Atlantic States Marine Fisheries Commission

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MEMORANDUM

TO: **Horseshoe Crab Management Board**

FROM: **Horseshoe Crab Plan Development Team**

DATE: **April 13, 2022**

SUBJECT: **Recommendations for Horseshoe Crab Draft Addendum VIII**

Background

On April 7, 2022, the Plan Development Team (PDT) met to discuss development of Draft Addendum VIII to the Horseshoe Crab Fishery Management Plan (FMP). The Board initiated Draft Addendum VIII in January 2022 to consider use of the recent 2021 Revision of the Adaptive Resource Management (ARM) Framework[1] in setting annual specifications for horseshoe crabs of Delaware Bay-origin. Delaware Bay horseshoe crab management using the original ARM Framework was originally established under Addendum VII in 2012.

Following the recommendations of the independent peer review panel, which endorsed the ARM Revision as the best and most current scientific information for the management of horseshoe crabs in the Delaware Bay Region, the Board reviewed and accepted the ARM Revision in January 2022. The ARM Revision addresses previous peer review critiques, includes new sources of data, and adopts new modeling software to set harvest levels for Delaware Bay-origin horseshoe crabs that account for the forage needs of migratory shorebirds. Below is a summary of the PDT's discussion and recommendations on issues and options to include in Draft Addendum VIII.

Recommendations for Management Options to Consider Use of ARM Revision

The PDT discussed three potential issues for consideration in the Draft Addendum. First, the core issue to consider is whether to adopt the ARM Revision for setting harvest specifications for Delaware Bay-origin horseshoe crabs or not. The PDT recommends only two main options: Option A is status quo and Option B is management using the ARM Revision to set specifications. Additional options related to the ARM should be nested under Option B. The PDT notes that because the Addendum VII (2012) ARM Framework uses antiquated software that is no longer supported nor is it compatible with contemporary operating systems, status quo is no longer possible. To operate under "status quo" would mean reducing the ARM Framework to essentially a harvest control rule where harvest recommendations would be based on a look-up table of current horseshoe crab and red knot population numbers.

The PDT made the following recommendations related to ARM revision changes in the Draft Addendum. First, the PDT recommends language to redefine/clarify the short and long term management, update, and revision processes for the ARM Framework. The PDT recommended a three-level process as follows:

- Annual management process: This should remain as is, with the ARM Framework being used to produce harvest recommendations for the upcoming fishing year.

[1] A detailed overview of the ARM Revision can be found here. The full Revision and Peer Review Report can be found here.

- Interim update process: Every three years, an update process should occur in which the model parameters (e.g., red knot survival and recruitment, horseshoe crab stock-recruitment relationship) are updated based on the annual routine data collected in the region.
- Revision process: every 9 or 10 years (or sooner if desired by the Board), the ARM Framework should undergo a revision process similar to what occurred for the 2021 ARM Revision. This amount of time is appropriate given it allows for two updates to occur, and encompasses one generation for horseshoe crabs.

Second, regarding the harvest recommendations produced by the ARM Framework, the PDT recommends providing independent sex-specific harvest recommendations based on continuous harvest output of the model rounded down to the nearest 25 or 50 thousand male or female crabs.

- The discrete harvest packages recommended in Addendum VII are no longer appropriate. The original discrete harvest packages were established as a result of limitations of the previous software that was used to run the ARM model. The newer, more powerful software no longer has these limitations.
- The ARM Revision allows for optimal harvest recommendations to be made on a continuous scale, providing more precise recommendations for the optimal harvest. While the model can produce continuous harvest recommendations, the PDT expressed concerns that if those continuous harvest recommendations were made public, it would be possible to back-calculate the biomedical mortality input, which is confidential. Therefore, the PDT agreed it is necessary to round the continuous harvest output down to the nearest 25 or 50 thousand crabs to obscure the confidential biomedical data. This would mean an optimal harvest recommendation of 130,000 would be rounded to either 100,000 or 125,000. The level of rounding could be decided by the Board or a management option for public comment.
- The Revised ARM also provides sex-specific harvest recommendations that are independent of one another. Whereas male and female harvest levels were linked in the previous ARM due to software limitations, the PDT does not recommend maintaining the link between male and female harvest, as unlinked harvest by sex is a more precise output.
- Additionally, the PDT does not recommend changing the maximum harvest values (i.e., 500,000 males, 210,000 females) as those values were established through extensive stakeholder engagement and committee workshops during the development of the previous ARM Framework.

Third, the PDT recommends including the updated lambda values (proportion of total bait harvest that is assumed to be of Delaware Bay-origin) for New Jersey, Delaware, Maryland, and Virginia from the ARM Revision, but leaving all other aspects of the allocation model established in Addendum VII unchanged. This means Section 3a of Addendum VII would be updated, but Sections 3b, 3c, and 3d would remain status quo. Section 3e, which describes alternative methods for setting harvest specifications in the absence of required data sets, should be updated to include new data sets required to run the revised ARM model, but the methods for setting the next season's harvest should remain the same.

Lastly, the PDT recommended that language be included in the Addendum to allow some aspects of the ARM model to be updated via Board action rather than an Addendum process. The items the PDT recommended for adaptive management are the lambda values, which could be updated with new

genetic data, and the model parameters which could be reviewed during the three-year update process. These values and parameters are data-driven and are expected to change as more data are collected and updated through monitoring and research.

Additional Issues for Consideration in the Addendum

An additional item discussed by the PDT is the biomedical mortality threshold. Previously, the Board tasked the PDT with reviewing the threshold for biomedical mortality of 57,000 crabs that was established by the 1998 FMP. The FMP states that if the threshold is exceeded the Board would reevaluate potential restrictions on horseshoe crab harvest by the biomedical industry. The PDT tasked the Horseshoe Crab Technical Committee with reviewing the biomedical data, threshold, and best management practices for the biomedical collections, and providing advice to the PDT on potential management options to address this issue. The TC will meet on April 14, 2022 to discuss this task.

Proposed Draft Management Options

Based on the recommendations of the PDT described above, the following is a draft structure for management options that could be included in Draft Addendum VIII.

Issue 1: Adoption of the Revised ARM Framework for Setting Delaware Bay Harvest Specifications

Option 1: Status Quo

Under this option the current ARM Framework would be used for developing harvest recommendations for horseshoe crabs of Delaware Bay origin. As noted previously, the software used for the original ARM model is obsolete and it cannot be run on current computer operating systems. Thus, this status quo option would result in the following process for developing harvest recommendations: annual estimates of horseshoe crab abundance from the swept area estimates of the Virginia Tech Trawl survey will be decremented by half a year's worth of natural mortality. Red knot abundance will be estimated by the current mark-resight methodology. These values will be compared to a lookup table of optimal horseshoe crab harvest generated by the original ARM model.

Option 2: Management using the Revised ARM

Under this option, the Revised ARM Framework would be used to set the annual harvest specifications for horseshoe crabs of Delaware Bay origin. Changes to the ARM would encompass all aspects of the 2021 ARM Revision, including updated population dynamics models, software, reward function, lambda values, and ARM update and revision process. The weighting scheme for allocation of the Delaware Bay-origin harvest would remain status quo. The following sub-options would allow the Board to select the level of rounding of the optimal harvest recommendations.

- **Sub-option 2A: Round down continuous optimal harvest recommendation to nearest 25 thousand horseshoe crabs.** This option has the potential to result in higher harvest levels than option B.
- **Sub-option 2B: Round down continuous optimal harvest recommendation to nearest 50 thousand horseshoe crabs.** This option has the potential to result in lower harvest levels than option A.

Board Guidance for Development of Proposed Options

The PDT is seeking additional guidance from the Board related to the proposed management options that should be considered for public comment in Draft Addendum VIII. Specific questions are listed below:

- Does the Board want to consider options to modify the current model for allocating the optimized harvest output by the ARM Framework amongst the four Delaware Bay states?
- Does the Board request any additional options be considered in the Draft Addendum?
- Does the Board want to include management options to modify the FMP biomedical mortality threshold in Draft Addendum VIII?
- Is the Board interested in including any additional issues in the Draft Addendum?