Horseshoe Crab Advisory Panel Report

May 11, 2011

The ASMFC Horseshoe Crab Advisory Panel (AP) met on May 11, 2011 in Baltimore, MD. Previously, the Horseshoe Crab Management Board reviewed the Delaware Bay Ecosystem Technical Committee (DBETC) report on the proposed allocation model for the Adaptive Resource Management (ARM) Harvest output. The Board requested further stakeholder input on the DBETC report and the allocation model from the Advisory Panels to the Board, both the Shorebird and the Horseshoe Crab APs. This report responds to the Board's request and summarizes the Horseshoe Crab AP's discussions regarding the recommendations of the DBETC and the allocation process at the May 11, 2011 meeting.

Attendees

Horseshoe Crab AP members and Invited Participants
Dr. James Cooper (SC)
Mr. Richard Robins (VA)
Mr. Jeff Eutsler (MD)
Mr. Allen Burgenson (MD)
Ms. Benjie Swan (NJ)
Mr. Peter Wenczel (NY)
Dr. Michael Dawson (MA)
Mr. Jay Harrington (MA)
Mr. Jeff Brust (DBETC Chair-NJ)
Danielle Brzezinski (ASMFC)

Public participants
Ben Wenczel (NY)

Introduction

Horseshoe crabs are linked ecologically with shorebirds in the Delaware Bay region, where many horseshoe crabs come ashore to breed and shorebirds stopover on their way to their breeding grounds. The need to successfully manage the horseshoe crab fishery to sustain both populations has driven the development of the Adaptive Resource Management (ARM) framework for management under the ASMFC. The ARM framework uses a double-loop process to allow for yearly and benchmark re-assessment based on model outputs and stock assessments. The model incorporates the population dynamics of both the horseshoe crabs and the red knots, a specific shorebird of international concern that is a candidate for listing under the Endangered Species Act.

Thresholds incorporated into the model structure the output of an optimized harvest, based on current conditions of the two populations. While providing novel management, the output of the ARM model is limited to a Regional Harvest Allocation only. That is, the optimized harvest is suggested for the entire Delaware Bay population of horseshoe crabs, from which it is assumed

that Delaware, New Jersey, Maryland, and Virginia draw at least a portion of their yearly horseshoe crab harvest. The ARM model does not dictate the allocation of these crabs among the four states.

In order to determine a state-by-state allocation in an open and objective way, four factors or decisions need to be considered:

1) How much of each state's harvest is comprised of Delaware Bay-origin crabs?
2) On what basis should the total recommended harvest, output by the ARM model, be divided among the four states of Delaware, New Jersey, Maryland, and Virginia?
3) Should there be an overall harvest cap placed on Maryland and Virginia's harvest to protect non-Delaware Bay origin horseshoe crabs?
4) Should there be an allowable but minimal harvest of Delaware Bay origin horseshoe crabs for Maryland and Virginia if the ARM-recommended harvest option requires a moratorium on one or both genders?

In a report the Horseshoe Crab Management Board, presented on March 23, 2011, the Delaware Bay Ecosystem Technical Committee (DBETC) presented background and recommendations on each of the four decisions. The Board further requested input on this report and the four decisions from the stakeholder community, represented by the two Advisory Panels. This report presents the input from the Horseshoe Crab Advisory Panel (AP) on the four decisions and recommendations to the Board. These recommendations include setting the lambda values at some level between the values based on the tagging and genetics data; a majority and minority opinion on the basis for the proportional allocation of the harvest; the use of a cap based on Addendum IV quota levels with a high priority to reassess as data become available; and a level of Delaware Bay Stock Allowance to allow status quo female harvest (assuming Harvest Package 3) in Virginia and Maryland.

The AP also recommended that the Board continue development of the ARM framework for horseshoe crab management but to include a contingency plan within any future addendum that would allow the Board to revert to Addendum IV/V management measures by Board vote if the Virginia Tech Trawl Survey is not funded in the future.

The problem

Under the ASMFC Fishery Management Plan, harvest is allocated on a state-by-state basis; however; the ARM framework, as designed, only recommends a regional (NJ, DE, MD, and VA combined) harvest. In order to translate this regional harvest into a state-by-state harvest, it is necessary to consider four factors and to decide how to incorporate these factors when calculating the state-by-state allocation. There are both technical and policy/value-based aspects to consider when incorporating these four factors. The DBETC report represents technical background and recommendations on the four factors. The AP convened a meeting to offer additional value-based background in order to determine:

1) How much of each state's harvest (DE, NJ, MD, and VA) annually comes from Delaware Bay, based upon tagging and genetic data as well as expert opinion (λ, lambda);
2) What weighting method to allocate the Delaware Bay harvest quota among the four states;

3) Whether to place an overall cap on MD and VA harvest levels; and
4) Whether to institute an allowable Delaware Bay Stock Allowance (DBSA) harvest option for Maryland and Virginia, should the ARM model recommend a complete or female-only moratorium.

Once these decisions are made and the ARM framework is fully implemented, the benefits will likely include:

- Management that is responsive to the current state of horseshoe crab and red knot populations
- Better ecological management of the fishery and the red knot and shorebird populations
- Improved understanding over time of the connections among the species, and
- Improved long-term management, anticipating more stable harvest levels

This report offers the AP's input and recommendations on the four decisions.

Decisions to be made in implementing ARM-based Management Harvest

Decision 1- Lambda (λ), Delaware Bay origin of Maryland and Virginia's catch

Delaware, New Jersey, Maryland, and Virginia all draw some portion of their yearly quota from Delaware Bay crabs. For Delaware and New Jersey, this level is assumed to be 100%; that is, all horseshoe crabs harvested by fishermen in Delaware and New Jersey come from the Delaware Bay population. This assumption is likely correct, as most of the fishery occurs by hand on the spawning beaches or during the spawning period. Thus it is a safe assumption that the crabs are in the Delaware Bay at that time to spawn. Thus their lambda values, λ, are set to one (1.0).

For Maryland and Virginia, the proportion of crabs is not as straight-forward to assess. As summarized by the DBETC, tagging data and genetics studies offer information on the movement and origins of crabs. The DBETC report included three options for lambda values, based on these data as well as a highly risk-averse default option that assumed all crabs caught in Maryland and Virginia fisheries originate in Delaware Bay.

The AP agreed with the DBETC that the default option for Maryland and Virginia (i.e., lambda = 1.0) is not a good option and should not be used in the management of horseshoe crabs since it is not supported by the best available data on tagging or genetics. Members' experience, both in their own research and in the industry, affirmed that there are additional spawning populations along the Virginia and Maryland coasts that contribute to the fisheries. Thus, the AP recommended that the Board not use the default option to set lambda values.

The AP was surprised at how low the lambda estimates were based on the tagging data. In contrast, the AP did not believe that the higher estimates based on the genetics data were accurate either. Again, experience in the industry and their research studies indicated that, while some north-south movement does occur in the region, there was not evidence of movement significant enough to indicate that approximately half of Maryland's crabs originated from Delaware Bay. In addition, the evidence of area fidelity in spawning supports crabs returning to the same spawning populations in a particular area.

The AP also believed that more information could potentially be mined from the tagging data and expressed interest in the continued work by Dr. Conor McGowan in further analyzing those data. The AP understood that the DBETC had serious technical concerns with the use of the tagging data as a basis for lambda, including the different levels of re-sighting effort; however, the AP expressed their own concern at the potential overestimate of lambda values within the genetics data, due to the low level of movement necessary to maintain genetic similarity. The AP members pointed out that an overestimate of lambda further biases the sex composition of the harvest by decreasing the number of females allowed.

In terms of improving the tagging data, the AP members noted that much of the horseshoe crab fishing by mobile gear occurs at night and potentially in conjunction with other species. The ability to collect all tags on captured horseshoe crabs is difficult, although efforts are made to collect and drop off tags.

The consensus recommendation from the AP is that the lambda values fall between the values based on the tagging data (Option 1) and those based on the genetics data (Option 3). The AP recommends that the Board consider these two sets of values as ends for a slot for determining the lambda values for use in future management.

Option 1: Highest Risk, based on tagging data

State	Lambda, λ
NJ	1.0
DE	1.0
MD	**0.13**
VA	**0.09**

Option 2: Lowest risk, highest possible lambda values

State	Lambda, λ
NJ	1.0
DE	1.0
MD	**1.0**
VA	**1.0**

Option 3: Medium risk, based on genetics data and expert opinion

State	Lambda, λ
NJ	1.0
DE	1.0
MD	**0.51**
VA	**0.35**

Decision 2- W_i, Weighting system for state allocation of optimized harvest

Based on the optimized harvest level, a total Delaware Bay horseshoe crab harvest will be set. The weighting system used will determine how that harvest will be apportioned among the four states of Delaware, New Jersey, Maryland and Virginia. The DBETC did not offer a recommendation but rather a set of three options that could provide the Board a baseline for its decision. The AP considered these three options and their pros and cons.

1) Historical, unregulated harvest levels:
   The Reference Period Landings (RPLs) represent the historic distribution of the catch, and presumably, also the historic distribution of the fishery.

State	Allocation weight, w_i
NJ	31.7%
DE	25.3%
MD	32.2%
VA	10.6%

2) Current management quotas:
   These allocations mirror the current quotas set by Addendum IV, which include the Addendum III reductions for NJ, DE, and MD as well as the Addendum IV restriction for VA regarding harvest east of the COLREGS line. This option recognizes the current distribution of quota that is currently occurring, although those numbers are based on entire quota levels and not just Delaware Bay.

State	Allocation weight, w_i
NJ	23%
DE	23%
MD	40%
VA	14%

3) Current estimated abundance levels:
   These levels are based on state-by-state estimates from the Virginia Tech trawl survey. This option has the advantages of being based on fishery-independent data and can be updated yearly pending survey results. It should be noted, however, that the survey design is not meant to be analyzed on a state-by-state basis, possibly introducing error into these estimates.

State	Allocation weight, w_i
NJ	28%
DE	47%
MD	18%
VA	7%

Most AP members considered the allocations based on the RPLs to be unreliable due to differences in levels of reporting during the period. Members also expressed concern that those levels, although assumed to be representative of the industry pre-regulation, did not represent the current structure and distribution of the fishery and the stocks today. One member disagreed, saying that those levels were accepted by the Horseshoe Crab Technical Committee and the Board as representing the levels of harvest prior to implementation of the Interstate Fishery Management Plan. This member indicated that it would be unfair to New Jersey and its fishermen, who have been committed to a higher level of conservation. Although New Jersey's moratorium on horseshoe crab harvesting is still current and is likely to remain so for some time, the member voiced her distress at the suggestion that allocating more crabs to New Jersey would be a waste, as they could not be harvested. This member did not agree with the rest of the AP and supported using the RPLs for determining proportional allocation of the ARM harvest.

All members agreed that allocations should not be based on the current estimated abundance levels, as the Trawl Survey was not designed for this particular breakdown of the tows. Additionally, the AP members expressed concern that, with only one year of data from inside Delaware Bay, the 2010 abundance levels would not capture the environmental variability that impacts crab distribution, such as weather and food abundance.

All members, except for one, agreed that determining the proportional allocation of the ARM Harvest should be based on the quota allocations included in Addendum IV. The majority of members agreed that basing the proportions on current harvest allocations would cause the least amount of disruption to the fishery and avoid an extended allocation fight. The majority also pointed out that disruption to the fishery likely brings no benefit with it.

Thus, the majority recommends that the Board base the proportional allocation of the ARM harvest on Addendum IV quota allocations; the minority member recommends that the Board based the proportional allocation of the ARM harvest on RPLs.

Decision 3- Harvest cap for Maryland and Virginia

Placing a cap on the quota for Maryland and Virginia would prevent any further increases in their harvest should the ARM model output an optimized harvest level that, under the current allocation decision scheme, would allow for such an increase. The DBETC reviewed potential scenarios that could occur in the future and recommended a cap based on Addendum IV allocation levels to serve as a precautionary measure against overharvest of non-Delaware Bay crab populations.

The AP reviewed the DBETC's recommendation and proposed options for cap levels (**Table 1**). The AP expressed large concerns that, if a cap is agreed upon and set, the ability to review and adjust the cap in the future would be severely limited by a lack of data on the non-Delaware Bay populations of crabs. Although the Virginia Tech Trawl Survey may offer some data, along with other state-based surveys, no surveys other than the one from Virginia Tech specifically target horseshoe crabs. The AP members recalled the same concerns from the 2009 stock assessment, in which data from areas outside Delaware Bay were limited.

Table 1. Proposed cap and resultant maximum quota levels for Maryland and Virginia

Cap Basis	MD quota	VA quota
RFPs	613,225	203,326
Add I	459,919	152,495
Add III	170,653	152,495
Add IV	170,653	60,998
Av Landings	160,746	21,280

The AP agreed that non-Delaware Bay crabs should be protected until evidence can be provided that the harvest levels can increase. However, the AP agreed that levels should not decrease from the current levels, as horseshoe crab populations seem to be doing well in Maryland and Virginia. The current industry, while having taken many cuts over the past decade, has reached a stable equilibrium for the time between its allocated supply and market demand. The AP believed that the Board should look to support this ecological and market balance.

The AP agrees with the DBETC and recommends a harvest cap based on Addendum IV quota allocations to cap the non-Delaware Bay harvest of Maryland and Virginia. Further, the AP recommends that the Board include review of the harvest cap and its level as a high priority in the normal course of double-loop review process of the ARM model.

Decision 4- Delaware Bay Stock Allowance (DBSA)

The Delaware Bay Stock Allowance (DBSA) decision is only relevant should the ARM model suggest a harvest package that has either a full or female-only moratorium AND should the Lambda values for Maryland and Virginia be set at some value less than 1.0. The current recommended ARM Harvest package, Package 3, contains a female-only moratorium, and both the DBETC and the AP have recommended that the Board consider lambda values less than 1.0 for Maryland and Virginia.

This option, if chosen, would still allow Maryland and Virginia to harvest some Delaware-Bay origin horseshoe crabs that are under a moratorium (e.g. females under Harvest Package 3) at a defined level. The option recognizes that at least some portion of the Maryland and Virginia harvest is composed of non-Delaware Bay origin crabs. Without this option, any sort of a moratorium on Delaware Bay origin crabs would impose a similar moratorium on Maryland and Virginia's harvests of non-Delaware Bay origin crabs.

The AP emphasized the mixed stock fishery in Virginia and Maryland, which requires consideration in management measures. The AP agreed that the DBSA is an important tool to prevent foreclosure of Virginia and Maryland's fisheries on their stocks that spawn on their own beaches and not in the Delaware Bay. The level at which the Board sets the DBSA will impact the catch composition that is allowed and will thus have economic impacts as well. Members of the AP noted that the most recent estimates of Delaware Bay mature female crabs were around 6 million crabs. Taken into the context of a 70,000 female crabs per year fishery (of which fewer

than 34,000 are of Delaware Bay origin, based on the genetic lambda values) that is currently occurring in Maryland and Virginia (east of the COLREGS), the AP agreed that the likely total impact of maintaining current removal levels would be small, as this level amounts to one percent or less of the total mature female population. The AP recommended that the Board consider this issue in the context of the overall performance of the horseshoe crab population, which has responded positively to the current management measures.

The AP noted that since Addendum IV, both Virginia and Maryland have instituted a 2:1, male:female ratio. Members agreed that these precautionary conservation efforts should be acknowledged, noting that Maryland's proactive adoption of the 2:1 ratio was not required by the ASMFC plan, and Virginia supported including the 2:1 ratio in Addendum IV. The use of the DBSA is one way to acknowledge those conservation efforts. In light of the ARM framework's review process, the AP agreed that review of this measure should occur in addition to review of the harvest cap and the ARM model inputs.

The AP recommends that the Board consider a full range of DBSA levels, including a level that would maintain the status quo fishing levels for both Virginia and Maryland. This level varies but given certain assumptions, the level of DBSA needed ranges around 10% of coastwide landings (Table 2). The AP noted that the status quo management measures in the Delaware Bay region are already highly male-biased and risk-averse, and establishing an appropriate DBSA level would minimize disruptive impacts associated with ARM implementation. The AP identified this issue as an important policy consideration.

Table 2. DBSA percentage and the resulting Maryland and Virginia female quotas of Delaware Bay origin female crabs under Harvest Option 3, based on an average of coastwide 2008-09 landings. Assumptions include basing lambda on the genetics data, using Addendum IV quota levels as the basis for weight allocation, and using a Harvest cap based on Addendum IV quota levels.

	MD	VA (east of COLREGS)
2010 female quota*	56,884	20,333
10% DBSA	27,120	6,653
Total Female Quota w/10% DBSA option	53,177	19.008

*Maryland has voluntarily imposed a 2:1 male:female ratio. This quota value takes that regulation into account.

Conclusions

The ARM Framework does not provide state-by-state allocations. In order to convert the ARM Regional Allocations to state-by-state allocations, the AP recommends the following options for the four decisions set up in the spreadsheet allocation model:

1) *Lambda, λ*
   The AP recommends lambda values between Option 3 (genetics) and Option 1 (tagging). **The AP recommends against lambda values in Option 2 (default).**

2) *Allocation weights, w_i*
   The majority of the AP members recommend basing the allocation weights on the Addendum IV quota levels. One member of the AP recommends basing the allocation weights on the RPLs.

3) *Harvest cap for Maryland and Virginia*
   The AP recommends basing an initial harvest cap on Addendum IV quota levels but also recommends that this cap be reviewed as part of the ARM Framework's review process at the first opportunity.

4) *Delaware Bay Stock Allowance (DBSA)*
   The AP recommends the Board establish a DBSA that maintains the current quota levels for female crab harvest in Virginia and Maryland, given other assumptions that impact the allowable harvest levels.

Further, the **AP recommends** that, in development of an addendum using the ARM Framework, the Board include a contingency option should the data needed to update the ARM Framework, such as the Virginia Tech Trawl Survey data, not be available. The AP recommends that this option be available to the Board and for implementation via Board action. The AP's concerns lie in the amount of time that would be necessary to adopt an addendum, should the management measures need to be changed.