</i>	Does not qualify for <i>de minimis</i>
Bait Harvest Restrictions and Landings		
ASMFC Quota (Voluntary State Quota)	330,377 (165,000)	330,377 (165,000)
Other Restrictions	Bait: 300 crab daily limit year round; limited entry; Biomedical: 1,000 crab daily limit; Conch pot and eel fishermen: no possession limit All: May and June 5-day lunar closures; No mobile gear harvest Fri-Sat during summer flounder season; 7" PW minimum size; Pleasant Bay Closed Area	Bait: 300 crab daily limit year round; Biomedical: 1,000 crab daily limit; Conch pot and eel fishermen: no possession limit All: May and June 5-day lunar closures; No mobile gear harvest Fri-Sat during summer flounder season; 7" PW minimum size; Pleasant Bay Closed Area
Landings	159,002	--
Monitoring Component A ₁		
Mandatory monthly reporting	Yes, plus weekly dealer reporting through SAFIS	Yes, plus weekly dealer reporting through SAFIS
Characterize commercial bait fishery	Yes	Yes
Monitoring Component A ₂		
Biomedical reporting	Yes	Yes
Required information for biomedical use of crabs	Yes	Yes
Monitoring Component A₃ Identify spawning and nursery habitat	Yes	Yes
Monitoring Component B₁ Coastwide benthic trawl survey	Yes, VT Trawl Survey was conducted in 2018	Yes, VT Trawl Survey will be conducted in 2019 & 2020; future years and spatial scope unknown at this time
Monitoring Component B₂ Continue existing benthic sampling programs	Yes	Yes
Monitoring Component B₃ Implement spawning survey	Yes	Yes
Monitoring Component B₄ Tagging program	Yes – w/NPS and USFWS; Pleasant Bay, Monomy NWR, Waquoit Bay	Yes – w/NPS and USFWS; Pleasant Bay, Monomy NWR, Waquoit Bay

RHODE ISLAND		
	2018 Compliance	2019 Management Proposal
<i>De minimis</i> status	Did not qualify for <i>de minimis</i>	Does not qualify for <i>de minimis</i>
Bait Harvest Restrictions and Landings		
ASMFC Quota (Voluntary State Quota)	26,053 (8,398)	26,053 (8,398)
Other Restrictions	State Restrictions: - Daily possession limit: 60 crabs per permit - Bait Fishery Closure: May 1- May 31 - Biomedical Fishery Closure: 48 hours prior to and 48 hours following new and full moons during May	State Restrictions: - Daily possession limit: 60 crabs per permit - Bait Fishery Closure: May 1- May 31 - Biomedical Fishery Closure: 48 hours prior to and 48 hours following new and full moons during May
Landings	1,889	--
Monitoring Component A ₁		
Mandatory monthly reporting	Yes, weekly call in and monthly on paper	Yes, weekly call in and monthly on paper
Characterize commercial bait fishery	Yes	Yes
Monitoring Component A ₂		
Biomedical reporting	Yes	Yes
Required information for biomedical use of crabs	Yes, details within Massachusetts' reports	Captured in Massachusetts' reports
Monitoring Component A₃ Identify spawning and nursery habitat	Yes	Yes
Monitoring Component B₁ Coastwide benthic trawl survey	Yes, VT Trawl Survey was conducted in 2018.	Yes, VT Trawl Survey will be conducted in 2019 & 2020; future years and spatial scope unknown at this time.
Monitoring Component B₂ Continue existing benthic sampling programs	Yes	Yes
Monitoring Component B₃ Implement spawning survey	Yes, since 2000 (methods unspecified)	Yes
Monitoring Component B₄ Tagging program	RI DEM 2001-2004 only, No current state program	No

CONNECTICUT		
	2018 Compliance	2019 Management Proposal
<i>De minimis</i> status	Did not qualify for <i>de minimis</i>	Does not qualify for <i>de minimis</i>
Bait Harvest Restrictions and Landings		
ASMFC Quota	48,689	48,689
Other Restrictions	Limited entry program, possession limits, and seasonal and area closures	Limited entry program, possession limits, and seasonal and area closures
Landings	15,181	--
Monitoring Component A₁		
Mandatory monthly reporting	Yes	Yes
Characterize commercial bait fishery	No – exempt under Addendum III because landings are < 5% of coastwide total	No – exempt under Addendum III because landings are < 5% of coastwide total
Monitoring Component A₂		
Biomedical reporting	Not Applicable	Not Applicable
Required information for biomedical use of crabs	Not Applicable	Not Applicable
Monitoring Component A₃ Identify spawning and nursery habitat	Yes	Yes
Monitoring Component B₁ Coastwide benthic trawl survey	Yes, VT Trawl Survey was conducted in 2018	Yes, VT Trawl Survey will be conducted in 2019 & 2020; future years and spatial scope unknown at this time
Monitoring Component B₂ Continue existing benthic sampling programs	Yes	Yes
Monitoring Component B₃ Implement spawning survey	Yes, since 1999 (methods differ from DE Bay survey)	Yes
Monitoring Component B₄ Tagging program	Yes, in collaboration with local universities (Sacred Heart University since 2015)	Yes

NEW YORK		
	2018 Compliance	2019 Management Proposal
<i>De minimis</i> status	Did not qualify for <i>de minimis</i>	Does not qualify for <i>de minimis</i>
Bait Harvest Restrictions and Landings		
ASMFC Quota (Voluntary State Quota)	366,272 (150,000)	366,272 (150,000)
Other Restrictions	Ability to close areas to harvest; seasonal quotas and daily harvest limits	Ability to close areas to harvest; seasonal quotas and daily harvest limits
Landings	138,223	--
Monitoring Component A ₁		
Mandatory monthly reporting	Yes	Yes
Characterize commercial bait fishery	Yes	Yes
Monitoring Component A ₂		
Biomedical reporting	Not Applicable	Not Applicable
Required information for biomedical use of crabs	Not Applicable	Not Applicable
Monitoring Component A₃ Identify spawning and nursery habitat	Yes	Yes
Monitoring Component B₁ Coastwide benthic trawl survey	Yes, VT Trawl Survey was conducted in 2018	Yes, VT Trawl Survey will be conducted in 2019 & 2020; future years and spatial scope unknown at this time
Monitoring Component B₂ Continue existing benthic sampling programs	Yes	Yes
Monitoring Component B₃ Implement spawning survey	Yes – adapted from DE Bay survey	Yes
Monitoring Component B₄ Tagging program	Yes	Yes

NEW JERSEY		
	2018 Compliance	2019 Management Proposal
<i>De minimis</i> status	Qualified for <i>de minimis</i>	Qualifies but not requesting <i>de minimis</i>
Bait Harvest Restrictions and Landings		
ASMFC Quota (Voluntary state quota)	162,136 [male only] (0)	162,136 [male only] (0)
Other Restrictions	Bait harvest moratorium	Bait harvest moratorium
Landings	0	--
Monitoring Component A₁		
Mandatory monthly reporting	N/A	N/A
Characterize commercial bait fishery	N/A	N/A
Monitoring Component A₂		
Biomedical reporting	Yes	Yes
Required information for biomedical use of crabs	Yes	Yes
Monitoring Component A₃ Identify spawning and nursery habitat	Yes	Yes
Monitoring Component B₁ Coastwide benthic trawl survey	Yes, VT Trawl Survey was conducted in 2018	Yes, VT Trawl Survey will be conducted in 2019 & 2020; future years and spatial scope unknown at this time
Monitoring Component B₂ Continue existing benthic sampling programs	Yes	Yes
Monitoring Component B₃ Implement spawning survey	Yes	Yes
Monitoring Component B₄ Tagging program	Outside, independent groups currently	No
Monitoring Component B₅ Egg abundance survey	Yes, but removed as a mandatory component	Yes
Monitoring Component B₆ Shorebird monitoring program	Yes	Yes

DELAWARE		
	2018 Compliance	2019 Management Proposal
<i>De minimis</i> status	Did not qualify for <i>de minimis</i>	Does not qualify for <i>de minimis</i>
Bait Harvest Restrictions and Landings		
ASMFC Quota (Adjusted Quota from Overage)	162,136 [male only] 123,140 [male only]	162,136 [male only] 159,211 [male only]
Other Restrictions	Closed season (January 1 – June 7); season closed early on June 16	Closed season (January 1 – June 7)
Landings	126,065 males	--
Monitoring Component A ₁		
Mandatory monthly reporting	Yes (daily call-in reports & monthly logbooks)	Yes
Characterize commercial bait fishery	Yes	Yes
Monitoring Component A ₂		
Biomedical reporting	Not Applicable	Not Applicable
Required information for biomedical use of crabs	Not Applicable	Not Applicable
Monitoring Component A₃ Identify spawning and nursery habitat	Yes – updates once every 5 years or as needed	Yes – updates once every 5 years or as needed
Monitoring Component B₁ Coastwide benthic trawl survey	Yes, VT Trawl Survey was conducted in 2018	Yes, VT Trawl Survey will be conducted in 2019 & 2020; future years and spatial scope unknown at this time
Monitoring Component B₂ Continue existing benthic sampling programs	Yes	Yes
Monitoring Component B₃ Implement spawning survey	Yes	Yes
Monitoring Component B₄ Tagging program	No state program but has assisted in the past with various Delaware Bay horseshoe crab tagging initiatives	No
Monitoring Component B₅ Egg abundance survey	Removed as component	Removed as component
Monitoring Component B₆ Shorebird monitoring program	Yes	Yes

Note: The egg abundance survey has been discontinued as a mandatory monitoring element. Delaware will include information on the survey if it continues, but is no longer required to perform the survey.

MARYLAND		
	2018 Compliance	2019 Management Proposal
<i>De minimis</i> status	Did not qualify for <i>de minimis</i>	Does not qualify for <i>de minimis</i>
Bait Harvest Restrictions and Landings		
ASMFC Quota	255,980 (male only)	255,980 (male only)
Other Restrictions	Delayed harvest and closed season/area combinations	Delayed harvest and closed season/area combinations
Landings	66,647 males	--
Monitoring Component A ₁		
Mandatory monthly reporting	Yes (weekly reports for permit holders; monthly for non-permit holders)	Yes (weekly reports for permit holders; monthly for non-permit holders)
Characterize commercial bait fishery	Yes	Yes
Monitoring Component A ₂		
Biomedical reporting	Yes	Yes
Required information for biomedical use of crabs	Yes	Yes
Monitoring Component A₃ Identify spawning and nursery habitat	Yes	Yes
Monitoring Component B₁ Coastwide benthic trawl survey	Yes, VT Trawl Survey was conducted in 2018	Yes, VT Trawl Survey will be conducted in 2019 & 2020; future years and spatial scope unknown at this time
Monitoring Component B₂ Continue existing benthic sampling programs	Yes	Yes
Monitoring Component B₃ Implement spawning survey	Yes	Yes
Monitoring Component B₄ Tagging program	Yes – through biomedical use	Yes – through biomedical use

POTOMAC RIVER FISHERIES COMMISSION		
	2018 Compliance	2019 Management Proposal
<i>De minimis</i> status	<i>De minimis</i> status granted for 2017.	<i>De minimis</i> requested and meets criteria.
Ability to close fishery if <i>de minimis</i> threshold is reached	No horseshoe crab fishery	No horseshoe crab fishery
Daily possession limit <25 for <i>de minimis</i> state		
HSC landing permit		
Bait Harvest Restrictions and Landings		
ASMFC Quota	0	0
Other Restrictions	None	None
Landings	0	0
Monitoring Component A ₁		
Mandatory monthly reporting	Yes - weekly	Yes - weekly
Characterize commercial bait fishery	Not Applicable	Not Applicable
Monitoring Component A ₂		
Biomedical reporting	Not Applicable	Not Applicable
Required information for biomedical use of crabs	Not Applicable	Not Applicable
Monitoring Component A₃ Identify spawning and nursery habitat	Not Applicable	Not Applicable
Monitoring Component B₁ Coastwide benthic trawl survey	Yes, VT Trawl Survey was conducted in 2018	Yes, VT Trawl Survey will be conducted in 2019 & 2020; future years and spatial scope unknown at this time
Monitoring Component B₂ Continue existing benthic sampling programs	Not Applicable	Not Applicable
Monitoring Component B₃ Implement spawning survey	Not Applicable	Not Applicable
Monitoring Component B₄ Tagging program	Not Applicable	Not Applicable

VIRGINIA		
	2018 Compliance	2019 Management Proposal
<i>De minimis</i> status	Did not qualify for <i>de minimis</i>	Does not qualify for <i>de minimis</i>
Bait Harvest Restrictions and Landings		
ASMFC Quota	172,828 (81,331 male-only east of COLREGS line)	172,828 (81,331 male-only east of COLREGS line)
Other Restrictions	Closed season (January 1 – June 7) for federal waters. Effective January 1, 2013 harvest of horseshoe crabs, from east of the COLREGS line, is limited to trawl gear and dredge gear only.	Closed season (January 1 – June 7) for federal waters. Effective January 1, 2013 harvest of horseshoe crabs, from east of the COLREGS line, is limited to trawl gear and dredge gear only.
Landings	140,584 (65,692 males)	--
Monitoring Component A ₁		
Mandatory monthly reporting	Yes – new permit system; limited entry to fishery and individual quotas established	Yes
Characterize commercial bait fishery	Yes	Yes
Monitoring Component A ₂		
Biomedical reporting	Yes	Yes
Required information for biomedical use of crabs	Yes	Yes
Monitoring Component A₃ Identify spawning and nursery habitat	Yes – completed	No
Monitoring Component B₁ Coastwide benthic trawl survey	Yes, VT Trawl Survey was conducted in 2018	Yes, VT Trawl Survey will be conducted in 2019 & 2020; future years and spatial scope unknown at this time
Monitoring Component B₂ Continue existing benthic sampling programs	No	No
Monitoring Component B₃ Implement spawning survey	No	No
Monitoring Component B₄ Tagging program	No	No

NORTH CAROLINA		
	2018 Compliance	2019 Management Proposal
<i>De minimis</i> status	Did not qualify for <i>de minimis</i>	Does not qualify for <i>de minimis</i>
Bait Harvest Restrictions and Landings		
ASMFC Quota	24,036	24,036
Other Restrictions	Trip limit of 50 crabs; Proclamation authority to adjust trip limits, seasons, etc.	Trip limit of 50 crabs; Proclamation authority to adjust trip limits, seasons, etc.
Landings	10,998	--
Monitoring Component A₁		
Mandatory monthly reporting	Yes – trip level reporting each month	Yes – trip level reporting each month
Characterize commercial bait fishery	Yes	Yes
Monitoring Component A₂		
Biomedical reporting	Not Applicable	Not Applicable
Required information for biomedical use of crabs	Not Applicable	Not Applicable
Monitoring Component A₃ Identify spawning and nursery habitat	Little information available; Survey discontinued after 2002 and 2003 due to low levels of crabs recorded	Not specified
Monitoring Component B₁ Coastwide benthic trawl survey	Yes, VT Trawl Survey was conducted in 2018	Yes, VT Trawl Survey will be conducted in 2019 & 2020; future years and spatial scope unknown at this time
Monitoring Component B₂ Continue existing benthic sampling programs	Yes	Yes
Monitoring Component B₃ Implement spawning survey	No	No
Monitoring Component B₄ Tagging program	No	No

SOUTH CAROLINA		
	2018 Compliance	2019 Management Proposal
De minimis status	<i>De minimis</i> status granted in 2018.	<i>De minimis</i> requested for 2019 and meets criteria.
Ability to close fishery if <i>de minimis</i> threshold is reached	No horseshoe crab bait fishery	No horseshoe crab bait fishery
Daily possession limit <25 for <i>de minimis</i> state		
HSC landing permit		
Bait Harvest Restrictions and Landings		
ASMFC Quota	0	0
Other Restrictions	None	None
Landings	0	--
Monitoring Component A ₁		
Mandatory monthly reporting	Yes (Biomedical)	Yes (Biomedical)
Characterize commercial bait fishery	Not Applicable	Not Applicable
Monitoring Component A ₂		
Biomedical reporting	Yes	Yes
Required information for biomedical use of crabs	Yes	Yes
Monitoring Component A₃ Identify spawning and nursery habitat	Completed	No
Monitoring Component B₁ Coastwide benthic trawl survey	Yes, VT Trawl Survey was conducted in 2018	Yes, VT Trawl Survey will be conducted in 2019 & 2020; future years and spatial scope unknown at this time
Monitoring Component B₂ Continue existing benthic sampling programs	Yes	Yes
Monitoring Component B₃ Implement spawning survey	Yes	Yes
Monitoring Component B₄ Tagging program	Yes	Yes

GEORGIA		
	2018 Compliance	2019 Management Proposal
De minimis status	<i>De minimis</i> status granted in 2018.	<i>De minimis</i> requested for 2019 and meets criteria.
Ability to close fishery if <i>de minimis</i> threshold is reached	Yes	Yes
Daily possession limit <25 for <i>de minimis</i> state	25/person; 75/vessel with 3 licensees	25/person; 75/vessel with 3 licensees
HSC landing permit	Must have commercial shrimp, crab, or whelk license; LOA permit required	Must have commercial shrimp, crab, or whelk license; LOA permit required
Bait Harvest Restrictions and Landings		
ASMFC Quota	29,312	29,312
(State Quota)	29,312	29,312
Other Restrictions	None	None
- Landings	0	--
Monitoring Component A ₁		
Mandatory monthly reporting	Yes	Yes
Characterize commercial bait fishery	No bait landings	Yes
Monitoring Component A ₂		
Biomedical reporting	Not Applicable	Not Applicable
Required information for biomedical use of crabs	Not Applicable	Not Applicable
Monitoring Component A₃ Identify spawning and nursery habitat	Completed	Not Applicable
Monitoring Component B₁ Coastwide benthic trawl survey	Yes, VT Trawl Survey was conducted in 2018	Yes, VT Trawl Survey will be conducted in 2019 & 2020; future years and spatial scope unknown at this time
Monitoring Component B₂ Continue existing benthic sampling programs	Yes	Yes
Monitoring Component B₃ Implement spawning survey	No	No
Monitoring Component B₄ Tagging program	No	No

FLORIDA		
	2018 Compliance	2019 Management Proposal
De minimis status	<i>De minimis</i> status granted in 2018.	<i>De minimis</i> requested for 2019 and meets criteria.
Ability to close fishery if <i>de minimis</i> threshold is reached	Yes	Yes
Daily possession limit <25 for <i>de minimis</i> state	25/person w/ valid saltwater products license; 100/person with marine life endorsement	25/person w/ valid saltwater products license; 100/person with marine life endorsement
HSC landing permit	See above	See above
Bait Harvest Restrictions and Landings		
ASMFC Quota	9,455	9,455
Other Restrictions	None	None
Landings	Confidential	--
Monitoring Component A ₁		
Mandatory monthly reporting	Yes	Yes
Characterize commercial bait fishery	No	Yes
Monitoring Component A ₂		
Biomedical reporting	Not Applicable	Not Applicable
Required information for biomedical use of crabs	Not Applicable	Not Applicable
Monitoring Component A₃ Identify spawning and nursery habitat	Yes	Yes
Monitoring Component B₁ Coastwide benthic trawl survey	Yes, VT Trawl Survey was conducted in 2018	Yes, VT Trawl Survey will be conducted in 2019 & 2020; future years and spatial scope unknown at this time
Monitoring Component B₂ Continue existing benthic sampling programs	No	No
Monitoring Component B₃ Implement spawning survey	Yes	Yes
Monitoring Component B₄ Tagging program	No	No

Alternative Baits

Trials testing effectiveness of alternative baits to horseshoe crab for the American eel and whelk fisheries have previously been conducted. Additionally, a survey of current bait usage in the eel and whelk fisheries was conducted in 2017. This survey is available at: http://www.asafc.org/uploads/file/5a04b785HSC_BaitSurveyTCReport_Oct2017.pdf. The Horseshoe Crab TC is currently determining whether any additional alternative bait products will be tested in the near future.

Shorebird

The USFWS received petitions in 2004 and 2005 to emergency list the red knot under the Endangered Species Act. In fall 2005, it determined that emergency listing was not warranted at the time. As part of a court settlement, the USFWS agreed to initiate proposed listings of over 200 species, including the red knot. In fall 2013, the USFWS released a proposal for listing the red knot as threatened. In January 2015 the USFWS determined that red knot be designated as threatened under the Endangered Species Act.

The red knot remains listed as an endangered species in the state of New Jersey (since 2012).

VI. Research Needs/PRT Recommendations

Funding for Research and Monitoring Activities

The PRT strongly recommends the funding and continuation of the VT benthic trawl survey. This effort provides a statistically reliable estimate of horseshoe crab relative abundance that is essential to continued ARM implementation and use of the CMSA stock assessment model.

De Minimis

States may apply for *de minimis* status if, for the last two years, their combined average horseshoe crab bait landings (by numbers) constitute less than one percent of coastwide horseshoe crab bait landings for the same two-year period. States may petition the Board at any time for *de minimis* status, if their fishery falls below the threshold level. Once *de minimis* status is granted, designated States must submit annual reports to the Board justifying the continuance of *de minimis* status.

States that qualify for *de minimis* status are not required to implement any horseshoe crab harvest restriction measures, but are required to implement components A, B, E and F of the monitoring program (Section 3.5 of the FMP; further modified by Addendum III). Since *de minimis* states are exempt from a harvest cap, there is potential for horseshoe crab landings to shift to *de minimis* states and become substantial, before adequate action can be taken. To control shifts in horseshoe crab landings, *de minimis* states are encouraged to implement one of the following management measures:

1. Close their respective horseshoe crab bait fishery when landings exceed the *de minimis* threshold;

2. Establish a state horseshoe crab landing permit, making it only available to individuals with a history of landing horseshoe crabs in that state; or
3. Establish a maximum daily harvest limit of up to 25 horseshoe crabs per person per day. States which implement this measure can be relieved of mandatory monthly reporting, but must report all horseshoe crabs harvests on an annual basis.

The following states have been removed from the Management Board in recent years: Pennsylvania (2007), Maine (2011), and New Hampshire (2014). The Potomac River Fisheries Commission, South Carolina, Georgia, and Florida are requesting *de minimis* status for the 2018 fishing season based on the 2017-18 season landings and meet the FMP requirements for being granted this status (Table 1). The PRT recommends granting these jurisdictions *de minimis* status.

Discard Mortality Estimation

Results of the 2019 Benchmark Stock Assessment indicate that discard mortality may be significant, of similar or greater magnitude than bait harvest. The Review Panel's report indicated that these estimates could be further refined to reduce their uncertainty and more precisely characterize this mortality source. The PRT recommends the Board take steps to increase access to and use of data from the NEFOP, allowing for improved monitoring and estimation of discard mortality.

Improvement of the New York Regional Population

Results of the 2019 Benchmark Stock Assessment indicate a "Poor" status for the New York regional population, due to negative trends in regional abundance indices. New York and Connecticut have indicated that they will take actions within their states to improve this population. The PRT recommends that the Board encourage such actions to continue so that this population's status may improve. The PRT has begun and will continue to annually report regional indices of abundance so that progress of management actions may be tracked through the annual FMP Reviews.

Biomedical Threshold

In 2018, biomedical mortality exceeded the FMP's mortality threshold of 57,500 crabs that, which requires the Board to consider management action. This threshold has been exceeded in 11 of the last 12 years. However, the PRT notes that results of the 2019 Benchmark Stock Assessment indicate that current levels of biomedical use do not result in mortalities that would significantly alter population status.

Compliance Report Due Date

Particularly in recent years, states have had difficulty meeting the annual compliance report due date of March 1. In many years, the Board does not receive the FMP Review until the summer or fall, when it meets to set annual harvest specifications. Therefore, the PRT recommends a later compliance report due date of July 1.