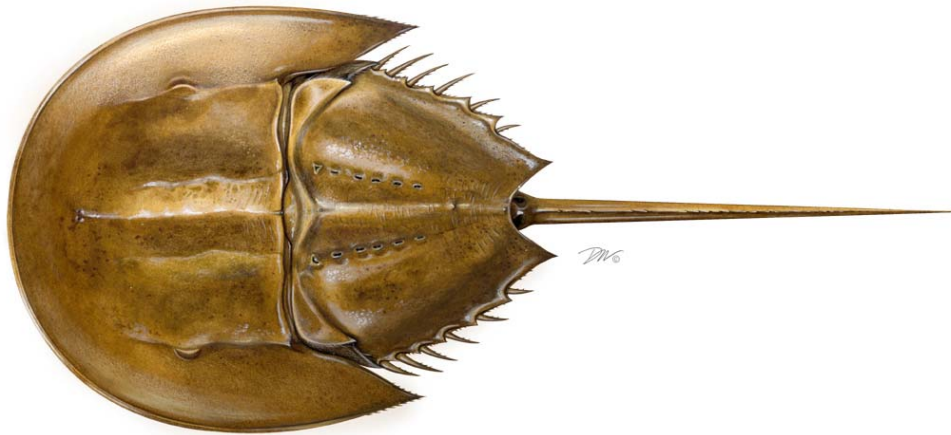


**2007 REVIEW OF THE FISHERY MANAGEMENT PLAN IN 2006 FOR
HORSESHOE CRAB
(*Limulus polyphemus*)**



Presented to the
ASMFC Horseshoe Crab Management Board

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2007 REVIEW OF THE 2006 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 seeks to further the conservation of horseshoe crab and migratory shorebird populations in and around the Delaware Bay. It reduces harvest quotas and implements seasonal bait harvest closures in New Jersey, Delaware, and Maryland, and revises monitoring components for all jurisdictions.

Addendum IV was approved in May 2006. It further limits bait harvest in New Jersey and Delaware to 100,000 crabs (male only) and requires a delayed harvest in Maryland and Virginia.

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.

Abundance measures in the Delaware Bay declined significantly during the 1990s. Declines from the late 1980s to early 1990s appear to be steeper than declines in recent years. However, the slopes of these declines were not statistically significant. The redesigned Delaware Bay spawning survey showed that bay-wide spawning activity has been stable from 1999 to 2006.

The SAS reviewed the results of three models/studies that focused on horseshoe crab population dynamics and abundance in the Delaware Bay region. It looked at a surplus production model, mark-recapture study, and age-structured model. The general picture that emerges from a synthesis of the assessments indicates that

- 1) relative abundance has declined through the 1990's to present,
- 2) relative fishing mortality rate has exceeded F_{MSY} since the mid-1990's with the F/F_{MSY} ratio peaking around 1998 and, on average, declining since then, and
- 3) current harvest rate is below 10%, but appears to be in excess of F_{MSY} .

III. Status of the Fishery

Bait Fishery

Reported coastwide bait landings in 2006 remained below the quota established under Addendum III and IV (Table 1, Figure 1). Bait landings increased for the third consecutive year, but also remained below one million crabs for the third consecutive year.

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 10th of a crab and can be fished for 2-3 days 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 2). Unclassified landings accounted for less than 12% 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 90% of the 2006 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 and dredge fisheries accounted for over 45% of the reported landings by gear in 2006. The dredge fishery accounted for 52% of the Delaware landings and 82% of the Virginia landings. The trawl fishery accounted for over 99% of Maryland's horseshoe crab bait landings.

The dominance of the hand fishery was reflected in the seasonal distribution of landings. Most of the 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 I 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; Cambrex Bioscience, Maryland; Wako Chemicals, Virginia; and 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 367,914 crabs (including crabs harvested as bait) coastwide were brought to biomedical companies for bleeding in 2006 (see table below). A total of 58,625 crabs were harvested as bait and counted against state quotas. These crabs were not included in the mortality estimates below. It was reported for 2006 that 309,289 crabs were harvested for biomedical purposes only. Crabs were rejected prior to bleeding because of mortality, minor injuries, and slow movement. Based on state reports, approximately 1.5% of crabs harvested and

brought to bleeding facilities were rejected because of death or serious injury. The PRT estimates a mortality of 4,639 crabs prior to bleeding.

The highest estimate of crab mortality from the bleeding process in the literature is 15% (Thompson 1998). Using the number of biomedical-only crabs and the estimated mortality rate during or after the bleeding process, the PRT calculated an estimated mortality of 44,543 crabs. The total coastwide mortality estimate of crabs not counted against state quotas is 49,182 crabs for 2006.

Year	<i>2004</i>	<i>2005</i>	<i>2006</i>
Number of crabs brought to biomedical facilities (bait and biomedical crabs)	343,126	323,149	367,914
Number of biomedical-only crabs harvested (not counted against state bait quotas)	292,760	283,720	309,289
Estimated mortality of biomedical-only crabs prior to bleeding	4,391	4,256	4,639
Number of biomedical-only crabs bled	275,194	270,496	296,958
Estimated mortality of biomedical-only crabs during or after bleeding	41,279	40,574	44,543
Total estimated mortality on biomedical crabs not counted against state bait quotas	45,670	44,830	49,182

The 1998 FMP establishes a mortality threshold of 57,500 crabs, where if exceeded the Board is required to consider action. The PRT recommends that the Board not consider action at this time but that it continues to monitor biomedical use of crabs closely. It appears that use of horseshoe crabs has increased slightly since the original FMP was approved. However, more crabs that were harvested for bait were bled in biomedical facilities in 2006, thereby keeping mortality under the threshold. While monitoring of biomedical harvest and use of crabs has improved under Addendum III, inconsistencies remain in reporting among the states. The PRT plans to work 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 and negated conservation efforts.

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 now available.

As mentioned at the end of Section II, several efforts have recently been undertaken 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.

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 in some areas 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 2001. The USGS - Biological Resources Division (USGS-BRD) completed the first phase of a genetics project to evaluate whether or not regional horseshoe crab populations exist along the Atlantic coast.

USGS Genetic Population Structure Project

Stock identification/delineation work by the USGS-BRD has been completed. The project led by Dr. Tim King included a sampling of 900 horseshoe crabs from Maine to Yucatan. The results suggest four distinct management units the Atlantic coast. However, more sampling and analysis is needed to test the hypothesis. King's assignment test will make a useful tool in identifying the management unit from which a horseshoe crab came from when caught at sea.

Virginia Tech Research Projects

In 2006, Virginia Tech received funding from Congress for various horseshoe crab research projects. Virginia Tech conducted several horseshoe crab and shorebird-related projects including the benthic trawl survey. In 2006, some areas have been sampled for up to 5 years of abundance data. Areas showed changes in abundance, but firm conclusions regarding abundance

trends should not be drawn from the short data set. As part of the survey researchers from Virginia Tech have been working on the development of criteria to identify horseshoe crabs newly recruited to the spawning population. To date, no quick, effective method has been developed. The survey will continue in 2007. In the NOAA FY2007 budget, \$542K is currently allocated for continuing VT projects. Funding for the benthic trawl survey in FY2008 is uncertain. 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 Delaware Bay horseshoe crab spawning survey has been annually conducted following the modified design developed during an ASMFC workshop in 1999. The survey is being conducted through a unique partnership between various state and federal agencies, a biomedical company, conservation groups, and numerous private citizens. Delaware funds the spawning survey coordinator's position (Atlantic Coastal Grant funds) and provides staff for sampling, data analysis and report writing. New Jersey provides staff for sampling, data entry and verification. The USGS-BRD provides statistical guidance, samples beaches and assists in data analysis and report writing. The survey provides estimates of female spawner abundance with excellent CVs (<10%) and is currently the best tool for monitoring changes in the Delaware Bay horseshoe crab spawning population. Spawning activity in the Delaware Bay has been stable over the past eight years (Slope = 0.01, SE=0.013, 90% CI = -0.01 to 0.04). Funding for the survey continues to be year-to-year. Funding was approved to continue the survey in 2007.

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 will be continued in 2007.

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.

At several recent meetings of the Horseshoe Crab Technical Committee (TC), requests were made to reconvene the Horseshoe Crab Tagging Subcommittee. The TC tasks the Tagging Subcommittee with reviewing all tagging information contained in the USFWS Tagging Database. The USFWS is currently drafting a report to summarize all tagging data available in the database and that information will be distributed to the Technical Committee in 2007.

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 is scheduled for this spring. The matrix containing crushed horseshoe crab will be tested against horseshoe crabs without the matrix. If the matrix proves successful, testing of other attractants will be made. A number of fishermen have agreed to test the prototype baits in both conch and eel pots. The partnership's goal is to have a functional prototype this summer that does not rely on horseshoe crabs.

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 Cambrex (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.

Shorebird Monitoring and Modeling

Coordinate monitoring of shorebirds in the Delaware Bay region continued in 2006. The USFWS Shorebird Technical Committee held its annual meeting in Cape May, New Jersey. The committee, New Jersey, and Delaware are cooperating and making progress in the development of a shorebird population model.

The Shorebird Technical Committee and Horseshoe Crab TC are expected to jointly meet in Fall 2007. One purpose is to begin discussion of joint-population modeling efforts.

VI. Status of Management Measures and Issues

ASMFC:

The Horseshoe Crab Management Board approved Addendum IV at its May 2006 meeting. Among other things, it contains options to restrict biomedical harvest and further restrict bait harvest in Delaware, New Jersey, Maryland, and Virginia.

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, there are no compliance issues for any ASMFC jurisdictions with regard to their horseshoe crab programs. 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 2007 should continue to comply with the requirements of the FMP, Addendum I, Addendum III, and Addendum IV.

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 2006.

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. The pilot trawl study conducted in 2001 clearly showed that this project could provide a statistically reliable estimate of horseshoe crab relative abundance at a relatively low cost. If congressional funding does not continue to support VT's research, the PRT recommends a state and federal partnership to fund a 'coastwide' trawl survey.

Research and Assessment:

The PRT recommends that states characterize commercial landings by maturity state as soon as the necessary criteria are defined. This information is crucial to the stock assessment framework proposed by the SAS. In the meantime, it urges the Technical Committee to continue pushing current assessment use and exploration. Also, the Board should be aware that new assessment approaches may be peer reviewed in the near future, which may lead to management recommendations.

The PRT recommends the continuation of the coordinated Delaware Bay-wide egg abundance survey.

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 the Tagging Subcommittee meet prior to the next assessment.

Biomedical Industry:

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 A₂. States must report that information in their annual compliance reports. The Commission will reevaluate potential restrictions on biomedical harvest if estimated mortality exceeds 57,500 horseshoe crabs per year.

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Table 1. Reported commercial horseshoe crab bait landings by jurisdiction.

Jurisdiction	Reference Period Landings (RPL)	Addendum I Quota ^a	Addendum III Quota ^a	Addendum IV Quota ^a	1998	1999	2000	2001	2002	2003	2004	Preliminary 2005	Preliminary 2006
ME	13,500	13,500	13,500	13,500	13,500	1,500	1,391	100	150	98	0	0	
NH	350	350	350	350	200	350	180	0	120	0	0	0	0
MA	440,503	330,377	330,377	330,377	400,000	545,715	272,930	134,143	138,613	125,364	69,436	73,740	171,646
RI	26,053	26,053	26,053	26,053	-	26,053	13,809	3,490	3,886	5,824	6,030	8,260	15,274
CT ^b	64,919	48,689	48,689	48,689	34,583	45,050	15,921	11,508	32,080	13,386	23,788	15,240	25,280
NY	488,362	366,272	366,272	366,272	352,462	394,026	628,442	129,074	177,271	134,264	142,279	155,108	172,381
NJ	604,049	453,037	150,000	100,000	241,456	297,680	398,629	261,239	281,134	113,940	46,569	87,250	3,444
PA	-	0	0	0	75,000	0	0	0	0	0	0	0	-
DE	482,401	361,801	150,000	100,000	479,634	428,980	248,938	244,813	298,318	356,380	127,208	154,269	146,070
MD	613,225	459,919	170,653	170,653	114,458	134,068	152,275	170,653	278,211	168,865	161,928	169,821	136,733
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	152,495	152,495	1,015,700	650,640	145,465	48,880	42,954	106,577	94,713	97,957	155,704
NC	24,036	24,036	24,036	24,036	21,392	28,094	14,973	9,130	12,906	24,367	9,437	7,337	6,288
SC	-	0	0	0	-	0	0	0	0	0	0	0	0
GA	29,312	29,312	29,312	29,312	-	29,312	0	0	0	0	0	0	0
FL	9,455	9,455	9,455	9,455	200	19,446	10,462	0	200	1,628	0	0	283
TOTAL	2,999,491	2,275,296	1,471,192	1,371,192	2,748,585	2,600,914	1,903,415	1,013,030	1,265,843	1,050,693	681,388	768,982	833,103
Pct. Reduction Relative to RPL					8.4	13.3	36.5	66.2	57.8	65.0	77.3	74.4	72.2
Pct. Reduction Relative to Quota I							16.3	55.5	44.4	53.8	70.1	66.2	63.4
Pct. Reduction Relative to Quota III											53.7	47.7	43.4

Table 2. Commercial horseshoe crab bait landings by sex by jurisdiction.

	1998			1999			2000			2001			2002		
	Males	Females	Unknown	Males	Females	Unknown	Males	Females	Unknown	Males	Females	Unknown	Males	Females	Unknown
ME	0	0	13,500	0	0	1,500	0	0	1,391	0	0	100	0	0	150
NH	0	0	200	0	0	350	0	0	180	0	0	0	0	0	120
MA	0	0	400,000	269,153	276,562	0	118,596	154,334	0	65,072	69,071	0	63,072	67,380	8,161
RI				0	0	26,053	0	0	13,809	0	0	3,490	0	0	3,886
CT	0	0	34,583	27,631	17,419	0	5,525	10,396	0	6,870	4,638	0	14,617	17,463	0
NY	0	0	352,462	0	0	394,026	288,305	338,637	1,500	48,381	80,693	0	78,156	99,115	0
PA	0	0	75,000	0	0	0	0	0	0	0	0	0	0	0	0
NJ	173,660	67,796	0	199,216	98,464	0	303,381	95,248	0	192,999	68,240	0	200,375	78,745	2,014
DE	220,326	259,308	0	237,137	191,843	0	153,860	95,078	0	109,496	135,317	0	180,700	117,618	0
MD	30,539	68,524	15,395	19,234	91,032	23,802	67,243	76,380	8,652	83,725	84,607	2,321	176,642	101,569	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	0	0	1,015,700	0	0	650,640	0	0	145,465	0	0	48,880	0	0	42,954
NC	0	0	21,392	0	0	28,094	0	0	14,973	0	0	9,130	0	0	12,906
SC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GA	0	0	0	0	0	29,312	0	0	0	0	0	0	0	0	0
FL	0	0	200	0	0	19,446	0	0	10,462	0	0	0	0	0	200
Total	424,525	395,628	1,928,432	752,371	675,320	1,173,223	936,910	770,073	196,432	506,543	442,566	63,921	713,562	481,890	70,391
Grand Total	2,748,585			2,600,914			1,903,415			1,013,030			1,265,843		

Table 2. Continued

	2003			2004			2005 (preliminary)			2006 (preliminary)		
	Males	Females	Unknown	Males	Females	Unknown	Males	Females	Unknown	Males	Females	Unknown
ME	0	0	98	0	0	0	0	0	0			
NH	0	0	0	0	0	0	0	0	0			
MA	60,877	64,487	0	28,469	36,153	3,814	36,549	37,191	0	82,525	80,734	8,387
RI	0	0	5,824	0	0	6,030	0	0	8,260			15,274
CT	0	0	13,386	0	0	23,788	0	0	15,240			25,280
NY	66,417	67,847	0	69,275	73,004	0	83,830	71,278	0	89,992	82,389	
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	
DE	233,878	122,502	0	83,380	43,074	754	104,940	49,329	0	119,806	26,264	
MD	95,792	73,073	0	96,955	64,973	0	108,707	61,114	0	46,833	89,900	0
PRFC	0	0	0	0	0	0	0	0	0			
DC	0	0	0	0	0	0	0	0	0			
VA	28,862	56,940	20,775	19,344	41,987	33,382	21,357	38,367	141	61,597	70,768	23,339
NC	0	0	24,367	0	0	9,437	0	0	7,337			6,288
SC	0	0	0	0	0	0	0	0	0			
GA	0	0	0	0	0	0	0	0	0			
FL	0	0	1,628	0	0	0	0	0	0			283
Total	570,344	414,271	66,078	331,148	272,035	77,205	413,809	275,944	41,137	402,781	351,471	78,851
Grand Total	1,050,693			680,388			730,890			833,103		

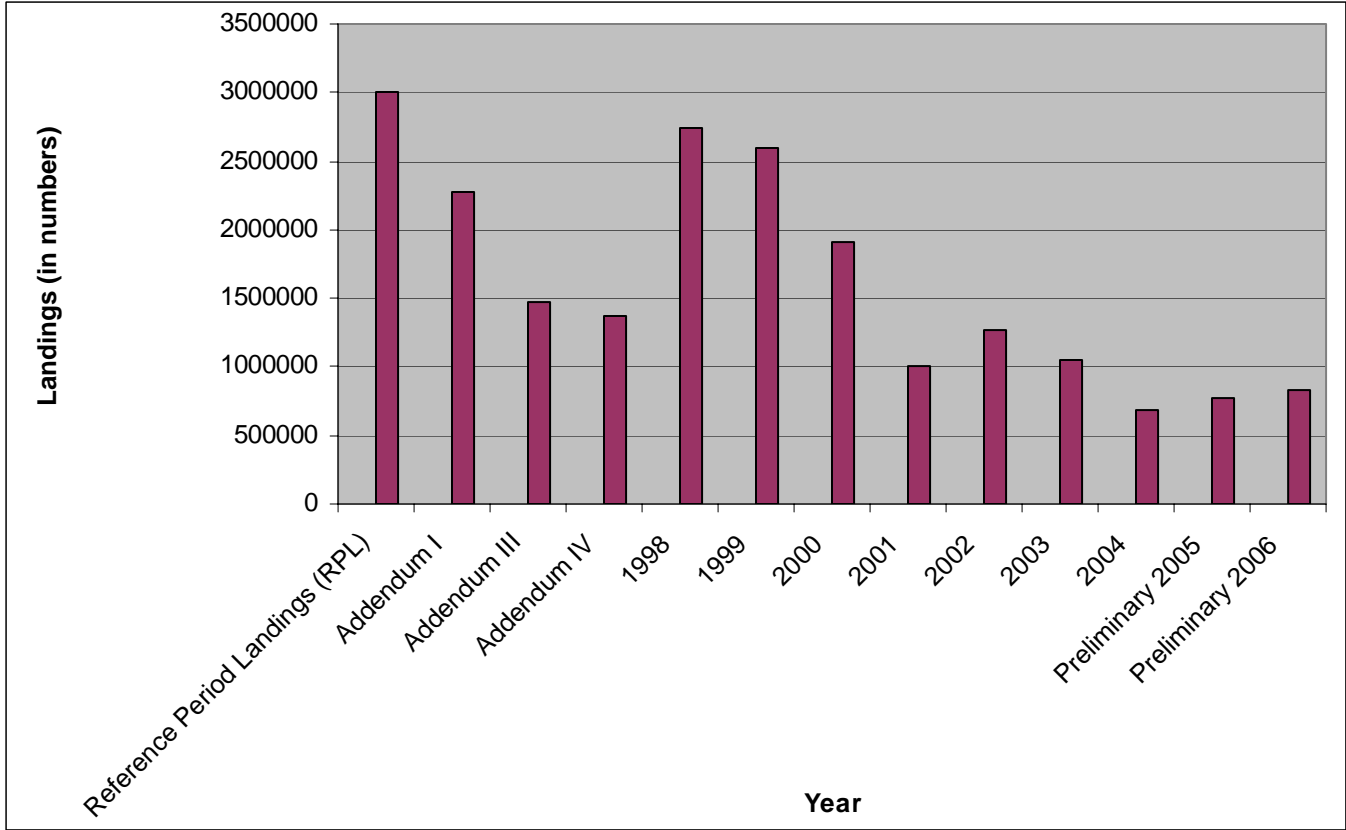


Figure 1. Coastwide horseshoe crab landings for bait expressed as number of crabs.