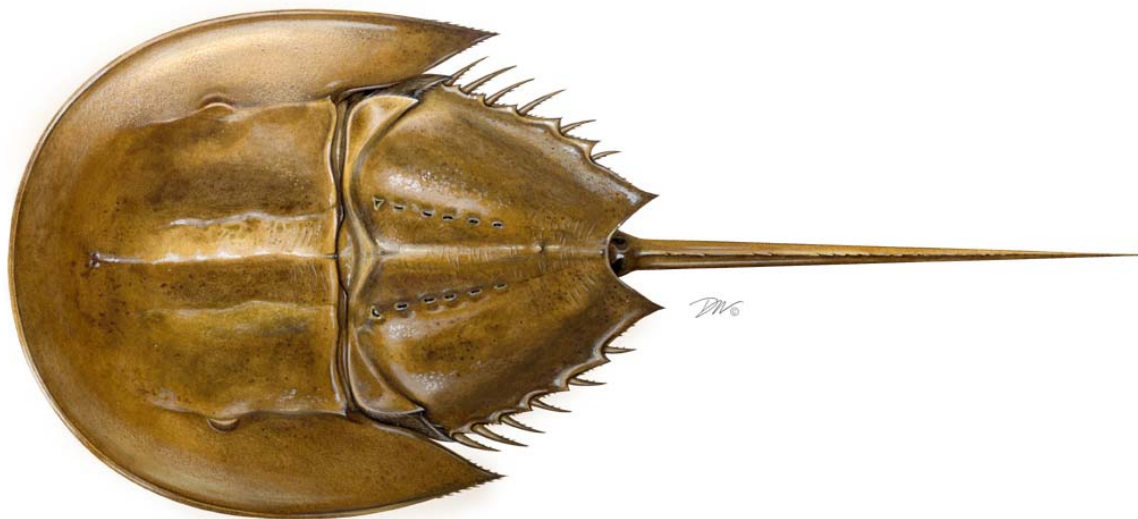


**REVIEW OF THE INTERSTATE FISHERY MANAGEMENT PLAN  
FOR  
HORSESHOE CRAB  
(*Limulus polyphemus*)  
2008 FISHING YEAR**



Presented to the  
ASMFC Horseshoe Crab Management Board

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April 2009

## **2009 REVIEW OF THE 2008 ASMFC FISHERY MANAGEMENT PLAN FOR HORSESHOE CRAB (*Limulus polyphemus*)**

### **I. Status of the Fishery Management Plan**

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 FMP required the States of Maryland, Delaware and New Jersey to maintain their existing horseshoe crab harvest reduction strategies, and required all states to implement certain horseshoe crab research and monitoring programs in an effort to facilitate future management decisions.

In February 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 by NMFS in the area recommended by ASMFC on March 7, 2001.

In April 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 March 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 reduces 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 May 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 September 2008, extends the provisions of Addendum IV through October 31, 2009. In addition, the Board can extend the provisions for an additional year through a vote, as opposed to an addendum. It is likely this vote will take place in August 2009.

### **II. Status of the Stock**

The initial horseshoe crab stock assessment and peer review was conducted in 1998 (ASMFC 1999; ASMFC 1998). The Stock Assessment Subcommittee (SAS) and the Peer Review Panel (PRP) concluded that there was inadequate information for a coastwide stock assessment.

Information was not available to establish biological reference points, fishing mortality rates, or recruitment estimates. The Technical Committee and PRP, based on their assessment of the available data, recommended a conservative, risk-averse management approach. This recommendation was based on localized population declines, increased catch and effort, slow maturation, susceptibility of spawning crabs to harvest, population resiliency, and the need for a superabundance of horseshoe crab eggs in the Delaware Bay.

Under the five-year trigger, a horseshoe crab stock assessment update was conducted in 2003 (ASMFC 2004), which employed trend, power and meta-analyses. The addition of several new datasets and the longer time series allowed for improved trend detection. Once again, the assessment methodology was not, in itself, considered a complete stock assessment as it did not provide estimates of biological reference points or stock status. Such estimates are not expected until sufficient data are obtained and incorporated into a model proposed by the Horseshoe Crab Stock Assessment Subcommittee (HSC SAS 2000).

Results from the most recent assessment indicated that horseshoe crab abundance trends varied regionally/sub-regionally. There was no evidence of a decline in the Southeast Region between 1995 and 2003. Four of five indices in western Long Island Sound showed significant or marginally significant positive trends. No trend was detected in eastern Long Island sound. However, indices trended downward since their peak in the early to mid-1990s and are at levels near or below those encountered in the mid-1980s. In the New England region, the Narragansett Bay data sets indicated population decline from the mid-1970s to present; however, the trends around Cape Cod were less clear. There was evidence that horseshoe crab abundance in Cape Cod was stable or declining.

In early 2008, the Technical Committee (TC) looked at survey data through 2007. Data from multiple lines of evidence indicate that the Delaware Bay horseshoe crab population is experiencing positive population growth. The VT trawl survey shows increasing trends in most demographic groups. The Delaware Bay spawning survey shows stable adult females and increasing adult males. The USGS/FWS tagging study conducted 2003-2005 showed increases in juveniles 7 to 8 years of age during that time.

The PRT and TC will continue to monitor any harvest increases in regions outside of Delaware Bay, which are coincident with harvest reductions within Delaware Bay. An overarching conclusion of recent coastwide assessments has been that management should be regional or embayment specific. It is now apparent that current harvest of the Delaware Bay population is consistent with population growth. However, it is unclear whether populations in the outlying regions can sustain increased harvest.

An external peer review of the next stock assessment is scheduled for 2009.

### **III. Status of the Fishery**

#### ***Bait Fishery***

Reported coastwide bait landings in 2008 remained below the coastwide quota (Table 2, Figure 1). Bait landings decreased over 23% from the previous year, mainly due to reduced landings in

the Massachusetts, New York, and North Carolina. Out of concern for increased harvest pressure due to DE Bay restrictions, Massachusetts and New York adopted regulations in 2008 to limit harvest. The new regulations appear to have had the desired effect in 2008.

An alternative bait/gear workshop conducted under the auspices of ASMFC in 1999 introduced the concept of using bait savings devices (bait bags) in whelk (conch) pots. Free bait bags were distributed to whelk potters in the Mid Atlantic and southern New England regions through a state, federal, and NGO partnership. National Marine Fisheries Service funded the acquisition of the bait bags. The Ecological Research and Development Group (ERDG), Delaware, Maryland, New Jersey, Virginia, New York, Connecticut, Rhode Island and Massachusetts assisted in the distribution of the bags. The reductions in reported bait landings in excess of the 25% reductions required under Addendum I were largely attributed to the success of this program, with the widespread use of the devices by the commercial fishery. Massachusetts fishermen have been using bait cups in conch traps with success. The cups use about a 10<sup>th</sup> of a crab and can be fished for 2-3 days in the relatively cold waters.

Reported coastwide landings since 1998 showed more male than female horseshoe crabs were annually harvested; though, a large proportion of the reported landings in 1998 and 1999 were unclassified (Table 3). Unclassified landings accounted for less than 10% of the reported landings since 2000. The American eel pot fishery prefers egg-laden female horseshoe crabs as bait, while the whelk (conch) pot fishery is less dependent on females.

The hand, trawl and dredge fisheries accounted for over 85% of the 2007 reported commercial horseshoe crab bait landings by gear type. This is consistent with the distribution of landings by gear since 1998. Although the hand fishery accounted for most of the coastwide harvest and was typically the most prominent method of take in most states, the trawl fishery accounted for almost 25% of the reported landings by gear in 2007. Maryland's entire reported harvest was by trawl and accounted for 87% of all reported trawl landings. The dredge and pound fisheries accounted for about 12% reported coastwide bait landings.

The dominance of the hand fishery was reflected in the seasonal distribution of landings. Most of the monthly reported coastwide harvest since 1998 came during May and June as crabs come ashore to spawn and, thus, were readily available to the fishery. There is typically a secondary mode in monthly landings during the late summer or fall. This secondary peak coincides with an increased demand for horseshoe crabs in the conch pot fishery.

### ***Biomedical Fishery***

The horseshoe crab is an important resource for research and manufacture of materials used for human health. There are four companies along the Atlantic Coast that process horseshoe crab blood for use in manufacturing Limulus Amoebocyte Lysate (LAL): Associates of Cape Cod, Massachusetts; Lonza (formerly Cambrex Bioscience), Maryland; Wako Chemicals, Virginia; and Charles River Endosafe, South Carolina. There is one company that bleeds horseshoe crabs but does not manufacture LAL: Limuli Labs, New Jersey. Addendum III requires states where horseshoe crabs are collected for biomedical use to collect and report harvest data and characterize mortality.

The Plan Review Team annually calculates total coastwide harvest and estimates mortality. It was reported that 511,478 crabs (including crabs harvested as bait) coastwide were brought to biomedical companies for bleeding in 2008 (see Table 1 below). This represents a 22% increase over the average of the previous three years. A total of 87,864 crabs reportedly were harvested as bait and counted against state quotas (Table 1: Column A minus B). These crabs were not included in the mortality estimates (Columns C, E, or F) below. It was reported for 2008 that 423,614 crabs were harvested for biomedical purposes only, an increase of approximately 20% over the previous three year average. Crabs were rejected prior to bleeding because of mortality, minor injuries, and slow movement. Based on state reports for 2008, approximately 0.7% of crabs harvested and brought to bleeding facilities were rejected because of death or serious injury. The PRT estimates a mortality of 2,973 crabs prior to bleeding.

The Technical Committee conducted a review of all available literature for estimating crab mortality during and after the bleeding process. It concluded that using an estimate of 15% mortality is reasonable and offered not better alternative. Using the number of biomedical-only crabs bled (Column D) and the estimated mortality rate during and after the bleeding process, the PRT calculated an estimated mortality of 60,312 crabs. The total coastwide mortality estimate of crabs not counted against state quotas (Column C plus E) is 63,285 crabs for 2008. This number does not include mortality of crabs prior to delivery to the biomedical facility (e.g. mortality due to harvest). While reports of this type of mortality are inconsistent among states, the PRT estimates for 2008 a mortality of an additional 2,000 crabs.

**Table 1. Characterization of Biomedical Use of Horseshoe Crabs**

	<b>Year</b>	<i>2004</i>	<i>2005</i>	<i>2006</i>	<i>2007</i>	<i>2008</i>
<b>A</b>	<b>Number of crabs brought to biomedical facilities (bait and biomedical crabs)</b>	343,126	323,149	367,914	500,251	511,478
<b>B</b>	<b>Number of biomedical-only crabs harvested (not counted against state bait quotas)</b>	292,760	283,720	309,289	428,872	423,614
<b>C</b>	<b>Estimated mortality of biomedical-only crabs prior to bleeding</b>	4,391	4,256	4,639	3,599	2,973
<b>D</b>	<b>Number of biomedical-only crabs bled</b>	275,194	270,496	296,958	398,844	402,080
<b>E</b>	<b>Estimated mortality of biomedical-only crabs during or after bleeding</b>	41,279	40,574	44,543	59,833	60,312
<b>F</b>	<b>Total estimated mortality on biomedical crabs not counted against state bait quotas</b>	45,670	44,830	49,182	63,432	63,285

The 1998 FMP establishes a mortality threshold of 57,500 crabs, where if exceeded the Board is required to consider action. Based on an estimated total mortality of 63,285 crabs for 2008, the PRT recommends that the Board consider action. This is the second year in a row the threshold was exceeded. The PRT notes that mortality from biomedical use is approximately 9.1% of the

total horseshoe crab mortality (bait and biomedical) coastwide for 2008. The reported use of horseshoe crabs has increased since the original FMP was approved. However, more crabs harvested for bait were bled in biomedical facilities in 2008, a trend the PRT expects to continue. While monitoring of biomedical harvest and use of crabs has improved under Addendum III, inconsistencies remain in reporting among the states and between biomedical companies and their harvesters. The PRT plans to continue working with the states that report biomedical landings to continue to standardize reporting.

#### **IV. Status of Assessment Advice**

A coastwide quantitative horseshoe crab stock assessment has not been completed. An internal review of the available data by the Stock Assessment Subcommittee (SAS) was completed in August 1998, and reviewed by an external peer review panel (PRP) in October 1998. Both groups concluded that there was inadequate data to conduct a coastwide stock assessment.

The SAS and Peer Review Panel advised a conservative, risk-averse approach to the management of the horseshoe crab, and identified research needs to facilitate future assessments. Although the FMP maintained the risk-averse management initiated in NJ, DE, and MD, failure to cap harvest in other states resulted in a redistribution of landings.

The SAS has proposed a framework for assessing the Atlantic coast horseshoe crab population (ASMFC SAS 2000). The framework recommends a catch-survey method be used to assess the East Coast horseshoe crab population. Application of this model is dependent upon a long-term survey to reliably monitor recruit and adult horseshoe crab relative abundance, and the proportion of recruit and adults in the commercial landings. A peer review of the proposed framework was conducted in June 2005. The Peer Review Panel report is available.

As mentioned at the end of Section II, several efforts were undertaken a few years ago to begin to better understand and quantify the horseshoe crab population. Michelle Davis (Virginia Tech), Jim Berskon (NMFS), and Marcella Kelly (Virginia Tech) explored a surplus production model that provides relative biomass and fishing mortality estimates as well as population projections for Delaware Bay crabs. Dave Smith (USGS) has presented results of a mark-recapture study that provides relative abundance estimates for the Delaware Bay population of horseshoe crabs. John Sweka (USFWS), Mike Millard (USFWS), and Dave Smith have conducted an age-structured population model that can provide insight into which parameters drive the dynamics of the horseshoe crab population. The PRT recommends continued exploration and refinement of current assessment efforts.

In 2008, the SAS completed an update of the 2004 stock assessment report to the TC. It included an updated meta-analysis of trends in fishery-independent surveys, Davis et al.'s 2006 surplus production model, and a comparison of size distributions of adult females from 1980s to 2003 – 2005. Trends were analyzed but no advice was given.

## **V. 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 over a hundred public volunteers. Statistically robust spawner and egg count surveys were designed and implemented in the Delaware Bay. The U.S. Fish and Wildlife Service coordinated the coastwide horseshoe crab tagging program. Virginia Tech has conducted a horseshoe crab benthic survey annually since its pilot study in 2001. The USGS - Biological Resources Division (USGS-BRD) with Virginia Tech completed the second phase of a genetics project to evaluate whether or not regional horseshoe crab populations exist along the Atlantic coast.

### ***Genetic Population Structure Project***

The Virginia Tech Horseshoe Crab Research Center is working with Dr. Tim King and Mike Eackles (USGS) to better understand population genetics of HSCs. They have supplemented previously analyzed samples with samples from new areas of spawning assemblages, commercial fisheries, and other sources. The goal is to help inform HSC management by delineating stock structure and identifying contributions in any mixed-stock fisheries. While the project is a work in progress, several findings are becoming clear. The research shows four distinct genetic units of crabs along the Atlantic coast: Gulf of Maine, mid-Atlantic (MA-NC), southeast (SC & GA), and Atlantic coast of Florida. The crabs on the Gulf side of Florida also appear to be a genetically distinct unit. There is lots of noise in the data for crabs in the mid-Atlantic unit.

### ***Virginia Tech Research Projects (Trawl Survey, Tagging Study, Shorebird Use of VA as a Stopover)***

In 2008, Virginia Tech again used funding from Congress for various horseshoe crab and shorebird research projects, including the benthic trawl survey. In 2008, some areas have been sampled for abundance data for up to six years. The trawl survey shows an increase (though not significant) in mean catch since 2007 in only primiparous females. Mean catches for all other demographics decreased since 2007. The survey will continue in 2009 including the New York apex portion of the survey. VT is expected to receive federal funding (\$400K) in FY2009 to continue its work in 2010. The PRT stresses the importance of the survey as it is expected to provide the most reliable estimates of horseshoe crab population abundance.

### ***Spawning Surveys***

The redesigned spawning survey was completed for the tenth year in 2008. Estimates of spawning activity continue to be precise. A strong nor'easter reduced water temperatures, altered spawning habitat and likely influenced 2008 spawning activity. Baywide female spawning activity has been stable over the past nine years. Estimates of baywide male spawning activity showed no significant trend over the course of the survey from 1999 through 2008.

### ***Egg Studies***

The first coordinated baywide horseshoe crab egg sampling was completed in 2005. The purpose of this survey was to provide a baywide index of horseshoe crab surface egg abundance

during the spring shorebird migration. Monitoring the availability of horseshoe crab eggs throughout the Delaware Bay is an important step in managing horseshoe crabs and migratory shorebirds. Such monitoring activities may be useful in establishing harvest thresholds, guiding beach nourishment activities, setting time-of-year restrictions, etc. Prior horseshoe crab egg surveys conducted by the states of Delaware and New Jersey were not designed to provide a baywide index of egg availability to migratory shorebirds. Survey design and implementation was the result of cooperation by numerous state and federal agencies, university researchers, and input from members of the horseshoe crab stock assessment and shorebird technical committees. A long-term funding source to ensure a continuation of the survey by both states has not been identified. Details in survey reporting responsibilities and format still need to be formalized. The survey is expected to be continued, at least in part, in 2009. Delaware notes that state seasonal hiring constraints may prevent or reduce egg abundance sampling in 2009

Though the survey has been conducted on a baywide basis since 2005, the results have not been reported regularly. Recently, the survey researchers from both sides of the Delaware Bay met to discuss reporting details and responsibilities. Researchers agreed to follow a report format similar to the annual Delaware Bay horseshoe crab spawning survey report. Concerns were raised over the large discrepancies in mean egg abundance found on Delaware beaches versus New Jersey beaches. Although the large differences in mean egg abundance between the two sides may be real, researchers were expected to conduct side-by-side sampling in 2008 to ensure these differences were not the result of sampling and/or counting procedures. However, at the time of review the 2008 report was unavailable.

### ***Tagging Studies***

The USFWS continues to maintain an "800" 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 and other parties involved in outreach and spawning surveys. In some cases, the tagging efforts would benefit by establishing clearly defined objectives and insuring better coordination among researchers. To increase quality of tagging data being collected and supplied to the USFWS in Annapolis, the Tagging Subcommittee developed an application to potential horseshoe crab taggers. The application gives reviewers discretion when issuing tags and better understanding of taggers' objectives. The subcommittee also developed guidelines for a coastwide tagging program. The intent of drafting such guidelines was to encourage existing tagging programs to follow a similar direction and to provide new programs with direction. Ultimately, it is hoped that all horseshoe crab programs along the coast will be coordinated to achieve common objectives that will benefit management of the species.

Over the course of the USFWS program, over 112K crabs have been tagged across most of the Atlantic coast. Nearly 10% of tagged crabs have been recaptured and reported. The TC notes that recapture rates inside and outside DE Bay are likely not directly comparable. This is because of increased re-sighting effort and spawning concentration in DE Bay compared to other areas along the coast. There may be data in the USFWS tagging database to determine differences in effort and recapture rates. However, this project would be time consuming and may not resolve the differences.



### ***Supplemental Bait and Alternative Trap Design***

ASMFC and Ecological Research and Development Group (ERDG) coordinated and New Jersey, Delaware, and University of Delaware Sea Grant funded a workshop to explore ideas to increase or maintain conch fishing success while lowering dependence on horseshoe crabs as bait. This workshop built on a similar workshop conducted in 1999. Watermen agreed that horseshoe crab is, without question, the most effective bait currently available to catch conch and eel. Researchers confirmed through lab and field-testing that no other bait catches conch as effectively as horseshoe crabs.

Researchers from the University of Delaware, Delaware State University and DuPont have partnered to develop and test an artificial bait for the conch and eel pot fisheries. DuPont has volunteered their staff and expertise to work on this project at no cost and Delaware DNREC continues to fund the initiative. The goal of their research is to develop a synthetic compound that is attractive to both eel and conch without dependence on horseshoe crabs. Field testing of a potential matrix was conducted last spring using eel pots. A matrix containing varying amounts of crushed horseshoe crab was tested against corresponding amounts of horseshoe crabs without the matrix. In general, no significant differences were found in eel catches down to ¼ of a horseshoe crab + matrix. The matrix is alginate-based, biodegradable, food grade, FDA approved, inexpensive, has adaptable pore size and is relatively heat stable. Research continues in identifying and replicating the specific attractant.

Another way to decrease dependence on horseshoe crabs for bait may be to use hemolymph, the byproduct of the biomedical bleeding process, to attract conch. Watermen have experimented with bait made from injecting hemolymph into a substrate, such as menhaden, and had varying fishing success which, at times has been judged equal to using horseshoe crabs. The varying degree of success may be related to treatment and handling of the “waste” product. Associates of Cape Cod (Massachusetts) and Lonza (Maryland) have previously offered to provide watermen with hemolymph for testing its effectiveness as an attractant.

Massachusetts fishermen are voluntarily using bait cups that reduce the amount of HSC needed to fish for conch. Parts of one HSC can be used in up to 10 traps (1 cup per trap). The bait cups work well for crabs that have been bled by the biomedical industry. Conch fishermen can use a single bait for about 3 days, after which time it ‘sours’. It’s important to note that waters in Massachusetts are generally colder than the southern states’ waters, which may affect the effectiveness of the bait cups.

### ***Adaptive Resource Management Modeling***

The ARM Work Group is a subset of the group that met in October at the joint ASMFC Horseshoe Crab (HSC) and USFWS Shorebird (SHBD) Technical Committee meeting. The ARM Work Group is being chaired by Jim Nichols (USGS-Patuxent) and Dave Smith (USGS-Leetown).

The Work Group has been tasked with developing models to estimate horseshoe crab harvest levels that will support the energetic needs of the red knot population passing through Delaware Bay. Led by a post-doc with USGS, a considerable amount of modeling work has taken place.

Preliminary results of the modeling work are expected in Summer 2009. The methodology, models, and results will be externally peer reviewed in Fall 2009.

## **VI. Status of Management Measures and Issues**

### **ASMFC:**

The Horseshoe Crab Management Board approved Addendum V at its August 2008 meeting. It extends the provisions of Addendum IV through October 31, 2009 and gives the Board the option to extend the provisions for an additional year through Board vote. This vote will likely occur in August 2009.

### **Shorebird:**

The US Fish and Wildlife Service formed the Shorebird Technical Committee in 2001 with the purpose of providing technical advice to the Board on how horseshoe crab management action might affect shorebird populations. This Committee is comprised of shorebird experts and a representative of the horseshoe crab Technical Committee and Stock Assessment Subcommittee. The group produced a peer-reviewed report that synthesizes current literature and data on the status of shorebirds in the Delaware Bay and to determine their energetic dependency on horseshoe crab eggs. The report's findings led to the initiation of Addendum III.

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. The USFWS has listed the red knot *rufa* subspecies as a candidate for ESA protection. This means protection is warranted but, at this time, it is precluded by higher priority species that are at more imminent risk of extinction.

## **VII. Current State by State Implementation of Compliance Requirements**

Currently, the PRT has no out of compliance recommendations for any ASMFC jurisdictions with regard to their horseshoe crab programs. ME, NH, PRFC, SC, GA and FL have requested and qualify for *de minimis* status. Please see the PRT report on State Compliance for more information on each state's program. State reports for 2008 should continue to comply with the requirements of the FMP, Addendum I, Addendum III, and Addendum V.

Washington, D.C. was added to the HSC Management Board to close a landings loophole that existed in the late 1990s. Since then DC has adopted regulations that prohibit landings of horseshoe crabs, thereby closing the loophole. In order to free DC of the requirement to submit compliance reports, the PRT recommends DC request removal from the HSC Board. Pennsylvania was in this same situation a couple years ago and was removed from the Board in 2006.

### **Law Enforcement:**

The ASMFC Law Enforcement Committee obtained and compiled this information for inclusion into the PRT Report on State Compliance. There were no significant enforcement cases regarding horseshoe crabs raised in 2008.

### **VIII. Recommendations by the Plan Review Team**

#### **Funding for Research and Monitoring Activities:**

The PRT strongly recommends the continuance of a benthic trawl survey in order to provide the necessary information for future stock assessments. A long-term benthic sampling program for horseshoe crabs has been repeatedly identified as a critical stock assessment need. This effort provides a statistically reliable estimate of horseshoe crab relative abundance at a relatively low cost. If VT is unable to secure congressional funding for its research in the future, the PRT recommends a state and federal partnership to fund or find funding for a 'coastwide' trawl survey.

#### **Research and Assessment:**

The PRT urges the Technical Committee to continue exploring different assessment approaches and models for a more quantitative assessment. Any new assessment approaches will be peer reviewed before use to inform management decisions.

The PRT recommends the continuation of the coordinated Delaware Bay-wide egg abundance survey with annual reports provided to the Horseshoe Crab and Shorebird Technical Committee's review and report to the Management Board.

#### **Tagging:**

All entities that currently have tagging programs are encouraged to continue. The PRT recommends using USFWS tags and reporting all data to the repository in the USFWS office in Annapolis.

The Technical Committee has recognized the need for reconvening the horseshoe crab tagging subcommittee. The Tagging Subcommittee should investigate all known tagging data to consider management units, glean life history information and movement information, and possibly estimate mortality and determine stock size. The PRT recommends that tagging information be forwarded to the Stock Assessment Subcommittee prior to the next assessment.

#### **Biomedical Industry:**

According to the FMP, the Board must consider potential restrictions on biomedical harvest because estimated mortality exceeded 57,500 horseshoe crabs in 2008.

The PRT reminds states that they are required to obtain the information outlined in Addendum III. This became a requirement in 2004. Please refer to Monitoring Requirement Component A<sub>2</sub>. States must report that information in their annual compliance reports.

The PRT recommends the TC continue to explore opportunities to engage the biomedical companies through improved reporting and possible tagging programs. However, before tagging

programs using bled crabs are recommended issues about mortality of bled and tagged crabs should be resolved.

#### Adaptive Resource Management Modeling:

The PRT supports the purpose and work of the ARM working group. This group should continue development of models that estimate horseshoe crab harvest levels that will support recovery of the red knot population.

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**Table 2. Reported commercial horseshoe crab bait landings by jurisdiction.**

Jurisdiction	RPL	Addendum IV		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Preliminary 2008
		Quota <sup>a</sup>	State Quota <sup>c</sup>											
ME	13,500	13,500	-	13,500	1,500	1,391	100	150	98	0	0	0	0	0
NH	350	350	-	200	350	180	0	120	0	0	0	0	5	0
MA	440,503	330,377	165,000	400,000	545,715	272,930	134,143	138,613	125,364	69,436	73,740	171,906	150,829	103,963
RI	26,053	26,053	13,586	-	26,053	13,809	3,490	3,886	5,824	6,030	8,260	15,274	15,564	15,549
CT <sup>b</sup>	64,919	48,689	-	34,583	45,050	15,921	11,508	32,080	13,386	23,788	15,240	25,280	24,761	32,535
NY	488,362	366,272	170,000	352,462	394,026	628,442	129,074	177,271	134,264	142,279	155,108	172,381	298,222	138,878
NJ	604,049	100,000	0	241,456	297,680	398,629	261,239	281,134	113,940	46,569	87,250	3,444	0	0
PA <sup>d</sup>	-	0	-	75,000	0	0	0	0	0	0	0	-	-	-
DE	482,401	100,000	-	479,634	428,980	248,938	244,813	298,318	356,380	127,208	154,269	147,813	76,663	102,113
MD	613,225	170,653	-	114,458	134,068	152,275	170,653	278,211	168,865	161,928	169,821	136,733	172,117	163,495
PRFC	-	0	-	-	0	0	0	0	0	0	0	0	0	0
DC	-	0	-	-	0	0	0	0	0	0	0	0	0	0
VA	203,326	152,495	-	1,015,700	650,640	145,465	48,880	42,954	106,577	94,713	97,957	155,704	79,570	49,660
NC	24,036	24,036	-	21,392	28,094	14,973	9,130	12,906	24,367	9,437	7,462	10,331	7,091	26,091
SC	-	0	-	-	0	0	0	0	0	0	0	0	0	0
GA	29,312	29,312	-	-	29,312	0	0	0	0	0	0	0	0	0
FL	9,455	9,455	-	200	19,446	10,462	0	200	1,628	0	0	469	186	0
<b>TOTAL</b>	<b>2,999,491</b>	<b>1,371,192</b>		<b>2,748,585</b>	<b>2,600,914</b>	<b>1,903,415</b>	<b>1,013,030</b>	<b>1,265,843</b>	<b>1,050,693</b>	<b>681,388</b>	<b>769,107</b>	<b>839,335</b>	<b>825,008</b>	<b>632,284</b>
<b>Pct. Reduction Relative to RPL</b>				8.4	13.3	36.5	66.2	57.8	65.0	77.3	74.4	72.0	72.5	78.9
<b>Pct. Reduction Relative to Addendum IV Quota</b>													39.8	53.9

**Table 3. Commercial horseshoe crab bait landings by sex by jurisdiction.**

	2003			2004			2005			2006			2007 (preliminary)		
	Males	Females	Unknown	Males	Females	Unknown	Males	Females	Unknown	Males	Females	Unknown	Males	Females	Unknown
ME	0	0	98	0	0	0	0	0	0	0	0	0	0	0	0
NH	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
MA	60,877	64,487	0	28,469	36,153	3,814	36,549	37,191	0	82,525	80,734	8,647	72,433	68,972	9,424
RI	0	0	5,824	0	0	6,030	0	0	8,260	0	0	15,274	0	0	15,564
CT	0	0	13,386	0	0	23,788	0	0	15,240	0	0	25,280	0	0	24,761
NY	66,417	67,847	0	69,275	73,004	0	83,830	71,278	0	89,992	82,389	0	154,905	129,215	0
PA	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-
NJ	84,518	29,422	0	33,725	12,844	0	58,426	18,665	10,159	2,028	1,416	0	0	0	0
DE	233,878	122,502	0	83,380	43,074	754	104,940	49,329	0	120,952	26,861	0	76,663	0	0
MD	95,792	73,073	0	96,955	64,973	0	108,707	61,114	0	46,833	89,900	0	70,568	101,549	0
PRFC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VA	28,862	56,940	20,775	19,344	41,987	33,382	28,825	44,296	24,836	61,597	70,768	23,339	39,017	39,203	1,350
IIC	0	0	24,367	0	0	9,437	0	0	7,462	0	0	10,331	0	0	7,091
SC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FL	0	0	1,628	0	0	0	0	0	0	0	0	469	0	0	0
<b>Total</b>	570,344	414,271	66,078	331,148	272,035	77,205	421,277	281,873	65,957	403,927	352,068	83,340	413,586	338,939	58,195
<b>Grand Total</b>	1,050,693			680,388			769,107			839,335			810,720		

	2008 Preliminary		
	Males	Females	Unknown
ME	0	0	0
NH	0	0	0
MA	48,046	53,764	2,153
RI	0	0	15,549
CT	0	0	32,535
NY	72,939	63,179	2,760
NJ	0	0	0
DE	102,113	0	0
MD	97,237	66,258	0
PRFC	0	0	0
DC	-	-	-
VA	28,591	21,069	0
NC	0	0	26,091
SC	0	0	0
GA	0	0	0
FL	0	0	0
<b>Total</b>	348,926	204,270	79,088
<b>Grand Total</b>	632,284		

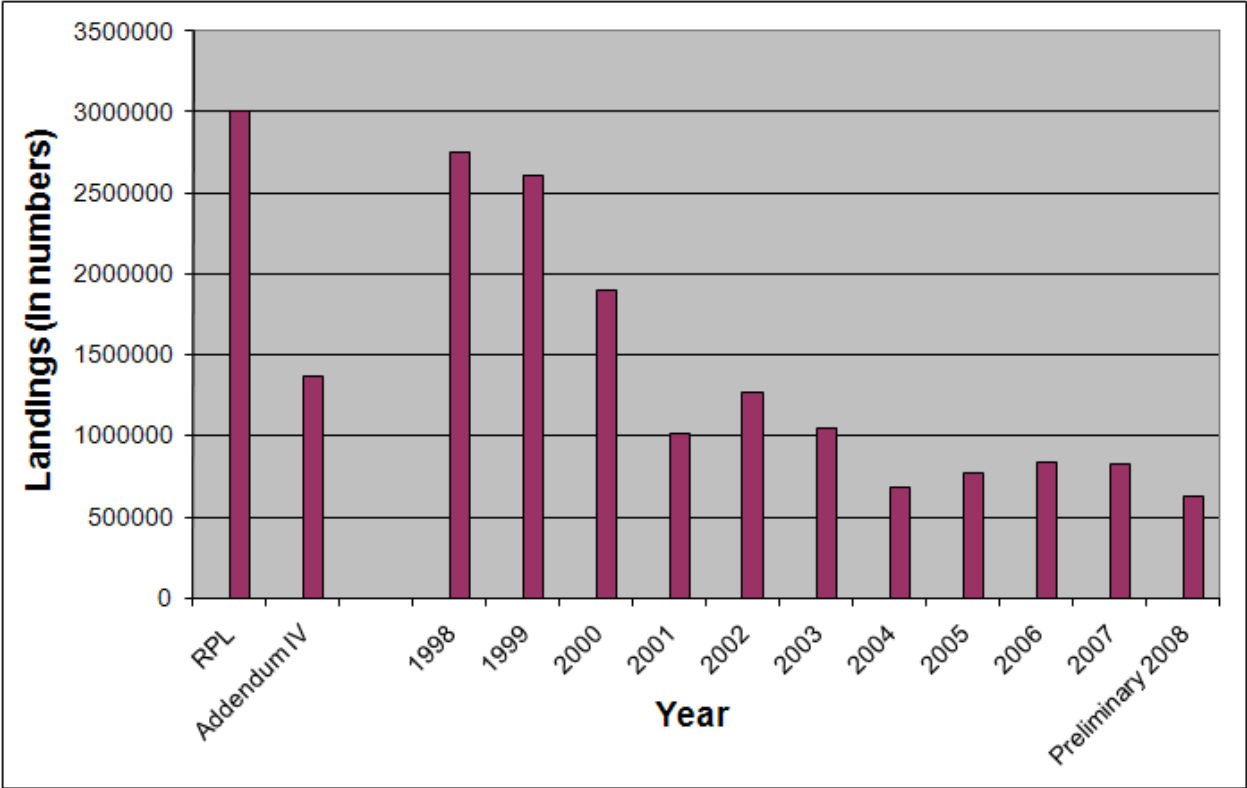


Figure 1. Coastwide horseshoe crab landings for bait expressed as number of crabs.