

2002 REVIEW OF THE FISHERY MANAGEMENT PLAN FOR
HORSESHOE CRAB
(Limulus polyphemus)

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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. NMFS may consider developing a proposal to prohibit the transfer of horseshoe crabs in federal waters in 2003; however, homeland security issues with the United States Coast Guard may make adequate enforcement impractical.

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.

II. Status of the Stock

The status of the stock is unknown. The Stock Assessment Subcommittee (SAS) and the Peer Review Panel (PRP) concluded that there was inadequate information for a coastwide stock assessment. Information is 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 will soon be due. The Stock Assessment Subcommittee will be meeting this year to plan its strategy for accomplishing this requirement. The assessment update will be conducted in late 2003 or 2004.

Preliminary conclusions are being drawn from the Delaware Bay Spawning Survey study. It is being concluded that over the past four years in the Delaware Bay spawning activity has been either stable or declining slightly. In another study, surface (0 - 5 cm) egg density sampling in New Jersey showed no appreciable changes in egg densities since 1999 (Kathy Clark (NJ DEP) pers. comm.). However, conclusions about population trends for a species such as horseshoe crabs should not be made on such short time series.

III. Status of the Fishery

Bait Fishery

Reported coastwide horseshoe crab bait landings declined from adoption of the FMP in 1998 to 2001 (Figure 1). There is a small increase in landings observed from 2001 to 2002. These commercial landings are a significant decrease from the reference period (1995-1997 for most states; 1998-1999 for others). Some states, particularly in the Delaware Bay region, have substantially reduced commercial effort by establishing criteria to limit permit eligibility. Preliminary coastwide bait landings for 2002 as of February 14, 2003, are 1,257,254 horseshoe crabs. This equates to over a 58% decrease relative to the RPL's adopted under Addendum I. Under Addendum I, the states of Maryland and New Jersey were encouraged to maintain their more restrictive (>25%) harvest regulations. New Jersey adopted a state quota of 297,680 crabs in September 2001 - about 50% below the state's RPL's. Maryland maintained its harvest restrictions until August 2000 when, with the Technical Committee and Management Board's approval, regulations were changed to reduce the targeting of female crabs. Maryland 2002 landings were 55% below the state's RPL's (Table 1).

Although horseshoe crab bait landings have declined in recent years, large-scale bait shortages were not apparent in 2002. This may be partially attributed to the use of bait bags in the whelk (conch) pot fishery. A study conducted by Fisher and Fisher (2000) showed no significant difference in whelk catch between conch pots baited with a whole female crab or two whole male crabs versus a half of female or two halves of male crabs placed in mesh bait bags. As a result, the State of Virginia required the use of bait bags in their whelk pot fishery.

Free bait bags have been distributed to whelk potters in several Mid-Atlantic States through a partnership with the Ecological Research and Development Group (ERDG), the states of Delaware, Maryland, New Jersey and Virginia. In addition, ERDG, in partnership with NOAA Fisheries, provided over 7,000 bait bags to conch fishermen in New York, Connecticut, Rhode Island and Massachusetts in the past couple years. NOAA Fisheries will no longer provide funding for distribution of free bait bags. It has successfully distributed bait bags across the area it had set out to do so. Conch fishermen are now developing modifications of bait bags and asking manufacturers to produce them.

Biomedical Fishery

The horseshoe crab continues to be an important resource for research and manufacture of materials used for human health. Several companies along the Atlantic Coast continue to

process horseshoe crab blood for use in manufacturing Limulus Amoebocyte Lysate (LAL). The State of North Carolina is no longer reporting a biomedical harvest, since Haemachem, Incorporated is closed and was sold. However, Georgia is now reporting a biomedical harvest for use by Endosafe, Incorporated in the State of South Carolina.

The PRT felt it was important to better understand the biomedical harvest of horseshoe crabs. Specifically, the groups would like to monitor the coastwide harvest by the biomedical community. It is suggested that this information be submitted to the PRT through the biomedical survey developed by the PRT and TC several years ago. The landings will be reported as an aggregate, so as to keep individual company or state landings confidential.

IV. Status of Assessment Advice

A coastwide quantitative horseshoe crab stock assessment has not been completed. A 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 PRP 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. Further, the failure of some states to require mandatory reporting by the 1999 fishing season hampered the development of strategies to reduce exploitation. The adoption of Addendum I provided a table of reference period landings and recommended a 25% state-by-state reduction in bait landings. A 40% reduction in RPL was realized in 2000, 66% reduction was realized in 2001, and preliminary data suggest a 58% reduction in 2002.

The SAS has proposed a framework for assessing the Atlantic coast horseshoe crab population (ASMFC 2000). The framework recommends a catch-survey method be used to assess the East Coast horseshoe crab population. This method employs survey data and harvest numbers to relate the number of adults and recruits (individuals that will mature the following year) present in year t to the number of adults available to the fishery in year $t+1$, and permits the estimation of catchability and abundance of adults and recruits. 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. As such, a formal quantitative stock assessment probably remains 5 to 10 years away once a reliable survey is fully implemented.

V. Status of Research and Monitoring

The Horseshoe Crab FMP set forth an ambitious research and monitoring strategy in 1999 in an effort to facilitate future management decisions. Despite limited time and funding there were many accomplishments. 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. A horseshoe crab benthic survey design workshop was conducted in July 1999 and the U.S. Geological Survey - Biological Resources Division (USGS-BRD) initiated a genetics project to evaluate whether or not regional horseshoe crab populations exist along the Atlantic coast.

State Challenge Fund Research

Since this time, the SAS has identified a potential model for a future quantitative stock assessment and developed a prioritized list of research and monitoring needs. With these needs in mind, the states of New Jersey, Delaware and Maryland contributed \$125,000 (with 50% match by the Fish and Wildlife Foundation) in 2001 to initiate:

- 1). A pilot trawl survey study;
- 2). Horseshoe crab stock identification/delineation;
- 3). Development of criteria for identifying new recruits;
- 4). The feasibility of aerial videography to monitor horseshoe crab spawning.

Researchers from Virginia Polytechnic Institute (VPI) and State University initiated the pilot trawl survey in 2001 to identify factors affecting horseshoe crab distribution and abundance and to develop protocol for a full-scale trawl survey. Results from this survey revealed that depth, topography (troughs) and time of day were important factors in determining horseshoe crab abundance. Further, low CV's (≤ 0.20) were achievable at relatively low sample sizes (.55 stations). The results from this pilot survey were extremely encouraging, with costs estimates for conducting such a survey much lower than expected.

So far, New York, Delaware, Maryland, U.S. F&WS, and NMFS have committed to contribute funds to continue the research at VPI. However, this project, which is the top priority for the horseshoe crab stock assessment, lacks long term funding. If the federal funding described below does not materialize, states should prepare to contribute funds to continue the trawl survey.

Stock identification/delineation work by the USGS-BRD is near completion. The project led by Dr. Tim King included a sampling of 900 horseshoe crabs from Maine to Yucatan. Six or seven distinct stocks have been identified along the Atlantic coast. The results of the study will be available within the next couple months.

Researchers from VPI have also been working on the development of criteria to identify horseshoe crabs newly recruited to the spawning population using 200 captive crabs. Development of a non-lethal biopsy technique is slowly progressing. Problems associated with identifying the pre-molting condition are hampering development of a rapid assessment technique. Work is continuing in 2003.

The night aerial videography project run by researchers from Virginia Tech has become a lower research priority. The results can be used to augment the stock assessment for horseshoe crabs. However, it is believed that resources may be put to better use with other studies.

Possible Federal Funds for HSC Research Projects

In this year's budget under the Senate Omnibus Bill HJRESZ, there is a line item in the NOAA Fisheries budget for \$850K for horseshoe crab research. It is believed the amount has been reduced to approximately \$665K, but it is still in the budget. NOAA Fisheries is waiting for final signoff before determining the mechanism for distribution of this money. Dr. Jim Berkson, Virginia Tech, has four proposed horseshoe crab projects, including one which expanding his pilot study, which equal the amount of money we hope to get. In addition to the money, NOAA Fisheries' Northeast Fisheries Science Center (NEFSC) has a new vessel, the R/V Nauvoo – 50 footer - which would be ideal for Dr. Berkson's study. I believe the vessel will be docked at the Sandy Hook, New Jersey Lab. NOAA Fisheries' State/Federal Fisheries Division (F/SF8), Office of Sustainable Fisheries has been in contact with NEFSC about using this vessel for Dr. Berkson's entire study. So far, and if the budget gets signed soon, the availability of this vessel looks good. F/SF8 has entered into preliminary discussions with Dr. Berkson and NEFSC about what the cost of the vessel would be, and if the money is received from Congress soon, it is believed the study will go forward.

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. The spawning survey coordinator is being funded by the state of Delaware using Atlantic Coastal Grant funds, the state of New Jersey provides staff for data entry and verification, the state of Maryland has contributed volunteers, and the USGS-BRD completes the annual data analysis. The survey is currently providing an estimate of female spawner abundance with good CVs (<10%) and should serve as a good tool to monitor horseshoe crab population using the Delaware Bay. The preliminary conclusion is that spawning activity in the Bay over the past four years is either stable or slightly declining. This work does lack permanent funding and is funded through the partnerships and short term funding each year. Funding is in place for 2003, and there is a proposal in to extend funding through 2004.

Egg Studies

Egg density studies continue in the Delaware Bay, although sampling methodologies differ between the states of Delaware and New Jersey. The State of Delaware funded a study to further refine egg-sampling methodologies in 2001. Delaware anticipates sampling horseshoe crab eggs (0-5 cm and 5-20 cm) in 2003; however, available funding may not be sufficient to ensure complete sample coverage. The State of New Jersey also anticipates sampling surface (0-5 cm) egg densities in 2003. The New Jersey egg sampling effort lacks a long-term funding source necessary to insure its continuation. The Technical Committee has recognized the importance of the study in each state. It has recommended that the SAS coordinate with the Shorebird TC, NJ and DE to make the study more useful.

A study to estimate horseshoe crab fecundity is being conducted by a graduate student from Delaware State University in cooperation with the Delaware Division of Fish and Wildlife. An estimate of average fecundity is necessary to evaluate how variable fishing mortality may affect horseshoe crab egg production. Female horseshoe crabs have been collected from the Delaware Bay and egg extractions are underway.

Tagging Studies

The USFWS continues to maintain an "800" telephone number for reporting horseshoe crab tag returns and assists interested parties in obtaining tags. In addition, the Service will continue a study in Delaware in 2003 to determine horseshoe crab movement, spawning frequency and site fidelity. Results from last year's work revealed that one-third of tagged crabs were resighted at the same beach within three weeks of being tagged. Tagged females were observed spawning up to five times and males were observed spawning up to ten times during the study period.

Additional 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. The Tagging Subcommittee has initiated several projects to address the issues mentioned above. First, an application to potential horseshoe crab taggers has been developed for the U.S. F&WS in Annapolis. The application will give reviewers discretion when issuing tags and better understanding of taggers' objectives. Second, the subcommittee would like to create a horseshoe crab tagging program database within the existing website (www.fishtag.info) that houses information of many other species' tagging programs. Last, the subcommittee developed guidelines for a coastwide tagging program. The intent of drafting such guidelines is 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.

Alternative Bait and Trap Design

Researchers at the University of Delaware (Dr. Nancy Targett and students) have isolated the protein that is the active factor. It has a wide range of thermal tolerance, which makes it less likely that an artificial bait developed with such a protein will need to be refrigerated. They have assayed for activity against both mud snails (a surrogate for whelk) and eels. A major publication on this work will be published in the February 2003 issue of the Journal of Chemical Ecology.

The University is also working with other researchers to generate a cDNA library of the horseshoe crab in the hope of identifying the gene that controls the production of the attractive protein. It is anticipated that it can then be placed in a lab-based system (bacteria or insects) that will express the protein.

Dr. Targett and her staff are also testing active horseshoe crab extract in various bait matrices. Two companies have incorporated horseshoe crab material into bait batches. They are

currently testing for optimal horseshoe crab concentrations. Once lab work is completed the testing will be taken to field trials. Funding for the field trial work is pending. The project could greatly benefit from additional funding for another student.

VI. Status of Management Measures and Issues

NMFS Activities:

The NMFS implemented a Final Rule (effective 3/7/2001) to prohibit fishing for horseshoe crabs and limit possession of them in the exclusive economic zone (EEZ) (per the recommendation of Addendum I of the FMP) encompassing a 30 nautical mile (nm) radius (in a shape roughly equivalent to a rectangle) seaward from the midpoint of the territorial sea line at the mouth of Delaware Bay.

Development of regulations to prohibit transfer at sea of horseshoe crabs and to improve Federal permitting and reporting of horseshoe crab landings are under review.

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 immediate task of this group is to produce 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 Committee has approved a Terms of Reference for operation of the group, agreed on an outline of topics to be addressed in the assessment report, and identified a set of peer-reviewers to evaluate the report. Committee members, and others, are currently writing sections that will be included in the final report. Information is being compiled concurrently into the final report format. The final report may be finalized and put through the peer-review process by the end of May 2003.

VII. Current State by State Implementation of Compliance Requirements

Currently, there are no compliance issues for any ASMFC states in regards to their horseshoe crab programs. New York deducted previous overages from the 2001 quota, but failed to pay back all of the overages. It has implemented a system that prevented them from landing more than their quota in 2002. New York has fully paid back its overages in 2002. All states have implemented the necessary monitoring components of the plan. The plan review team (PRT) is concerned that some states are using trawl survey data in place of characterizing their fishery. The PRT has referred this issue to the stock assessment subcommittee for input on whether or not the information collected in this component of the plan is necessary for future stock assessments. ME, NH, PA, DC, PRFC, NC, SC, GA and FL have requested and qualify for *de minimis* status. Please see the PRT report on State Compliance for detailed information on each state's program.

Law Enforcement:

In the 2001 FMP Review the PRT recommended to the Board an Addendum III to the FMP, which would have changed the reporting requirement for law enforcement. At its May

2002 meeting, the Board decided to forgo a formal addendum. Instead the Board decided that looking at this issue across all species managed by the ASMFC would be more appropriate. In the interim, the Board approved the changes that the PRT recommended in the proposed Addendum III.

The Plan Review Team suggested replacing the detailed form currently used with a general description of horseshoe crab law enforcement issues to include the following: significant law enforcement violations, any regulations that law enforcement are finding unenforceable, as well as a general description of how the horseshoe crab regulations are enforced in that state. This new format was put into place for reporting of 2002. The ASMFC Law Enforcement Committee obtained and compiled this information for inclusion into the PRT Report on State Compliance. Please see that Report for the few minor enforcement issues that were raised this past year.

VIII. Recommendations by the Plan Review Team

Live Trade:

The Florida annual report outlined increasing marine life collection taking place in their state. At this time the PRT does not believe the landings for marine life collection to be a problem but asks that all states include any of this activity in their annual state compliance reports so the PRT may monitor the situation.

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 materialize to support Dr. Berkson's research, the PRT recommends a state and federal partnership to fund a Dr. Berkson's trawl survey.

Tagging:

The Technical Committee has recognized the need for reconvening the horseshoe crab tagging subcommittee. This need is supported by the PRT, recognizing the potential benefits to defining management units, gleaning life history information and the potential for estimating mortality and determining stock size. The PRT recognizes that a number of tagging efforts are underway along the coast, some of which lack clearly defined objectives. The Tagging Subcommittee should report its findings and recommendations to the Stock Assessment Subcommittee and the Interstate Tagging Committee to receive feedback on its initiatives.

Biomedical Industry:

The PRT recommends that the Technical Committee, working with the PRT, resurvey the biomedical companies in an effort to monitor the total number of crabs used and (based on mortality estimates during processing and post-processing) the total number of crab mortality associated with the industry. The Commission would reevaluate potential restrictions on biomedical harvest if mortality exceeds 57,500 horseshoe crabs per year.

The PRT also recommends that the Technical Committee revisit the issue of promoting use of dead horseshoe crabs processed by the biomedical industry for reuse by the bait industry. The Technical Committee could reevaluate whether reuse of such crabs is logistically or technically feasible.

Habitat Delineation:

The PRT recommends that states continue to improve habitat delineation in their states including categorizing the spawning importance on different beaches. Several states have continued this work and are providing valuable results while others have not continued to do this work.

IX Literature Cited.

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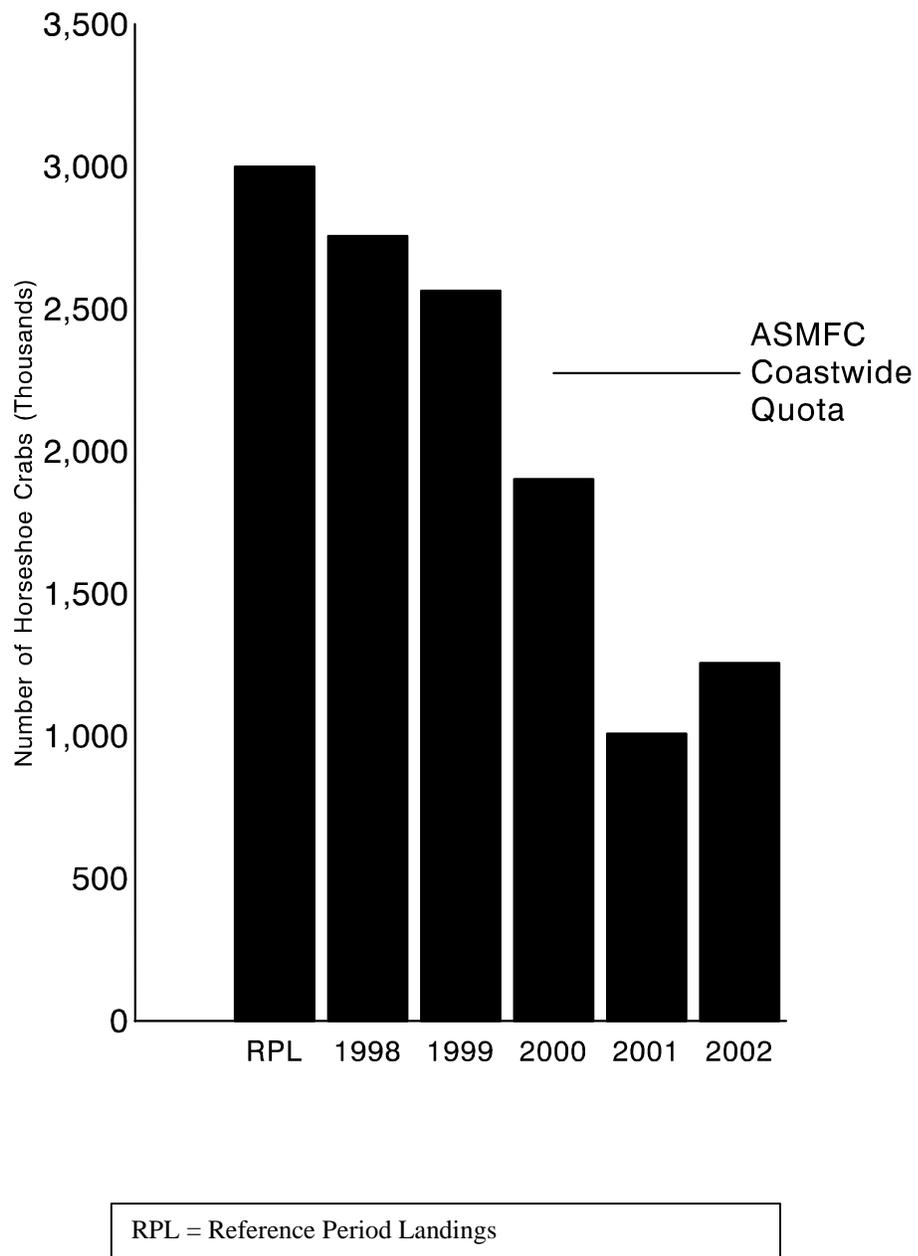


Figure 1. Coastwide horseshoe crab landings expressed as number of crabs (thousands).