Atlantic States Marine Fisheries Commission

Horseshoe Crab Management Board

November 10, 2022
9:00 - 11:30 a.m.
Hybrid Meeting

Draft Agenda

The times listed are approximate; the order in which these items will be taken is subject to change; other items may be added as necessary.

1.	Welcome/Call to Order *(J. Clark)*	9:00 a.m.
2.	Board Consent • Approval of Agenda • Approval of Proceedings from August 2022	9:00 a.m.
3.	Public Comment	9:05 a.m.
4.	Consider Addendum VIII on Implementation of Recommended Changes from 2021 Adaptive Resource Management (ARM) Revision and Peer Review Report for Final Approval **Final Action** • Consider Public Comment Summary *(C. Starks)* • Consider Advisory Panel Report *(B. Hoffmeister)* • Consider Final Approval of Addendum VIII	9:15 a.m.
5.	Set 2023 Delaware Bay Harvest Specifications **Final Action** • Review Horseshoe Crab and Red Knot Abundance Estimates and ARM Model Results *(J. Sweka)* • Set 2023 Specifications *(C. Starks)*	10:30 a.m.
6.	Review and Populate Work Group to Review Best Management Practices for Handling Biomedical Collections *(C. Starks)* **Action**	11:10 a.m.
7.	Consider Fishery Management Plan Review and State Compliance for 2021 Fishing Year *(C. Starks)* **Action**	11:20 a.m.
8.	Other Business/Adjourn	11:30 a.m.

The meeting will be held at The Ocean Place Resort (1 Ocean Boulevard, Long Branch, NJ 07740; 732.571.4000) and via webinar; click here for details

MEETING OVERVIEW

Horseshoe Crab Management Board Meeting
November 10, 2022
9:00 - 11:30 a.m.
Hybrid Meeting

Chair: John Clark (DE) Assumed Chairmanship: 1/22	Horseshoe Crab Technical Committee Chair: Natalie Ameral (RI)	
Vice Chair: Justin Davis (CT)	Horseshoe Crab Advisory Panel Chair: Brett Hoffmeister (MA)	Law Enforcement Committee Representative: Nick Couch (DE)
Delaware Bay Ecosystem Technical Committee Chair: Wendy Walsh (FWS)	Adaptive Resource Management Subcommittee Chair: Dr. John Sweka (FWS)	Previous Board Meeting: August 3, 2022
Voting Members: MA, RI, CT, NY, NJ, DE, MD, DC, PRFC, VA, NC, SC, GA, FL, NMFS, USFWS (16 votes)		

2. Board Consent

- Approval of Agenda
- Approval of Proceedings from August 3, 2022

3. Public Comment – At the beginning of the meeting public comment will be taken on items not on the agenda. Individuals that wish to speak at this time must sign-in at the beginning of the meeting. For agenda items that have already gone out for public hearing and/or have had a public comment period that has closed, the Board Chair may determine that additional public comment will not provide additional information. In this circumstance the Chair will not allow additional public comment on an issue. For agenda items that the public has not had a chance to provide input, the Board Chair may allow limited opportunity for comment. The Board Chair has the discretion to limit the number of speakers and/or the length of each comment.

4. Consider Draft Addendum VIII on Implementation of Recommended Changes from 2021 ARM Revision and Peer Review Report for Final Approval (9:15-10:30 a.m.) Final Action
Background • In October 2019, the Board directed the Adaptive Resource Management (ARM) Subcommittee to begin working on updates to the ARM Framework to revisit several aspects of the ARM model to incorporate horseshoe crab population estimates from the Catch Multiple Survey Analysis (CMSA) model used in the 2019 Benchmark Stock Assessment and the most current scientific information available for horseshoe crabs and red knots. • In January 2022, the Board accepted the ARM Revision and Peer Review for management use, and initiated a Draft Addendum to consider allowing its use in setting annual specifications for horseshoe crabs of Delaware Bay-origin. The draft addendum document was approved for public comment in August 2022 (**Briefing Materials**). • Draft Addendum VIII includes two proposed management options: A) No Action, and B) Implement the ARM Revision for setting bait harvest specifications for Delaware Bay-origin horseshoe crabs. Option A would result in the management program reverting back to the

provisions of Addendum VI, including static state quotas for NJ, DE, MD and VA along with seasonal closures and other restrictions to the fishery. Option B would result in continued adaptive management using the Revised ARM Framework, in which annual specifications would be set according to harvest recommendations from the ARM based on abundance levels of horseshoe crabs and shorebirds.

- During the comment period four public hearings were held, and over 34,000 written comments were submitted by individuals and organizations (**Briefing Materials**).

Presentations

- Review of Draft Addendum VIII and Summary of Public Comments by C. Starks

Board actions for consideration at this meeting

- Select management options and approve Draft Addendum VIII

5. Set 2023 Delaware Bay Harvest Specifications (10:30-11:10 a.m.) Final Action

Background

- In October 2022, the Delaware Bay Ecosystem TC (DBETC) and Adaptive Resource Management (ARM) Subcommittee met to review results of 2020-2021 horseshoe crab and red knot population abundance surveys in the Delaware Bay region (**Briefing Materials**).
- The ARM Subcommittee used population estimates from the Virginia Tech Trawl Survey in 2021 to estimate horseshoe crab abundance in the Delaware Bay region. A report was also provided on the red knot stopover population estimate for 2022 (**Briefing Materials**).
- The ARM model was run using estimated abundances of horseshoe crabs in fall of 2021 and red knots in spring of 2022 to provide a recommendation for harvest specifications for Delaware Bay states in 2023. Both the original ARM and the 2021 Revision were used to generate optimal harvest outputs for comparison by the committees. The committees recommended using the 2021 ARM Revision results for setting 2023 specifications (**Briefing Materials**).

Presentations

- Horseshoe Crab and Red Knot Abundance Estimates and 2022 ARM Model Results by J. Sweka

Board actions for consideration at this meeting

- Consider ARM harvest recommendations and set 2023 specifications for states in the Delaware Bay region.

6. Review and Populate Work Group to Review Best Management Practices for Handling Biomedical Collections (11:10-11:20 a.m.) Action

Background

- In October 2021, The Board tasked the Plan Development Team to review biomedical mortality, discuss biologically-based options for setting the threshold, and consider updates to best management practices (BMPs) for handling biomedical collections.
- In August 2022, after considering recommendations from the PDT, TC, and Advisory Panel (AP) the Board agreed to take no action on the biomedical mortality, noting that biomedical mortality contributes a relatively small amount of overall mortality, to continue to annually review estimated biomedical mortality levels, and also to form a Work Group to address the biomedical BMPs.

• The Board submitted nominations for members to serve on the Work Group following the August 2022 meeting.
Presentations • Nominations to the Work Group by C. Starks
Board actions for consideration at this meeting • Approve Work Group membership

7. Consider Fishery Management Plan Review and State Compliance for the 2021 Fishing Year (11:20-11:30 a.m.) Action
Background • State Compliance Reports were due July 1, 2021. • The Plan Review Team reviewed each state report and compiled the annual FMP Review (**Briefing Materials**). • South Carolina, Georgia, and Florida have requested and meet the requirements of *de minimis* status.
Presentations • FMP Review of the 2021 Fishing Year by C. Starks
Board actions for consideration at this meeting • Accept FMP Review and State Compliance Reports for the 2021 Fishing Year. • Approve *de minimis* requests.

8. Other Business/Adjourn

Horseshoe Crab

Activity level: Medium

Committee Overlap Score: Low (SAS overlaps with BERP)

Committee Task List
• PDT – Development of Draft Addendum VIII to consider use of the ARM Revision in setting Delaware Bay harvest specifications • PDT – review the threshold for biomedical use to develop biological based options for the threshold and to develop options for action when the threshold is exceeded; review best management practices for handling biomedical catch and suggest options for updating and implementing best management practices (BMPs). • TC – July 1st: Annual compliance reports due • ARM & DBETC – Fall: Annual ARM model to set Delaware Bay specifications, review red knot and VT trawl survey results

TC Members: Natalie Ameral (RI, Chair), Jeff Brunson (SC), Derek Perry (MA), Deb Pacileo (CT), Catherine Ziegler (NY), Samantha Macquesten (NJ), Jordan Zimmerman (DE), Steve Doctor (MD), Ingrid Braun (PRFC), Adam Kenyon (VA), Jeffrey Dobbs (NC), Eddie Leonard (GA), Claire Crowley (FL), Chris Wright (NMFS), Joanna Burger (Rutgers), Mike Millard (USFWS), Kristen Anstead (ASMFC), Caitlin Starks (ASMFC)

Delaware Bay Ecosystem TC Members: Wendy Walsh (USFWS, Chair), Samantha MacQuesten (NJ), Henrietta Bellman (DE, Vice Chair), Jordan Zimmerman (DE), Steve Doctor (MD), Adam Kenyon (VA), Jim Fraser (VA Tech), Eric Hallerman (VA Tech), Mike Millard (USFWS), Kristen Anstead (ASMFC), Caitlin Starks (ASMFC)

ARM Subcommittee Members: John Sweka (USFWS, Chair), Linda Barry (NJ), Henrietta Bellman (DE), Jason Boucher (DE), Steve Doctor (MD), Wendy Walsh (USFWS), Conor McGowan (USGS/Auburn), David Smith (USGS), Jim Lyons (USGS, ARM Vice Chair), Jim Nichols (USGS), Kristen Anstead (ASMFC), Caitlin Starks (ASMFC)

DRAFT PROCEEDINGS OF THE

ATLANTIC STATES MARINE FISHERIES COMMISSION

HORSESHOE CRAB MANAGEMENT BOARD

The Westin Crystal City
Arlington, Virginia

August 3, 2022

These minutes are draft and subject to approval by the Horseshoe Crab Management Board.
The Board will review the minutes during its next meeting.

TABLE OF CONTENTS

These minutes are draft and subject to approval by Horseshoe Crab Management Board.
The Board will review the minutes during its next meeting.

INDEX OF MOTIONS

1. **Move to approve Agenda** by Consent (Page 1).

2. **Move to approve Proceedings of May 3, 2022** by Consent (Page 1).

3. **Move to approve Draft Addendum VIII for public comment** (Page 7). Motion by Roy Miller; second by Mike Luisi. Motion carried (15 in favor) (Page 17).

4. **Move to approve Horseshoe Crab Advisory Panel nominations for David Meservey from Massachusetts, and Jordan Giuttari and Matt Sarver from Delaware** (Page 23). Motion by Dan McKiernan; second by Emerson Hasbrouck. Motion approved by consent (Page 23).

5. **Move to elect Dr. Justin Davis of Connecticut as Vice-chair or the Horseshoe Crab Management Board** (Page 23). Motion by Joe Cimino; second by Jim Gilmore. Motion approved by consent (Page 23).

6. **Motion to adjourn** by Consent (Page 23).

ATTENDANCE

Board Members

Dan McKiernan, MA (AA)
Raymond Kane, MA (GA)
Sarah Ferrara, MA, proxy for Rep. Peake (LA)
Conor McManus, RI, proxy for J. McNamee (AA)
David Borden, RI (GA)
Eric Reid, RI, proxy for Sen. Sosnowski (LA)
Justin Davis, CT (AA)
Bill Hyatt, CT (GA)
Sen. Craig Miner, CT (LA)
Jim Gilmore, NY (AA)
Emerson Hasbrouck, NY (GA)
Joe Cimino, NJ (AA)
Tom Fote, NJ (GA)
Peter Clarke, NJ, proxy for T. Fote (GA)
John Clark, DE (AA)
Roy Miller, DE (GA)
Mike Luisi, MD, Administrative proxy
Russell Dize, MD (GA)
Pat Geer, VA, proxy for J. Green (AA)
Bryan Plumlee, VA (GA)
Chris Batsavage, NC, proxy for K. Rawls (AA)
Jerry Mannen, NC (GA)
Mel Bell, SC (AA)
Malcolm Rhodes, SC (GA)
Chris McDonough, SC, proxy for Sen. Cromer (LA)
Doug Haymans, GA (AA)
Spud Woodward, GA (GA)
Erika Burgess, FL, proxy for J. McCawley (AA)
Gary Jennings, FL (GA)
Marty Gary, PRFC
Chris Wright, NMFS
Rick Jacobson, US FWS

(AA = Administrative Appointee; GA = Governor Appointee; LA = Legislative Appointee)

Ex-Officio Members

Natalie Ameral, Technical Committee Chair
Brett Hoffmeister, Advisory Panel Chair
Nick Couch, Law Enforcement Representative

Staff

Robert Beal
Toni Kerns
Maya Drzewicki
Tina Berger
Pat Campfield
Kristen Anstead
Lindsey Aubart
Lisa Havel
Chris Jacobs
Jeff Kipp
Adam Lee
Sarah Murray
Heather Power
Caitlin Starks

Guests

Pat Augustine, Coram, NY
Linda Barry, NJ DEP
Rachel Barrales, Cape Cod CFA
Meredith Bartron, US FWS
Henrietta Bellman, DE DFW
Ruth Bergstrom
Alan Bianchi, NC DENR
Nora Blair, Charles River Labs
John Bloomfield
Jeff Brust, NJ DEP
Diane Bynum
Nicole Caudell, MD DNR
Mike Celestino, NJ DEP
Laura Chamberlin
Kristin Comolli, DE DFW
Margaret Conroy, DE DFW
Heather Corbett, NJ DEP
Deborah Cramer
Claire Crowley, FL FWC
Tim Dillingham, Littoral Society
Jacob Espittia, FL FWC
Sheila Eyler, US FWS
Catherine Fede, NYS DEC
James Fletcher
Angela Giuliano, MD DNR
Dave Grant
Ellie Gruber
Helen Takade-Heumacher, EDF
Harry Hornick, MD DNR
Jessie Hornstein, NYS DEC

Guests (continued)

Lani Hummel
Christian Hunt
Aidan Kaiser-Bulmash
Adam Kenyon, VMRC
Karen Knotts, USGA
Rob LaFrance, Quinnipiac Univ
Lynn Lankshear, NOAA
Christina Lecker, Fuji Film
Benjamin Levitan, EarthJustice
Tom Lilly
Susan Linder
Olivia Liu
Loren Lustig, PA (GA)
Samantha MacQuesten, NJ DEP
Shanna Madsen, VMRC
Jennifer Malpass, US Geo. Survey
John Maniscalco, NYS DEC
Cathy McConnell, OptOnline
Kim McKown, NYS DEC
Nichola Meserve, MA DMF
David Meservey, Chatham, MA
Steve Meyers
Mike Millard
Kirby Rootes-Murdy USGS
Josh Newhard, US FWS
Thomas Newman
Tamara O'Connell, MD DNR
George O'Donnell, MD DNR
Joanne Pannone
Derek Perry, MA DMF
Jessica Ponder, PCRM
Jill Ramsey, VMRC
Kathy Rawls, NC (AA)
Harry Rickabaugh, MD DNR
Karla Rossini
Mike Ruccio, NOAA
Dan Ryan, DC
Matthew Sarver
Amy Schueller, NMFS
Chris Scott, NYS DEC
Ross Self, SC DNR
Jeff Shenot, NOAA
Ethan Simpson, VMRC
Somers Smott, VMRC
Renee St. Amand, CT DEP
David Stormer, DE DFW
John Sweka, US FWS
Toni Rose Tablante, Littoral Society
Joseph Tricarico
Corinne Truesdale, RI DEM
Christina Vaeth
Carly Valco
Scott Curatolo Wagemann, Cornell
Mike Waine, ASA
Wendy Walsh, US FWS
Ritchie White, NH (GA)
Quinn Whitesall, Littoral Society
Kelly Whitmore, MA DMF
Kristoffer Whitney, RIT
Meredith Whitten, NC DENR
Chris Wright, NOAA
Jennifer Zarcone
Faith Zerbe, DE Riverkeeper
Erik Zlokovitz, MD DNR
Renee Zobel, NH F&G

The Horseshoe Crab Management Board of the Atlantic States Marine Fisheries Commission convened in the Jefferson Ballroom of the Westin Crystal City Hotel, Arlington, Virginia, via hybrid meeting, in-person and webinar; Wednesday, August 3, 2022, and was called to order at 10:15 a.m. by Chair John Clark.

CALL TO ORDER

CHAIR JOHN CLARK: Welcome, everybody. This is the call to order for the Horseshoe Crab Management Board. I'm John Clark, I'm the Administrative Commissioner from the fabulous first state, and I will be chairing this meeting.

APPROVAL OF AGENDA

CHAIR CLARK: We will now move on to our Board consent items. Does anybody have any changes to the agenda?

I do not see any, so we will consider that approved by consent.

APPROVAL OF PROCEEDINGS

CHAIR CLARK: Everybody has had a chance to look at the proceedings from the May, 2022 meeting, does anybody have any revisions to the proceedings? Not seeing any; those are approved by consent.

PUBLIC COMMENT

CHAIR CLARK: We'll move on to the next item, Public Comment, and this is public comment for items that are not on the agenda.

We know there is a lot of interest in the next agenda item, and when we discuss that we will take public comment on that item. But right now, this is public comment on items that are not on the agenda.

CONSIDER DRAFT ADDENDUM VII ON THE IMPLEMENTATION OF RECOMMENDED CHANGES FROM THE 2021 ADAPTIVE RESOURCE MANAGEMENT REVISION AND PEER REVIEW REPORT FOR PUBLIC COMMENT

CHAIR CLARK: I don't see any hands, we don't have any sign ups, so now we'll move on to the next item. That is to consider Draft Addendum VII on the implementation of recommended changes from the 2021 Adaptive Resource Management Revision and Peer Review Report for Public Comment.

As you know, we approved the ARM for management use at the January Board meeting, and we approved starting the Draft Addendum at the May meeting, and so now Caitlin is going to bring us up to speed as to where we are now and where we will be going next. Thank you, take it away, Caitlin.

MS. CAITLIN STARKS: Thanks, John did a quick summary of where we are, but for the presentation today I'm just going to cover some of that background leading up to this meeting, and then review the recommended changes to the ARM that are being considered in the Addendum.

The proposed action timeline, the proposed management options, and then finally wrap up with the Board action for consideration and next steps. Just as a refresher, on the current management process, Addendum VII to the Horseshoe Crab FMP established the Adaptive Resource Management or ARM Framework for recommending bait harvest quotas for the Delaware Bay Region, and under Addendum VII the ARM annually recommends a bait harvest package, which is based on the abundance of both horseshoe crab and red knot. As you all know, this ARM went through a revision process and peer review process, which the Board accepted in January, 2022. Through that process the ARM was updated to address some of the peer review critiques that were made about the original ARM framework.

It includes new data sources to improve the models, and also adopt a new modeling software to replace the previously used program, which is now obsolete and can no longer be used to run the ARM model. At that January meeting, the Board also initiated Draft Addendum VIII to consider using the revised ARM to set the annual specifications for horseshoe crabs of Delaware Bay origin, which is what the Board is discussing today.

This slide shows the conceptual model of the ARM framework, which I just wanted to briefly show to remind everyone how it works. You can see the ARM involved the population models for both horseshoe crabs and for red knots, which incorporates survey data for both species.

In the ARM revision, the major changes that were made to the whole framework were improvements to the horseshoe crab population dynamics model, and the red knot population dynamics model, revised reward function that relates those two, and the transition to the new software, as well as harvest recommendations on a continuous scale, rather than discreet harvest packages, and the model can now be more easily updated with new data.

I want to note here that through that review process the conceptual model of horseshoe crab abundance influencing red knot survival and reproduction has been maintained, to ensure that the abundance of horseshoe crabs does not become a limiting factor for the population growth of red knots.

This is our current timeline for Draft Addendum VIII. The Board initiated the Addendum in January, and since then the PDT or Plan Development Team has met a number of times and developed the Draft Addendum document before you today. Today the Board will consider Draft Addendum VIII for public comment. If it is approved today, the public comment period could occur in September or late August through September, and the Board could meet again in November, 2022 to consider final action on the Addendum.

Within the Draft Addendum we have two main options. Option A would be a no action option, and Option B would be to use the revised ARM for management, to set bait harvest specifications for the Delaware Bay. For Option A, we used the no action option, because true status quo is no longer an option, due to the fact that the previous ARM model and the software that was used for it is now outdated, and it cannot be updated.

This means it is no longer adaptive resource management. Option B would incorporate all of the changes that were recommended in the 2021 ARM Revision and in the peer review, in terms of the data and model updates. But the general structure of how the ARM optimal harvest recommendation is allocated among the four Delaware Bay states would essentially be the same. I'll go over exactly what the proposed changes are in a few slides. Under Option A, if we take no action the management would revert back to the provisions of Addendum VI, and this means the quotas for the four states of New Jersey through Virginia would go back to what is shown in this table. In addition to those quotas, Addendum VI prohibits directed harvest and landing of all horseshoe crabs in New Jersey and Delaware from January 1, through June 7, and it prohibits female horseshoe crab harvest in New Jersey and Delaware for the remainder of the year from June 8 to December 31.

It also prohibits the landing of horseshoe crabs in Virginia from federal waters from January 1 through June 7, and it mandates that no more than 40 percent of Virginia's annual quota may be harvested east of the COLREGS line in ocean waters, and it also requires that horseshoe crabs harvested east of the COLREGS line and landed in Virginia must be comprised of a minimum male to female ration of 2 to 1.

Alternatively, Option B would adopt the changes recommended in the 2021 ARM revision, and going forward the revised ARM would be used for recommending and setting the bait harvest specifications for Delaware Bay origin horseshoe crab. Option B addresses each of the aspects that were established in Addendum 7, related to how harvest specifications are set.

This includes the harvest recommendations that come out of the ARM. The adaptive management cycle, the percent harvest of Delaware Bay origin crab for each state, and then the state allocations and fallback options. I'm going to walk through each of these one by one, and review what's proposed in Draft Addendum VIII.

First on the issue of harvest recommendations, the Addendum proposes that the revised ARM be used to annually recommend the optimal harvest levels for males and females. I want to note that the maximum number of males and females that the ARM can recommend is the same as before at 500,000 males and 210,000 females.

However, where the original ARM recommended 1 of 5 discreet harvest packages of males and females, the revised ARM recommends sex-specific harvest levels on a continuous scale. That means that the optimal harvest recommendation for males and females could be any number from 0 to the maximum amount of males and females.

For this issue there are two sub-options that would take that optimal harvest output from the ARM for each sex, and round it down to the nearest 25 or 50,000 crabs. Rounding the harvest recommendation to some degree is necessary, because Delaware Bay specific biomedical data, which is confidential, would be fed into the model.

Rounding that output would prevent anyone from being able to back calculate the biomedical mortality input data. Sub-Option B1 would generally result in a harvest recommendation that is closer to the optimal harvest, and Sub-Option B2 would generally result in a more conservative harvest recommendation.

But one clarification here to add is that if the ARM does recommend the maximum amount for either males or females, rounding would not be necessary to protect the confidential data, because in that case you're already doing that by limiting it to the maximum. This table shows what the harvest recommendations for 2017 through 2019 would have been if they had been produced with the revised ARM. As a note, in these examples the CMSA or Catch Multiple Survey Model uses the coastwide biomedical mortality data, rather than Delaware Bay specific data. This means these numbers are slightly overestimated from what would come out of the model if we used the Delaware Bay specific biomedical data.

As you can see here, each of these years the ARM recommends a maximum amount of male harvest and a varying amount of female harvest around 150,000 crabs. Using the 2019 optimal harvest recommendation from the last slide, which are shown again in the uppermost table here. The lower two tables below that show what each of the two sub-options for rounding would produce for the final harvest recommendation.

Under B1 the optimal harvest of 144,803 crabs gets rounded down to 125,000 crabs, and under B2 the female harvest gets rounded down to 100,000 crabs. As I noted before, the male harvest does not get rounded down, because it's already being capped at 500,000, and so the biomedical mortality data could not be back calculated.

This is the second item under Option B and it is the management process for using the ARM framework, so it's slightly modified from the text in Addendum VII to more clearly describe each of the steps of the short- and long-term management process in ARM revision process. Under the Option B there is a three-level process that would be adopted, including an annual management process, an interim update process, and a revision process.

The annual management process is basically the same as the annual cycle described in Addendum VII, which is what we use now, where the ARM framework is used to produce harvest recommendations for the upcoming fishing year. The interim update process is a new addition, and that is that every three years the model parameters, including things like red knot survival and recruitment and horseshoe crab stock recruitment relationships would be updated based on the most recent years of data that are routinely collected for the region.

Then the third level is a more intensive revision process that would occur every 9 or 10 years, or sooner if desired by the Board, in which the ARM framework would undergo a revision process similar to what occurred for the 2021 ARM revision. This 9-to-10-year timeline was selected, because it allows for two interim updates to occur, and it also encompasses a generation for horseshoe crab.

Our third issue is the proportion of harvest that is of Delaware Bay origin for each state, and this value is called Lambda. As the 2021 revision recommends, Option B would update the Lambda values for each state based on more recent genetic data, and this would result in decreases to the proportion of Maryland and Virginia's harvest that is assumed to be of Delaware Bay origin, and Delaware and New Jersey's proportions would remain unchanged.

As you'll see shortly, these Lambda values do affect the state-by-state allocations of the overall Delaware Bay quota. This is a comparison of the current Lambda values that are used in the original ARM in Addendum VII, with the proposed updated Lambda values. The fourth issue is the methodology for calculating the state allocations of the total Delaware Bay harvest. Under Option B in Draft Addendum VIII, the only change to the allocation methodology from Addendum VII is that those updated Lambda values would be used, which results in new allocation weights for each state. With this change the new state allocations of the Delaware Bay harvest limit would be shown in the top table, and with the change the allocations for New Jersey and Delaware slightly increased, and the allocations for Maryland and Virginia slightly decrease.

The other two aspects of the state allocations, which are the harvest cap provision and the 2:1 male/female offset provision would remain status quo from Addendum VII under option B. Just to describe what those are, the harvest cap for Maryland and Virginia limits the total level of allowed harvest by those two states, in order to provide some protection to crabs that are not of Delaware Bay origin.

The caps are shown in the bottom table, and those were based on Addendum VI quota levels for Maryland and Virginia. These caps do not apply when the ARM framework outputs and optimized harvest output prohibits female harvest of horseshoe crab. As a result, to date these harvest caps have not come into play, because since the original ARM was implemented, it has not recommended female harvest.

The two-to-one offset is relevant when the ARM recommends zero female crab harvest for the Delaware Bay. When that recommended female harvest is zero, this provision allows a two-to-one offset of males to females, which means the total male harvest allocation of Maryland and Virginia is increased at a two-to-one ratio, and it's allowed to rise above the cap level.

Again here, we're only talking about Virginia's quota for crabs east of the COLREGS line, for clarity. These are the state allocations under Addendum VII, compared with the proposed allocations under Addendum VIII. This is as an example to show you if the total harvest quota for Delaware Bay that comes out of the ARM is 500,000 males and 100,000 females.

The breakdown among the four states would look like this. This is just the Delaware Bay portion of the state's quotas, not their total quotas when you add in non-Delaware Bay origin crab. I'm going to go to the next slide and show you, on this slide you can see both the Delaware Bay origin quotas, which are on the left in blue, and the total quotas on the right in orange. These totals include the non-Delaware Bay origin crabs. You can see for each of the states, using the revised allocation.

Delaware and New Jersey are the same on both sides, because 100 percent of their harvest is considered Delaware Bay origin crab, while Maryland and Virginia's overall quotas, which are in red, are greater than their Delaware Bay only quotas to account for those additional crabs in their harvest that are not of Delaware Bay origin. I also want to note in this example that the harvest cap for Maryland and Virginia are being applied, because there is female harvest recommended in this example.

The other thing I want to note is that Maryland and Virginia's overall quotas end up being the same as what was in Addendum IV and VI, and the quota for Virginia shown here is just the quota for east of the COLREGS line. The last item in Option B is the fallback option for if the ARM cannot provide a harvest recommendation in a given year. Option B includes the same fallback options as Addendum VII, which is that if in a given year there is not enough data, if a model cannot produce a harvest recommendation, the next year's harvest may be set either based on Addendum VI quotas and management measures for New Jersey, Delaware, Maryland and Virginia coastal waters, or it can be based on the previous year's ARM framework harvest level and allocation for the four states.

Beyond that language the section is just updated to reflect the new datasets that are required for running the revised ARM model, but this is essentially the same as Addendum VII. This is the tentative timeline for the next steps for Draft Addendum VIII. Today again, the Board will consider the document for public comment.

If it's approved today public hearings could be held in September, and the Board could consider the Addendum for final approval at the annual meeting in November this year. With that the two things the Board could choose to do today are to specify any desired changes to the document before releasing it for public comment, and to consider approval of the Addendum for public comment. That's my last slide, I'm happy to take any questions.

CHAIR CLARK: Thank you, Caitlin. If we have questions at this point, and I was remiss before, I wanted to point out that also up here we have Kristen Anstead, who led the ARM development process here, which has been phenomenal. We also have Brett Hoffmeister, who is head of the Advisory Panel for Horseshoe Crab. Does anybody have any questions for Caitlin about the Addendum? Yes, Justin.

DR. JUSTIN DAVIS: I'm hoping Commission staff might be able to speak to the letter that was received from Earth Justice, with the records request, because it seems like that is something we should discuss, as part of this discussion of whether to send the Addendum out for public comment at this point.

As I understood that letter, it was referencing a records request to the Commission and to USGS and U.S. Fish and Wildlife Service, and also asking that this body delay sending the Addendum out for public comment until that records request is met, and the information could be considered. I'm just wondering if Commission staff could speak to how the Commission responded or plans to respond to that request.

You know issues around data confidentiality, that might be relative to that request, and also kind of considerations for what meeting this request or not meeting it, or meeting it partially could mean for sort of the future of the science program that we're conducting here for this species, or even assessments for other species. That's a whole host of stuff, but I'm just kind of hoping someone can speak to that.

CHAIR CLARK: Somebody else is up here that can answer these questions, and it's Toni Kerns, so Toni, do you want to take that?

MS. TONI KERNS: Thank you for the question, Justin. The Commission did receive an information request. It was the first request after we posted our new policy on information requests from Earth Justice. We responded back to Earth Justice on all parts of the information they requested, either with the data or where to reach out to receive the data. What the Commission did provide was information that we own, I guess you would call it, or information that the Commission created in-house. For the models that use the ARM, I would call it that we have three main models for that.

The CMSA model, which is what we use to assess the population, is the model that the Commission owns, so we did provide that to the requesters, as

well as, Kristen will inform me if I say this wrong, but the data that was used in the run itself. If you use the raw data, some of that raw data could be confidential, or it's not proprietary to the Commission, because we did not collect that data.
We pointed out to them on raw datasets that are used in that, and who it was at the state or federal agency or university that they could make that request to them from. The other two models are not property of the Commission, and they are for USGS, and so we sent them to USGS for that information.

USGS is responding to a very similar FOIA request for them, as well as U.S. Fish and Wildlife Service. In terms of if all of the models were provided to the requesters. As I said before, there are confidential data sources in these models, so the requesters would not be able to receive that confidential information, so they would not be able to replicate the exact runs that the ARM Subcommittee did use because of that.

I will also just point out that in terms of transparency, that question was asked of us earlier at the Executive Committee. The Commission did send out a press release notifying that the ARM Peer Review would be happening. That peer review was open to the public. It was posted on the calendar as well, and anybody that wanted to follow along on how the ARM worked, minority reports that were asked of the Committee, could have done so.

There is public comment during those peer reviews. We went back and looked, and we did not have very many of the public in attendance for those that are asking these questions of the Commission at this time. I'm trying to make sure I'm hitting on all the points that you raised. Am I missing anything that you were hoping to receive, Justin?

CHAIR CLARK: Want to follow up, Justin?

DR. DAVIS: No, I think that pretty much covers it, and I guess to summarize. It would be fair to say that at this point the Commission has released any information that is proprietary to the Commission, non-confidential that we can release, including some models, so that the models even without the source data. Somebody could look at the modeling code and see how the models work, and that we directed the requester for those sources of information we couldn't provide to where they could go request that information from outside the Commission.

MS. KERNS: John, one more piece.

CHAIR CLARK: Sure thing, Toni.

MS. KERNS: I'll just note that some of the questions that are being raised on the different, I guess data information that there are discrepancies on. Some of that was brought up in these minority reports. The Peer Review looked at those, addressed them, sensitivity analyses were done on those.

That's all in the Peer Review Report, which is posted to the Commission's web page, and those questions could be asked of Committee members as well if people wanted to have more information on this. But we haven't received any specific questions about those minority reports or the Peer Review's review of them.

CHAIR CLARK: Thank you for that question, Justin, and thank you for the very thorough answer, Toni. It's good to get that on the record. Are there other questions about the Addendum itself from the Board? Is there anybody online? Okay, at this point if we have a question from the audience there, if you would like to come up to the public microphone.

DR. JON HARE: Thank you very much, Jon Hare, NOAA Fisheries. Toni, thank you for describing the Peer Review process for the Horseshoe Crab model. Is that sort of the standard process that ASMFC follows for all of its assessments and advice?

MS. KERNS: That is correct, Jon.

DR. HARE: Thank you very much, may I comment, Mr. Chair?

CHAIR CLARK: Sure thing, Jon, I'm sorry I didn't recognize you. My eyes aren't what they used to be.

DR. HARE: My eyes aren't good either.

CHAIR CLARK: Go right ahead.

DR. HARE: Again, there has been a thorough Peer Review process, which is how we have defined evaluating science to use in our management decisions, and if that process needs to be revisited, the Science Center is happy to work with ASMFC on revisiting processes and helping where we can. Listening to Toni describe, it sounds like your Peer Review and scientific process has been followed. There are opportunities to bring new science into that process, so I just encourage you to think about supporting the processes that you have in place.

CHAIR CLARK: Thank you, Jon. Is that all we have in terms of questions at this point? All right, I would say to the Board, maybe the next step could be that we get a motion up here about this Addendum, and then we can have a discussion amongst the Board, and also then take comments from the public at this point. Is anybody ready to offer a motion? I see Roy Miller.

MR. ROY W. MILLER: Hopefully staff has this motion prepared. That's the quick and dirty version. Just for clarification purposes, let me say what that entails. It would be: Move to approve Draft Addendum VIII on the implementation of recommended changes for the 2021 Adaptive Resource Management Revision and Peer Review Report for public comment, which has been whittled down to read: **Move to approve Draft Addendum VIII for public comment,** as modified today. I don't know as we modified it today.

MS. STARKS: Correct. Maya, could you please remove "as modified today" thank you.

CHAIR CLARK: Do we have a second? Mike Luisi. Now let's have discussion on that. Roy, would you like to start the discussion, since you made the motion?

MR. MILLER: I would like to put on record that by approving this Draft Addendum VIII for public comment, it is not approving specific harvest levels that are contained in Addendum VII. That becomes a Board decision at future meetings. In other words, by approving this Addendum, it is not saying necessarily that the Delaware Bay jurisdictions will approve a female harvest scenario. That is yet to be determined.

This is a framework for how we can manage this species in the future, but it will be annual decision making involved. I just wanted to state that. But I think if we're going to hang our hat on the ARM model, which we have for many years now, this is an upgrade that needs to happen. The original ARM model is no longer appropriate, it's outmoded, and this is the right thing to do, because it's the best available science for us in managing horseshoe crabs.

CHAIR CLARK: Thank you, Roy, and Mike, did you have anything to add as the seconder?

MR. MICHAEL LUISI: What Roy said. Thanks.

CHAIR CLARK: Anybody else have any comments they would like to make about the motion? Okay, I see Bill, Justin, and Joe and go ahead, Bill.

MR. WILLIAM HYATT: Just a quick question, and I think it's largely a follow up to the question that Justin had asked earlier, and that Toni had responded to. That is obviously there are FOIA requests that are being filed elsewhere for information that the Commission does not have control over. I think some of the people that are reaching out to us and others would ask, is there benefit in waiting until those FOIA requests are addressed elsewhere before taking this first step? I'm not advocating for that. But I feel that the question needs to be asked.

CHAIR CLARK: Would you like to respond to that? Bob. Thank you.

EXECUTIVE DIRECTOR ROBERT E. BEAL: I don't think I have much to add, Bill, beyond what Toni said earlier. I think our Peer Review Process was followed, and it's an open and transparent process, and the public was able to participate throughout that process. We at ASMFC have responded as well as we can, with all the information we do have that is non-confidential to the folks that asked for information from us.

You know I think the difficult part is, at the end of the day you know some of the requesters of this information want to recreate the model. They want to be able to rerun the model, tweak the model, and recreate the output that went through Peer Review. The difficult part there is going to be that recreating the exact runs that the Technical Committee, Stock Assessment Committee, and Peer Reviewers looked at. You can't do that unless you have access to all the confidential data. Someone could rerun that model if they had the software package, which is pretty complicated to do that. But they could probably get kind of close by making assumptions about confidential data, and lumping together that confidential data and other things.

But they won't be able to recreate the total runs, because of the data confidentiality laws at the state and federal level. I guess where I'm going is I'm not sure how much additional information the public will have at the end of the day, once all those FOIA requests at the federal level are fulfilled.

I don't think the requesters will be able to completely rerun the model and do exactly what the technical folks have done, just because of confidential data. I don't like giving that answer, because you know I wish everyone could access all the data, we could see everything and it was an open book.

But the confidentiality laws are what they are, and we can't share those things, so those are the laws. I don't know, I guess the question is what additional information would be available, and how much better would the public be able to comment? They won't be able to recreate everything that has taken place up to now.

CHAIR CLARK: Do you want to follow up, Bill?

MR. HYATT: Yes, thank you, Bob, I appreciate that response. I just want to mention that I also appreciate the point that Roy made earlier that this model is providing recommendations, and that the Board is not obligated to determine and set harvest levels at the numbers that are kicked out by the model, if it ultimately does get approved and put into practice.

CHAIR CLARK: Next I have Justin Davis.

DR. DAVIS: My question is, what would be the implications of delaying sending the Draft Addendum out for public comment at this point, you know perhaps indefinitely until all the records request were satisfied? You know what would be the implications for management next year of the horseshoe crab fishery?

MS. KERNS: As you all know, we can no longer run the old ARM model, so we would not be able to do the interactions with current information. The only thing that we would be able to do is Addendum VII allows us to, in the event that you can't run the arm, you can just use the previous year's package, or the Board can default back to the Addendum VI quotas, and that is pre-ARM, so it takes no consideration how horseshoe crab and red knot interact.

CHAIR CLARK: All right, thanks, next question is from Joe Cimino.

MR. JOE CIMINO: Yes, not really a question, just a discussion on the motion, Mr. Chair. You know since we did have the minority report, and the authors of those were given the opportunity to be at the Peer Review and give their responses. I think that that added level of exchange is important. I think really the public has a great deal of information to go back through the Peer Review and the responses to the minority reports. That is available prior to this document coming out, and their chance to go through the public comments. I think one of the interesting things that came out of the peer review was not really a concern for the model.

But just where the ARM model is trying to bring management, or co-management for these species, was talked about by the Peer Reviewers, with suggestions that maybe there is a next step to come. One of the suggestions I believe was to consider management strategy evaluation. I think through this public process that might be part of the discussion that you have done well. I fully support the motion.

CHAIR CLARK: Next we have Mike Luisi, then we have a couple from online.

MR. LUISI: I said it before. I fully support the rationale that Roy gave, in continuing to develop Draft Addendum VIII, and moving this forward to the public. I certainly understand the concern about this request for information. I support third party requests for information to try to understand more fully the work that is being done and presented to the Board. My concern about delaying as a result of a third-party request for information is that it could set up a precedent down the road for whenever a third party wants a delay.

They would ask for information that may or may not be available, to try to slow down the process that we're undertaking. I just don't like that idea that somebody could just asking for more information just to slow us down if we decide that we would pause here, and wait for something more to develop with that request. I support moving forward today, and will look forward to hearing from the public if that is approved.

CHAIR CLARK: Online we have Rick Jacobson of the Fish and Wildlife Service would like to make comment.

MR. RICK JACOBSON: Just for everyone else, my name is Rick Jacobson; I'm the Assistant Regional Director for Fisheries and Aquatic Conservation in the Northeast Region, and I'll be representing the Service on the Horseshoe Crab Management Board portion. We at the Service are committed to the duality of species recovery and sustainable use.

In that context we've been actively engaged in the acquisition and compilation of analysis and interpretation of best available science to guide our decision making, and fulfilling these dual roles. We've concluded that the ARM Revision is a manifestation of that best available science. The Service is aware of concerns from some stakeholders about the possibility of take under the ESA if the ARM Revision is adopted for management use.

With that we've conducted an analysis to evaluate the risk of take, and have determined that the risk of take of red knot under ESA is negligible. Thus, we're supportive of moving the Draft Addendum forward for public comment. The Service is also committed to transparency. To meet that commitment, we will make our analysis available to the public before or coincident with the start of the ARM Revision public comment period. Thank you.

CHAIR CLARK: Thank you, Rick, next up we have Chris Wright from NOAA Fisheries.

MR. CHRIS WRIGHT: Yes, I just wanted to say that we support moving forward with the current process, and going out to the public. I just wanted to, maybe we should clarify that the Peer Review Process was an independent process. You know the Peer Reviewers were independent.

In that I believe they also had access to that confidential data, so that I believe they did have that. If we can clarify that for the public, so that they know that those Peer Reviewers saw the whole thing. I think that might help. But we're in support. I think it is critical that we move forward with this, since we don't have the old model any more, and I think this helps more with the red knot situation and our ESA requirements on the federal side.

CHAIR CLARK: I'm going to turn it over to Kristen to answer your point about the Peer Review.

DR. KRISTEN ANSTEAD: For the 2019 benchmark, the full SAS and the Peer Review Panel all had access to confidential data. That's when the catch survey model was originally brought forward for a model for horseshoe crab, and fully reviewed gridding into that data. For the ARM revision we used the same model.

We used coastwide data to develop this full ARM model, so that we didn't have to deal with the confidential data at that scale. The Peer Review Panel actually didn't have access to the confidential data. They saw the run using coastwide data, they saw the output of models with confidential data, and determined that the sensitivity runs around that, it's didn't really move the needle all that much.

We're not talking about large numbers here. The Peer Review Panel actually didn't see the confidential data. That's not the only confidential data that is in question here. There is also tagging bird data that is confidential. It's not just biomedical that is a question mark here. Some of the inputs to the bird side of the models also is confidential.

CHAIR CLARK: Thank you, Kristen, and did that fulfill what you were looking for there, Chris?

MR. WRIGHT: Right, I just wanted to make sure that folks knew that throughout the whole process there was access to that data, especially initially in that, as Kristen mentioned, that there was a lot of scrutiny under this from both the federal side and from the public. There was a more than ample opportunity for folks and the Peer Reviewers to access and have a full review of the process.

CHAIR CLARK: Do we have any other comments from Commissioners, either at the table or in the virtual realm? Okay, we don't have any there. Before we call the question, is there anybody from the public then that wants to make comments? Just give us a second here. Okay, we have a comment from Tim Dillingham. Tim, please go right ahead.

MR. TIM DILLINGHAM: Tim Dillingham, and I'm the Executive Director for the American Littoral Society, based up in Highlands, New Jersey. We've been involved for a long time in the horseshoe crab and shorebird recovery work. I want to thank the Board for their thoughtful discussion, and really identifying and raising some of the central questions. I guess we would like to raise two points, and asking you to delay this and to give it further consideration. I don't think anybody opposes the idea of updating the model so that it is functional and can be used, and making it as accurate as possible.

But I think in that technical work of updating the model, the new Addendum changes a fundamental policy that has been in place since 2009, when this conversation started. That is this idea of reserving or not providing utilities of female horseshoe crab take, until the crab populations and the red knot populations have recovered.

I think as far as the idea of whether or not the Peer Review process was sufficient in flagging these important issues. In the Peer Review report itself, it acknowledges. It says, because the changes would lead to the harvest of female horseshoe crabs, which have been restricted since the implementation of the original ARM framework.

The Panel cautions the Working Group to fully consider if the new reward function truly represents the values articulated by stakeholders in the 2009 ARM framework. I think that language that is in the Addendum, and the description of the, so the old model, about these thresholds, in terms of recovery of the knots and the crabs themselves before female harvest is provided for, is now being left behind.

I appreciate Mr. Miller's comments about, you know these are recommendations. But the public, and I think some of the stakeholders one, that question was not debated in a stakeholder process, so these are not one that sort of intricately involved a lot of people, which I think is why you have seen the reaction to it.

But I think it's also we're urging you to maintain that policy, not allow the harvest of females, particularly because of the eggs needed by the birds, and the fact we haven't recovered to the conservation thresholds that have been identified. I think that's a question that ought to be worked out before it goes out to the public, because it is a fundamental policy frame for your decision making, and we would urge you to retain that as you go forward.

On the transparency part of it, you know I think it's in transparency and whether information is sufficient, and whether people had access to it. It really seems to me that the stakeholders or the public should be the ones to decide whether or not they've had enough information. I understand the confidentiality laws, which are very problematic to me, in terms of the management of a public resource.

But I think you should take to heart the idea of the central stakeholder who is saying, we still have questions about the mechanics of this model, and we would like to examine them for ourselves to our own satisfaction. I appreciate your work, and thank you for the opportunity to provide comments.

CHAIR CLARK: Thank you, Tim. Joe, did you have something you want to follow up on those comments?

MR. CIMINO: Thanks, Mr. Chair, it's an indulgence as a former Chair. Perhaps Dr. Anstead could discuss how the old model would have allowed harvest, and it was knife edge. In fact, if a threshold was hit it would more or less be wide open after that. It's important, I think, to have a discussion on, and of course if this does go out for public comment that discussion can happen on the best way forward. But to talk about what the old model really allowed with that knife edge, and then perhaps why this is a potential improvement as an actual safety measure.

DR. ANSTEAD: Thank you, I'll do the best that I can with this. In the old model there were two thresholds, which you're probably familiar with. There was a horseshoe crab threshold and a red knot threshold, and if you got to one of those thresholds, either one, most likely the harvest package selected would be the maximum amount of harvest.

In a scenario where horseshoe crabs from the Virginia Tech Trawl Survey hit that 11 million around their population number, you would automatically jump to 210 female harvest and slightly less than that for the males. There was some criticism during the Peer Review that these knife edge functions, so it's all of nothing, was not ideal, and also might not be adaptive management, because you are kind of putting on top of it what the answer should be, by saying you have to hit this level or this level.

That is not really adaptive management. That is sort of a harvest control rule. When we came to the revision, we did two different things. We changed the objective functions so that we would give credit to both red knots and both horseshoe crabs, before it was just credit for horseshoe crabs. You get a little bit of credit if your horseshoe crab populations are hitting some level.

That is not the maximum, it's kind of more of an S shape, so it kind of slowly ramps up to maximum harvest. The same with the birds. Instead of saying you get no credit for birds below the 81,000, it kind of slowly, when you're at the 40 you get just a tiny bit, and it slowly ramps up to that 81,000. In combination you get a little bit of credit if the horseshoe crabs are high, a little bit of credit if the birds are not below certain levels, and more credit as their populations increase.

Those two, kind of work together and that is why you get female harvest now. Those values are still in there, but they are not acting as thresholds. They are kind of acting as an ideal situation we would like to get to. But when the population specifically of horseshoe crabs is growing, you get a little bit more credit. It doesn't automatically jump to that 210, so we thought that that was a way to deal with it, address the Peer Review comments, and continue to use adaptive management to assess the species.

CHAIR CLARK: Thank you for that explanation, Kristen. The next commenter we have from the public is Ben Levitan.

MR. BEN LEVITAN: Hi, thanks so much. This is Ben Levitan. I work at Earth Justice, and I submitted the FOIA requests and information request that you all were discussing. Those were submitted on behalf of New Jersey Audubon and Defenders of Wildlife. I really appreciate the discussion that you all had raising concerns about those FOIA requests, and I just thought that a little bit more context might help inform your consideration of this issue. We submitted requests for information to ASMFC, FWS, and USGS back in February, and as was mentioned, ASMFC did provide us with information about the CMSA model. However, that was only one of the four components of the model that ASMFC described as comprising the new ARM framework. The other three modeling components are all held by USGS. Just to give you an update on where that FOIA request stands.

Last week USGS officially denied the request for those models, pursuant to the deliberative process privilege. Those aren't even pending at this point. USGS has said that those are deliberative and cannot be released. The other thing that USGS informed us over e-mail is that they are actually hoping and intending to publish those models, but they are still undergoing fundamental science practices review within USGS, which is a necessary step before they can be published.

It seems like the review process at USGS is still ongoing for whether these models are even appropriate for public viewing at this point, and on top of that USGS is planning, apparently relatively soon, to release the models to the public. You know from that I would say two things. One, it seems like it would be a real move for transparency for the Board just to allow USGS to release the models on its own timeline, as it's planning to do, before opening the public comment period, so that the public is able to see the model that it's being asked to comment upon.

The other point that I would make, and you know I totally understand the concern that the public could submit records request just as sort of a manipulative technique to delay the process. That is really not where we are. We submitted these requests five months ago, more than five months ago. At this point it's not even about the timeline of our request.

We're just waiting on the federal agency USGS to release the models on its own timeline. The ball is in their court, it's not some strategy that we're using to try to delay this process. We just feel that the public needs to see what they're being asked to comment upon. It seems like the models will be released to the public fairly soon anyway, and that should just happen before the public comment period opens. Thank you.

CHAIR CLARK: Thank you for those comments, Ben, and I don't believe we have anybody from USGS online to address that. We have another hand from the Board, were there any other public comments? Okay, we don't have any other public comments, so Bill Hyatt.

MR. HYATT: Yes, John, I was going to ask the same question you just asked, if there was anybody available who might, from either USGS or who might be able to address some of the comments that were just made relative to timeline and review process, and what is actually happening within USGS. I do think that's valuable information to have.

CHAIR CLARK: Sure, agreed, and we do have one more commenter from the public that is Matthew Sarver. Go ahead, Matt.

MR. MATTHEW SARVER: Hey, thank you. Yes, I just wanted to just briefly echo many of the thoughts, comments that Tim made a few minutes ago around this. I do think it's important for the Board to remember that for a lot of the stakeholders, so first of all I'm the Conservation Chair of the Delaware and Ecological Society here in Delaware, It's all volunteer bird conservation organization. You know we're not all particularly well versed in the inner workings of ASMFC, and the various boards and processes and so forth. I personally, I mean I'm a professional ecologist.

I have a hard time sometimes finding information on these public comment periods, revisions, et cetera, even on the ASMFC website. I think that is important to keep in mind with thinking about the opportunity for stakeholder and public input into some of these changes. It's not particularly easy for a lot of folks from the public who aren't fisheries management professionals, to know where to find some of this information.

I think that is part of why a lot of folks in the bird conservation world are, you know perhaps weren't involved initially in some of the comment during the Peer Review process and so forth. I think part of that also has to do with what Tim said, which is that you know ostensibly, looking at a technical revision of an adaptive resource framework, doesn't necessary imply to members of the public that there is going to be a major change in stated policy.

I think I share the same concern that he referenced, with regard to the female harvest threshold that was presented in the past. I think that this sort of policy direction change that seems to be happening within this science/technical process, as a result of changing the ARM, is really the issue here for a lot of us.

Being a little bit blindsided by how that change within what seemed like it was a needed and is a needed and valid process to change the ARM. I would just say that there is a broader issue here for me, at least, and one of those is looking at the ARM goals. To me they don't show targeting and increase back to a higher population level for horseshoe crab, which would support continued success of red knots.

The ARM looks to me to project essentially a no loss, unless I'm misinterpreting it, keeping the population at current levels, which I think a lot of us thought was not the goal long term for this resource. I guess that's just a broader concern here for me, more so than the exact data, the exact model runs, all that kind of thing.

I have good confidence in the folks who worked on this, the scientists from multiple agencies that had input. I have more of a concern with where we're trying to get, and the overall problem of shifting baselines in fisheries management, and what that means for these connected ecological resources in the future.

One other specific point I would make is again, if I am interpreting the model correctly, is that there was one statistically significant factor for adult red knot survival, which was abundance of female horseshoe crabs. I find it interesting that that was one of the only pieces of data found to be significant in the model, but yet the model is still generating a female harvest.

I didn't really understand that, maybe somebody could clarify that for me. I realize that adult survival for red knots was not found to be the major population determinant, it was more of a recruitment. However, if female horseshoe crab abundance is a significant factor for adult survival, it seems that that should be an important consideration with the federally listed species, even though it's perhaps not the major determinant of population trends for the bird. Anyway, those are my thoughts, and I appreciate your work.

CHAIR CLARK: Thanks, Matt, we appreciate the comments, and Kristen can, to the question you had in there, she can respond to that. Then we are getting a little short on time, so we're going to take one more comment from the public after Kristen responds here.

DR. ANSTEAD: Yes, thank you for that question. You are correct that there is a link between female horseshoe crab abundance and red knot survival. I think that where the confusion might be is that the horseshoe crab female population has been increasing, the adult, mature population that is going to spawn.

If you look at either the Virginia Tech Trawl Survey by itself, we use the Delta Distribution Swept Area estimate. There are several time series in their report each year, but there is one that we use specifically, or you use our catch survey population estimates, which we think are the best estimates available.

Both of those have been increasing over time. If their female population is around 10 million mature female horseshoe crab, the model is still recommending some female harvest, because that population is considered quite high. If you have 10 million females and the harvest coming out is about 140,000 females, the model doesn't see that as conflicting in the purpose of the management.

CHAIR CLARK: We have one more comment from the public, because we are running short on time. The commenter is Faith Zerbe. We are going to have to limit it to three minutes, so thank you and take it away, Faith.

MS. FAITH ZERBE: Thank you very much, Commissioner. My name is Faith Zerbe; I'm Director of Monitoring with the Delaware River Keeper Network. I won't be using a three-minute time, so perhaps you could have others speak, if possible, if there are others. We've been monitoring horseshoe crabs along the Delaware Bay.

Myself, I've been out there for over 22 years. This year of course you've also participated in egg survey density studies that have been done by the shorebird team. We're learning a lot on the ground. I really would just urge you to use the precautionary principal here, and not allow this to move forward at this time.

Certainly, Mr. Levitan from Earth Justice has talked about the issue of USGS and this information that if they are still looking at information related to the models, understanding if the model is really operating as they would choose. Moving this forward now at this point would be premature, in our eyes.

We also would just say that the peer and then again, the presentation by the presenter was very good. It was nice to see those slides, it was very fast. There is a lot of information there also to digest, of course, so we can't just take it on the Agency standard that this is adequate for the public. The other point I would note is that it was talked about if the Commissioners do decide to move this forward today, that there may be public hearings, I believe in August or September, which we would also urge is completely premature, and would not allow adequate time for the public.

People will take vacations in August, they're getting their kids ready to go back to school, as you all talk about and have said, the public has a hard time looking at this information. It's a lot of information to digest, and Earth Justice doesn't even have the information that they requested in February. This just feels like a rush job forward, to basically turn up more female crabs for fish bait.

Again, we're on the water, we see the crabs during our spawning surveys. We've participated in bird surveys last year; the red knot was the lowest it had been in years. This just is completely flying in the face of what we need, to the point that you might have this ARM model and then you have a framework. But then we may decide not to take female crabs.

Just looking at how the industry works, and how things have been in the past. Again, we've been doing this for decades, working on this. I'm sure that if the ARM model is recommending female crab harvest, it is going to be very hard to stop that train coming from off the tracks. I would just urge you to hold the line.

It sounds like USGS is also not available to acknowledge what Mr. Levitan said. We would echo what American Littoral Society has said, and really just others on the ground and the scientists on the ground, to just please hold the line right now, and vote to not take this forward at this time. Thank you very much for your time and your attention.

CHAIR CLARK: Thank you for the comment, Ms. Zerbe. To your specific point about the public comment period. I just want to turn it over to Caitlin again to refresh us on that before we call the question, but also to remind you that you don't have to attend a public hearing in order to comment. The comment period is going to be open for much longer. Written comments are accepted, they can be e-mailed, and they can be mailed. We want as much public input as possible in this process, and I'll let Caitlin comment further on that.

MS. STARKS: Yes, so if the document is approved today, it would take a little bit of time to set up a public hearing schedule, and get the notice out on that. It's unlikely that hearings would occur in August. I think the public comment period would be open.

But the typical process is that we have the public comment period open two weeks in advance of any public hearings, and then following the public hearings as well. There would be more time for public comment via written comments, which again can be e-mailed, mailed or faxed. Then those public hearings would probably occur in September.

CHAIR CLARK: Is there any further discussion on this motion by the Board? Okay, not seeing any, do we have any online? Given that I will call the question. Do we need time to caucus? All right, I'm not seeing anybody. Oh, you do want to caucus. Three-minute caucus.

MS. KERNS: I just want to note really quickly a clarification to what Caitlin said. We will do our best to have a two-week opening, two weeks prior and two weeks after. It is not required in Addenda, but we have heard from the public that this is complicated, and so therefore we will do our best. But if some state wants a late hearing, then we may not be able to make that perfect.

CHAIR CLARK: Okay, did everyone have enough time to caucus? Does anybody need more time? Do you need more time, Mike? Okay, before I go to you, Mike, Bill Hyatt asked to ask a question, and then I'll go to you.

MR. HYATT: If today we were to approve this to go out for public comment, and assuming then at the annual meeting we would be looking to take further action. Is it safe to assume that we could get, as that process is unfolding, some updates on where things stand relative to USGS and how they are handling the requests that have been put forth?

CHAIR CLARK: Kristen, do you want to respond to that?

DR. ANSTEAD: I want to talk a little bit about the models, just to manage expectations about this. I'm not speaking on behalf of the USGS at all. The way that this ARM revision model works is there are several models that feed into the adaptive management entirety model, so I have part of it, Anna Tucker at USGS did the bird modeling, and then they feed into this larger model.

What we have struggled with, even as a committee, is how to get that model all in one place, because of the massive size and complexity of it. Even now, my computer doesn't have enough cores to run the full ARM model, because the vision was to hand over the model to me, so I can run it each year. We have not resolved how to do that yet.

It's fairly common for a stock assessment to have models spread over several computers, so that is not unusual in this case. But this is one of the most complex models that I've worked with, and I'm not sure what the platform will be to make, that's not to say we don't want to make it public, but it will probably have to go in a GitHub, and I don't know how we will run it from there as individual people, apart from the data confidentiality. These are not excuses, this is just something we have struggled with.

MS. KERNS: Bill, we can give you an update, you know if we can get something from USGS on where they are in their internal deliberative process, to give you that. But I think what Kristen is trying to say is that your average stakeholder would not be able to run the model itself. Yes, there are individuals out there in the world that can look at this and do this, but your average person, I myself could never do it, I'm included in that group.

CHAIR CLARK: Follow up, Bill.

MR. HYATT: Yes, thank you, Mr. Chair. Yes, I was asking just for an update. It was specifically because what I thought I heard before, while not coming directly from the USGS, was that there was an internal review going, and that there was a commitment to, in one form, shape or another, to be able to provide this model out to those who are interested in looking at it. I don't know what form or shape that will take. What I was asking primarily is just as long as we can be assured that we're going to be updated, as information is available. Thank you.

CHAIR CLARK: Mike, you had a comment?

MR. LUISI: Yes, it was along the same lines that Bill was just asking about. I was talking to Roy, and we were saying, you know the points that were made through public comment were good points. If USGS, you know it's a shame we can't get any update from them today. But I just wonder if.

I was starting to think that maybe we can just get an agreement as direction to staff from the Board in moving forward that we pump the brake just a little bit, and give a little bit more time to the USGS to get that information out before we start to have the hearings. But I don't know if there is any appetite around the table for trying to set up something like that.

What I was thinking was, if we don't have information from USGS by October 1st, we could then go to the public to get feedback, or as part of the public comment the comment could be, we don't have the right information to comment on, and then the Board gets to deliberate on that in November as well. I see there being two ways forward, so that we get the feedback that we need from the public. But I'm not trying to complicate things.

CHAIR CLARK: Thanks, Mike, Toni has a response for you.

MS. KERNS: Mike, if we waited until October, we would not be able to bring this back to you all, so that would be too late for November. Again, I'll restate that we have had a very open and transparent process for the review of this model. If the public want to comment that they want to see different thresholds, I'm using that as a paraphrase, I know that is not the exact right term, Kristen, some other evaluation of the bird data.

Then they can provide that data to the Board and the Board can consider that as you decide how to move forward. These are products. You know what comes out of the ARM is a package, and the Board gets to decide what to do with that package. You don't have to have female harvest, and then a state can decide if they want to have female harvest if the Board approves that package.

You know I think the public can add all of these types of comments to their public comment, but in terms of the model itself and the review of it, you know we've had this transparent process. I'm not sure that is going to change. I think USGS, when they have models, do internal reviews. It's not necessarily doing this independent peer review like we completed, I think it's just an in-house process before they release packages.

CHAIR CLARK: Thanks, Toni. Before I call the question, we have another comment from Rick Jacobson.

MR. JACOBSON: This really builds on Bill and Mike's comments. If I am correct, a decision of the Commission to move forward with this motion, to adopt this motion, and go to public comment, in no way binds Commission's actions come the November meeting. Is that correct? I mean we have the opportunity to review what public comment comes in, and then consider anew what actions we feel are most appropriate to take at that time. Is that correct?

CHAIR CLARK: That is correct, Rick. Okay, thank you. We've had a very good discussion on this, but now it's time to call the question. All those in favor of the motion, please indicate by raising your right hand.

MS. KERNS: I have Rhode Island, Massachusetts, Connecticut, New York, New Jersey, Florida, Georgia, South Carolina, North Carolina, Virginia, Potomac River Fisheries Commission, Maryland and Delaware.

MR. WRIGHT: NOAA Votes yes.

MR. JACOBSON: U.S. Fish and Wildlife Service votes yes as well.

CHAIR CLARK: Okay, so we have two yes votes from online. All right, are we ready for no votes? **Okay, all those opposed, please raise your hand. Seeing none, and I think by process of elimination we don't have any abstentions or null votes, do we? No, okay, it looks like the motion passes, and what is the final tally, Caitlin? It's 15 in favor, 0 opposed, 0 abstentions and 0 null votes.** What are the next steps now, Caitlin? We just want to review that again.

MS. STARKS: After this meeting we will publish the document for public comment. We will release a press release with a hearing schedule. I will be reaching out to all the states to get information from each state on whether they would like having an in-person public hearing, and what their availability is to put that schedule together. Those should be our next steps; we will have a public press release to let everyone know when that comment period is open.

CHAIR CLARK: Thank you very much, Caitlin, thank you to the Board for the discussion on that and the public.

UPDATE ON PLAN DEVELOPMENT TEAM REVIEW OF THE BIOMEDICAL MORTALITY, BIOLOGICALLY-BASED OPTIONS FOR SETTING THE THRESHOLD, AND BEST MANAGEMENT PRACTICES FOR HANDLING BIOMEDICAL COLLECTIONS

CHAIR CLARK: Now we'll move on to our next agenda item, which is going to be back with Caitlin again, which is to update on Plan Development Team Review of the Biomedical Mortality Biologically-based Options for Setting the Threshold, and Best Management Practices for Handling Biomedical Collections**.** Take it away, Caitlin.

MS. STARKS: Thank you again. Just quickly, in this presentation I am going to go over the Board task to the Plan Development Team, provide some background information and data on the topic, and then I am going to pass it off to our Technical Committee Chair, Natalie Ameral, to cover the TCs discussion and recommendations on this issue.

Then Brett Hoffmeister, who is here at the front with us, is the Advisory Panel Chair for Horseshoe Crab, and he'll cover the AP Report. Then I will wrap up with the PDT recommendation, and set the Board up for a discussion today. The task that the Board assigned to the Plan Development Team had two components.

The first part was to review the threshold for the biomedical mortality, to develop biologically based options for that threshold, and to develop options for action when that threshold is exceeded. The second part was to review the best management practices for handling biomedical catch, and suggest options for updating and implementing the BMPs. Then the reason that the Board assigned this task, is that during the FMP review last year it was noted that the annual threshold for mortality for crab used for biomedical purposes, which is established in the fishery management plan, has been exceeded in almost all of the last 13 years.

The Board wanted to take a look into this and assign this task to the PDT. The FMP language on this states that if horseshoe crab mortality associated with collecting, shipping, handling or use by the biomedical industry exceeds 57,500 horseshoe crabs per year, the Commission would reevaluate potential restrictions on horseshoe crab harvest by the biomedical industry.

It should be noted that this threshold was set simply based on estimates of the annual biomedical mortality at the time that the FMP was developed in the 1990s, and it does not have any scientific or biological basis to it. To provide more context, this graph shows the bait harvest levels and the biomedical mortality levels.

The orange area is the bait harvest, and the blue sliver on top is the coastwide biomedical mortality estimated in each year. As you can see the vast majority of total mortality throughout the time series is bait harvest, and the blue area representing the biomedical mortality is relatively small, and it doesn't change very dramatically from year to year.

In the whole time series, the biomedical has remained under 20 percent of the total mortality. To show this data another way, this table shows the ASMFC coastwide quota for bait in the top row, and then the second row is the total allowed bait harvest under the more restrictive state quotas. The actual coastwide bait harvest is below that in the third row, and then the next rows are the coastwide biomedical mortality estimates, and the total mortality with bait and biomedical added together.

On the bottom, the two rows there are showing the total mortality, bait plus biomedical, as a percent of the overall ASMFC quota and the combined state quotas. What you see from this is that when the biomedical mortality is added on top of bait harvest, the total has remained well below the ASMFC coastwide bait quota, and then in the final row except in 2017, it has also remained under the bait harvest limit that is allowed under the state restrictive state quotas.

That is how it compares to the ASMFC quotas for bait harvest. As we discussed earlier, the biomedical mortality is accounted for in the ARM, in the framework revision for the Delaware Bay population, which this is the only population where we have biologically based harvest specifications. If Addendum VIII is adopted, that Delaware Bay specific biomedical mortality would be accounted for in setting the harvest specifications for the Delaware Bay.

Switching gears to the other part of this task, the best management practices for handling biomedical collections were developed by an ad hoc workgroup in 2011. This BMP list is a list of recommended practices to minimize stress injury and mortality of biomedical horseshoe crabs in every step of the process, from when they are collected to when they are returned to the sea. The horseshoe crab FMP recommends that these BMPs be followed by biomedical industry and harvesters, but the BMPs are not required by the ASMFC. What the Commission's FMP does require is that states must issue a special permit for, or authorization for collecting crabs for biomedical purposes, and also, they must return the horseshoe crabs that are taken for biomedical purposes to the same state or federal waters from which they were collected.

TECHNICAL COMMITTEE RECOMMENDATIONS

MS. STARKS: With that background, I'm going to hand it over to Natalie to present on the TC discussion, and Natalie, if you're not unmuted, please raise your hand, so we can unmute you.

MS. NATALIE AMERAL: Good morning. I think I should be unmuted. To summarize our TC discussion on the biomedical mortality threshold, the first thing we did was reach out to the staff to look at multiple CSMA runs, and population simulations. Using those, we did not find any significant impacts.

The real issue here is that we lack coastwide biological reference points, and there are regional differences in stock status. Not only can we not determine how biomedical mortality thresholds would impact each region, we are not sure how to even set that number to begin with. A lot of emphasis was also placed on sex ratios playing into these issues as well.

To summarize our BMP discussion. To figure out where each state stands, as far as implementing BMPs, each TC member per state provided information on what requirements currently exist. The disparities we saw between states, I think was largely attributed to different seasonality's, and harvest methods employed by each state.

If we go to the next slide, I can summarize our recommendations. Currently we don't have the data to inform upon a biologically based threshold for biomedical mortality, and also importantly, we only have a population estimate for Delaware Bay. To summarize the best management practices.

Right now, we think that our best focus for best management practices for decreasing mortality, would be to assemble a working group. I think that is recommended on the next slide. Really, if we want to spend the time to review, revise and recommend updated BMPs, we will probably need the time allowed to a working group to pursue that option. I think with that I am handing it off to Brett for the AP summery.

ADVISORY PANEL REPORT

MR. BRETT HOFFMEISTER: Thank you, Natalie, thank you, Caitlin. The AP met virtually on July 11. Caitlin started us off with a view of the TC document, or review. Right out of the gate there were comments on biomedical mortality with some of the AP members maintaining the 15 percent estimate we thought was high, pointing to the fact that as many of the papers that were used for the 2019 benchmark assessment did not follow many of the BMPs.

There was only a handful that did, so it was just really a notation. It was also pointed out that the Smith paper released in 2020 was really a good example of the effects of long-term biomedical processes. This looked at, you know almost 70,000 crabs that were bled by biomedical companies over many years.

We thought that that was a good reference. One AP member repeatedly was concerned about egg densities on the beaches, about them remaining low in the Delaware Bay region, as well as post handling effects, or biomedical use on horseshoe crabs, regardless of the estimated mortality level. This prompted some discussion, really talking about the timing of the egg density studies, the design of the studies themselves, and the fact that they weren't used in the benchmark assessment at the time. This member stated that they had a lot of data, and we encouraged them to share that with the ASMFC in the future.

As far as post handling of the biomedical crabs, the BMPs are designed to address some of that. Those were just comments there. Comments directly related to the BMPs. Another member was concerned about the vagueness of the BMP language leaving too much room for interpretation. For example, a recommendation that tows are around 30 minutes suggested that maybe we make that a requirement.

Another would be release area, you know where you should release the crab. Should it be at the same latitude and longitude location where they were caught? The biomedical members kind of countered that really the BMPs were designed to be somewhere variable, because of the practices along the coast.

As the TC noted, each state is very different in its fisheries practices. There are methods of harvest equipment that varies. The BMPs are a pretty comprehensive list of recommendations, but we didn't see that they could really be codified. Again, things such as temperature-controlled transport may make sense in one place and not another. Waters in Massachusetts are much cooler than they are in South Carolina.

Not all things considered equal, it's not really possible to have a lot of recommendations on these BMPs that will fit every nook and cranny. There was concern voiced about collection during spawning activity, and it was a reminder that many states have specific regulations to protect spawning horseshoe crabs, such as lunar closures, daily quotas, weekly quotas or late seasons, such as I know at least one processor in Delaware Bay Region, they don't even start harvesting until mid-June or late June.

I guess the message from the biomedical industry was that we are following the relevant and applicable BMPs, and doing everything reasonable to address mortality and injury with these crabs. It is in the best interest of the biomedical companies to do that. We need healthy animals for a good product. That was a point of some discussion.

It was also noted that the states have incorporated some of the BMPs into regulations, so things like storage conditions, transport, data collection, marking crabs prevent re-bleeding, or things that are found in some of the permitting or contingencies to permitting in some of the states. Biomedical members were suggesting some minor language changes in the elimination of a recommendation to check salinity at release point.

Prior to this meeting I did reach out to the industry. We reviewed the BMPs, and suggested some minor changes. I think you'll see some of that in the memo that is a part of the materials. It was also stated as a general statement by the biomedical companies, that the preservation of the species is a common goal. I'll just remind people that, you know we've been doing this for about 50 years, long before there was any management of the fishery itself. This has been a goal with the catch and release fishery and what not. Overall, I thought it was a good dialogue with the meeting, and there was some good input but not great surprises here. Thank you.

CHAIR CLARK: Thank you, Brett. Thanks, Caitlin and thank you Natalie. Do you have some comments to follow up?

MS. STARKS: Sorry, I just have a few more slides here. I just want to go to the next slide on the PDT recommendations. Considering what the TC and AP inputted on this issue, the PDT has made a recommendation not to use the biologically-based biomedical mortality threshold at this time, because there is currently insufficient data to support the coastwide threshold based on biological reference points.

The PDT said that any coastwide mortality threshold would not be scientifically based. The PDT does agree with reviewing and discussing the best management practices to proposed recommended updates, which could be done through a workgroup such as what was originally done and put together to develop those BMPs.

I think to start the Board's discussion on this topic it would be helpful to hear how the Board wishes to move forward, both with the mortality threshold issue, and with the BMPs. Some questions to think about are, is the Board interested in forming a workgroup to address either of these issues, and what should the focus of that workgroup be? With that I can take any questions.

CHAIR CLARK: Okay, thank you, Caitlin. Now, thank you, Caitlin, Natalie and Brett, and does the Board have any questions or comments on the biomedical here? Emerson.

MR. EMERSON C. HASBROUCK: Thank you, Caitlin, Natalie and Brett for your presentations. My question is, since we indicate in the FMP a threshold for biomedical collection of crabs, and every year we exceed that, and we just say well, okay, we exceeded it. How do we go forward here relative to this biomedical threshold? Do we just leave the FMP as it is, and ignore it essentially, or is there some other direction we should go in? Because I understand that we cannot develop a biologically-based threshold for biomedical collection.

CHAIR CLARK: Go ahead, Caitlin.

MS. STARKS: Thanks, Emerson, for the question. I think this is really a matter of what the Board is interested in doing. There is a threshold in the FMP of 57,500 crabs for a mortality threshold for the biomedical industry. Again, that was just based on estimates of what it was at the time. If the Board wanted to change that threshold in some way, it would require an addendum.

I think the options for something that could be done through an addendum would be removing the threshold, modifying the threshold, or potentially changing it in some other way that a work group could potentially propose. Those are my initial thoughts on how to move forward if you want to change that threshold in some way.

CHAIR CLARK: Do you have any follow up on that, Emerson?

MR. HASBROUCK: Yes, thank you. I don't know what the sense of the rest of the Board is, but we've been ignoring that threshold for, what did you say, Caitlin, 14 years, I think. If we've been ignoring it for 14 years, I guess we could continue to ignore it, unless somebody thinks we really need to move forward with an addendum.

CHAIR CLARK: Okay, are there any other questions for Caitlin? Not seeing any, can we put the PDT recommendations back up on the screen? Oh, Bob.

EXECUTIVE DIRECTOR BEAL: While the recommendations are coming back up. Just to kind of respond to Emerson's comment. I wouldn't characterize it as the Board is ignoring the threshold. I think you know it is reported out every year where we stand relative to that threshold. The Board looks at it and decides whether it's a significant component of the mortality, and if you remember the slide with the orange block and the blue sliver, you know it's a small component.

You know I hear what you're saying. You know they haven't reacted, and haven't made any management changes. But I don't want anyone to perceive that the Board just doesn't care. The Board does get a report out where we stand relative to that number, and looks at it, and hasn't decided that it's met a threshold where we need to have a management reaction to it.

CHAIR CLARK: Caitlin.

MS. STARKS: Yes, if I could just add on to that slightly. Again, the language in the FMP says that if that threshold is exceeded the Commission would reevaluate potential restriction on horseshoe crab harvest by the biomedical industry. I do think it's accurate to say that that is what the Board has been doing every year.

When they get the report out on what the biomedical mortality estimate is, and then through this process that the Board just asked of the PDT to evaluate the information, and look into some options. I think that is a reevaluation of potential restrictions. I think what Bob says stands, and if there needs to be a change to that, the Board can initiate an addendum.

CHAIR CLARK: We have these suggestions here from the Plan Development Team of course, that if the Board was to move ahead with the workgroup, to come up with best management practices, I'm assuming a new addendum could also address the biomedical threshold. Sorry, I think I saw another hand. Dan.

MR. DANIEL McKIERNAN: I'm assuming that in the annual Plan Review Document there is a statement in there that says that even though the threshold has been exceeded, this is inconsequential, because the overall mortality is declining. Is that accurate?

MS. STARKS: Off the top of my head, I don't remember if we have a statement exactly to that effect, but it is given as a percentage of the total mortality. I don't know if there is a desire for more information, we can add it.

MR. McKIERNAN: I would recommend that that be stated, that way there is some position that we're comfortable with that says yes, we know we're exceeding it, but it's no big deal.

CHAIR CLARK: Thanks, Dan, any other comments on this? Does the Board wish to proceed with the recommendations of the PDT on this issue? Dan.

MR. McKIERNAN: Yes, I would welcome PDT analysis of the levels of mortality attributable to the biomedical firms, maybe on a regional basis, because since we have quotas on a regional basis, I'm sorry, on a state basis. You know as states we're managing these activities. The potential take for that industry is not infinite, and so I guess it would be good to have some kind of a conversation about that by the PDT.

CHAIR CLARK: I'm seeing shaking heads over here, Dan. I think that gets into confidentiality issues, and that's why it's not broken out that way. But is that something that can or should be looked into further, or are we kind of stuck on that?

MS. STARKS: I think that was part of what the Technical Committee discussed through this process, was that while we have the biomedical information from each of the states, and can look at it regionally. We don't have population estimates for each region, so there is no way to compare what is an acceptable level of biomedical mortality or any type of mortality, including bait for those regions, because we don't have population estimates.

CHAIR CLARK: Any follow up, Dan?

MR. McKIERNAN: Yes, well frankly we have a trend in Massachusetts that is very positive. We have an annual bait harvest that is published. We're pretty confident that the levels of mortality at this time, attributable to bait harvest and whatever is going on with the confidential biomedical harvest, is probably rather appropriate. I just don't want to be handcuffed to actually having a management strategy going forward.

I'll work with this internally. It's not necessarily for discussion today, but this does represent a blind spot for horseshoe crab management for us state managers to not even be able to assure the public that we got this. That the number of crabs being killed at a local level within a state is appropriate. I'm confident that it is, but I'm just in the future I would like to maybe make some headway on that.

CHAIR CLARK: Are there any other comments? Conor.

MR. CONOR McMANUS: I guess I would just make a comment on the second recommendation. I would support that a workgroup be developed to review the best practices. It's been a while, I believe, since there has been a formal technical amendment or review of the document. I appreciate the feedback of the AP and the TC and the PDT to date on it. I think it just provides us an opportunity to reassess the practices more holistically.

CHAIR CLARK: Thanks, Conor, I see Emerson's hand.

MR. HASBROUCK: Yes, I agree with Conor. Do we need a motion to that effect or is just consensus fine?

CHAIR CLARK: We can do it by consensus. Does the Board agree that we should put together a working group on this? I'm not seeing any opposition, so yes, we can do that. In terms of what Dan was asking, is there enough information there that something can be pursued, or are we just kind of at an impasse on that whole issue?

MS. STARKS: I think I could get more information from Dan, maybe on what he's looking for after the meeting, or now. In terms of the workgroup, I am hearing that we want to look at the BMPs. I just want to clarify. Is there any interest in thinking about this mortality issue any further, or is the Board comfortable with keeping the threshold as it is? I just want to make sure we don't need to be doing any additional work beyond looking at the BMPs.

CHAIR CLARK: We have Emerson.

MR. HASBROUCK: I'm fine with leaving things the way they are relative to the threshold. As long as we incorporate in the annual FMP review the language that Dan suggested. I think that puts us in good shape.

CHAIR CLARK: Any other comments? Dan.

MR. McKIERNAN: Yes, and I'm comfortable leaving it just to the best management practices at this time. I will kind of deal with my local level issues locally.

CHAIR CLARK: Thanks, Dan. Okay, any further comments on this or are we ready to move on from this topic?

REVIEW AND POPULATE THE ADVISORY PANEL MEMBERSHIP

CHAIR CLARK: Okay, not seeing any we're going to move on to our next item, which is Review and Populate the Advisory Panel Membership, and that is Tina.

MS. TINA L. BERGER: Thank you, Mr. Chairman. I offer for your consideration and approval David Meservey, an inshore commercial otter trawler from Massachusetts.

CHAIR CLARK: We also had two more from Delaware.

MS. BERGER: Okay, forgive me, but I was not aware of those nominations. But if you have them in your packet then you know better than I.

CHAIR CLARK: Okay, Tina. I think they were in the supplemental, and they are in the motion, so we are fine on that, **and we have a motion by Dan McKiernan, seconded by Emerson Hasbrouck there**. Is there any opposition to this motion?

MS. KERNS: Mr. Chairman, can you read the motion, please?

CHAIR CLARK: Oh, certainly. **Move to approve Horseshoe Crab Advisory Panel nominations for David Meservey from Massachusetts, Jordan Giuttari and Matt Sarver from Delaware.** Motion by Mr. McKiernan, seconded by Mr. Hasbrouck. **Any opposition to the motion? Seeing none; the motion is approved by consent.**

ELECT A VICE-CHAIR

CHAIR CLARK: Now we are on to our penultimate item, which is Elect a Vice-Chair. Do we have a nomination? Joe Cimino.

MR. CIMINO: I know how good it feels to have a Vice-Chair waiting in the wings. **I move to elect Dr. Justin Davis from Connecticut as Vice-Chair of the Horseshoe Crab Management Board.**

CHAIR CLARK: We have a second by Jim Gilmore. I would say everybody is in approval of this nomination. Congratulations, Justin, and thank you.

ADJOURNMENT

CHAIR CLARK: Okay that brings us to our last item, which is Other Business. In the interest of time maybe we do have a discussion maybe we could have in the future about the amount of misinformation that has been out there over this. But given that we are already running late, shall we just adjourn the meeting at this point? Okay, no objections to that, so the Horseshoe Crab Board is adjourned. Thank you.

(Whereupon the meeting adjourned at 12:00 p.m. on Wednesday, August 3, 2022)

Atlantic States Marine Fisheries Commission

DRAFT ADDENDUM VIII TO THE HORSESHOE CRAB FISHERY MANAGEMENT PLAN FOR PUBLIC COMMENT

Implementation of the 2021 Adaptive Resource Management Framework Revision

August 2022

Sustainable and Cooperative Management of Atlantic Coastal Fisheries

Horseshoe Crab Draft Addendum VIII for Public Comment

Public Comment Process and Proposed Timeline

In January 2022, the Atlantic States Marine Fisheries Commission's (Commission) Horseshoe Crab Management Board (Board) initiated Draft Addendum VIII to the Horseshoe Crab Interstate Fishery Management Plan to consider implementing the recommendations included in the 2021 Revision of the Adaptive Resource Management (ARM) Framework and Peer Review Report, and using the ARM Framework Revision for setting bait harvest specifications for horseshoe crabs of Delaware-Bay origin. This document presents background on the Commission's management of horseshoe crab in the Delaware Bay Region, the addendum process and timeline, a statement of the problem, and management measures for public consideration and comment.

The public is encouraged to submit comments regarding the proposed management options in this document at any time during the addendum process. The final date comments will be accepted is **September 30, 2022 at 11:59 p.m**. **EST.** Comments may be submitted by mail, email, or fax. If you have any questions or would like to submit comments, please use the contact information below.

Mail: Caitlin Starks
Atlantic States Marine Fisheries Commission
1050 N. Highland St. Suite 200A-N
Arlington, VA 22201

Email: comments@asmfc.org
(Subject line: Horseshoe Crab Draft Addendum VIII)

January 2022	Board Initiated Draft Addendum VIII
August 2022	Board Approved Draft Addendum VIII for public comment
September 2022	Public Comment Period Including Public Hearings
November 2022	Board Reviews Public Comment, Selects Management Measures, Final Approval of Addendum VIII
TBD	Implementation of Addendum VIII Provisions

Horseshoe Crab Draft Addendum VIII for Public Comment

1.0 Introduction

The Atlantic States Marine Fisheries Commission's (Commission or ASMFC) Horseshoe Crab Management Board (Board) approved the Interstate Fishery Management Plan for Horseshoe Crabs (FMP) in October 1998. The goal of the FMP includes management of horseshoe crab populations for continued use by current and future generations of the fishing and non-fishing public, including the biomedical industry, scientific and educational researchers, migratory shorebirds, and other dependent fish and wildlife, including federally listed sea turtles. ASMFC maintains primary management authority for horseshoe crabs in state and federal waters. The management unit for horseshoe crabs extends from Maine through the east coast of Florida.

Additions and changes to the FMP have been adopted by the Board through seven addenda. The Board approved Addendum I in 2000, establishing a coastwide, state-by-state annual quota system to reduce horseshoe crab landings. Addendum I also included a recommendation to the federal government to create the Carl N. Shuster Jr. Horseshoe Crab Reserve. The Board approved Addendum II in 2001, establishing criteria for voluntary quota transfers between states. Addenda III (2004) and IV (2006) required additional restrictions on the bait harvest of horseshoe crabs of Delaware Bay-origin and expanded the biomedical monitoring requirements. Addenda V (2008) and VI (2010) extended the restrictions within Addendum IV. The provisions of Addendum VI were set to expire after April 30, 2013. Addendum VII replaced the Addendum VI requirements by establishing a management program for the Delaware Bay Region (i.e., coastal and bay waters of New Jersey and Delaware, and coastal waters only of Maryland and Virginia).

Draft Addendum VIII considers implementing the 2021 Revision to the Adaptive Resource Management (ARM) Framework originally established under Addendum VII.

2.0 Overview

2.1 Statement of the Problem

The Board initiated Draft Addendum VIII in January 2022 to consider use of the recent 2021 Revision of the ARM Framework (ASMFC 2021) in setting annual bait harvest specifications for horseshoe crabs of Delaware Bay-origin. Delaware Bay horseshoe crab management using the ARM Framework was originally established under Addendum VII for use during the 2013 fishing season and beyond. The Framework considers the abundance levels of horseshoe crabs and shorebirds in determining the optimal harvest level for the Delaware Bay states of New Jersey, Delaware, Maryland, and Virginia (east of the COLREGS).

In the past decade, more data has been collected on shorebirds and horseshoe crabs and modeling software and techniques have advanced. Additionally, the original ARM Framework used software that is now antiquated, not supported, does not run on current computer operating systems, and is limited in its capacity to incorporate uncertainty when determining optimum harvest strategies. Thus, the ARM Subcommittee was tasked with revising the ARM

Framework to address critiques from the previous peer review panel, include newly available data, and transition to new modeling software.

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 Framework Revision in January 2022. Draft Addendum VIII considers incorporating the recommended changes in the ARM Framework Revision into the management program for bait harvest of Delaware Bay-origin horseshoe crabs.

2.2 Background

The original ARM Framework and Addendum VII were developed in response to public concern regarding the horseshoe crab population and its ecological role in the Delaware Bay. While the stock assessment at that time (ASMFC 2009a) found increases in the Delaware Bay horseshoe crab abundance, the red knot (*rufa* subspecies), one of many shorebird species that feed on horseshoe crab eggs, was at low population levels. To address these concerns, an effort began to develop a multi-species approach to managing horseshoe crabs by employing the tools of structured decision making and adaptive management. In 2007, the Horseshoe Crab and Shorebird Technical Committees met and endorsed the development of a structured decision making (SDM) framework and adaptive management approach. An ARM Subcommittee was formed including representatives from state and federal partners, as well as horseshoe crab and shorebird biologists. The Subcommittee produced a framework for adaptive management of horseshoe crabs in the Delaware Bay that was constrained by red knots. It was peer-reviewed with a coastwide benchmark stock assessment for horseshoe crab in 2009 (ASMFC 2009a, 2009b).

Addendum VII, approved in February 2012, implemented the ARM Framework for use during the 2013 fishing season and beyond. The Framework considers the abundance levels of horseshoe crabs and shorebirds in determining the optimal harvest level for the Delaware Bay states of New Jersey, Delaware, Maryland, and Virginia (east of the COLREGS). Since 2013, the Board has annually reviewed recommended harvest levels from the ARM Subcommittee, who run the ARM model, and specified harvest levels for the following year in New Jersey, Delaware, Maryland, and Virginia.

2.3 Original ARM Framework

A goal of the ARM Framework is to transparently incorporate the views of stakeholders along with predictive modeling to assess the potential consequences of multiple, alternative management actions in the Delaware Bay Region. The ARM process involved several steps: 1) identify management objectives and potential actions, 2) build alternative predictive models with confidence values that suggest how a system will respond to these management actions, 3) implement management actions based on those predictive models, 4) monitor to evaluate the population response to management actions, validate the model predictions, and provide timely feedback to update model confidence values and improve future decision making, 5) as necessary, incorporate new data into the models to generate updated, improved predictions, and 6) revise management actions as necessary to reflect the latest state of knowledge about the ecosystem. The ARM Framework is an iterative process that adapts to new information and success of management actions.

Underlying the original ARM model are population models for both red knots and horseshoe crabs. The optimization routine in the ARM model determines the best choice among five potential harvest packages (numbers of male and females that can be harvested) given the current abundance of each species in order to maximize the long-term value of horseshoe crab harvest. The ARM model values female horseshoe crab harvest only when the abundance of red knots reaches 81,900 birds (a value related to the historic abundance of red knots in the Delaware Bay) or when the abundance of female horseshoe crabs reaches 80% of their predicted carrying capacity (11.2 million assuming a carrying capacity of 14 million; ASMFC 2009b). On an annual basis, the ARM model is used to select the optimal harvest package to implement for the next year given the current year's estimate of horseshoe crab abundance from the swept area estimate from the VA Tech trawl survey and a mark-resight estimate of red knot abundance.

Within this ARM Framework, a set of alternative multispecies models were developed for the Delaware Bay Region to predict the optimal strategy for horseshoe crab bait harvest. These models accounted for the need for red knot stopover feeding during migrations through the region. These models incorporated uncertainty in model predictions and are meant to be updated with new information as monitoring and management progress.

On an annual basis, the ARM model is used to select the optimal harvest package to implement for the next year given the current year's estimate of horseshoe crab abundance from the swept area estimate from the VA Tech trawl survey and a mark-resight estimate of red knot abundance. The current harvest packages for horseshoe crab bait harvest that can be selected by the ARM model are:

Package 1) Full harvest moratorium on both sexes
Package 2) Harvest up to 250,000 males and 0 females
Package 3) Harvest up to 500,000 males and 0 females
Package 4) Harvest up to 280,000 males and 140,000 females
Package 5) Harvest up to 420,000 males and 210,000 females

The numbers of horseshoe crabs in the packages listed above are totals for the Delaware Bay Region, and not per state. Since its implementation in 2013, neither the 81,900 red knot threshold nor the 11.2 million female horseshoe crab thresholds have been met and harvest package 3 has been selected every year by the Framework and specified by the Board for the Delaware Bay bait harvest limit.

2.4 Allocation of the ARM harvest output

The ARM Framework incorporates horseshoe crabs from the Delaware Bay Region as one unit. The modeling and optimization portions of the Framework do not address distribution and allocation of the harvest among the four Delaware Bay states. Allocation of the overall Delaware Bay harvest allowance was established in Addendum VII. Based on tagging and genetic analysis (ASMFC 2019, 2021), there is very little exchange between Chesapeake Bay and Delaware Bay horseshoe crab populations. However, there is movement of horseshoe crabs between coastal embayments (from New Jersey through Virginia) and Delaware Bay.

An allocation model for the four Delaware Bay states was developed to allocate the optimized harvest output by the ARM Framework, which is described in Section 2.4 of Addendum VII, and summarized below.

Each state's allocation of the total Delaware Bay-origin harvest recommended by the ARM Framework was determined by multiplying the state's quota under Addendum VI by the proportion of the state's total harvest that is of Delaware Bay-origin (lambda, λ), then dividing this value by the sum of the values for each of four states (Table 1). The state lambda values established in Addendum VII were based on the genetic data available at the time. Virginia's quota level and landings refer to those quota and landings that occur east of the COLREGS line, as these crabs have been shown to be part of a mixed stock.

Table 1. Calculation of State Allocations of Delaware Bay Harvest Established in Addendum VII

State	Lambda	Addendum VI Quota	Delaware Bay-Origin Quota	Add VII Allocation of Delaware Bay-Origin Quota
NJ	1.00	100,000	100,000	32.4%
DE	1.00	100,000	100,000	32.4%
MD	0.51	170,653	87,033	28.2%
VA (east of COLREGS)	0.35	60,998	21,349	7.0%

Along with the state allocation percentages, Addendum VII also established two additional provisions impacting the state quotas for Maryland and Virginia. First, it established a harvest cap for Maryland and Virginia, which set a maximum limit on the total level of allowed harvest by Maryland and Virginia to provide protection to non-Delaware Bay-origin crabs. The cap is based on Addendum VI quota levels for Maryland and Virginia; the Maryland cap is 170,653 crabs, and the Virginia cap is 60,998 crabs. These caps apply except when the ARM Framework recommends a package that prohibits harvest of female horseshoe crabs. When female harvest is prohibited, a second provision allows for a 2:1 offset of males:females for Maryland and Virginia, which allows the total male harvest of Maryland and Virginia to rise above the cap level. Note again that Virginia's quota only refers to the number of crabs that can be harvested east of the COLREGS line.

3.0 Management Options

When the Board takes final action on the addendum, there is the opportunity to select any measure within the range of options that went out for public comment, including combining options across issues.

Draft Addendum VIII considers two management options:

- Option A: No action
- Option B: Implement the ARM Revision for setting bait harvest specifications for Delaware Bay-origin horseshoe crabs

Option B includes additional sub-options to specify how annual harvest recommendations will be made based on the output of the ARM model.

Option A: No Action

Because the ARM Framework adopted under Addendum VII can no longer be updated due to its obsolete software, under this option, the management program would revert back to the provisions implemented under Addendum VI. These include the following harvest quotas and limitations for New Jersey, Delaware, Maryland, and Virginia.

Addendum VI prohibits directed harvest and landing of all horseshoe crabs in New Jersey and Delaware from January 1 through June 7, and female horseshoe crabs in New Jersey and Delaware from June 8 through December 31. It also limits New Jersey and Delaware's harvest to 100,000 horseshoe crabs per state per year.

Addendum VI prohibits directed harvest and landing of horseshoe crabs in Maryland from January 1 through June 7 for two years, from October 1, 2006 to September 30, 2008. It also prohibits the landing of horseshoe crabs in Virginia from federal waters from January 1 through June 7.

Addendum VI mandates that no more than 40% of Virginia's annual quota may be harvested east of the COLREGS line in ocean waters. It also requires that horseshoe crabs harvested east of the COLREGS line and landed in Virginia must be comprised of a minimum male to female ratio of 2:1.

Table 2. Commercial horseshoe crab bait harvest quotas for the Delaware Bay states under Addendum VI.

Jurisdiction	Addendum VI ASMFC Quota
NJ*	100,000
DE*	100,000
MD	170,653
VA**	152,495
DELAWARE BAY TOTAL	523,148

*Male-only harvest
**No more than 40% of Virginia's annual quota may be harvested east of the COLREGS line in ocean waters. Horseshoe crabs harvested east of the COLREGS line and landed in Virginia must be comprised of a minimum male to female ratio of 2:1.

Option B: Implement the ARM Revision for setting bait harvest specifications for Delaware Bay-origin horseshoe crabs
This option would adopt the updates to the ARM Framework recommended in the 2021 Revision and incorporate them into the process for setting specifications for bait harvest of Delaware Bay-origin horseshoe crabs. Changes to the ARM Framework are described in detail in the 2021 Revision to the Adaptive Resource Management Framework and Peer Review Report, and include:

- Catch multiple survey analysis (CMSA) to estimate male and female horseshoe crab population estimates using all quantifiable sources of mortality (i.e., natural mortality, bait harvest, coastwide biomedical mortality, and commercial dead discards) and several abundance indices from the Delaware Bay Region
- Integrated population model (IPM) to quantify the effects of horseshoe crab abundance on red knot survival and recruitment based on data collected in the Delaware Bay
- Transition to new modeling approach which can be implemented through readily available R software and incorporates uncertainty on all life history parameters for both horseshoe crabs and red knots
- Harvest recommendations based on a continuous scale rather than discrete harvest packages as in the previous Framework
- Female harvest decoupled from the harvest of males

Harvest Recommendations

Harvest recommendations under the ARM Revision are based on a continuous scale rather than the discrete harvest packages in the previous Framework. Therefore, any harvest number up to the maximum allowable harvest could be recommended, not just the fixed harvest packages. Harvest of females is decoupled from the harvest of males so that each are determined separately. The maximum possible harvest for both females and males are maintained as in Addendum VII at 210,000 and 500,000, respectively.

Although harvest is treated as continuous in the new ARM Framework, if the continuous harvest recommendations were made public, it would be possible to back-calculate the biomedical mortality input, which is confidential. Therefore, it is necessary to round the continuous sex-specific harvest outputs to obscure the confidential biomedical data, unless the maximum sex-specific harvest is recommended. There are two sub-options for rounding the harvest output from the ARM Framework:

- **Sub-option B1:** Round down continuous optimal harvest recommendation to nearest 25,000 horseshoe crabs. For example, if the continuous optimal harvest recommendation is 135,000 males and 96,000 females, these values would be rounded down to 125,000 males and 75,000 females.

- **Sub-option B2:** Round down continuous optimal harvest recommendation to nearest 50,000 horseshoe crabs. For example, if the continuous optimal harvest recommendation is 135,000 males and 96,000 females, these values would be rounded down to 100,000 males and 50,000 females.

The Board is seeking public input on the level of rounding of the optimal harvest recommendation. Sub-option B2 would be more conservative, but sub-option B1 would yield harvest levels closer to the optimal harvest.

Adaptive management cycle

Under this option the adaptive management cycle would include three tiers of short and longer term management, update, and revision processes for the ARM Framework, as follows:

1. **Annual management process:** The annual specification of harvest will occur at the ASMFC annual meeting in calendar year *t* for the harvest to be implemented the following season (year *t*+1). The CMSA requires multiple indices of abundance and removals from multiple sources. Because the necessary data take time to be finalized, and final data for a given year would not be available by the time of the annual meeting, the results of a run of the CMSA in year *t* will be based on data obtained from the previous two years. Inputs to the CMSA will include the Virginia Tech trawl survey that is conducted in the fall of year *t*-2; Delaware and New Jersey trawl surveys from year *t*-1; and removals from year *t*-1. To match the abundance estimates of horseshoe crabs with red knot mark-resight population estimates, horseshoe crab abundance estimates from year *t*-1 and red knot population estimates from year *t*-1 will be used as input to the ARM Revision harvest policy functions in year *t*. Optimal harvest recommendations can then be implemented in year *t*+1. The two year time lag between data availability and implementation of optimal harvest was incorporated in the ARM Revision modeling when determining what the optimal harvest would be based on horseshoe crab and red knot abundance.

   Each annual step is identified in the timeline below:

- April - July (year *t*) – The ARM workgroup compiles monitoring data to run the CMSA (Virginia Tech trawl survey data from year *t*-2, New Jersey and Delaware survey data from year *t*-1, removal data from year *t*-1). The ARM workgroup estimates red knot stopover population size from the mark-resight analysis in year *t*-1.
- August (year *t*) – The ARM workgroup inputs horseshoe crab and red knot population estimates to the ARM Revision harvest policy functions and calculates the optimal harvest.
- September (year *t*) – The Delaware Bay Ecosystem Technical Committee reviews the ARM Revision results and optimal harvest recommendations.
- ASMFC Annual Meeting (year *t*) – The Management Board reviews the optimal harvest recommendations from the ARM workgroup and decides on the harvest to be implemented in year *t*+1.

2. **Interim update process:** Every three years, an update process would 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.
3. **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. This should incorporate the following components:
   - Solicit formal stakeholder input on ARM Framework to be provided to the relevant technical committees
   - Technical committees review stakeholder input and technical components of ARM models and provide recommendations to the Board
   - At the ASMFC Spring Meeting, Board selects final components of the ARM Framework, and tasks technical committees to work with ARM Working Group to run models /optimization
   - Merge with the annual management process
     - In August, ARM Subcommittee runs models/optimization
     - At the ASMFC Annual Meeting, the Board revisits harvest decision

If Option B is selected, implementation of the ARM Framework Revision would likely occur for the 2023 fishing season, with Board review and decision-making likely to occur at the Board's 2022 annual meeting.

Allocation of the Delaware Bay-origin harvest recommendation

Under this option, the allocation methodology established in Addendum VII would be modified to update state lambda values as recommended in the 2021 Revision based on more recent genetic data analysis. Lambda indicates how much of a state's harvest is of Delaware Bay-origin (i.e., has spawned at least once in Delaware Bay). Lambda shall be assumed to be 1.00 for New

Jersey and Delaware and based upon the recent genetics data and analysis (ASMFC 2021), 0.45 for Maryland, and 0.20 for Virginia.

State	Lambda, λ
NJ	1.00
DE	1.00
MD	0.45
VA	0.20

Allocation values will be calculated using the same formula used under Addendum VII. Lambda will be multiplied by the state's Addendum VI quota. The resulting value will be divided by the sum of values for all four states to provide the percent of the Delaware Bay harvest recommendation that will be allocated to each state. Virginia's quota level and landings refer to quota and landings that occur east of the COLREGS line, as these crabs have been shown to be part of a mixed stock (Shuster 1985).

State	Allocation of Delaware Bay Harvest (%)
NJ	34.6%
DE	34.6%
MD	26.6%
VA	4.2%

Harvest cap for Maryland and Virginia

Under this option the harvest cap for Maryland and Virginia established under Addendum VII will be maintained. The harvest cap places a maximum limit on the total level of allowed harvest by Maryland and Virginia, providing protection to non-Delaware Bay-origin crabs. The cap is based on Addendum VI quota levels for Maryland and Virginia. Note again that Virginia's quota only refers to the amount able to be harvested east of the COLREGS line.

MD Cap	VA Cap
170,653	60,998

These caps shall apply except when the ARM Framework outputs an optimized harvest that prohibits harvest of female horseshoe crabs. In this situation, female horseshoe crab harvest in Maryland and Virginia will be prohibited but a 2:1 offset of males:females shall apply and allow the total male harvest of Maryland and Virginia to rise above the cap level.

2:1 Male:female offset for female crabs below the Addendum VI levels

When a female harvest moratorium output by the ARM Framework restricts female crab harvest in Maryland and Virginia below the Addendum VI quota levels, male harvest would be increased at a 2:1 ratio. These increases are the only allowable increases above the designated harvest cap above. The offsets assume an allowed harvest under Addendum VI in Virginia of 20,333 female crabs and in Maryland of 85,327 female crabs.

Fallback option if ARM Framework cannot be used

As part of the 2021 ARM Framework Revision, the models are dependent on annual data sets for the yearly harvest setting, and include the following:

- Horseshoe crab abundance estimates from the Virginia Tech Horseshoe Crab Trawl Survey
- Horseshoe crab relative abundance indices from Delaware and New Jersey fishery-independent surveys
- Total horseshoe crab removals (bait harvest, biomedical mortality, and estimated commercial discards)
- Horseshoe crab spawning beach sex ratio from the Delaware Bay Horseshoe Crab Spawning Survey
- Red knot abundance estimates, including stopover counts and re-sightings

The absence of these annually-collected data sets could inhibit the use of the ARM Framework depending on which data sets were missing. If model results were not available for the fall harvest decision, the Board, via Board action and after consultation of the relevant Technical Committees and Advisory Panels, may set the next season's harvest by one of the following methods:

- Based upon Addendum VI quotas and management measures for New Jersey, Delaware, and Maryland, and Virginia coastal waters; or,
- Based upon the previous year's ARM Framework harvest level and allocation for New Jersey, Delaware, and Maryland, and Virginia coastal waters. Harvest could be more conservative than the previous year's ARM Framework harvest level and allocation for New Jersey, Delaware, and Maryland, and Virginia coastal waters.

4.0 Compliance

TBD

5.0 Literature Cited

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Appendix A. Example Allocation of Delaware Bay Horseshoe Crab Harvest

Table 1. Horseshoe crab and red knot population estimates and resulting harvest recommendation for 2017-2019 based on the 2021 ARM Revision. Coastwide biomedical mortality was used for model development, so actual Delaware-Bay specific values will likely result in slightly lower population estimates and harvest levels. Source: Supplemental Report for ARM Revision, Table 11.

	CMSA Estimates		Red knots	Optimal HSC Harvest (revised ARM)	
Year	Female HSC	Male HSC		Female	Male
2017	10,967,100	31,664,430	49,405	154,483	500,000
2018	9,735,690	24,715,290	45,221	146,792	500,000
2019	9,357,400	21,897,920	45,133	144,803	500,000

Table 2. Example allocation of the Delaware Bay optimal horseshoe crab harvest using the 2019 Optimal HSC Harvest (see Table 1). Top: Example allocation under Option B, sub-option B1. Bottom: Example allocation under sub-option B2. Total quota includes crabs of non-Delaware Bay Origin.

	DE Bay Origin Quota			Total Quota		
State	Sexes Combined	Male	Female	Sexes Combined	Male	Female
DE	216,268	173,014	43,254	216,268	173,014	43,254
NJ	216,268	173,014	43,254	216,268	173,014	43,254
MD	166,080	132,864	33,216	170,653	136,522	34,131
VA*	26,384	21,107	5,277	60,998	48,798	12,200
Total	**625,000**	**500,000**	**125,000**	**664,187**	**531,349**	**132,837**

	DE Bay Origin Quota			Total Quota		
State	Sexes Combined	Male	Female	Sexes Combined	Male	Female
DE	207,617	173,014	34,603	207,617	173,014	34,603
NJ	207,617	173,014	34,603	207,617	173,014	34,603
MD	159,437	132,864	26,573	170,653	142,211	28,442
VA*	25,328	21,107	4,221	60,998	50,832	10,166
Total	**600,000**	**500,000**	**100,000**	**646,885**	**539,071**	**107,814**

*Virginia’s total quota refers to the number of crabs that can be harvested in Virginia state waters east of the COLREGS line.

Atlantic States Marine Fisheries Commission

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MEMORANDUM

TO: Horseshoe Crab Management Board

FROM: Caitlin Starks, Senior FMP Coordinator

DATE: October 20, 2022

SUBJECT: Public Comment on Draft Addendum VIII to the Horseshoe Crab Fishery Management Plan

The following pages represent a draft summary of all public comments received by ASMFC on Horseshoe Crab Draft Addendum VIII as of 11:59 PM (EST) on September 30, 2022 (closing deadline). Comment totals for the Draft Addendum are provided in the tables below, followed by summaries of the state public hearings, and written comments sent by organizations and individuals. A total of 34,631 written comments were received. These included eight form letters submitted by a total of 33,932 individuals, 24 letters from organizations, and 245 comments from individual industry stakeholders and concerned citizens. Four public hearings were held (three virtual and one in-person hearing in Virginia). The total public attendance across the four hearings was 69, though some individuals attended multiple public hearings. Eighteen individuals provided comment at public hearings.

For the purposes of this summary, three or more comments that have the same language or state support for an organization's comments are considered form letters. However, if the commenter provides additional comments/rationale related to a potential management action beyond the organization's or letter's comments, then it is considered an individual comment.

The following tables are provided to give the Board an overview of the support for each of the management options contained in Draft Addendum VIII. Comment totals by state for comments provided during public hearings were tallied based on the hearing attended. It should also be noted that some individuals provided comments at a public hearing and also submitted written comments, and these are counted separately in the tables below. Additional comments that did not indicate support for a particular option are included in the breakdown of total comments received. Prevailing themes from the public comments on Draft Addendum VIII, including rationales for support or opposition and general considerations, are summarized below the tables.

Table 1. Support for Draft Addendum VIII Options indicated in written comments submitted to ASMFC & comments provided at public hearings

	Option A	Option B	Sub-option B1	Sub-Option B2	No Option Selected
Form Letters	34,399	0	0	0	5
Written Comments	108	1	0	1	160
Public Hearings					
New Jersey	4	1	1	0	0
Delaware	1	0	0	0	7
Maryland	2	0	0	0	2
Virginia	0	1	0	0	0
Total	**34,459**	**3**	**1**	**1**	**169**

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Table 2. Breakdown of Total Comments Received by Category

Comments Received by Category	
Form Letter 1	25,948
Form Letter 2	4,010
Form Letter 3	15
Form Letter 4	289
Form Letter 5	674
Form Letter 6	2,987
Form Letter 7	4
Form Letter 8	5
Form Letter 9	412
Total Form Letters	34,344
Organization Letters	24
Individual Comments	245
Total Written Comments	34,613
Comments Provided at Public Hearings	
New Jersey	5
Delaware	8
Maryland	4
Virginia	1
Total Comments Received	**34,631**

Support for Option A. No action

Organizations and individuals in support of Option A (No action) based their decision upon concern over how any change in the current regulations for horseshoe crabs could have direct and indirect negative effects on the horseshoe crab population, the red knot population (listed as threatened on the Endangered Species Act [ESA]), and the overall ecosystem balance.

Additional Rationales Provided

- Opposition to female horseshoe crab harvest permitted by the revised Adaptive Resource Management ("ARM") Framework
- Prior population thresholds set for female horseshoe crabs (11.2 million individuals) and *rufa* red knot (81,900 individuals) in the original ARM Framework have not been reached and should not be disregarded in Addendum VIII.
- Concern about red knot counts being low in 2022
- The new framework does not include as a management objective the timely increase of either the horseshoe crab or red knot populations toward any metric related to an estimate of ecological carrying capacity, as the original ARM had done.
- The revised ARM Framework's assumptions and decisions do not properly support knowledge of red knot reliance on horseshoe crab eggs at the Delaware Bay.
    - Lack of confidence in the assessment that horseshoe crabs and red knots metrics are high enough to warrant any increase in horseshoe crab harvest quota

- Red knot populations are too low to risk further inhibiting their population growth by modifying horseshoe crab harvest quota, thus reducing horseshoe crab egg availability.
- Safeguards are lacking for the uncertainty inherent in the population models that underpin the ARM model, and in the ARM model itself.

- More population dynamics should be included in the new ARM Framework as it is too narrowly focused in how it determines a healthy horseshoe crab population.
    - Horseshoe crab abundance data (mark-resight and counts) from 2011-2020, show a fairly stable horseshoe crab population but do not consider the relative decline from a much higher pre-1990's population size.
    - Spring surveys in 2021 and 2022 which were not included in the Framework showed significant decline in population size suggesting greater variation and instability in the population than the Framework supports.
    - Horseshoe crab egg density surveys and spawning survey and red knot field surveys should be included as they are reliable indicators of horseshoe crab population and are an index of value for red knots and other shorebirds by showing the relationship between horseshoe crab egg availability and shorebird abundance.
    - Egg density surveys conducted by the Delaware Bay Shorebird Project and other organizations, do not support the assertion that horseshoe crab populations are recovering from their population crash in the 1990s.
- No change in the ARM model should occur until the US Fish and Wildlife Service (USFWS) has completed its Critical Habitat Designation process for red knots which will likely highlight the Delaware Bay as a critical habitat to preserve, thus, implying preservation of a high quantity of horseshoe crab eggs as necessary for a successful migration and breeding season for red knots.
    - The USFWS Draft Recovery Plan for red knots states that reduced food availability in the Delaware Bay is a driving factor behind red knot decline which led to its listing under the ESA.
- Any increase in horseshoe crab harvest (especially female) could have negative cascading effects to red knots, the fishing industry, and the overall ecosystem.
    - Many species diets rely on horseshoe crab eggs.
    - Red knots are dependent on horseshoe crab egg consumption during their migratory stopover therefore a change in female horseshoe crab abundance could hinder the population dynamics of a threatened species.
    - Recreational fisheries could be affected though changes in population dynamics of sportfish like striped bass and flounder, which consume horseshoe crab eggs.
- Opposition to the raw data, modeling, and analysis in the new ARM Framework not being available for review by the general public and concerned stakeholders to objectify verify.
    - The general public would not be able to review all data for the continuous harvest recommendations due to the inclusion of confidential data.
    - If all data sets (biomedical mortality) were accessible to review by the public and interested scientific communities there would be greater confidence in the ARM Framework, and the biomedical industry would be held accountable for its impact on horseshoe crab abundance and essential related interspecies relationships

Support for Option B. Implement the ARM Revision for setting bait harvest specifications for Delaware Bay-origin horseshoe crabs

Comments from organizations in support of Option B were based upon the desire to use science-based management, and the new ARM Framework's ability to make updates and improvements to the ARM modeling approach, inputs of new data, and continuation of multispecies management models.

Additional Rationales Provided

- Option B is science-based.
- Support for the Revised ARM Framework as a management approach, but without female harvest for ten years.
- Support for the research recommendations of the framework revision that has informed the proposed addendum, in particular the data collection to support 1) inclusion of egg density into the management model and 2) research on the effects of climate change on spawning and breeding habitat for the crabs and birds

General Considerations

Among the organization and individual written comments, stakeholders addressed a number of general considerations. Prevailing themes included concern over any increase in harvest, especially female harvest, and ensuring ecosystem-based management that supports interspecies conservation, limits industry harvest, and proactively addresses climate change impacts.

- Regardless of which option is selected, there should be a moratorium on the harvest of female horseshoe crabs in the commercial fishery and the biomedical industry.
    - Any harvest of female horseshoe crabs would lower the egg availability for consumption by the migratory red knot population.
- Desire for more holistic ecosystem-based management approach that supports protection across the food web against cascading negative effects caused by horseshoe crab harvest
    - Destabilizing the horseshoe crab population dynamics in Delaware Bay could have future negative consequences for the entire ecosystem.
    - Local breeding fish, crabs, birds, and reptiles consume these eggs, creating ecological linkages of impact that extend far beyond the Delaware Bay.
- Concerns about observed negative trends in the Virginia Tech trawl survey
- The Commission should consider how climate change and sea level rise may further hinder horseshoe crab population growth and management, red knot population recovery, and other long-distance migratory shorebirds, and the health of the Delaware Bay ecosystem.
    - Effects of sea level rise and warmer water temperature on horseshoe crab spawning and survival
    - Increase in frequency and severity of storms may change beach habitat availability for spawning horseshoe crabs
- Concern over the number of horseshoe crabs used by the biomedical industry and how bleeding may increase risk of female post discard mortality
    - Desire for better assessment of post-release mortality of horseshoe crabs collected by the biomedical industry
    - Request for no female horseshoe crab harvest for the biomedical industry
    - Request for ASMFC to encourage the biomedical industry to switch to synthetic alternatives to horseshoe crab harvest for bleeding whenever possible
- Concern over how maximizing harvest of horseshoe crabs as bait for the conch (whelk) and eel fisheries may lead to further damage to horseshoe crab populations, red knot populations, and the overall ecosystem
    - The bait harvest industry should be encouraged to find a bait alternative due to the keystone role of horseshoe crabs within their ecosystem.
    - Eel and conch fisheries should be limited because populations are not in good condition.
    - Encourage states to mandate bait-saving technology by fishermen
    - Request for no female horseshoe crab harvest for bait

- Anecdotal observations by lifelong residents to the Delaware Bay area and volunteers for horseshoe crab counts suggest that the Delaware Bay horseshoe crab population has not rebounded to the degree necessary to permit any increase in the harvest quota.
- The red knot migratory stopover in the Delaware Bay area has become a tourist attraction that seasonally supports the local economy.
    - Reduction of horseshoe crab egg availability would deter the stopover of red knots in the Delaware Bay, putting at risk the associated economic influx from ecotourism in the area specifically for this event.

Horseshoe Crab Draft Addendum VIII Public Hearings

New Jersey Webinar Hearing
September 7, 2022
23 Public Participants

Commissioners: Joe Cimino (NJ), John Clark (DE), Rick Jacobsen (USFWS), Chris Wright (NOAA)

ASMFC & State Staff: Caitlin Starks (ASMFC), Kristen Anstead (ASMFC), Linda Barry (NJ), Jeff Brust (NJ), Margaret Conroy (DE), Mike Celestino (NJ), Heather Corbett (NJ), Samantha MacQuesten (NJ), Jordan Zimmerman (DE)

Hearing Overview

- Five individuals provided public comments
- Four attendees supported Option A, no action
    - Concerns were raised by multiple participants that the models were not made available for review by the public. Staff responded that the agencies are in the process of publishing the models and they cannot be shared at this time for proprietary reasons and due to confidential data, but they are not refusing to share them.
    - Concern that female harvest is a threat to the population recovery of red knots, as well as the horseshoe crab population
- One attendee supported Option B, and sub-option B1 because it is a science-based choice
- Staff explained what the next steps for Board action could be at the meeting in November. The Board could select either option, and would then need to set the specifications for 2023 based on the management program selected.

Public Comment Summary

Timothy Dillingham, American Littoral Society (NJ)

- As a supporter of red knot recovery we have a lot of concerns with the proposal.
- Shorebird biologists counted around 7,000 knots this year, which is low. The birds are still in a dire situation and not showing signs of recovery.
- There is debate about the rate of horseshoe crab population growth, especially for females which are key to both populations' recovery.
- Was supportive of the idea of the ARM originally, and participated on committees when it was envisioned and developed
- Disagrees that there should be any female harvest
- There are questions about the population models and the inputs, but the public have not been able to review and evaluate them
- There has not been enough public engagement on this issue
- Not opposed to updating the model but urges the thresholds in the original ARM framework to be restored
- Does not make sense to increase female harvest for fisheres (eel, conch) that are in poor condition themselves

Zoe Leach (NJ)

- Does not support Option B
- Strongly opposes harvest of female horseshoe crabs

- They are listed as vulnerable on the IUCN red list
- Thinks it is unwise to harvest females when we rely on the crabs for medical purposes
- It is unwise to endanger their population and does not seem like a good use to use them as bait, especially for fishing for eel, which have a depleted population

Kyle Fisher, local waterman (NJ)

- In favor of Option B and sub-option B1
- This option is based on actual science of the local population in the Delaware bay
- Responded to comments from others on the status of the fisheries for eel and conch, and using horseshoe crab as bait for those fisheries:
    - Cannot speak for conch but can for eel. Thinks there is a correlation in the amount harvested and the number of fishermen pursuing those species. In his area of the Delaware Bay there are maybe only four fishermen that fish for eel. The further down the bay you go the fewer there are. Regarding the statement that they are depleted, he says that while tending crab pots today he threw over a dozen large eel from his traps, and the crab pot has a bigger size mesh so they should be able to get out. That gives some perspective on Delaware Bay population of eel. Thinks research on the correlation between number of fishermen and the weight of landings might show some clarity on the state of the eel fishery.

Laura Chamberlain (NJ, reTURN the Favor horseshoe crab rescue)

- Supports Option A
- Works with volunteers on beaches saving stranded crabs, many of whom live in NJ but also come from other states in the region.
- Shares concerns about female harvest and the transparency of the models raised by Tim and David.
- The spawning data are not being used in a way that is indicating what is happening on beaches, and egg density data not being used, so we are not looking at what is going on the beaches where the birds are using the eggs and where the greatest impacts are.
- It is not clear how the Board chooses the harvest levels, what the role of stakeholders in that process is, and how to move forward without understanding what female harvest could be.
- There are a lot of stakeholders to consider for female horseshoe crabs.
- The Board should apply the precautionary principle here. Without females we are putting future of the species at risk.
- Opposed to revisions of the ARM model

David Mizrahi (NJ, Audubon Society)

- Does not support the current options
- Vice President for research and monitoring for NJ Audubon, and a shorebird ecologist in the Delaware Bay.
- Disagrees with the account given that the federal agencies are willing to share the models. Audubon's request under the freedom of information act (FOIA) was denied due to "deliberative process." ASMFC is asking for comments on this without the ability to review the models.
- Opposes the revision and Draft Addendum 8.
- This Addendum and previous addenda have not addressed egg density on beaches, which is the more important factor for red knot recovery.
- Egg densities have not increased over the last decade.

New Jersey Hearing Attendance
Wednesday, September 7, 2022

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Faith	Zerbe	Bristol	Pennsylvania	faith@delawareriverkeeper.org
Jordan	Zimmerman	Dover	Delaware	jordan.zimmerman@delaware.gov

Horseshoe Crab Draft Addendum VIII Public Hearings
Delaware Webinar Hearing
September 8, 2022
24 Public Participants

Commissioners: John Clark (DE), Chris Batsavage (NC), Chris Wright (NOAA)

ASMFC & State Staff: Caitlin Starks (ASMFC), Kristen Anstead (ASMFC), Toni Kerns (ASMFC), Tina Berger (ASMFC), Tracey Bauer (ASMFC), Margaret Conroy (DE), Samantha Robinson (DE), Jordan Zimmerman (DE)

Hearing Overview

- Eight individuals provided public comments
- One commenter preferred Option A of the two available options, but does not necessarily agree that the Addendum VI measures are the best solution for management
- The other seven commenters did not support either addendum option
- The commenters do not support any female harvest at this time
- Two commenters advocated for a full moratorium for bait harvest of horseshoe crabs
- Several individuals commented that they are supportive of adaptive resource management and acknowledge the strength of the science of the ARM Framework Revision, but would like to see further improvements (incorporation of more years of data, egg density data, and carrying capacity) before it is used to set specifications
- Staff explained that even if the ARM Revision is adopted to produce optimal bait harvest recommendations, the Management Board and the states have the option to implement more restrictive harvest levels than what is recommended

Public Comment Summary

Steve Cottrell (DE, Audubon Society)

- Neither of the addendum options are good enough.
- Will advocate for a full moratorium on bait harvest.
- Red knot population numbers from the ARM model do not align with the numbers from observational surveys. There are two populations of red knots, but only those migrating from Tierra del Fuego in South America rely on the horseshoe crab eggs for their migration.

MaryCatherine Feola (PA)

- Does not support this addendum and is not for the harvest of any female horseshoe crabs in the bay because it is a keystone species.
- The horseshoe crab population is far from healthy, and we cannot undermine the efforts to recover it.

Mark Martell (DE, Audubon Society)

- Asked about the economic value of female horseshoe crab harvest
- Will advocate for a moratorium

Donna Repoli (NJ, American Littoral Society)

- Prefers Option A to revert back to Addendum 6 quotas over allowing female harvest.

- Addendum 8 is too risky on an ecological standpoint.
- Feels like economics are being valued over ecology, but both are interlinked. If populations of crabs are too low then the economics also suffer.
- Computer models are not flawless and mistakes can be costly to the ecosystem, and economically as well.
- We have not met the abundance thresholds to allow female harvest.
- We need to have more of a middle ground. We do not have to have ecological risk to have economic benefits.
- The Addendum needs revisions and changes because I do not support either option.
- States should not be given the power to do what they want because they are always going to act in their economic interest.
- The models place blatant value on harvest and not on actual conservation.

Chris Bason (Delaware Center for Inland Bays)

- There is not a clear choice for either option in the Addendum
- Do not support female harvest at this time.
    - Significant consideration should be given to the Virginia Tech Trawl survey because it does not show a strong increase in the horseshoe crab population but it is the only survey used that specifically targets horseshoe crab.
    - More information on egg abundance and distribution is needed. Studies and anectodal information indicate that in the past there were much greater egg densities ont he beaches.
    - Concerned about the impact female harvest could have on red knots.
    - Unclear how climate change is going to impact both crabs and birds.
- Suggested that no female harvest should be permitted for 10 years. This would allow for testing of the ARM model projections. It also aligns well with the proposed timing of another revision cycle under Option B.
- Supports the research recommendations on egg density and climate change.
- Requests development of ecosystem-based management research that would elucidate predator-prey relationships of shorebirds, forage fish, and other species that interact with horseshoe crab in the food web.
- Provided background on the Delaware Center for Inland Bays
    - The inland bays support a significant population of horseshoe crabs, which is indistinct from the Delaware Bay region population.
    - The Center has a management plan for inland bays that focuses on reversing eutrophication and restoring species and habitats. The objective is to restore fish populations and habitat through ecosystem-based management. There is also an environmental monitoring plan, with actions related to horseshoe crabs including the spawning survey. The survey found that the inland bay population is stable and is slightly lower than the bay side. They do not have large aggregations of birds, but eggs are still important to other species in the inland bays.
- Thanks the Commission for adding more empirical data from Delaware Bay into the ARM model and acknowledges the revision and research recommendations. Very thankful for the science and management, and also appreciate the economic value of the fishery.

Leah Zerbe (PA)

- Is a volunteer horseshoe crab monitor and nature educator in PA.

- It seems like there is not a consensus among stakeholders that eggs densities are where they need to be to support the populations of horseshoe crab and red knots.
- Do not support female harvest for bait.
- Allowing female harvest would be backtracking on the little progress that we have made.
- Has taken many schoolkids down to the beaches to monitor and tag crabs. It is a life changing experience for them. They learn about the ecosystem and they boost the economy during these trips. The economy is not just grinding up crabs. The feedback from the younger generations is that they are worried adults are failing them when it comes to conservation.

Matthew Sarver (DE, Delaware Ornithological Society)

- Agrees with Chris Bason's comments.
- Also acknowledges the work on the ARM model, but still has concerns.
    - In particular, concerned that there is not an inherent carrying capacity in the model. Thinks shifting baselines will be an issue as a result.
    - Also concerned that there are not other climate variables in the model like water temperatures that affect spawning, etc.
    - Threatened shorebirds and other declining species can be more seriously impacted by stochastic climate events.
    - Other birds nor other aquatic species that rely on horseshoe crabs are considered in the model.
- Concerned that there is high variance in last few years of population estimates for red knots. This is bad timing for quota changes when we are coming off several years of unreliable population estimates, due to effort changes related to COVID-19.
- Agrees that we need to ground truth the model with more years of data before using it for setting specifications, especially for female crabs.

Faith Zerbe (DE Riverkeeper Network)

- Is a scientist with the DE Riverkeeper Network, which has 26,000 members in the Delaware River watershed. Has been involved with spawning surveys over last 20 years.
- It is unfortunate that the hearings came up quickly at a busy time for people.
- Many people enjoy volunteering to help with crabs.
- Agree with comments about the fisheries – the fisheries the bait is used for are also crashing
- Allowing female harvest is not precautionary at this time, with the COVID years affecting data, egg density not being used in the model, and climate change effects on spawning.
- Does not support either of the options and thinks there should be a moratorium.
- It is outrageous to jeopardize strides we have made and recovery efforts.
- There should be an extension of the comment period.

Delaware Hearing Attendance Thursday, September 8, 2022				
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Horseshoe Crab Draft Addendum VIII Public Hearings
Maryland Webinar Hearing
September 14, 2022
17 Public Participants

Commissioners: Mike Luisi (MD), Roy Miller (MD), Shanna Madsen (VA), Chris Wright (NOAA)

ASMFC & State Staff: Caitlin Starks (ASMFC), Kristen Anstead (ASMFC), Toni Kerns (ASMFC), Emilie Franke (ASMFC), Steve Doctor (MD)

Hearing Overview

- All comments provided were against harvest of female horseshoe crabs
- Two commenters preferred the no action option
- Attendees asked questions about why female harvest is being proposed. Staff explained that the Addendum was initiated to update the science that is used for management rather than a specific desire to modify harvest levels.

Public Comment Summary

Amelia Seaman (Annapolis, MD)

- Totally against harvesting females. Does not see how this would help the red knots or anything else
- We are so dependent on horseshoe crab blood for vaccinations and the medical field so we shouldn't risk the population by harvesting female crabs
- Only 2-3 eggs from each spawning female survive; I don't understand how the population will continue to increase if you harvest female crabs
- Crabs are still spawning after June 7, so they won't be protected by the season; you can be picking female crabs right off the beach so that is not a good time to start harvesting

Kurt Schwartz (Maryland Ornithological Society)

- The Maryland Ornithological Society supports the no action option.
- Perplexed by the general lack of transparency in terms of where the proposal to harvest female crabs came from. The public has not seen the data. Calling for a transparent publication on this.
    - Staff responded that the ARM Revision is published and the peer review was open to the public.

David Curson (Maryland, Audubon Mid-Atlantic)

- Against any increase in bait harvest of crabs in the Delaware bay, prefer the no action option
- It is disappointing to have recommendations based on a model that can't be reviewed; even though the conceptual model is public, the parameterization of the model is possibly faulty and the data may not be the best sources of data. There is reason to believe the model is faulty because we know the red knot reproduction and survival is dependent on crab egg density, and horseshoe crabs have increased in the Delaware bay, but red knots have not increased. The current estimate is around 45,000, which is only about half of the recovery target; it seems bizarre when red knots have not recovered and the red knot populations have dipped sharply to have an increase in harvest with females taken, which would reduce eggs on the beach.

Robin Todd (Maryland Ornithological Society)

- We need a simple explanation of how the ARM is forecasting allowable harvests of horseshoe crabs when their population and the numbers of red knots visiting the Delaware Bay are not increasing.

Maryland Hearing Attendance Thursday, September 8, 2022				
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Horseshoe Crab Draft Addendum VIII Public Hearings

Virginia Public Hearing
Chincoteague, Virginia
September 15, 2022
5 Public Participants

Commissioners: Shanna Madsen (VA)

ASMFC & State Staff: Caitlin Starks (ASMFC), Ethan Simpson (VA)

Hearing Overview

- One individual commented in favor of Option B
- Other participants were not sure which option was preferred given uncertainty about how each option would affect the state quota
- State staff noted that if female harvest were allowed, then Virginia would not benefit from the 2:1 offset provision that allows them to increase their quota of male horseshoe crabs

Public Comment Summary

- One harvester mentioned that when fishing with gillnets the horseshoe crabs are not targeted, they are bycatch. So even if they cannot keep the crabs as harvest, the crabs will likely still die in the process of removing them from the nets.
    - Gillnets cannot select for female or male crabs, so females would still die even if bait harvest is not allowed

Public Hearing on Horseshoe Crab Draft Addendum VIII
Thursday, September 15, 2022
Chincoteague, Virginia

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EARTHJUSTICE

September 30, 2022

Horseshoe Crab Management Board
Atlantic States Marine Fisheries Commission
1050 N. Highland Street, Suite 200 A-N
Arlington, VA 22201
comments@asmfc.org

VIA ELECTRONIC MAIL

Re: Draft Addendum VIII to the Horseshoe Crab Fishery Management Plan for Public Comment

Dear Members of the Horseshoe Crab Management Board:

I write on behalf of New Jersey Audubon and Defenders of Wildlife to urge you to reject Addendum VIII to the Horseshoe Crab Fishery Management Plan. Since the Board instituted the Adaptive Resource Management ("ARM") Framework in 2012, red knot[1] abundance at Delaware Bay has fallen to historically low levels, and the U.S. Fish & Wildlife Service ("FWS") has listed the species as "threatened" under the Endangered Species Act ("ESA"). Horseshoe crabs, too, remain severely depleted compared to historical benchmarks. These circumstances demand greater protections and a precautionary strategy. But Addendum VIII would instead weaken the protections currently in place. Among other harmful outcomes, the Addendum almost certainly would reinitiate the female horseshoe crab bait harvest. Recognizing that neither red knots nor horseshoe crabs have recovered, the ARM Framework, until this proposal, has prohibited female harvest to protect the eggs on which the red knots rely.

Horseshoe crab eggs are critical to the red knot's ability to survive its 9,000-mile migration from as far south as Tierra del Fuego and to breed successfully in the Arctic Circle. The importance of horseshoe crab eggs to red knot success has long been recognized by scientists, government agencies, and the Atlantic States Marine Fisheries Commission ("ASMFC" or "Commission"), and the overharvest of horseshoe crabs has been a primary cause of the red knots' decline over the past three decades.

Nevertheless, despite the well-established link between horseshoe crab eggs and red knot survival and reproduction, Draft Addendum VIII proposes a starkly different version of reality. Through a combination of modeling defects and risk-prone decision-making, the revised ARM Framework now determines that the relationship between these species is scarcely perceptible, and that red knots would be virtually indifferent to the renewed harvest of female horseshoe crabs.

[1] In this document, "red knot" refers to the *rufa* subspecies.

As detailed in these comments and the attached expert reports by Dr. Kevin Shoemaker and Dr. Romuald Lipcius, this depiction of the relationship between horseshoe crab eggs and red knot demography is deeply flawed. Contrary to the conclusions represented in Draft Addendum VIII, adopting a new management approach that would enable resumption of the harvest of female horseshoe crabs at this juncture, when both red knots and horseshoe crabs are depleted, would harm red knots and present risks to the horseshoe crab population itself. Accordingly, the revised ARM Framework is not suitable for recommending horseshoe crab bait harvest quotas.

More specifically, the Board should reject Addendum VIII for reasons including but not limited to:

- **<u>The revised ARM Framework errs in concluding that red knots are not highly dependent on horseshoe crabs at Delaware Bay.</u>**
    - After flying thousands of miles, red knots arrive at Delaware Bay to renourish on horseshoe crab eggs. Under ideal conditions, red knots can double their body weight in less than two weeks. In the late 20th century, the peak count of red knots at Delaware Bay usually exceeded 40,000 and sometimes exceeded 90,000.
    - Horseshoe crabs were overharvested in the 1990s. In 2015, FWS listed red knots as "threatened" under the ESA and called horseshoe crab overharvest and corresponding egg depletion a "primary causal factor" in red knot decline. The peak red knot count has stayed below 13,000 for each of the past two years.
    - Despite this strong evidence of the importance of horseshoe crab eggs to red knots, the revised ARM Framework posits a weak link between the two species. By so doing, the revised ARM Framework subverts the premise of ASMFC's management regime for the horseshoe crab fishery, which is to manage the horseshoe crab harvest for red knot recovery.

- **<u>New analysis reveals significant technical flaws that make the revised ARM Framework unsuitable for managing the horseshoe crab harvest.</u>**
    - The revised ARM Framework abandons the well-established understanding of the importance of horseshoe crab eggs to red knots in favor of an extreme, contrary reconstruction of the ecosystem that defies history and reality. Even if horseshoe crabs vanished entirely today, the revised ARM Framework's computer model predicts that red knot abundance would remain stable on average or even increase over the next 50 years. The model clearly would not have predicted the decline of red knots that resulted from horseshoe crab overharvest in the 1990s, which discredits its usefulness in making projections that could help both species recover.
    - The revised ARM Framework also undermines sustainable management of horseshoe crabs. By miscalculating uncertainty, the horseshoe crab projection model generates artificially stable horseshoe crab population projections, when there actually exists a significant threat of decline.
    - The horseshoe crab population projections are significantly influenced by nonsensically high recruitment rates that were plugged in for years when recruitment was not measured empirically, thus further undermining the reliability of its projections.

  - The horseshoe crab population model bears very little correlation even to the data that the model is based upon, raising significant additional doubt about its predictive power and usefulness.

- **The revised ARM Framework's risk-prone assumptions and decisions are inappropriate, especially when a threatened species is at stake.**
  - Horseshoe crab demographic information, including size and sex ratio, strongly suggests that the species is not recovering and that a risk-averse management approach is required.
  - The Framework does not consider the availability of horseshoe crab eggs, which is the most direct measure of food resources for red knots. Analysis of horseshoe crab demographic trends indicates that egg production may be declining more than abundance estimates suggest.
  - The model finds a weak relationship between horseshoe crabs and red knots partly because it is based on data from years when both species had already declined rather than when the ecosystem was flourishing. Modeled projections of a depleted ecosystem offer no guidance on managing to achieve recovery of either red knots or horseshoe crabs.
  - The Framework does not assess whether Delaware Bay provides adequate food for Southern wintering red knots, which are especially dependent on horseshoe crab eggs.
  - The Framework would eliminate protective population thresholds that must be met prior to any female harvest, creating risks to red knots and horseshoe crabs and contravening stakeholders' precautionary intent.
  - For population estimates, the model equally weights three surveys, despite stakeholders' express preference—and ASMFC's practice until now—to rely exclusively upon the model that is purpose-designed for counting horseshoe crabs. This results in artificially inflated horseshoe crab population estimates.

- **ASMFC has repeatedly excluded input from stakeholders and the broader public.**
  - In addition to its other flaws, the revised ARM Framework is based on a model that has never been released to the public. Analysis of even the limited information made available to the public to date indicates significant problems with the model, as discussed above. If the Board approves Addendum VIII now and the model is subject to public evaluation, new concerns and critiques will inevitably arise after the revised ARM Framework is already in use.
  - The ARM Subcommittee failed to solicit formal stakeholder input in this proceeding, in violation of its own procedures and past practice.
  - By designating Addendum VI the "No Action" alternative, the Board artificially narrowed its options to two addenda that would reinitiate the female horseshoe crab harvest, thus deciding the most important issue before the public comment period even began.

- **<u>The flaws in the revised ARM Framework must be addressed now.</u>**
  - The authority of ASMFC to deviate from the ARM Framework's harvest quotas in the future is not a rationale for approving Addendum VIII based on a flawed modeling framework now. Prematurely approving Addendum VIII would set the stage for contentious and arbitrary decisions about annual quotas for years to come.
  - The authority of states to set lower quotas than ASMFC provides does not lessen the Board's obligation to ensure that the revised ARM Framework is fully vetted and reflects stakeholder values.
  - Updating the revised ARM Framework's model as new data become available will not correct its fundamental flaws, many of which—as explained in these comments—are apparent from expert reviews of even the limited data made publicly available to date.

- **<u>Approving Addendum VIII would likely lead to a violation of the Endangered Species Act by ASMFC.</u>**
  - The ESA requires a precautionary approach to protecting threatened species.
  - By reinitiating the bait harvest of female horseshoe crabs, ASMFC would commit "take" of red knots. ASMFC is responsible under the ESA for harvests conducted pursuant to the quotas it sets.
  - FWS's purported "evaluation" of the revised ARM Framework merely repackages ASMFC's modeling, with all of its flaws, and uses it to generate an unreliable conclusion regarding the impact of red knots. It therefore sheds no new light on the Board's stewardship responsibilities or the Commission's legal obligations.

The objections listed above are elaborated in the comments and expert reports that follow. Each objection is an independently sufficient reason to reject Addendum VIII. Collectively, they demonstrate that Addendum VIII is incompatible with the Board's mandate to maintain the ecosystem integrity of Delaware Bay and to comply with the Endangered Species Act.

Respectfully submitted,

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I. THE REVISED ARM FRAMEWORK ERRS IN CONCLUDING THAT RED KNOTS ARE NOT HIGHLY DEPENDENT ON HORSESHOE CRABS AT DELAWARE BAY.

Each year, a population of red knots completes one of the most epic migrations in the animal kingdom. Starting from Tierra del Fuego at the southern tip of South America, the red knots fly more than 9,000 miles to their breeding grounds in the Arctic Circle. For most red knots, the final staging area before the Arctic Circle is Delaware Bay, where their stopover coincides with another ecological marvel: the spawning of millions of horseshoe crabs that emerge from the water and lay clusters of approximately 4,000 eggs, with the potential for an individual to lay more than 100,000 eggs over the course of several nights.[2] For red knots that have already flown thousands of miles at enormous physiological expense, the eggs provide essential replenishment, enabling a doubling of body mass in fewer than 14 days, versus 21 to 28 days at comparable stopovers where they eat clams and mussels.[3] This unique resource fuels the duration of their journey and enhances breeding success in the Arctic.[4]

The abundance of red knots and horseshoe crabs at Delaware Bay as recently as the 1990s is almost unimaginable today. From 1981 to 2002, the peak red knot count in Delaware Bay usually exceeded 40,000 and twice surpassed 90,000.[5] One participant in an aerial survey of shorebirds during that period described "lines of deposited horseshoe crab eggs set like mineral veins in smooth white marble, virtually an unlimited food supply."[6] In a single day, his survey tallied 62,000 red knots and 318,000 total shorebirds on just the New Jersey side of Delaware Bay.[7]

In the 1990s, increasing and unregulated horseshoe crab harvest by the bait and biomedical industries crashed the population of horseshoe crabs.[8] Red knots, no longer able to rely on the irreplaceable horseshoe crab eggs, declined in tandem. ASMFC adopted a fishery management plan for horseshoe crabs in 1998 and instituted adaptive management in 2012. Since then, the female bait harvest has been prohibited. But the fate of horseshoe crabs remains highly uncertain, and red knots have continued to decline. Red knot peak counts that previously topped 90,000 have, for the past two years, languished below 13,000, including a record low of 6,800 in 2021. Twenty years have passed since the population topped a modest 33,000.[9] Instead of these peak

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[2] NOAA Fisheries. *Horseshoe Crabs: Managing a Resource for Birds, Bait, and Blood* (July 31, 2018), https://www.fisheries.noaa.gov/feature-story/horseshoe-crabs-managing-resource-birds-bait-and-blood.

[3] Lawrence Niles et al., *Effects of Horseshoe Crab Harvest in Delaware Bay on Red Knots: Are Harvest Restrictions Working?*, 59 BioScience 153, 154 (2009); New Jersey Department of Environmental Protection, *Wildlife Populations: Red Knot* 1-2 (2020), https://www.nj.gov/dep/dsr/trends/wildlife-redknot.pdf.

[4] Sjoerd Duijns et al., *Body Condition Explains Migratory Performance of a Long-Distance Migrant*, 284 Proceedings of the Royal Society of London B 20171374, at 4-6 (2017).

[5] FWS, *Rufa Red Knot Background Information and Threats Assessment* 100 tbl. 12 (2014) (excluding 1984-1985, when the survey was not conducted).

[6] Pete Dunne, *Tales of a Low-Rent Birder* 10 (1986).

[7] *Id.* at 13-14.

[8] FWS, *Rufa Red Knot Background Information and Threats Assessment* 232 ("Evidence that commercial harvests caused horseshoe crab population declines in recent decades comes primarily from a strong temporal correlation between harvest levels . . . and population levels.").

[9] *Id.* at 100 tbl. 12 (for years 1981-2014); ASMFC, *Revision to the Framework for Adaptive Management of Horseshoe Crab Harvest in the Delaware Bay Inclusive of Red Knot Conservation (Draft for Board Review)* 155 tbl.

counts, the revised ARM Framework uses modeled estimates of the total number of red knots passing through Delaware Bay. While these modeled estimates face criticism for overrepresenting red knots' use of Delaware Bay, they have fallen as well, from as high as 152,900 in 1989, to an average of 77,000 per year for 1998-2001, to numbers in the 40,000s over the past several years.[10]

In 2015, FWS formally listed the red knot as a threatened species under the Endangered Species Act.[11] At the time of the listing, FWS cited several studies indicating that red knot abundance had declined, "probably sharply," since the 1980s.[12] FWS found that "[r]educed food availability in Delaware Bay due to commercial harvest of the horseshoe crab . . . is considered a primary causal factor in red knot population declines in the 2000s."[13] Reduced food availability is a particular threat for the Southern wintering population of red knots, which is disproportionately reliant on the Delaware Bay staging area and which FWS views as "a bellwether for the subspecies as a whole."[14] According to FWS, "[R]educed food availability at just one key migration stopover area (Delaware Bay) is considered the driving factor behind the sharp decline in the Southern wintering population in the 2000s."[15]

As FWS has stated, "Studies have shown red knot survival rates are influenced by the condition (weight) of birds leaving the Delaware Bay staging area in spring."[16] Research has also shown that, while red knots arriving relatively late to Delaware Bay were able to compensate by gaining weight at a higher rate, that was not the case in years with low horseshoe crab egg availability.[17]

Until now, the well-established link between horseshoe crabs and red knots has been the cornerstone of ASMFC's management of the horseshoe crab fishery at Delaware Bay. Addendum VIII would subvert that regime. While the proposed model nominally bases harvest quotas on red knot and horseshoe crab abundance estimates, it assigns an extremely weak correlation between the abundance of the two species. It thereby concludes that red knots would be essentially unaffected by the resumption of the female horseshoe crab bait harvest.

As explained below, Addendum VIII's baseline assumption—that increasing the horseshoe crab harvest would only marginally impact red knots at Delaware Bay—is unsupported. It relies on evaluating a limited dataset that omits years when the ecosystem flourished. (For example, its dataset about horseshoe crab abundance is drawn entirely from the last 20 years, after the crash

12 (2021) ("ARM Report") (for years 2011-2020); Larry Niles, "2022 Delaware Bay Stopover Project Final Update-5 June 2, 2022," *A Rube with a View* (June 15, 2022), https://www.arubewithaview.com/2022/06/15/2022-delaware-bay-stopover-project-final-update-5-june-22022/ (for years 2021-2022).

[10] FWS, *Rufa Red Knot Background Information and Threats Assessment* 101 tbl. 13; ASMFC, *ARM Report* 155 tbl. 12.

[11] FWS, "Endangered and Threatened Wildlife and Plants; Final Threatened Status for the Rufa Red Knot," 79 Fed. Reg. 73,706 (Dec. 11, 2014). The listing became effective on January 12, 2015. *Id.* at 73,706.

[12] FWS, *Rufa Red Knot Background Information and Threats Assessment* 85. While FWS primarily analyzed red knot population trends within individual regions, it "note[d] a temporal correlation between declines at Tierra del Fuego and Delaware Bay." *Id.* at 84.

[13] 79 Fed. Reg. at 73,707.

[14] FWS, *Draft Recovery Plan for the Rufa Red Knot* 13 (May 2021).

[15] *Id.* at 14.

[16] *Id.* at 25; FWS, *Rufa Red Knot Background Information and Threats Assessment* 254.

[17] FWS, *Rufa Red Knot Background Information and Threats Assessment* 253.

of the horseshoe crab population and during a period when red knot abundance has been comparatively low.) And it suffers from modeling defects that, among other things, erroneously overstate the size and stability of the horseshoe crab population.

For these reasons and others detailed below, Addendum VIII is not a pathway for sustaining red knots, much less restoring a thriving ecosystem, nor does it honor the precautionary approach required when a threatened species is at stake. Instead, it risks a violation of ASMFC's legal obligations, including its obligation to avoid "take" of red knots under the ESA. The Board therefore should reject Addendum VIII and instead adopt adequate protections for horseshoe crabs and red knots at Delaware Bay.

II. NEW ANALYSIS REVEALS SIGNIFICANT TECHNICAL FLAWS THAT MAKE THE REVISED ARM FRAMEWORK UNSUITABLE FOR MANAGING THE HORSESHOE CRAB HARVEST.

As detailed in the following sections, the parties to this letter solicited independent expert reviews of the revised ARM Framework. These reviews reveal significant technical and methodological flaws that render the Framework unreliable for ASMFC management decisions.

For the first expert review, Dr. Kevin Shoemaker conducted an independent analysis of the horseshoe crab abundance and projection model that informs the revised ARM Framework. Dr. Shoemaker demonstrates that the Framework contains significant flaws that make it unsuitable for managing the horseshoe crab harvest. These flaws are especially alarming given the implications of the Framework for a threatened species such as the red knot. This section details many of Dr. Shoemaker's key findings, all of which are explained in more detail in the attached expert report.

At the outset, it is important to note that most of the components of the revised ARM Framework's model still have not been made available to the public. As a result, Dr. Shoemaker was unable to evaluate the components that link horseshoe crab abundance to red knot abundance or generate horseshoe crab harvest recommendations. Although Dr. Shoemaker was able to draw some conclusions about those aspects of the model, most of the analysis below necessarily focuses on the horseshoe crab model. As these comments proceed to discuss, the analysis that Dr. Shoemaker was able to conduct reveals severe issues concerning the reliability of the modeling. Nevertheless, Dr. Shoemaker's focus on the publicly available modeling information should not be interpreted to suggest that the unreleased components do not also contain significant flaws. To the contrary, given the flaws that are apparent in the information released to date, it is vital that *all* components of the model be subject to public evaluation before the Board takes any action to approve Addendum VIII.

A. The revised ARM Framework Is an Inappropriate Tool for Helping to Reverse the Decline and Promote the Recovery of Red Knots.

Considering that adaptive management is premised on the link between horseshoe crabs and red knots, the weakness of that link in the revised ARM Framework is breathtaking. By way of illustration:

- Dr. Shoemaker shows that, even if the horseshoe crab population in Delaware Bay completely collapsed to zero, the revised ARM Framework would predict that red knot abundance would remain stable or even increase over the next 50 years on average.[18]
    - Furthermore, "This simulation exercise makes it very clear that the REKN model used in the revised ARM would not be able to predict or explain the decline in the REKN population observed during the 1990s."[19] In other words, the model could not even have diagnosed the problem that it is supposed to solve.
- The data informing the revised ARM Framework actually show a negative correlation between female horseshoe crab abundance and red knot recruitment.[20] That is, according to the model, as female horseshoe crab abundance *increases*, red knot recruitment *decreases* on average.
- Due to the weak relationship between red knot and horseshoe crab abundance, it is not implausible that, with future updates to the revised ARM Framework, the relationship will disappear entirely or even become negative. Dr. Shoemaker observes that "[t]his outcome would pose an existential problem for the ARM framework . . . . There does not appear to be a contingency plan for this outcome."[21]
- Whatever weak signal the model has detected in historical data appears to be overwhelmed by random noise. As Dr. Shoemaker explains, it is highly likely that the model's "information about the HSC/REKN relationship would explain little if any of the variation in independent validation data."[22]

Due to the weak relationship between red knots and horseshoe crabs represented in the revised ARM Framework, it is unlikely that the model would outperform—much less significantly improve upon—a "null" model that entirely omits any effect of horseshoe crab abundance.[23] Yet it was impossible for Dr. Shoemaker to explore this key issue further because of the limitations on the materials made publicly available to date. Nevertheless, the concerns raised by the analysis that Dr. Shoemaker was able to perform are profound and call into question the revised ARM Framework's utility to guide any decision-making about the status or management of the affected species.

In sum, while the revised ARM Framework nominally recommends harvest quotas based on the relationship between horseshoe crabs and red knots, it effectively decouples the fates of the two species, unjustifiably transforming the methodology and philosophy that underlie the management of this fishery. This is an independently sufficient reason for the Board to reject Addendum VIII.

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[18] Kevin Shoemaker, *Review of 2021 ASMFC ARM Revision* 6-9 & fig. 1 (Sept. 2022) ("*Shoemaker Expert Report*").
[19] *Id.* at 8.
[20] *Id.* at 9 fig. 2.
[21] *Id.* at 10.
[22] *Id.* at 26.
[23] *Id.* at 25-26.

B. <u>The Horseshoe Crab Population Simulation Model Does Not Properly Account for Uncertainty, Resulting in Artificially Stable Abundance Projections.</u>

The revised ARM Framework profoundly underestimates uncertainty in the horseshoe crab recruitment rate, thereby calling into question its projections concerning the impact of harvest. As Dr. Shoemaker explains, the rate at which new recruits join the reproductive population "is the most consequential empirically fitted component of the HSC simulation model."[24] Other components of the model, such as natural and biomedical mortality, are fixed values, but the recruitment rate is calculated based on data.

Dr. Shoemaker shows[25] that the model errs by conflating two distinct types of uncertainty: (i) natural, year-over-year variation and (ii) the potential that the model incorporates incorrect parameters (most importantly, the mean horseshoe crab recruitment rate). The model treats both types of uncertainty as natural, year-over-year variation, with the consequence that the abundance estimates regress to a mean. In other words, the variations cancel each other out, making the projected population appear highly stable. But if evaluated properly, parameter uncertainty would likely compound over time, yielding a very different picture of the population. For example, if average recruitment is actually lower than the rate used in the model, that uncertainty would *not* cancel out over time. Instead, the horseshoe crab population could be headed for a one-way decline. Notably, the revised ARM Framework accounts for the two types of uncertainty separately in the *red knot* projection model, suggesting that the modelers recognized the importance of that approach, but nevertheless they did not implement it when projecting horseshoe crab abundance.

The consequences of this error are significant for estimates of the population's trajectory. Properly accounting for uncertainty, Dr. Shoemaker found that the horseshoe crab population faces a very real threat of declining well below levels acknowledged by the revised ARM Framework's projection model. Notably, he used the same estimates of uncertainty as the revised ARM Framework (as well as the same values for natural mortality, biomedical mortality, etc.). All that changed in his analysis was the method of evaluating uncertainty. Dr. Shoemaker's analysis[26] reveals that:

- Even under a scenario with *no* bait harvest, *no* biomedical mortality, and *no* discard mortality, the female horseshoe crab population has a 17.4% probability of declining below 4 million, and a 3.8% probability of declining below 3 million, over the next 50 years.
    - For comparison, 4 million is the lowest female abundance estimated for any year from 2003 to 2019 (the years upon which the model was based).
    - In contrast, by incorrectly accounting for uncertainty, the revised ARM Framework's model does not project female abundance values below 4 million within the 95% confidence interval under optimal harvest scenarios, *including* bait harvest, biomedical mortality, and discard mortality.[27]

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[24] *Id.* at 12.
[25] The information in this paragraph is drawn from *Shoemaker Expert Report* 12-18 & figs. 3-4.
[26] Except where noted, these findings are presented in greater detail at *Shoemaker Expert Report* 15, 18 fig. 4.
[27] ASMFC, *Supplemental ARM Report* 35 fig. 15.

- Under a scenario in which horseshoe crabs are harvested for bait under the maximum quotas of 500,000 males and 210,000 females but are still *not* subject to biomedical or discard mortality, the female population has a 33% probability of declining below 4 million, an 11% probability of declining below 3 million, and a 2% probability of declining below 2 million, over the next 50 years.

Dr. Shoemaker concludes that, "if sources of error in the recruitment process are properly accounted for, the outlook for the HSC population in Delaware Bay is uncertain even in the absence of any harvest pressures."[28] If the Board approves Addendum VIII, it would increase harvest pressure through a model that fails to properly account for the risk of a declining horseshoe crab population.

C. The Horseshoe Crab Projection Model's Recruitment Estimates Are Strongly Influenced by Nonsensical, Unverified Estimates from the Virginia Tech Gap Years.

The revised ARM Framework's conclusions are further undermined by its reliance on fantastical recruitment projections to fill in a key gap in actual population-monitoring data for horseshoe crabs. Of the three trawl surveys that inform the catch multiple survey analysis ("CMSA") component of the framework, only the Virginia Tech survey measures primiparous (i.e., newly mature) females to provide an empirically based estimate of recruitment. Thus, the CMSA does not incorporate any direct measurement of recruitment during the 2013-2016 period when the Virginia Tech survey was not conducted. Instead, it indirectly estimates annual recruitment rates, but two of these estimates are many times higher than any estimate from years with direct observations. Since the average recruitment rate in the population projection model treats all of the estimates as equally valid—whether or not they were based on empirical observations or hypothetical estimates—the model's estimated annual recruitment rate is heavily influenced by the nonsensical estimates from the Virginia Tech gap years.

To understand the impact of the nonsensical gap year estimates, first consider the years with empirically derived recruitment estimates. The average annual estimated recruitment for 2003-2012 was 1.2 million primiparous females. The average annual estimated recruitment for 2017-2019 was 1.9 million. Now consider the non-empirically derived gap year estimates. In 2013, the estimate was *9.6 million*—roughly eight times larger than the average over the previous ten years, and four times larger than the maximum annual estimate from that period.[29] In 2014, the estimate dropped to only two primiparous females across all of Delaware Bay, but the estimate is so uncertain that the upper limit of the confidence interval approaches infinity.[30] All told, the *average* estimate for the four Virginia Tech gap years was 4.2 million primiparous females, which is nearly *2 million* higher than the *maximum* ever estimated for any year with empirical observations.[31]

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[28] *Shoemaker Expert Report* 17.
[29] ASMFC, *Supplemental Report to the 2021 Revision to the Adaptive Resource Management Framework* 16 tbl. 3 (2022) ("*Supplemental ARM Report*").
[30] *Id.* at 25 fig. 5.
[31] *Id.* at 16 tbl. 3.

The nonsensical estimates from the Virginia Tech gap years compromise the horseshoe crab projection model because they significantly affect its recruitment estimate. As Dr. Shoemaker shows,[32] in the original ARM report, the ARM Subcommittee based the recruitment rate exclusively on data from 2013 to 2019, which relied overwhelmingly on estimates from the gap years and generated an annual recruitment estimate of 3.1 million primiparous females. Following criticism from the Peer Review Panel, the Subcommittee expanded the dataset to include 2003-2019, which reduced the recruitment estimate to 1.67 million. But if the nonsensical data from the gap years were excluded, this estimate would fall to 1.26 million. Dr. Shoemaker illustrates how the difference in these estimates has huge implications for the model's projection of future horseshoe crab abundance.

Dr. Shoemaker concludes that "the inflated estimates of recruitment during the VT gap years are likely to be an artifact of the CMSA model specification (and the lack of data on recruitment for those years) and are unlikely to be reflective of true HSC recruitment rates. . . . [A] conservative (precautionary) approach would be to exclude the VT gap years when computing recruitment for the HSC population simulations."[33] Doing so would yield a substantially lower recruitment estimate with a commensurately lower capacity to withstand a resumption of female harvest.

D. The Horseshoe Crab Population Model Has a Poor Correlation to Existing Data.

The CMSA's usefulness is cast further into doubt by its failure to correlate with any source of data about horseshoe crab abundance. As Dr. Shoemaker shows from an analysis of female horseshoe crab abundance estimates, the model does not correlate even with the data sources upon which it was based, much less any independent validation data.

For the years 2003-2019, the CMSA's correlation with the Delaware Adult Trawl Survey is extremely weak, and any correlation that exists is entirely attributable to the model's apparent ability to predict that horseshoe crab populations rose during 2013-2016, when the Virginia Tech survey was not conducted.[34] For the years before and after the Virginia Tech gap—that is, for the vast majority of years evaluated—the coefficient of determination (R^2) between the CMSA model and the Delaware Survey was *negative*, meaning that the model performed worse than a null model. The CMSA performs almost as poorly against data from the New Jersey Ocean Trawl Survey, with a weak positive correlation for the years prior to the Virginia Tech gap and a negative R^2 for the years after. The CMSA's worst performance comes when measured against the Virginia Tech survey, with a negative R^2 across the full time series for which data are available. To test the CMSA against independent validation data, Dr. Shoemaker compared it to the results of Delaware Bay spawning surveys and found no detectable relationship whatsoever between the results.

As this summary makes clear, the CMSA's modeled outcomes bear little relationship to actual data on the Delaware Bay horseshoe crab population. For this reason, Dr. Shoemaker recommends comparing the CMSA's horseshoe crab estimates to a null model that omits all information about horseshoe crab harvest from the model fitting process. Given its poor fit to

[32] The data discussed in this paragraph can be found at *Shoemaker Expert Report* 22-24 & fig. 7.
[33] *Id.* at 23.
[34] The findings in this paragraph are presented in greater detail at *Shoemaker Expert Report* 19-22 & figs. 5-6.

existing data, the CMSA's horseshoe crab projection model is "unlikely to outperform" even a relatively simple null model.[35] Dr. Shoemaker concludes, "If the HSC simulation model fails to outperform a model in which population dynamics are driven by noise instead of harvest, it should prompt managers to acknowledge that our current understanding of the effects of harvest on HSC populations remains insufficient for robust forecasting."[36] Absent a sound basis for robust forecasting, adoption of Addendum VIII and its attendant resumption of the female harvest cannot be justified.

III. THE REVISED ARM FRAMEWORK'S RISK-PRONE ASSUMPTIONS AND DECISIONS ARE INAPPROPRIATE, ESPECIALLY WHEN A THREATENED SPECIES IS AT STAKE.

In addition to its technical flaws, the revised ARM Framework incorporates risk-prone assumptions and decisions that further render it unsuitable as a management tool. It neglects important variables related to horseshoe crab demography and egg density that cast doubt upon the recovery of horseshoe crabs and their ability to provide adequate food resources for red knots. It draws conclusions from data collected when both red knots and horseshoe crabs were already depleted and therefore does not understand how the species would interact in a healthy ecosystem. It also reverses precautionary decisions made by stakeholders in the original ARM Framework—without soliciting renewed stakeholder input—in order to eliminate protections against the female horseshoe crab harvest and utilize previously-rejected surveys that inflate horseshoe crab abundance estimates.

The findings in this section draw heavily from an independent analysis of the revised ARM Framework and related materials conducted by Dr. Romuald Lipcius, as well as the analysis of Dr. Shoemaker. Both expert reports are attached.

A. <u>Demographic Trends Indicate that the Horseshoe Crab Population Is Not Recovering.</u>

Despite the Subcommittee's assertion that horseshoe crab abundance is increasing in Delaware Bay, Dr. Lipcius has identified troubling indicators that are inconsistent with a recovering population. The revised ARM Framework ignores these trends and treats abundance estimates as a comprehensive indication of population health. That would be a risk-prone approach even if the abundance estimates were fully reliable (which they are not).

As shown in Dr. Lipcius's report, the mean size (prosomal width) of female horseshoe crabs has recently declined. In the most recent three years of available data (2018-2020), adult female horseshoe crabs recorded the lowest mean sizes of any year since data collection began in 2002.[37] The same is true for newly mature females over the most recent two years of available data.[38]

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[35] *Id.* at 25.
[36] *Id.*
[37] Romuald Lipcius, *Expert Report* 6 (Sept. 2022) ("*Lipcius Expert Report*").
[38] *Id.*

Dr. Lipcius explains that, given constant recruitment, a prohibition on female harvest would typically lead to an increase in size due to reduced harvest pressure on older, larger females.[39] The declining size of female horseshoe crabs is inconsistent with the premise that the female segment of the population has recovered.[40] It is further evidence that the revised ARM Framework does not properly account for the population dynamics of horseshoe crabs.

A female harvest prohibition would also be expected to decrease the ratio of males to females in the population. But the data indicate that the male-to-female ratio increased between 1999 and 2019, suggesting *fewer* females for every male.[41] This is another warning sign that the population has not recovered, and the harvest of female horseshoe crabs should not resume.[42] Resuming such harvest would only further deplete a critical component of the population that has failed to show expected signs of recovery even under the female harvest prohibition.

Abundance data for immature and newly mature females raise additional concerns about the recovery of the female population. In 2019 and 2020, the Virginia Tech survey estimated the lowest abundance of newly mature female horseshoe crabs since data collection began in 2002, "indicating low influx of young mature females into the spawning stock."[43] Moreover, abundances of immature females and males for 2016-2020 were similar to those before 2013, when there was no female harvest prohibition in place. That is again contrary to expectations, since a prohibition on harvesting females should correlate to an increase in younger individuals.[44]

Dr. Lipcius explains that estimates of abundance can be less sensitive to serious problems in a population than variables including female size, female size structure, spawning stock biomass, and sex ratio. But the revised ARM Framework relies on abundance estimates to the exclusion of these other important variables. That is a risk-prone strategy and is not suitable for protecting horseshoe crabs or the threatened red knots.

B. The Revised ARM Framework Fails to Consider Horseshoe Crab Egg Density, the Most Direct Measure of Food Availability for Red Knots.

Another critical omission in the revised ARM Framework is its exclusion of data about the most direct measure of the adequacy of food resources for red knots: the availability of horseshoe crab eggs on the beach. As explained above, for red knots arriving at Delaware Bay after flying thousands of miles, horseshoe crab eggs provide energy-rich, easily digestible nutrition as the birds prepare to complete their journey northward and breed in the Arctic Circle. Red knots flying from South America shrink their digestive organs for the journey, and no other food source can replace easily digestible horseshoe crab eggs in enabling red knots to quickly rebuild their organs and muscles.[45] When conditions permit, a red knot at Delaware Bay can double its

[39] *Id.*
[40] *Id.*
[41] *Id.* at 10.
[42] *Id.*
[43] *Id.* at 6, 7 fig. 1.
[44] *Id.*
[45] Niles et al., *Effects of Horseshoe Crab Harvest* 154.

body mass in as little as 12 days by feasting on horseshoe crab eggs.[46] Research indicates that the red knots that have flown the farthest, from Tierra del Fuego, are particularly dependent on the density of horseshoe crab eggs (i.e., the number of eggs per square meter of beach).[47] Nevertheless, the revised ARM Framework has failed to consider actual data on egg density in the Delaware Bay region. Whatever concerns may have existed about such data at the time the original ARM Framework was developed, egg density should now be considered in light of new scholarship (discussed below) and the importance of horseshoe crab eggs for red knots. The revised ARM Framework's failure to do so represents another key flaw.

1. Egg density is the most direct measure of food availability for red knots.

Scientific studies link food availability at Delaware Bay to red knot survival and fecundity. Under favorable conditions including abundant horseshoe crab eggs, red knots at Delaware Bay roughly double their body mass from 90-120 grams to 180-220 grams before departing for the Arctic.[48] Individual red knots can gain up to 15 grams per day, "probably when horseshoe crab eggs are superabundantly available," allowing even late-arriving red knots to gain adequate mass in a brief period.[49] Researchers have observed that red knots experience "striking fitness consequences . . . correlated with the amount of nutrient stores accumulated in Delaware Bay."[50] Specifically, research has found a positive correlation between the mass of birds leaving Delaware Bay in the spring and the speed at which they complete their migration to the Arctic, reproductive success, and survival to the autumn.[51]

A superabundance of horseshoe crab eggs is required to meet the nutrition needs of red knots, other shorebirds, and the many other species that rely on this unique resource. Horseshoe crabs lay eggs too deep in the sand for red knots to access. But as more horseshoe crabs spawn on the beach, they disturb the sand, churning some of the eggs closer to the surface.[52] It is this churning, as well as wave action, that makes horseshoe crab eggs accessible to red knots.[53] The system depends on the successive spawning of large numbers of horseshoe crabs.[54]

2. Egg Density Has Declined Dramatically in Recent Decades, Correlating with the Decline in Red Knots.

Research strongly demonstrates that the abundance of horseshoe crab eggs near the beach surface (where the eggs are accessible to red knots) used to be at least ten times greater than the

[46] New Jersey Department of Environmental Protection, *Wildlife Populations: Red Knot* 1-2.
[47] FWS, *Species Status Assessment Report for the Rufa Red Knot* (Version 1.1) 9 (Sept. 2020) ("*Species Status Assessment Report*").
[48] Allan J. Baker et al., *Rapid Population Decline in Red Knots: Fitness Consequences of Decreased Refuelling Rates and Late Arrival in Delaware Bay*, 271 Proceedings of the Royal Society of London B 875, 876 (2004).
[49] *Id.* at 876.
[50] *Id.* at 881.
[51] Duijns et al., *Body Condition Explains Migratory Performance* 5-6.
[52] Niles et al., *Effects of Horseshoe Crab Harvest* 155.
[53] *Id.*
[54] *Id.*

abundance in recent years.[55] Measurements from 1985 to 1987 conservatively indicate that egg density averaged 156,000 eggs per square meter of beach. In recent years, egg density averaged only around 10,000 eggs per square meter of beach.[56]

This decline in egg density correlates with the dramatic decline of migratory shorebirds, especially red knots. The trends mirror each other over decades but also converge on smaller timescales. Among years when measurements were taken, the nadir for horseshoe crab egg density appears to have been the early 2000s, shortly after the unregulated overexploitation of horseshoe crabs in the 1990s.[57] This corresponds to a "changepoint" for red knots when the peak count dropped from more than 43,000 to fewer than 16,000.[58]

3. Horseshoe Crab Abundance Is Not an Adequate Proxy for Egg Availability.

Notwithstanding the research documenting a dramatic decline in the availability of horseshoe crab eggs, the revised ARM Framework posits that the abundance of female horseshoe crabs is increasing. That is a dubious claim, as explained in section III.A of these comments. But even assuming for the sake of argument that it were correct, it would not necessarily result in more eggs for horseshoe crabs. To the contrary, demographic trends suggest that the production of eggs per horseshoe crab is likely decreasing.

Dr. Lipcius describes how egg production is directly proportional to the weight of horseshoe crabs, such that heavier crabs produce more eggs.[59] Data from the Virginia Tech Horseshoe Crab Trawl Survey indicate that the average prosomal width of female horseshoe crabs has fallen considerably, with an especially marked drop in the largest crabs over the past few years (2018-2020). Weight is an exponential function of prosomal width, meaning that even a modest decline in crab width could signify a very significant decline in weight and therefore in egg production. The trend toward smaller female horseshoe crabs may partially explain the low egg density numbers in recent years. Dr. Lipcius concludes that "total reproductive (egg) output has likely not improved, which hampers recovery of the HSC and RK populations."[60]

4. The ARM Report Presents No Compelling Reason to Ignore Egg Density.

There is no defensible rationale for completely excluding from the revised ARM Framework any direct measure of the most direct indicator of the adequacy of the red knot food supply: egg density. None of the ARM Subcommittee's reasons for excluding data about food availability withstands scrutiny.

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[55] Joseph A.M. Smith et al., *Horseshoe Crab Egg Availability for Shorebirds in the Delaware Bay: Dramatic Reduction After Unregulated Horseshoe Crab Harvest and Limited Recovery After 20 Years of Management*, Aquatic Conservation: Marine and Freshwater Ecosystems (2022) (in press) ("*Horseshoe Crab Egg Availability*").
[56] *Id.*
[57] *Id.*
[58] *Id.*
[59] The information in this paragraph is drawn from *Lipcius Expert Report* 7-10 & figs. 2-6.
[60] *Id.* at 10.

First, the Subcommittee asserted that the protocol for measuring egg density over the years was too variable to provide reliable comparisons.[61] Even if that was previously a legitimate concern, scientists have now demonstrated a long-term reduction in the surface availability of horseshoe crab eggs based on multiple studies using similar methods and sampling from comparable or even identical locations.[62] More fundamentally, in the context of a threatened species, major warning signs should not be disregarded on the basis of uncertainty in the data, especially when the data that exist point strongly in the same troubling direction. As Dr. Lipcius explains, "Lack of use of HSC egg density data, as a proxy for RK food availability, amounts to a failure to incorporate all available scientific information into the analysis to guide management decisions in a risk-averse manner."[63]

The Subcommittee next asserted that habitat loss had not been "adequately rule[d] out" as the cause of declining egg density. This argument is equally misplaced. Recent research demonstrates that egg density has declined even where habitat continues to be suitable, such as where sand depth exceeds 40 centimeters.[64] Moreover, habitat loss does not provide a basis for disregarding the availability of horseshoe crab eggs for red knots. As Dr. Lipcius explains, while the Board does not have control over all sources of stress on horseshoe crabs, the existence of multiple stressors demands a *more* risk-averse approach with respect to factors such as harvest quotas that are fully within the Board's control.[65]

In addition, the Subcommittee denied the ability to link horseshoe crab egg abundance with red knot nutrition or survival.[66] However, as shown above, there is a strong correlation between declining egg density and declining red knot abundance.

Regardless of the Subcommittee's concerns that egg density data are not sufficiently conclusive, or that habitat loss is a contributing factor, multiple studies over several decades uniformly point in the same direction: egg density has declined to an alarming degree, as have the red knots that consume the eggs. At a minimum, the Commission must recognize that plentiful eggs are a necessary and critical element of red knot recovery and solicit formal stakeholder input on incorporating that principle into harvest decisions in light of recent research.

C. <u>The Revised ARM Framework Finds a Weak Relationship Largely Because It Relies on Data from Years When Both Red Knots and Horseshoe Crabs Were Already Depleted.</u>

In contrast to all of the scientific information discussed above demonstrating a critical connection between horseshoe crabs and red knots, the revised ARM Framework finds a weak link between these species partly because it is based entirely on data from after the ecosystem

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[61] ARM Subcommittee, *Majority Response to Niles and Justification for Why Opinion Not Adopted* (in *ASMFC, ARM Report*) 105-06.
[62] Smith et al., *Horseshoe Crab Egg Availability*.
[63] *Lipcius Expert Report* 12.
[64] Smith et al., *Horseshoe Crab Egg Availability*.
[65] *Lipcius Expert Report* 13.
[66] ARM Subcommittee, *Majority Response to Niles* 104.

crashed in the late 1990s.[67] The most the model can do is interpret the interaction between two perilously depleted species, without any concept of how a healthy ecosystem would function. In defiance of historical and scientific evidence, the revised ARM Framework seems to assume that a supposedly minimal correlation between horseshoe crabs and red knots when both species are degraded is indicative of how the ecosystem would operate when both species are plentiful. Rather than viewing its finding of a weak link appropriately as a symptom of an ailing ecosystem, the revised ARM Framework leverages it to justify greater exploitation.

As one example of why recent data may not represent the historic relationship between the two species, consider the population of red knots migrating from southern South America. These birds travel the farthest to reach Delaware Bay and need to rebuild their digestive organs upon arrival, making them particularly dependent upon easily digestible horseshoe crab eggs.[68] Even more than other red knots, this Southern wintering population has suffered "sharp and well-documented declines" in recent decades due to reduced food availability at Delaware Bay.[69] As a result, the relatively small number of red knots that pass through Delaware Bay may be increasingly skewed toward birds that winter farther north, with fewer of the birds that most heavily depend upon horseshoe crab eggs. The revised ARM Framework would interpret these conditions to mean that red knot abundance is less affected by horseshoe crab abundance and that greater exploitation is acceptable. It would thus ignore the impact of egg scarcity on the most vulnerable population of red knots.

While the revised ARM Framework may necessarily be limited by the years from which data are available, it should not draw overbroad conclusions from a constrained dataset. As Dr. Shoemaker explains, these constraints give the model a "limited scope of historical variation . . . . Using these models to forecast system dynamics under conditions outside the range of values used to fit the model (e.g., lower HSC abundances, higher REKN abundances) therefore requires extrapolation, which can be highly uncertain (and often inaccurate)."[70] Based on Dr. Shoemaker's expert judgment, "[I]t does not seem prudent to implement management 'experiments' that could potentially imperil a threatened or endangered species (TES), even under the rubric of adaptive management."[71]

D. <u>The Revised ARM Framework Would Arbitrarily and Unjustifiably Remove Abundance Thresholds Below Which the Harvest of Female Horseshoe Crabs Is Prohibited.</u>

The revised ARM Framework would arbitrarily lift the protective abundance thresholds intended to preserve the availability of food for red knots. Specifically, under the existing Framework, the female harvest quota is zero until the estimated abundance of female horseshoe crabs exceeds 11.2 million or the estimated abundance of red knots exceeds 81,900 in Delaware Bay.[72] These

[67] *E.g.*, *ARM Report* 156 tbl. 13 (illustrating that the catch multiple survey analysis for horseshoe crabs uses data starting from 2003). Compounding the chronological limitations on the data informing the model, the revised ARM Framework also imposes geographic constraints by including only data from Delaware Bay.
[68] FWS, *Species Status Assessment Report* 9.
[69] *Id.* at 28; FWS, *Draft Recovery Plan for the Rufa Red Knot* 14.
[70] *Shoemaker Expert Report* 11.
[71] *Id.*
[72] ASMFC, *ARM Report* 21.

thresholds reflect stakeholders' desire to take a precautionary approach to managing the delicate relationship between horseshoe crabs and red knots. Because neither species has reached its threshold since the original ARM Framework was implemented, the model has never recommended a female harvest. Under the revised ARM Framework, the model could (and likely would) recommend a significant female harvest even when neither red knot nor female horseshoe crab abundance has exceeded its protective threshold. Indeed, the Subcommittee's calculations show that the model would have recommended a female harvest of approximately 150,000 for 2017-2019, years when the original ARM Framework recommended a female harvest of zero.[73]

1. ASMFC Has Provided No Defensible Rationale for Removing the Protective Thresholds.

Removal of the protective thresholds received significant criticism in the minority opinions submitted by ARM Subcommittee members.[74] In rejecting these critiques, the Subcommittee relied on two primary arguments, neither of which is defensible.

First, the Subcommittee stated, "The presence of these threshold constraints in the utility function was criticized during this revision for not being consistent with adaptive management and optimization procedures and therefore they were removed from the utility functions."[75] But the Subcommittee's argument assumes that stakeholder values have no role in adaptive management, and that adaptive management is inconsistent with any constraint that arises from something other than an optimization model. This view squarely defies the adaptive management process as described in Addendum VII, which highly values stakeholder input, as explained in section IV.B of these comments. Moreover, the Subcommittee's view is internally inconsistent, as the revised ARM Framework appropriately maintains precautionary limits on the maximum harvest of male and female horseshoe crabs,[76] which represents a constraint on the model in deference to precautionary values. Thus, the revised ARM Framework is arbitrarily selective about its willingness to consider precautionary constraints.

Second, the Subcommittee described the thresholds as a "knife-edge utility function[]" and stated that, once the thresholds were exceeded, the existing ARM Framework would immediately recommend the maximum harvest package, with its female quota of 210,000.[77] According to the Subcommittee's calculations, the model is unlikely to ever select the interim harvest package, with a female quota of 140,000.[78]

The Subcommittee's argument misses the mark. The immediate issue is whether female harvest is allowed *below* the thresholds. The Subcommittee may have concerns about what

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[73] ASMFC, *Supplemental ARM Report* 21 tbl. 11.
[74] *E.g.*, Wendy Walsh, *Walsh Minority Opinion* (in ASMFC, *ARM Report*) 113-14.
[75] ARM Subcommittee, *Majority Response to Niles* 107.
[76] ASMFC, *ARM Report* 81 ("[O]ne feature from the packages used in the original ARM version was retained: the maximum harvest for females was set to 210,000 and for males 500,000."). The Subcommittee pointed to these limits as an example of maintaining an "earlier decision[] made by stakeholders." ARM Subcommittee, *Majority Response to Walsh and Justification for Why Opinion Not Adopted* (in ASMFC, *ARM Report*) 125.
[77] ARM Subcommittee, *Majority Response to Walsh* 124.
[78] *Id.*

recommendations the current model would make in the unprecedented event that the thresholds were exceeded, but that is a separate question. In addition, if the current model would catapult over the interim harvest package and immediately recommend the maximum harvest package in the event that red knots or female horseshoe crabs met their abundance threshold, that would seem to indicate a defect in the existing model. A more reasonable correction would be to adjust the existing model to facilitate a gradual increase in female harvest recommendations once an abundance threshold is met. It is not at all clear why removing the thresholds altogether is a necessary or logical solution. Regardless, a potential defect in the current model's response to the achievement of protective thresholds for horseshoe crabs or red knots cannot offer any justification for eliminating the thresholds well before they are met. At the very least, the Subcommittee should have made its decision in consultation with stakeholders, not unilaterally.

2. The Elimination of the Protective Thresholds Illustrates the Improper Exclusion of Stakeholder Input.

In section IV.B, these comments detail why the exclusion of formal stakeholder input from the development of the revised ARM Framework was inappropriate and violated the requirements for adaptive management. This section explains why excluding stakeholders from decisions about the protective thresholds was particularly improper and contravened the views of the Commission's own experts and peer review panel.

During the Board's early consideration of developing Addendum VIII, the ARM Subcommittee Chair explained what process would be required to change (much less eliminate) the protective thresholds:

> [M]oving forward with this new Population Dynamics Model, where that threshold is at 11.2 million, you know that could change. It is a possibility to have a different utility function. *That is something that would have to be discussed amongst stakeholders* and among the ARM Workgroup members.[79]

Despite the Chair's acknowledgement that changing the female horseshoe crab threshold would require stakeholder input, the revised ARM Framework would eliminate the threshold even in the absence of stakeholder input.

The exclusion of stakeholders and elimination of the thresholds was criticized in the minority opinion of Subcommittee member (and Chair of the Delaware Bay Ecosystem Technical Committee) Dr. Wendy Walsh, the national lead for red knot recovery at FWS. Dr. Walsh meticulously detailed the role of stakeholder input in adaptive resource management and observed that the ARM Subcommittee had "failed to consult a broad array of stakeholders in the reinterpretation of previously agreed-upon objectives."[80] With respect to the abundance thresholds, Dr. Walsh explained:

[79] Comments of John Sweka, ARM Subcommittee Chair, *Proceedings of the Atlantic States Marine Fisheries Commission Horseshoe Crab Management Board* 5 (Oct. 29, 2019) (emphasis added), https://www.asmfc.org/uploads/file/5fb2ea02HorseshoeCrabBoardProceedingsOct2019.pdf.
[80] *Walsh Minority Opinion* 113.

> These threshold values act as a constraint on female harvest, which was the express intent of the stakeholders. . . . [T]he formulation of these values as a constraint was an explicit and clear choice in the development of the existing framework. . . . [T]he high risk-aversion to female crab harvest by the stakeholders is clear, and thus it can be presumed that the new utility function . . . would be of considerable concern to those same stakeholders.[81]

The ASMFC-convened Peer Review Panel echoed these concerns. Recognizing that the Subcommittee had not convened stakeholders for this proceeding, the Panel tentatively stated that it "does not disagree" with the revised modeling functions, "as long as they truly reflect the objectives related to HSC harvest and REKN recovery and the risk associated with the HSC harvest."[82] The Panel reiterated its concern in its list of recommendations:

> The new utility and harvest functions are a representation of values, and the Panel understands that convening a group of stakeholders for this revision was not possible. Therefore, the Panel recommends the WG fully consider whether the new utility and harvest functions represent stakeholder values as articulated in 2009.[83]

The rejection of Dr. Walsh's minority opinion indicated a troubling misunderstanding of the Subcommittee's assignment. The Subcommittee wrote that retaining the threshold values "is more consistent with a simple harvest control rule" and "would not be adaptive management and would not require the Framework developed in this assessment."[84] By this statement, the Subcommittee revealed that it viewed stakeholder input as an impediment to adaptive management—an obstacle to the Framework the Subcommittee had already devised. But as explained in more detail below in section IV.B, stakeholder input has consistently been recognized as the foundational step of adaptive management. There is no adaptive management without stakeholder input, and the revised ARM Framework is therefore not an exercise in adaptive management.

E. <u>The Horseshoe Crab Population Estimates Are Improperly Based, in Large Part, on Two Surveys that Stakeholders Have Rejected.</u>

The omission of stakeholder input was particularly harmful because it obscured stakeholder objections to new survey data upon which the revised ARM Framework extensively relies. Since its inception, the ARM Framework has based horseshoe crab abundance estimates entirely on data from the Virginia Tech Horseshoe Crab Trawl Survey, which reflected the original stakeholders' greater confidence in that survey compared to other surveys of horseshoe crabs in Delaware Bay. The Virginia Tech survey is purpose-designed to count horseshoe crabs, as opposed to general surveys that count horseshoe crabs just incidentally, and FWS has called it

[81] *Id.* at 113-14.
[82] ASMFC, *Horseshoe Crab Adaptive Resource Management Revision Peer Review Report* (in ASMFC, *ARM* Report) 10 (277 of PDF) ("*Peer Review Report*"). Significantly, the Peer Review Panel's tentative approval of the revised ARM Framework was uninformed by independent expert reviews such as those offered by Drs. Shoemaker and Lipcius in this comment process.
[83] *Id.* at 12.
[84] ARM Subcommittee, *Majority Response to Walsh* 122.

"the best benthic trawl survey to support the ARM."[85] Yet the revised ARM Framework would drastically downgrade the model's reliance on the Virginia Tech survey, rendering it one of three equally weighted surveys.[86] The two additional surveys that would comprise the abundance estimates—the New Jersey Ocean Trawl Survey and the Delaware Adult Trawl Survey—are general trawl surveys and not purpose-designed to count horseshoe crabs.

In her minority opinion, Dr. Walsh explained (as the Subcommittee acknowledged) that the revised approach would generate significantly higher abundance estimates,[87] which will lead to higher harvest recommendations for female horseshoe crabs. Dr. Walsh urged that, if the Subcommittee determined to rely upon all three surveys, it should at least accord greater weight to the Virginia Tech survey based on its "technical rigor and deliberate design" and "the high level of confidence that stakeholders have expressed in" it, among other reasons.[88] As Dr. Walsh noted, using all three surveys generates such high estimates that it would sometimes have resulted in female harvest recommendations even under the existing ARM Framework.[89]

The original decision to rely exclusively on the Virginia Tech survey reflected explicit stakeholder input. By introducing two additional surveys that stakeholders previously disfavored, and weighting all three surveys equally, the revised ARM Framework alters yet another stakeholder-driven component of the model without soliciting formal stakeholder input.

IV. ASMFC HAS REPEATEDLY EXCLUDED INPUT FROM STAKEHOLDERS AND THE BROADER PUBLIC.

The development of Draft Addendum VIII omitted input from stakeholders and the public throughout the process. The Atlantic Coastal Fisheries Cooperative Management Act of 1993 requires the Commission to "provide[] adequate opportunity for public participation in the [fishery management] plan preparation process."[90] ASMFC has violated legal requirements and its own guidelines by severely limiting public participation in this proceeding. Specifically, the Commission held a public comment period before essential information was publicly available, failed to solicit formal stakeholder input, and decided to artificially limit its range of options to adopting Addendum VIII or reverting to Addendum VI—both of which would lead to resuming the female horseshoe crab harvest—without any public input whatsoever.

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[85] FWS, *Rufa Red Knot Background Information and Threats Assessment* 247.
[86] ASMFC, *ARM Report* 55.
[87] Walsh Minority Opinion 111; ARM Subcommittee, *Majority Response to Walsh* 123 ("[I]t was noted in the 2019 assessment that equally weighting the surveys resulted in higher population estimates and that characterization by Walsh is accurate."); ASMFC, *Supplemental ARM Report* 21 tbl. 11 (for a comparison of abundance estimates under the current and proposed methodologies).
[88] *Walsh Minority Opinion* 111.
[89] *Id.* at 111-12.
[90] 16 U.S.C. § 5104(a)(2)(B).

A. <u>ASMFC Held the Public Comment Period Before the Revised ARM Framework's Core Model Was Publicly Available.</u>

The public comment period for Addendum VIII occurred while crucial, material information was being withheld from the public. Specifically, the public still has not been allowed to see the model that generates bait harvest recommendations for horseshoe crabs in Delaware Bay.

New Jersey Audubon and Defenders of Wildlife requested the model on February 23, 2022, in FOIA requests submitted to the U.S. Geological Survey ("USGS") and FWS, as well as a record request submitted to ASMFC. While ASMFC provided certain components related to the horseshoe crab estimates, USGS controls the core component that links horseshoe crabs and red knots to generate harvest recommendations. In a letter prior to the Board's August 2022 meeting, New Jersey Audubon and Defenders of Wildlife explained that USGS had not yet released the model and urged the Board not to initiate the public comment period on Draft Addendum VIII until the public could access the model that underlies the revised ARM Framework.[91] At the Board meeting, several members expressed concern about the unavailability of the model, noted USGS's stated intent to release the model following internal review,[92] and asked to be kept apprised of developments in the public's access to the model.

As of September 30, 2022—the close of the public comment period on Draft Addendum VIII—USGS has still not released the model. As a result, the public's ability to submit substantive technical comments has been severely constrained. As this comment letter demonstrates, public evaluation is essential for identifying significant issues for the Board's consideration. Indeed, many of Dr. Shoemaker's critiques were enabled by the limited model components released by ASMFC. But the preponderance of the model underlying the revised ARM Framework still has not been subject to public evaluation. Dr. Shoemaker listed several questions that he could have investigated more thoroughly if that model were available,[93] including:

- Does the red knot projection model outperform a null model that excludes any effect of horseshoe crab abundance?
- How much variation in apparent survival in the red knot IPM model is explained by the horseshoe crab effect compared to random among-year variation?
- Would an index of horseshoe crab egg density explain more variation in red knot survival and fecundity than the CMSA-derived estimate of horseshoe crab abundance?

While the Board should resolve the issues that have already been raised before further considering Addendum VIII, it is impossible to anticipate all of the additional questions that will

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[91] Letter from Benjamin Levitan, Earthjustice, to ASMFC Commissioners re *Consideration of Draft Addendum VIII on the Implementation of Recommended Changes from 2021 Adaptive Resource Management Revision and Peer Review Report for Public Comment* (July 26, 2022).

[92] In an email accompanying its denial of a Freedom of Information Act Request for the model, a U.S. Geological Survey representative wrote, "We have withheld the two USGS models, but they and their associated use publications will be published following the required USGS Fundamental Science Practices reviews." Email from Janis Wilson, USGS, to Benjamin Levitan, Earthjustice, re: *FOIA: DOI-USGS-2022-002312 – Response* (July 28, 2022). On August 15, 2022, New Jersey Audubon and Defenders of Wildlife administratively appealed the denial of access to the model, but USGS has not yet responded.

[93] *Shoemaker Expert Report* 26-27.

be identified once the model is released. New issues will inevitably arise. The proper time to address those questions is before the Board approves Addendum VIII. Enabling the public to identify additional questions only after the revised ARM Framework has been approved would subject red knots and horseshoe crabs to unacceptable risk and raise difficult administrative questions about how to limit the harm even as the Framework is in place.

B. The Subcommittee Violated ASMFC's Procedures by Failing to Solicit Formal Stakeholder Input.

The ARM Subcommittee's failure to solicit formal stakeholder input in this proceeding violated the principles and process of adaptive management. When the Board first approved the ARM Framework in Addendum VII more than a decade ago, stakeholder input was integral to the process. The *first sentence* of the "ARM Framework" section of Addendum VII was, "A goal of the ARM Framework is to transparently incorporate the views of stakeholders along with predictive modeling to assess the potential consequences of multiple, alternative management actions in the Delaware Bay Region."[94] The ARM Subcommittee expressed the same sentiment about the "ARM approach" in the current proceeding: "First, there is a great emphasis on complete elicitation of objectives and management actions from a full range of stakeholders."[95] The Subcommittee took that sentence verbatim from the Commission's Framework for Adaptive Management from 2009,[96] demonstrating how consistently stakeholder input has been acknowledged as the cornerstone of adaptive management.

The Board formalized the role of stakeholder input when it approved Addendum VII, which implemented an adaptive management framework for the Delaware Bay horseshoe crab fishery. Addendum VII required that the ARM Framework's "[i]mplementation *shall* be comprised of two cycles."[97] The *first step* of the "Longer Term Cycle," which was to occur "every 3 or 4 years," was to "[s]olicit formal stakeholder input on ARM Framework to be provided to the relevant technical committees."[98]

The ARM Subcommittee's failure to convene stakeholders in preparing Addendum VIII violated the Board's express requirements, as well as the principles underlying the adoption of adaptive management. And if the Board approves Addendum VIII, the exclusion of stakeholders is unlikely to be rectified anytime soon. Addendum VIII sets forth a default period of "every 9 or 10 years" for revising the ARM Framework, which "should incorporate" soliciting "formal stakeholder input."[99] Pursuant to that schedule, if the Board approves Addendum VIII in 2022—which it should not do—the ARM Framework will be due for a revision in the early 2030s. Assuming that stakeholders are formally consulted at that time (unlike this time), roughly *20*

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[94] ASMFC, *Addendum VII to the Interstate Fishery Management Plan for Horseshoe Crabs for Public Comment: Adaptive Resource Management Framework* 2 (2012), https://www.asmfc.org/uploads/file/hscAddendumVII_Feb2012.pdf ("*Addendum VIII*").
[95] ASMFC, *ARM Report* 21.
[96] ASMFC, *Stock Assessment Report No. 09-02 (Supplement B): A Framework for Adaptive Management of Horseshoe Crab Harvest in the Delaware Bay Constrained by Red Knot Conservation* 1 (2009), https://www.asmfc.org/uploads/file/2009DelawareBayARMReport.pdf.
[97] ASMFC, *Addendum VII* at 4 (emphasis added).
[98] *Id.*
[99] ASMFC, *Horseshoe Crab Draft Addendum VIII for Public Comment* 8 (Aug. 2022).

years will have elapsed between such consultations, a striking contrast to the "3 or 4 year[]" interval required by Addendum VII. That would also mean that stakeholders would not be formally consulted for roughly *17 years* after FWS's 2015 determination to list red knots under the Endangered Species Act. While it is impossible to know all the ways that soliciting stakeholder input would have affected the current proceeding, the revised ARM Framework's elimination of the protective abundance thresholds (described above in section III.D.2) demonstrates that this concern is not merely theoretical.

It bears repeating how significantly the revised ARM Framework departs from the paradigm that the stakeholders accepted in preparation for Addendum VII, which instituted harvest recommendations based on the relationship between horseshoe crabs and red knots. The revised Framework would weaken that relationship almost to the point of nonexistence and recommend quotas accordingly. While presented as a technical update, the revised ARM Framework cannot plausibly be considered a reflection of the stakeholders' articulated values. At the very least, stakeholders should have been involved in designing a revised approach. Failure to involve them represents another reason for rejecting the current proposal.

C. Even Before the Public Comment Period, ASMFC Purported to Limit Its Options to Those that Would Reinitiate the Female Horseshoe Crab Harvest.

In addition to the inaccessibility of crucial information and the exclusion of stakeholder input, there was no public notice or comment for arguably the most critical decision presented by Draft Addendum VIII, which ASMFC now presents as a foregone conclusion: designating a reversion to Addendum VI as the "No Action" alternative if the Board does not approve Addendum VIII.[100] Addendum VI would increase the Bay-wide horseshoe crab harvest quota and *allow for the resumption of the female harvest* in Maryland and Virginia. Thus, the Board has effectively foreclosed public comment on the pressing question of *whether* to resume female harvest for this fishery. Under the terms of draft Addendum VIII, whichever option the Board selects—and regardless of any information that might surface during the public comment period—that decision is preordained.

On the merits, selecting Addendum VI as the "No Action" alternative was arbitrary, unnecessary, and misleading. Addendum VI would completely transform the management framework. The transition from Addendum VI to Addendum VII was arguably the most significant event in ASMFC's management of the horseshoe crab fishery, and reverting to Addendum VI would be equally significant.

To justify the selection of Addendum VI, Draft Addendum VIII indicates that Addendum VII is unavailable as the "No Action" alternative because the model underlying it was built on obsolete software and can no longer be utilized.[101] Even if the software is obsolete, that does not back the Board into a corner with no option but to adopt an addendum with a female harvest. The current ARM Framework has generated the same harvest quota for ten consecutive years, and the legitimate "No Action" alternative would be to apply the same quota to the 2023 fishing season. In fact, Addendum VII contains two "fallback option[s]" for when the data required to run the

[100] *Id.* at 5.
[101] *Id.*

ARM model are not available: use the quotas from Addendum VI *or* use the same quotas as the previous year.[102] It is unclear why the Board would have fewer options when the Addendum VII model cannot be run. The natural understanding of "No Action" would be to maintain the current status quo—i.e., the current addendum and current quotas—not to revert to an addendum and quotas that mark a major departure from the status quo.

At the August 2022 Board meeting, ASMFC staff explained that simply reusing last year's quotas is not appropriate because that would not qualify as "adaptive resource management."[103] Even if that were so, the solution should not be to reinstate the 12-year-old static quotas from Addendum VI. If the Board has authority to impose such a drastic change, then surely it has authority to continue relying on the most recent outputs of the current ARM Framework. It may be that neither option offers a satisfactory long-term solution, but the question now is what to do while questions about the revised ARM Framework are being addressed. The Board is not required to rush through a new (or old) addendum. It can temporarily maintain the current Framework to allow for thorough consideration of the appropriate next step, which clearly does not include accepting Addendum VIII as currently proposed.

V. THE FLAWS IN THE REVISED ARM FRAMEWORK MUST BE ADDRESSED NOW.

The Board's decision on Addendum VIII is highly consequential and could determine the course of the horseshoe crab fishery for many years to come. It is vital that the revised ARM Framework be subject to full vetting, and that foreseeable flaws be identified, prior to implementation by the Board. There will not be realistic opportunities to remedy defects in the revised ARM Framework in the future—at least not without imposing large burdens on both the Board and the public.

A. Flaws in the Revised ARM Framework Cannot Realistically Be Remedied at the Quota-Setting Stage.

At the Board's meeting in August 2022, some speakers observed that Addendum VIII will not, in itself, set binding quotas because the Board will retain discretion to deviate from the ARM Framework's harvest recommendations, and states will retain discretion to set quotas below those set by the Board.[104] But that is not a valid rationale for approving an addendum that has not been fully vetted and has been demonstrated to be flawed based on even the limited amount of information that has been made publicly available.

The purpose of the ARM process is to generate harvest recommendations based on rigorous science and sound policy.[105] As these comments detail, the revised ARM Framework incorporates many substantive and procedural flaws, and additional flaws are likely to emerge

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[102] ASMFC, *Addendum VII* at 6.
[103] ASMFC, *Horseshoe Crab Management Board Proceedings Aug2022*, at 5:11, https://www.youtube.com/watch?v=OZvpdTTPj8c.
[104] *E.g.*, *id.* at 28:00, 1:12:57.
[105] 16 U.S.C. § 5104(a)(2)(B) (requirement in the Atlantic Coastal Fisheries Cooperative Management Act of 1993 for ASMFC to follow "standards and procedures to ensure that . . . [fishery management] plans promote the conservation of fish stocks throughout their ranges and are based on the best scientific information available.").

when the underlying model is released to, and evaluated by, the public. Regardless of the Board's or states' ability to deviate from those recommendations, the Board must ensure that the Framework represents the best available—and properly vetted—science and policy. To do otherwise would call into question the purpose of the ARM process and the harvest recommendations.

It would also not be practical for the Board or states to resolve the flaws in the revised ARM Framework at the quota-setting stage. If Addendum VIII were approved and the Board were unable to rely upon the Framework's flawed harvest recommendations, there would be no clear criteria or guidelines for establishing quotas, leading to a confusing, burdensome, and arbitrary quota-setting process. Similarly, if the Board approved Addendum VIII and adopted the revised ARM Framework's flawed harvest recommendations, states would need to determine the proper course in the absence of reliable information or direction from ASMFC. That would undermine the Horseshoe Crab Fishery Management Plan's purpose of creating "[a] coordinated and consistent management strategy."[106]

B. Flaws in the Revised ARM Framework Cannot Be Addressed Through Updates to the Model.

While the revised ARM Framework can be "updated based on the annual routine data collected in the region,"[107] updates will not remedy its flaws. Many of the defects identified in these comments cannot be addressed by new data but rather demand a deeper restructuring of the model. For example, the model's miscalculation of the uncertainty in horseshoe crab abundance projections will persist despite new data. The same is true for all of the variables that are omitted from the model but indicate an unstable horseshoe crab population: egg density, prosomal width, sex ratio, etc.

Other defects would theoretically be alleviated by new data, but not on any relevant timescale. For example, the effect of the nonsensical horseshoe crab recruitment rates from the Virginia Tech gap years will gradually be diluted as new data are added, but they will continue to have perilously high influence for many years—realistically, for as long as Addendum VIII will be in effect. And even if, for the sake of argument, the estimated recruitment rate will slowly become more accurate over the years, that does not justify neglecting to fix a clear defect before implementing the revised ARM Framework.

Finally, some defects may be compounded by the addition of more data. As explained above in section III.C, the model is based entirely on data from when both horseshoe crabs and red knots had already crashed. It does not reflect the dynamics of a properly functioning ecosystem. As more data from the post-crash years are added, the model may only grow more confident that the current state of the ecosystem represents the norm. As Dr. Shoemaker observes, additional data may even yield a negative relationship between the abundance of horseshoe crabs and red knots, which would pose an existential problem for the Framework.[108]

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[106] ASMFC, *Fishery Management Report No. 32 of the Atlantic States Marine Fisheries Commission: Interstate Fishery Management Plan for Horseshoe Crab* 1 (1998).
[107] ASMFC, *Draft Addendum VIII* at 8.
[108] *Shoemaker Expert Report* 10.

VI. APPROVING ADDENDUM VIII WOULD LIKELY LEAD TO A VIOLATION OF THE ENDANGERED SPECIES ACT BY ASMFC.

In addition to the other bases for rejecting Addendum VIII discussed above, the Endangered Species Act provides a powerful further reason: adopting Addendum VIII would threaten to violate the federal prohibition against "taking" a threatened species. The ESA prohibits any person from "tak[ing] any [endangered] species within the United States or the territorial sea of the United States."[109] Such prohibited "taking" includes actions that "harm" listed species, including "significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering."[110] The ESA's "taking" prohibition extends to governmental authorization to take protected species that facilitates such harm by "solicit[ing]" or "caus[ing]" an offense.[111] By regulation, that prohibition extends to the taking of most threatened species, including the red knot.[112]

A. The Endangered Species Act Requires a Precautionary Approach.

In the Endangered Species Act, Congress adopted a precautionary approach. As the Supreme Court has stated, "Congress has spoken in the plainest of words, making it abundantly clear that the balance has been struck in favor of affording endangered species the highest of priorities, thereby adopting a policy which it described as 'institutionalized caution.'"[113] This principle is echoed in the ARM Framework's objective statement, which calls for "*ensur[ing]* that the abundance of horseshoe crabs is not limiting the red knot stopover population or slowing recovery."[114] Within the context of the ESA's legal framework, to ensure against such harms means taking a precautionary approach of "giv[ing] the benefit of the doubt to the species."[115] By setting ASMFC on a path to harm a threatened species whose population shows no sign of recovery, the revised ARM Framework would fall far short of ESA requirements and ASMFC's own objective.

As shown above, in many instances, Addendum VIII would enshrine a risk-prone approach instead of the risk-averse, precautionary approach required under the ESA. Even as it would allow the renewed harvest of female horseshoe crabs, Addendum VIII would utilize a model that, among other risky decisions:

- rejects the significant connection between horseshoe crabs and red knots,

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109 16 U.S.C. § 1538(a)(1)(B).
110 50 C.F.R. § 17.3.
111 *Strahan v. Coxe*, 127 F.3d 155, 163 (1st Cir. 1997); 16 U.S.C. § 1538(g).
112 50 C.F.R. § 17.31(a) (applying the provisions of § 17.21 (addressing endangered species) to threatened species); *id.* § 17.21(a), (c) ("[I]t is unlawful . . . to solicit another to commit or to cause to be committed" the taking of an endangered species.).
113 *Tenn. Valley Auth. v. Hill*, 437 U.S. 153, 194 (1978).
114 ASMFC, *ARM Report* 25 (emphasis added).
115 *See, e.g., Roosevelt Campobello Int'l Park Comm'n v. U.S. Envtl. Prot. Agency*, 684 F.2d 1041 (1st Cir. 1982) (quotations and citation omitted); *see also Defs. of Wildlife v. U.S. Dep't of the Interior*, 931 F.3d 339, 351 (4th Cir. 2019) (same regarding scientific determinations).

- neglects egg-density data, which provide the most direct measure of the adequacy of food for red knots,
- rejects protective populations thresholds that were essential to the only group of stakeholders that ASMFC ever formally consulted about this matter,
- assumes that horseshoe crabs are recovering despite negative demographic trends, and
- uses horseshoe crab projections that fail to account for uncertainty and are scarcely more accurate than a null model.

The exclusion of public input at multiple stages of this proceeding exacerbates the risk of an ESA violation because ASMFC has evaded the public scrutiny that would be appropriate for such a consequential proceeding. A risk-averse approach would be to welcome public input in order to identify and address weaknesses that create unacceptable risk for the red knot. But the Board has taken a different, risk-prone approach: hastening a vote on Addendum VIII even as the underlying model continues to be withheld, despite record requests submitted more than seven months ago. The Board will therefore make a decision without the benefit of crucial public input and the important considerations such input would raise.

Both ASMFC and FWS suggest that the model will be improved by future updates.[116] As shown above in section V.B, updates cannot remedy the flaws in the revised ARM Framework. But even if they could, relying on future updates is not appropriate when an ecosystem is dangerously degraded and a threatened species hangs in balance. Future updates are likely to come too late.

B. By Utilizing the Revised ARM Framework, ASMFC Would Harm Red Knots.

Like any other association or governmental entity, ASMFC is subject to the ESA taking prohibition.[117] Under the Atlantic Coast Fisheries Cooperative Management Act of 1993,[118] ASMFC's fishery management plans are legally binding upon affected states. Once the Commission issues a plan, states "shall implement and enforce the measures of such plan within the timeframe established in the plan."[119] Because ASMFC's quotas cannot be exceeded, states have been prohibited from authorizing female horseshoe crab bait harvest in Delaware Bay under the existing framework. States may authorize a female bait harvest only if ASMFC sets a non-zero female harvest quota.[120]

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[116] ASMFC, *Draft Addendum VIII* at 8; FWS, *U.S. Fish and Wildlife Service Evaluation of the Atlantic States Marine Fisheries Commission Horseshoe Crab/Red Knot Adaptive Resource Management Revision* at 3 of PDF (2022) ("*Evaluation*"), https://www.fws.gov/sites/default/files/documents/service-evaluation-of-atlantic-states-marine-fisheries-commission-horseshoe-crab-red-knot-adaptive-resource-management-revision.pdf.
[117] The ESA applies to any "person," which is broadly defined. 16 U.S.C. § 1532(13) ("The term 'person' means an individual, corporation, partnership, trust, association, or any other private entity; or any officer, employee, agent, department, or instrumentality of the Federal Government, of any State, municipality, or political subdivision of a State, or of any foreign government; any State, municipality, or political subdivision of a State; or any other entity subject to the jurisdiction of the United States.").
[118] Atlantic Coastal Fisheries Cooperative Management Act of 1993, Pub. L. 103-206, 107 Stat. 2419, Tit. VIII (codified at 16 U.S.C. § 5101 *et seq.*).
[119] *Id.* § 5104(b)(1).
[120] *Cf. Defs. of Wildlife v. U.S. Envtl. Prot. Agency*, 882 F.2d 1294, 1301 (8th Cir. 1989) (EPA's registration of pesticide effected a taking because the pesticide could not be used without such registration).

ASMFC's fishery management decisions therefore have a direct causal connection to the ultimate bait-harvesting actions that impact horseshoe crabs and red knots.[121] Indeed, the connection between the Board's management decisions and red knot demographics is the premise and intent of the ARM Framework's objective statement:

> Manage harvest of horseshoe crabs in the Delaware Bay to maximize harvest but also to maintain ecosystem integrity, provide adequate stopover habitat for migrating shorebirds, and ensure that the abundance of horseshoe crabs is not limiting the red knot stopover population or slowing recovery.[122]

Draft Addendum VIII shows that, if the revised ARM Framework had been utilized in 2017-2019, it would have allowed for the harvest of around 150,000 female horseshoe crabs each year,[123] compared to the actual quota of zero for each of those years. Going forward, allowing such an increase in the harvest of female horseshoe crabs, upon which egg abundance depends, threatens significant degradation and modification of red knot habitat at Delaware Bay that would kill or injure red knots by significantly impairing breeding and feeding activities that are essential to the continued existence of the species.[124]

As explained above, the revised ARM Framework raises serious questions that the Board has not answered or publicly considered. After 24 years of ASMFC management, including 10 years under an ARM Framework, neither red knots nor horseshoe crabs are on a trajectory to recover. There are serious reasons to doubt even the modest increase in the horseshoe crab population that ASMFC reports. ASMFC's red knot abundance estimates are essentially flat at low numbers, while other estimates based on direct counting have shown a dangerous decline in recent years.

Now, in the Board's first addendum since red knots were listed as threatened, Addendum VIII would result in the increased harvest of horseshoe crabs, including the resumed harvest of females, thus magnifying the factors imperiling red knots. This poses an enormous risk to the ecosystem, which is precisely the wrong response to a species being listed under the ESA.

C. <u>FWS's "Evaluation" Does Not Offer Independent Support for Addendum VIII.</u>

Recent statements from FWS do not bolster the credibility of the revised ARM Framework. When FWS listed red knots as threatened under the ESA, it stated, "[A]s long as the ARM is in place and functioning as intended, ongoing HSC bait harvests should not be a threat to the red knot."[125] In her minority opinion raising concerns about the revised ARM Framework, Dr. Walsh

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[121] *E.g.*, *Sierra Club v. Yeutter*, 926 F.2d 429, 438-39 (5th Cir. 1991) (holding that government agency violated ESA taking prohibition by authorizing logging that destroyed habitat and thereby impaired essential behavioral patterns of listed woodpecker species); *Loggerhead Turtle v. County Council of Volusia County*, 896 F. Supp. 1170, 1181-82 (M.D. Fla. 1995) (holding that county that regulates vehicular access to beaches is liable under ESA for taking of sea turtles caused by nighttime beach driving).
[122] ASMFC, *ARM Report* 25.
[123] ASMFC, *Draft Addendum VIII* at 12 app'x A tbl. 1 (showing annual female harvest quotas ranging from 144,803 to 154,483).
[124] 50 C.F.R. § 17.3 (defining "[h]arm").
[125] 79 Fed. Reg. at 73,709.

wrote that "[i]mmediate resumption of female harvest by the means described in the draft report may prompt the USFWS to reconsider if the ARM is functioning as intended."[126]

In contrast to Dr. Walsh's minority opinion, the document that FWS released on August 16, 2022, styled as an "evaluation" of the revised ARM Framework, did not offer any independent assessment of the revised ARM Framework. Rather, it repackaged the revised ARM Framework's modeling with all of its flaws detailed above, at times appearing to copy and paste figures directly from the Subcommittee's materials, and stated that the revision "poses negligible risk to red knot recovery and negligible risk of take under the Endangered Species Act."[127] Nowhere did FWS question the validity of the revised ARM Framework or any of the underlying assumptions or decisions, including on any of the bases discussed in these comments and accompanying expert reports.

With its complete deference to ASMFC's flawed modeling, assumptions, and conclusions, FWS unsurprisingly reached the same flawed result but did not bolster its validity. As these comments have shown, the revised ARM Framework incorporates numerous erroneous methodologies and assumptions. In its document, FWS propagated the same errors and replicated the same flaws as ASMFC. Moreover, since FWS relied on ASMFC's non-public model, its assertions are effectively unverifiable. The revised ARM Framework is unreliable for the reasons demonstrated in these comments. The Framework also still needs a legitimate, thorough, independent review based on all underlying information—not just the information released publicly to date. FWS's imprimatur does not resolve the defects of Addendum VIII.

VII. CONCLUSION

The window to save red knots is closing rapidly, especially for Southern wintering birds that fly the farthest and are most reliant upon horseshoe crab eggs at Delaware Bay. The revised ARM Framework would increase the pressure on this species, which is already vastly diminished on the beaches that once hosted its extraordinary migration. The Framework does not appreciate the importance of horseshoe crabs to red knots or the fragility of the horseshoe crab population itself. The weak relationship that it perceives between red knots and horseshoe crabs may well become a self-fulfilling prophecy, as the computer model continues to run while the ecosystem around it fades away.

The Horseshoe Crab Management Board has an obligation to restore red knots and horseshoe crabs at Delaware Bay. Just as importantly, it has a real—and maybe a final—opportunity to do so. For the reasons described above and in the attached expert reports, the Board should reject Addendum VIII.

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[126] *Walsh Minority Opinion* 117.

[127] FWS, *Evaluation* at 3 of PDF. While the document is dated January 18, 2022, it was not released to the public until August 16. For an example of a copied figure, compare ASMFC, *Supplemental ARM Report* 30-31 figs. 10-11, with FWS, *Evaluation* at 5 of PDF fig. 1.

Review of 2021 ASMFC ARM revision

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September 2022

This is an expert review of the Adaptive Resource Management plan (ARM) proposed by ASMFC to guide management of the Horseshoe Crab fishery in Delaware Bay, performed by Kevin Shoemaker, Ph.D.

Dr. Shoemaker has a Ph.D. in Conservation Biology, a Master of Science degree in Conservation Biology, both from SUNY-ESF in Syracuse, NY, and a Bachelor of Science degree in Biology from Haverford College. He is a former Postdoctoral Fellow in the Department of Ecology and Evolution at Stony Brook University and a former Senior Scientist at Applied Biomathematics, an ecological research and development company located in Setauket, NY. Dr. Shoemaker is currently employed as an Associate Professor of Population Ecology at the University of Nevada, Reno. He has over 15 years of experience as a wildlife conservation scientist and has authored over 45 peer-reviewed scientific articles and book chapters on topics in wildlife ecology and conservation. He has expertise in Bayesian inference, machine learning, population ecology, and ecological modeling.

OVERVIEW

This report presents my review of the Adaptive Resource Management plan (ARM) proposed for use by the Atlantic States Marine Fisheries Commission (ASMFC) as a tool for guiding management of the horseshoe crab (HSC) fishery in Delaware Bay and protecting the Federally Threatened *Rufa* Red Knot (*Calidris canutus rufa*; REKN). Delaware Bay is a critical stopover site for REKN in their spring migration to breeding grounds in the high arctic from wintering grounds as far south as Tierra del Fuego (USFWS 2021). Specifically, HSC eggs deposited on coastal beaches provide a necessary high-calorie food resource for REKNs and other migrating shorebird species as they replenish fat reserves depleted from their long migration and prepare for breeding. At the heart of the proposed ARM framework is an optimization model that provides harvest recommendations for female and male HSC, conditional on current estimates of HSC and REKN abundance. These recommendations are calibrated to maximize HSC harvest while causing minimal risk to the REKN population. The optimization model is based on a linked two-species simulation model (comprising a HSC and a REKN simulation model) that incorporates a one-way biotic interaction in which annual REKN survival and recruitment depend on female HSC abundance in Delaware Bay (among other covariates). While the stated objectives of the revised ARM are sensible, my review identified several concerns that suggest the revised ARM framework is not an appropriate tool for managing risk to HSC or REKN populations. Specifically, this report identifies six main areas of concern:

(1) **The fitted relationship between HSC abundance and REKN vital rates (survival and fecundity) is of insufficient magnitude to forecast a decline in mean projected REKN population growth even under a total collapse of the HSC population**. The extremely weak REKN/HSC relationship used in the revised ARM is inconsistent with previous research documenting HSC eggs as a critical food resource for migrating REKN and with the documented decline of the REKN population over recent decades, which experts have linked to increases in HSC bait harvest during the 1990s (Niles et al. 2009; USFWS 2014). If the REKN population model is inconsistent with what has been observed in the recent past, it seems unlikely to yield robust forecasts of future risk to the REKN population (or recovery of this population) from which to base management decisions. The inclusion of a REKN population model within the ARM framework (both the initial and revised versions) presupposes that HSC harvest could put REKN populations at risk, at least under some scenarios. As it stands, the apparent inability of the revised ARM model to predict a decline of the REKN population even under a total collapse of the HSC population seems to violate this premise, and practically guarantees that the REKN population model will play an insignificant role in setting optimal HSC harvest rates.

(2) **The HSC population simulation model fails to correctly propagate uncertainty about mean recruitment rates**. In specifying the bivariate normal distribution used to generate

annual male and female HSC recruitment rates (the most consequential empirically fitted parameters of the HSC simulation model), the proposed ARM framework treats incertitude about annual recruitment rates as representative of temporal process variance (natural year-to-year fluctuations) rather than as a mixture of parameter uncertainty and process variance (Link and Nichols 1994; Regan et al. 2002; McGowan et al. 2011). This subtle but significant shortcoming will tend to manifest in simulation replicates that closely resemble one another, since key sources of uncertainty "regress to the mean" (good years cancel out bad years) instead of propagating over time. The importance of this distinction is magnified for long-lived iteroparous species like HSC, since these populations tend to be resilient to short-term fluctuations in reproduction or recruitment (Lovich et al. 2015). When this issue is corrected (using the same Bayesian approach used to treat process variation and uncertainty in the REKN simulation models in the revised ARM framework), preliminary simulation results suggest a highly uncertain outlook for the HSC population in Delaware Bay, especially when faced with harvest pressures. In sharp contrast to the ARM report and supplement, the population of HSCs in Delaware Bay appears to have a substantial (17.5%) probability of falling below the lowest previously estimated levels even in the absence of all direct anthropogenic sources of mortality (bait harvest, biomedical bleeding and discard mortality) over the next 50 years. Furthermore, a scenario in which HSCs are harvested annually at the current maximum allowable rates is accompanied by a severe risk of decline (33.45%) and disruption to the population age structure (lower multiparous/primiparous ratios than previously observed). Finally, an extreme harvest scenario in which two million male and female HSCs are harvested each year results in near-certain catastrophic population collapse over the 50-year time horizon, in contrast to the (original) ARM report, which suggests a relatively stable HSC population even under this extreme scenario (which greatly exceeds current maximum allowable rates).

(3) **The Catch Multiple Survey Analysis (CMSA) exhibits poor fit to training and independent data, raising concerns about its use in projecting future HSC abundance**. Aside from being able to explain the apparent difference in mean HSC abundance before and after the "VT gap years" (see below; higher HSC abundance is both predicted and observed after the

period 2013-2016), the CMSA model explains very little, if any, of the observed variation in the primary data sources (three trawl surveys conducted in and around Delaware Bay). The CMSA results exhibit relatively good fit ($R^2 > 0.5$) to the recruitment data (primiparous abundance); however, this is unsurprising since there is only one source of data (VT swept area surveys) for estimating annual primiparous abundance versus three sources for estimating adult (multiparous) and total abundance. Given the overall lack of fit to training data, the HSC simulation model is unlikely to perform well for predicting independent validation data (data not used to fit the model). Indeed, when the CMSA results are challenged against the HSC spawning surveys – an independent estimate of HSC abundance for this region – there is no detectable relationship between these two independent estimates of HSC abundance. This lack of fit to both training and validation data raises concerns about the utility of the CMSA model, which informs all aspects of the proposed ARM, including the REKN IPM (where it represents the abundance of female HSC each year), the HSC projection model, and the annual harvest recommendation.

(4) **The "gap years" in the VT trawl survey data raise concerns about HSC recruitment estimates from the Catch Multiple Survey Analysis (CMSA)**. As noted above, the CMSA is fundamental to all aspects of the proposed ARM framework. For the HSC population simulation models, the primary role of the CMSA is to parameterize HSC recruitment rates (which are the most consequential empirically derived inputs for the HSC simulation model). Unfortunately, of the three trawl surveys used to fit the CMSA models, the only survey that provides information for estimating recruitment – the Virginia Tech (VT) trawl surveys – was not conducted during a critical four-year period from 2013 to 2016 (hereafter referred to as the "VT gap", during which no direct information was available for estimating annual HSC recruitment rates). The CMSA results suggest that the HSC population underwent a substantial state transition during the VT gap years in which the population was small but stable prior to the gap, and larger and more variable after the gap. More concerningly, the CMSA predicts much higher average recruitment rates during the VT gap (for which no data are available for estimating recruitment) than at any single year before or after. The inflated average recruitment rates during the VT gap period are subsequently used for estimating

mean HSC recruitment rate for the HSC simulation models (thereby increasing estimated population resilience to harvest) – but unfortunately these high recruitment rates cannot be verified empirically. If average recruitment rates were computed from only those years in which recruitment could be verified empirically (i.e., excluding estimates from the VT gap years) the expected resilience of the HSC population to harvest would be substantially reduced.

(5) **The proposed ARM framework lacks 'null model' benchmarks and independent performance validation**. Null models are simplified representations of a system that lack many or all the proposed mechanisms that may help to explain the system dynamics; the typical null model in statistics assumes all observed variation is the result of a single random error process. By comparing complex models such as those used in the revised ARM with one or more null-model benchmark(s), researchers can determine whether the more complex models represent useful learned knowledge about a system (Koons et al. 2022). If a complex model fails to outperform a null model in terms of bias or precision (typically using independent validation data), the complex model is likely to be improperly specified or "overfitted" (whereby parameters are fitted to "noise" rather than true signal; Radosavljevic and Anderson 2014) and therefore not useful for prediction. The CMSA model fails to outperform even the simplest statistical null model (single intercept term with sampling error) for at least one data source (the VT swept-area estimate of female multiparous abundance). For the REKN component of the revised ARM, it would be informative to compare the performance of the REKN simulation model against a null model that omits any effect of female HSC abundance. It was recently demonstrated (Koons et al. 2022) that the ARM framework for guiding North American mallard harvest was unable to outperform a null model, and it would be instructive to pose a similar challenge to the REKN simulation model. If either model fails to outperform a null model, it should prompt managers to acknowledge that our current understanding of the effects of harvest on HSC populations remains insufficient for robust forecasting (Dietze 2017), and that a more precautionary approach may be warranted.

(6) **Lack of transparency**. The public still has no access to the data and code used for estimating

REKN population parameters, simulating REKN and HSC population dynamics, and running optimization routines (the CMSA code and data were made available). Without this data and code, it is difficult to fully assess the proposed ARM framework and to run scenario tests. If granted access to the code and data, there are a number of important null model tests (see above) and scenario tests that can be run, including (1) developing and testing the HSC and REKN models against a "null model" benchmark, (2) determining the 'optimal' female HSC harvest rates from the "canonical" versions of the HSC and REKN models in the absence of defined harvest limits, and (3) running the REKN simulation model under a scenario representing near-total collapse of the HSC population. The concerns identified above, which arise from analysis of the limited data and code made available to date, demonstrate, at a minimum, that such further testing is warranted. It seems prudent to delay implementation of the new ARM framework until the public and outside experts have had adequate time to scrutinize the statistical and simulation models that play such a central role in this proposed decision-making framework.

SUPPORTING EVIDENCE AND ANALYSES

The remainder of this report provides additional supporting details for the six major areas of concern identified above, including results and figures from re-analyses of the data presented in the ARM report.

1. The fitted relationship between HSC abundance and REKN vital rates (survival and fecundity) is of insufficient magnitude to forecast a decline in mean projected REKN population growth even under a total collapse of the HSC population

Including a model of REKN population dynamics as part of the previous and revised versions of the ARM framework implicitly acknowledges that reduction of the HSC population could, under some circumstances, have a negative impact on REKN populations. This assumption has a strong empirical basis, as multiple lines of evidence suggest that HSC eggs are an extremely important resource for migrating REKNs during their spring migration (e.g., Karpanty et al. 2006; Niles et al. 2009; USFWS 2014; USFWS 2021). Therefore, it is surprising that the fitted relationship between HSC abundance and REKN survival used in the revised ARM is very weak and appears to be overwhelmed by random among-year variation (Fig. 47 from ARM Report; Fig. 9 from Supplemental Report; hereafter, I will use the notation 'ARM Fig. 47/9'). In fact, it appears from the ARM report that estimated REKN survival rates have generally decreased weakly over time despite an estimated increase in HSC abundance (ARM Fig. 44/7). Years with the lowest HSC abundance in the study period (at or near the lowest HSC abundances ever recorded in Delaware Bay) are coincident with the highest estimated REKN survival rates (ARM Fig. 47/9). Given this weak fitted relationship, simulated REKN abundance based on this model seems unlikely to be very sensitive to changes in HSC abundance. Indeed, a 'back of the envelope' calculation based on the REKN vital rates presented in the ARM report (and the slightly modified numbers presented in the Supplement) shows that the mean population growth rate (Lambda) of the REKN population is likely to remain at or above replacement levels (Lambda ≥ 1) even at HSC population size equal to zero (Fig. 1). This calculation was produced by using the mean survival from Supplemental Table 8, mean recruitment estimated from Supplemental Fig. 7b, and the standardized logistic regression coefficients from Supplemental Table 9 (effect size = 0.37 for survival and -0.14 for recruitment) to model REKN survival and recruitment as a function of HSC abundance. As a brief aside, the regression coefficients presented in the ARM report (e.g., effect of HSC on survival) are standardized and are on the logit (log-odds) scale, making them difficult to interpret. A quick example may help to aid interpretation of the effect size of this relationship: given a coefficient of 0.37 (the mean regression coefficient for the relationship between HSC abundance and REKN survival from the ARM Supplement, Table 8), a loss of 1 million female horseshoe crabs from Delaware Bay would result in REKN survival rate declining by only 0.004 (from 0.93 to 0.926). This is consistent with visual inspection of ARM Fig. 47/9.

Although I did not have access to the code and data used to fit the relationships between HSC abundance and REKN survival and recruitment, the relationships I used to generate Fig. 1 closely match the relationships presented in ARM Fig. 46/8 (Fig. 2). Interestingly, the value for mean recruitment provided in Supplemental Table 8 (ρ_{mean} = 0.063) yields a declining REKN population (Lambda = 0.99) even under average conditions from 2005 to 2017. Since this result is inconsistent with the reported Lambda of 1.04 during that same period from ARM Table 25 (and the generally increasing population trajectories indicated in ARM Fig. 58/15), I chose to use the mean annual recruitment estimated from Supplemental Fig. 7b, which I calculated to be 0.109 (or geometric mean of 0.099). Using these mean recruitment values resulted in a Lambda of 1.035 (for arithmetic mean) or 1.027 (for geometric mean), more closely resembling but still below the reported baseline Lambda of 1.04 from the ARM report; setting baseline Lambda to 1.04 would only make a stronger case that REKN populations would not be expected to decline under an HSC population collapse (Fig. 1). This simulation exercise makes it very clear that the REKN model used in the revised ARM would not be able to predict or explain the decline in the REKN population observed during the 1990s, which has been attributed to unregulated harvest of HSCs in Delaware Bay (Niles et al. 2009; USFWS 2014). If this framework is unable to explain the decline of the REKN population in the first place, it does not appear to be an appropriate tool for helping to reverse the decline and promoting the recovery of this threatened subspecies.

Note that the population vital rates used to generate Fig. 1 represent point estimates. Because there was uncertainty associated with the estimate of Lambda (CI from 1.00 to 1.06; ARM Table 25), and with the effect size of HSC abundance on survival rate (CI from 0.12 to 0.63; ARM supplemental Table 9), some simulation runs (i.e., those with small Lambda and larger effect size sampled randomly from the joint posterior distribution) are likely to indicate REKN population decline at low HSC abundances. It is likely that these (probably rare) simulations drive the shape of the REKN “harvest function” yielded by the approximate dynamic programming algorithm. However, without access to the IPM and simulation code, I am not able to formally test the behavior of the REKN simulation model under scenarios of HSC population decline or collapse.

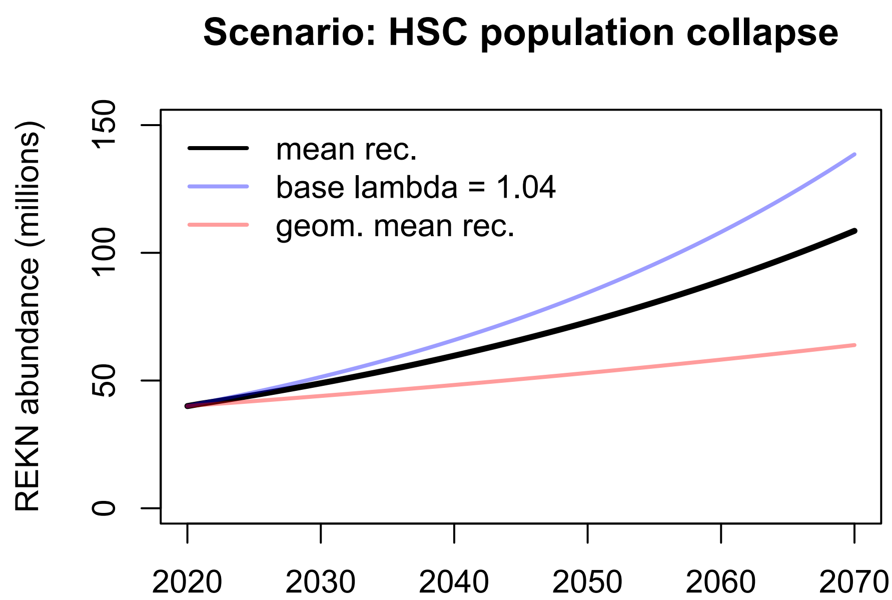

Figure 1. *Results from a 'back of the envelope' calculation of REKN population growth under a scenario with depleted HSC population (female HSC abundance = 0 based on numbers presented in the ARM report. Mean recruitment rate was computed in three ways: arithmetic mean of values from ARM Supplemental Fig. 7b ("mean rec"), the geometric mean of these same values ("geom. mean rec."), and a value fitted to ensure a population growth rate (Lambda) of 1.04, as indicated in the ARM report. Although somewhat simplistic, this figure illustrates that the reduction in REKN survival due to the collapse of HSCs in Delaware Bay appears to be insufficient to induce a meaningful REKN population decline. This figure is based on a simple age-structured population model and does not incorporate a density-dependence mechanism (the revised ARM includes a density ceiling that prevents the REKN population from growing above ~150k).*

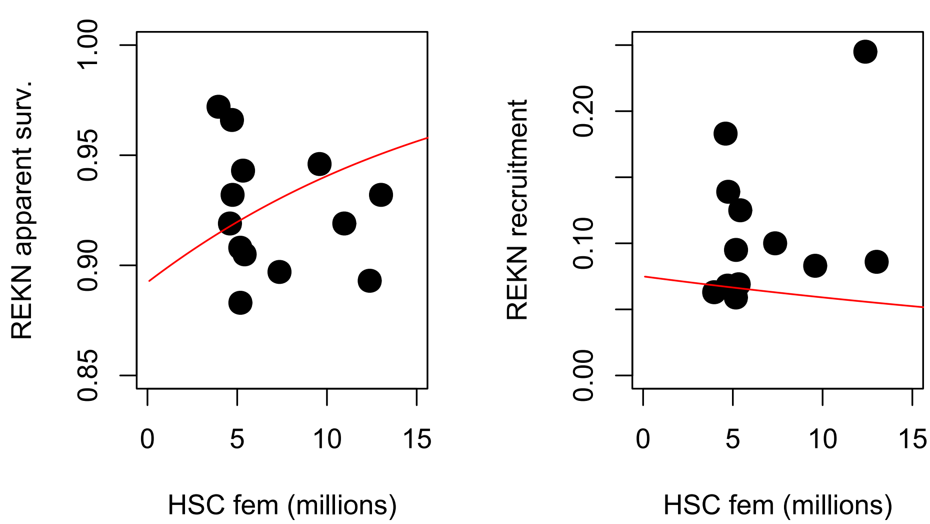

Figure 2. *Relationships between female HSC abundance and REKN survival (left panel) and recruitment (right panel), recreated from information in the ARM supplemental report for the purpose of calculating the expected REKN population response to changes in the HSC population. Solid black dots represent annual vital rates estimated from ARM Supplement Fig. 9, and the red lines represent the fitted relationships presented in ARM Supplement Table 9.*

Due to the weakness of the HSC/REKN relationship used in the revised ARM, and due to the complexity of the Integrated Population Model (IPM) framework used to represent the REKN population in the revised ARM, the relationship between HSC abundance and REKN population vital rates are likely to be unstable (sensitive to new data and alternative model specifications). Therefore, it is not implausible that the fitted relationship may disappear (become "non-significant") – or even flip sign to become a negative relationship – when the IPM is fitted to additional observations. This outcome would pose an existential problem for the ARM framework, decoupling the two-species framework and rendering the REKN model unusable in the context of management. There does not appear to be a contingency plan for this outcome. More generally, the REKN IPM appears to have gone through several distinct versions before researchers settled on a final set of decisions to incorporate into the final model (there are several important differences between an earlier version of the IPM presented in Tucker [2019] and the ARM report). Ideally, the results from alternative representations of the REKN system should be considered in aggregate to better represent structural uncertainty about this system (Williams 2011).

The linked two-species modeling framework in the revised ARM assumes the relationship between REKN and HSC is independent of REKN densities (i.e., it assumes a prey-dependent functional response). Under this assumption, larger REKN populations do not require larger abundances of HSC females (i.e., more HSC eggs deposited) to support adequate per-capita weight gain; in other words, the ARM model assumes that a REKN population of 40k would experience the same per-capita survival and fecundity as a population of 400k for a given abundance of female HSC. Implicitly, this assumes a lack of interference among REKN individuals, and no decline in the mean quality or accessibility of HSC egg resources at elevated REKN abundances (Karpanty et al. 2011). Some researchers have argued convincingly that a ratio-dependent functional response – in which per-capita prey consumption depends on the ratio between prey and predator abundances – is likely to be more realistic for simulation models with discrete time steps that span the entire reproductive periods of predator and prey (Abrams and Ginzburg 2000), such as the linked two-species model used in the revised ARM.

The previous ARM framework used data gathered from multiple sources of data outside

Delaware Bay to parameterize the simulation models. The revised ARM attempts to use Delaware Bay data sources wherever possible – which is a significant advance in many ways, as the revised ARM is "fine-tuned" for the system and can be updated relatively easily as new data are collected. However, this modeling decision also limits the analyses to a small geographic area over a short period of time, potentially ignoring relevant evidence from other regions and/or time periods. Furthermore, the time frame over which data are available for fitting the population models used in the revised ARM represents a limited scope of historical variation during which populations of REKN and HSC were relatively small in comparison with earlier estimates. Using these models to forecast system dynamics under conditions outside the range of values used to fit the model (e.g., lower HSC abundances, higher REKN abundances) therefore requires extrapolation, which can be highly uncertain (and often inaccurate). Since both the HSC and REKN simulation models tend to produce forecasts that differ from current conditions (e.g., larger numbers of both species), and because the optimization routine relies on these simulated results, the management recommendations emerging from the revised ARM rely on highly uncertain extrapolations about HSC and REKN population dynamics and about how these two species may interact (analogous to extrapolations of species and community distributions under climate change; Araujo and Rahbek 2009). On one hand, the ARM framework is designed to be able to refine management policies as new data become available and as sources of uncertainty are reduced (Nichols et al. 2007). On the other hand, it does not seem prudent to implement management "experiments" that could potentially imperil a threatened or endangered species (TES), even under the rubric of adaptive management.

In summary, the relationship between HSC abundance and REKN survival appears to be too weak to induce a decline in REKN abundance (Fig. 1). If all HSCs in Delaware Bay disappeared today, the model would continue to predict a generally stable or increasing population of REKN over the next 50 years. Therefore, the revised ARM model would be unable to predict the decline of REKNs that was observed in recent decades, and which has been attributed in part to the decline in the HSC population (Niles et al. 2009; USFWS 2014). This lack of consistency between the revised ARM model and recent historical observations raises significant doubts about the ability of this model to accurately reflect future risks to the REKN population or to guide HSC harvest decisions in a way that promotes REKN survival and recovery. Furthermore, the decision to include a REKN population model as part of the ARM framework (in both the original and revised versions) presupposes that HSC harvest could result in risk to the REKN population; the apparent inability of the ARM model to predict a decline in REKN abundance under a total HSC population collapse violates this premise and undermines the apparent purpose of the model.

2. The HSC population simulation model fails to propagate uncertainty about mean recruitment rates

The HSC recruitment process is the most consequential empirically fitted component of the HSC simulation model. Other elements of the HSC simulation model are not fitted to data – for example, natural mortality rate, the biomedical mortality rate, and bait harvest rates are fixed by the modelers. In the revised ARM, the recruitment process is fitted to data indirectly via the CMSA model; annual male and female recruitment estimates were used to fit a bivariate log-normal distribution (defined by a mean and standard deviation for each sex, along with a covariance between sexes – all on a logarithmic scale), which was then used to represent annual recruitment in the simulation model. The only other parameter fitted in the CMSA model – initial abundance – is not directly used in the simulation model. Recruitment is critical for any assessment of population resilience to harvest, since (in the absence of immigration, which is not included in the revised ARM), it is the only process that enables the population to overcome sources of mortality. Therefore, it is not surprising that the HSC simulation model is highly sensitive to changes in mean (log) fecundity (ARM Fig. 33; note that when I omit any reference to the supplemental report, I am referring to the primary ARM report). Given the high sensitivity of the HSC simulation model to the (log) mean HSC recruitment for males and females, it is critical that uncertainty about these parameters is properly represented in simulation models. However, the revised ARM framework incorrectly treats incertitude about annual recruitment rates as representative of temporal process variance (natural year-to-year fluctuations) rather than as a mixture of parameter uncertainty and process variance (Link and Nichols 1994; Regan et al. 2002; McGowan et al. 2011). This is a subtle but consequential error, as sources of uncertainty will tend to “regress to the mean” (with good years cancelling bad years) instead of propagating over time.

To estimate the parameters for the log-normal recruitment process in the revised ARM, the following steps were taken: (1) log-normal distributions were separately fitted to each estimate of primiparous abundance (separately for each year and sex), based on estimates of parameter uncertainty (95% confidence intervals) derived from the CMSA results, (2) this collection of lognormal distributions (representing parameter uncertainty) was used to simulate annual male and female primiparous abundance for the years represented in the CMSA model (confusing parameter uncertainty with temporal process variation), and then (3) data from these simulations were used to fit a bivariate lognormal distribution (via maximum likelihood) for representing annual HSC recruitment in the ARM model. In general, parameter uncertainty should be represented in simulation models by drawing a single sample per replicate from a distribution of values representing parameter uncertainty (or by running replicates with "worst-case" and "best case" values for key parameters). However, the "canonical" version of the HSC projection model fails to address parameter uncertainty – most notably, uncertainty about the mean HSC recruitment rate, to which the HSC projection model is highly sensitive (ARM Fig. 33). Therefore, there is more uncertainty about the future of the HSC population in Delaware Bay than the revised ARM acknowledges. It is important to note that a sensitivity analysis was run in which expected recruitment was allowed to vary across simulation replicates within ca. 5% or 10% of the median recruitment value. This sensitivity test demonstrates an appropriate method for modeling parameter uncertainty; however, this test fails to represent the extent of uncertainty about the median HSC recruitment, which extends far beyond 10% of the mean estimated value (Fig. 3). Furthermore, this treatment of uncertainty was only run as a scenario test and was omitted from the 'canonical' version of the ARM that is proposed for use in managing the HSC harvest in Delaware Bay.

Interestingly, the REKN projection model in the revised ARM appears to represent parameter uncertainty appropriately. The key parameters of the REKN model were estimated using an Integrated Population Model (IPM), which were fitted in a Bayesian framework. In this framework, parameter uncertainty is represented by a joint posterior distribution that embodies the set of values that are consistent with the observed data. Furthermore, temporal process variation in the REKN population model is treated by explicitly modeling annual variability in key vital rates (survival and recruitment) via annual random effects fitted with hyperparameters (Kery and Schaub 2011). This Bayesian hierarchical approach enables parameter uncertainty and process variation to be interpreted and modeled separately in a straightforward and intuitive manner. Specifically, parameter uncertainty is incorporated by running multiple replicates with different values drawn from the joint posterior distribution, and temporal process variation is included by sampling from the hyperparameters across years within each replicate (Goodman 2002).

To enable sensible propagation of parameter uncertainty in the HSC simulation model (analogous to the REKN model in the ARM), I constructed and fitted a hierarchical Bayesian version of the CMSA model. This model was fitted using the same data and model structure as the CMSA model included in the revised ARM. However, instead of estimating annual recruitment separately for each year and sex, the Bayesian CMSA model included an explicit representation of temporal process variance in recruitment (i.e., a "random effect" describing inter-annual variation in recruitment). This temporal process model was specified using a bivariate lognormal distribution exactly analogous to the HSC simulation model included in the ARM model, which included "hyperparameters" for male and female (log) mean recruitment, male and female (log) standard deviation, and a correlation term. By estimating temporal process variation directly, the Bayesian CMSA closely mirrors the HSC simulation model (analogous to the direct relationship between the IPM and the REKN simulation model), circumventing the multi-step process used in the ARM to generate the bivariate lognormal distribution from the CMSA results, and (most importantly) enabling the parameters of the bivariate lognormal distribution to be estimated directly from the data. To simulate HSC abundance over time, parameters for each replicate were drawn from the joint posterior distribution (representing parameter uncertainty), and temporal process variation within each replicate was simulated by sampling from the bivariate lognormal distribution. For the simulations, I incorporated the same restrictions in the stock-recruitment relationships indicated in the ARM report (driven by abundance and sex ratios for the years in which recruits were expected to have hatched).

Results from the Bayesian CMSA model indicate substantial uncertainty around mean HSC recruitment rates for both males and females (Fig. 3). Simulations (50 year time horizon) from this model in the absence of any direct anthropogenic sources of mortality (no bait harvest, biomedical mortality or discard mortality) indicate that the future of the HSC population in Delaware Bay is uncertain; the population has a 17.4% chance of declining below 4 million females (combined multiparous and primiparous abundance) at least once in the next 50 years, equivalent to the lowest abundances estimated from 2003 – 2019 (period for which the CMSA model was fitted) (Fig. 4). This no-harvest scenario also had a 3.8% probability of falling below 3 million females over the 50-year simulation, well below any estimate from the VT swept area surveys. In contrast, the HSC projection model in the revised ARM indicates a large and sustainable HSC population under a scenario with no bait harvest but including other anthropogenic sources of mortality including biomedical harvest and discard mortality (ARM Fig. 30; note that this figure does not reflect changes in mean HSC recruitment following peer review—the Supplement does not update this figure but contains other figures indicating a sustainable HSC abundance even with a bait harvest; Supplemental Fig. 15). Simulations from the Bayesian CMSA also indicate a much higher probability of decline under a scenario in which males and females are harvested at their respective maximum allowable rates (but are not subject to biomedical and discard mortality); this scenario had a 33% probability of declining below 4 million females over the next 50 years, 11% probability of declining below 3 million females, and a 2% probability of declining below 2 million females (Fig. 4). This scenario also appeared to disrupt the age structure in many simulations, resulting in fewer multiparous adults than primiparous adults. In contrast, the HSC simulation model in the revised ARM suggests a stable or increasing HSC population even under maximum allowable harvest scenarios that also include biomedical and discard mortality (ARM Fig. 31; see above caveat). Finally, a scenario in which both female and male HSCs were harvested at a rate of 2 million per year (much higher than the current maximum rate) results in a high probability of decline or even extirpation over the 50-year simulation; there was a >99% probability of declining to below 3 million females, a 92% probability of declining below 1 million females, and a 12% chance of falling below 10k females (Fig. 4). In contrast, the HSC simulation model in the revised ARM predicted a relatively sustainable population of HSC even under this extreme scenario, with no risk of population collapse (ARM Fig. 32; note that the HSC simulation model in the supplemental report may not sustain this level of harvest due to the reduced mean recruitment rate relative to the model used to generate ARM Fig. 32).

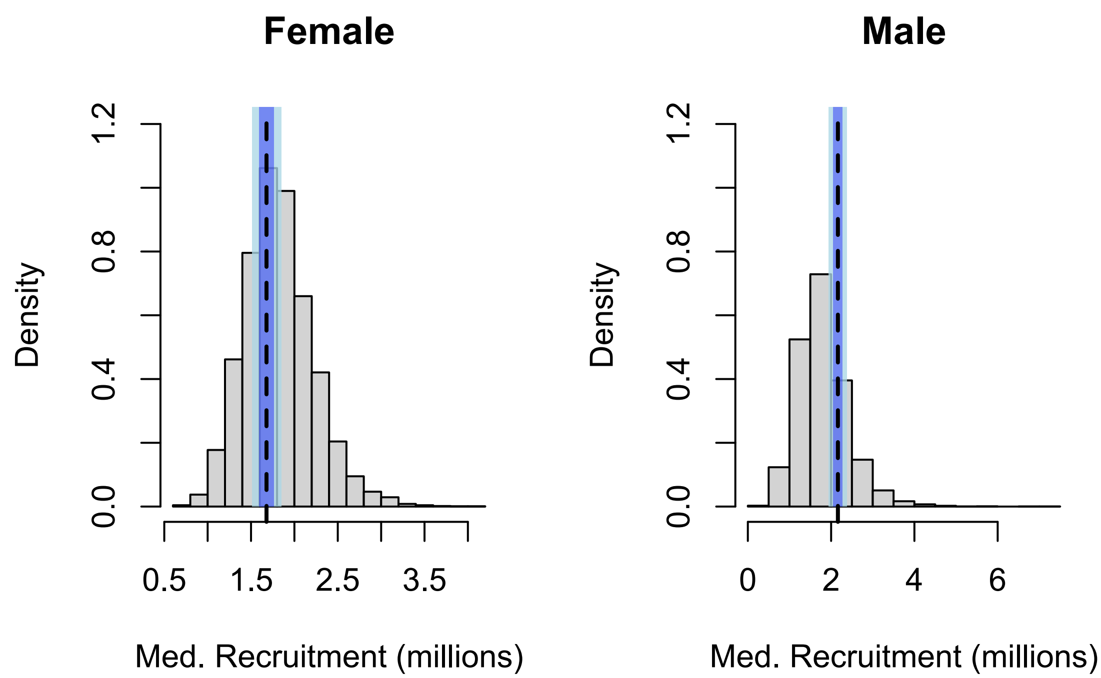

Figure 3*. Posterior distributions representing parameter uncertainty for median female and male HSC recruitment rates, fitted using a Bayesian reanalysis of the CMSA model from the revised ARM (same data and model structure used to fit the CMSA model). Vertical dashed lines denote the median HSC recruitment values used in the base HSC projection model in the revised ARM. Light and darker blue shaded polygons represent the "added variation in expected recruitment" sensitivity tests from the ARM report (e.g., Fig. 69, 70). Note that the true range of parameter uncertainty falls well beyond the bounds of these sensitivity tests.*

This critique is focused primarily on uncertainty about the annual HSC recruitment (primiparous abundance) parameters since they represent the ultimate source of projected resilience (or non-resilience) to harvest pressures and are therefore the most consequential fitted parameters in the CMSA simulation model. However, there are several other sources of uncertainty that should be accounted for in the HSC simulations. For example, natural mortality of HSC is set at exactly 0.3 (30%) across all sexes and age classes (primiparous and multiparous) in the revised ARM model, whereas there is substantial uncertainty about this parameter. The value of 0.3 was based on tag recovery data (assuming negligible harvest), but other lines of evidence seem to suggest natural mortality may be closer to 20% or even lower (as noted in the ARM report). Lower estimates of mortality (higher survival and greater longevity) could imply lower resilience to harvest of adults (Midwood et al. 2015). Interestingly, natural mortality is an estimable parameter in the CMSA model; when modeled as a free parameter in the Bayesian CMSA, the model suggests that natural mortality is lower than 30%, but higher for females than males (note that Figs 3 and 4 are based on a model with natural mortality set at 30%, to match the ARM models). Other sources of uncertainty in the HSC population model include discard mortality (where 5% mortality was assumed for trawl and dredge surveys, while 12% mortality applied for gill nets) and biomedical mortality (assumed to be 15%). Although the ARM report documents a limited set of sensitivity analyses that were designed to test the degree to which key results changed under alternative parameter values (including mortality; ARM Table 18, 19), the relatively small set of sensitivity tests does not appear to comprehensively address these sources of uncertainty and seem inadequate for characterizing uncertainty about this system. Furthermore, uncertainty about these processes is not propagated through the HSC projection models.

In summary, if sources of error in the recruitment process are properly accounted for, the outlook for the HSC population in Delaware Bay is uncertain even in the absence of any harvest pressures. Based on a reanalysis of the existing data (using the same model specification used in the CMSA and HSC projection model), I found that harvest at the current maximum allowable rates has a high risk (11%) of causing the female HSC population to decline below the lowest levels ever recorded (3 million females). The HSC population models presented in the ARM report and supplement are not useful because they mis-characterize the risk of harvest pressures to the HSC population in Delaware Bay.

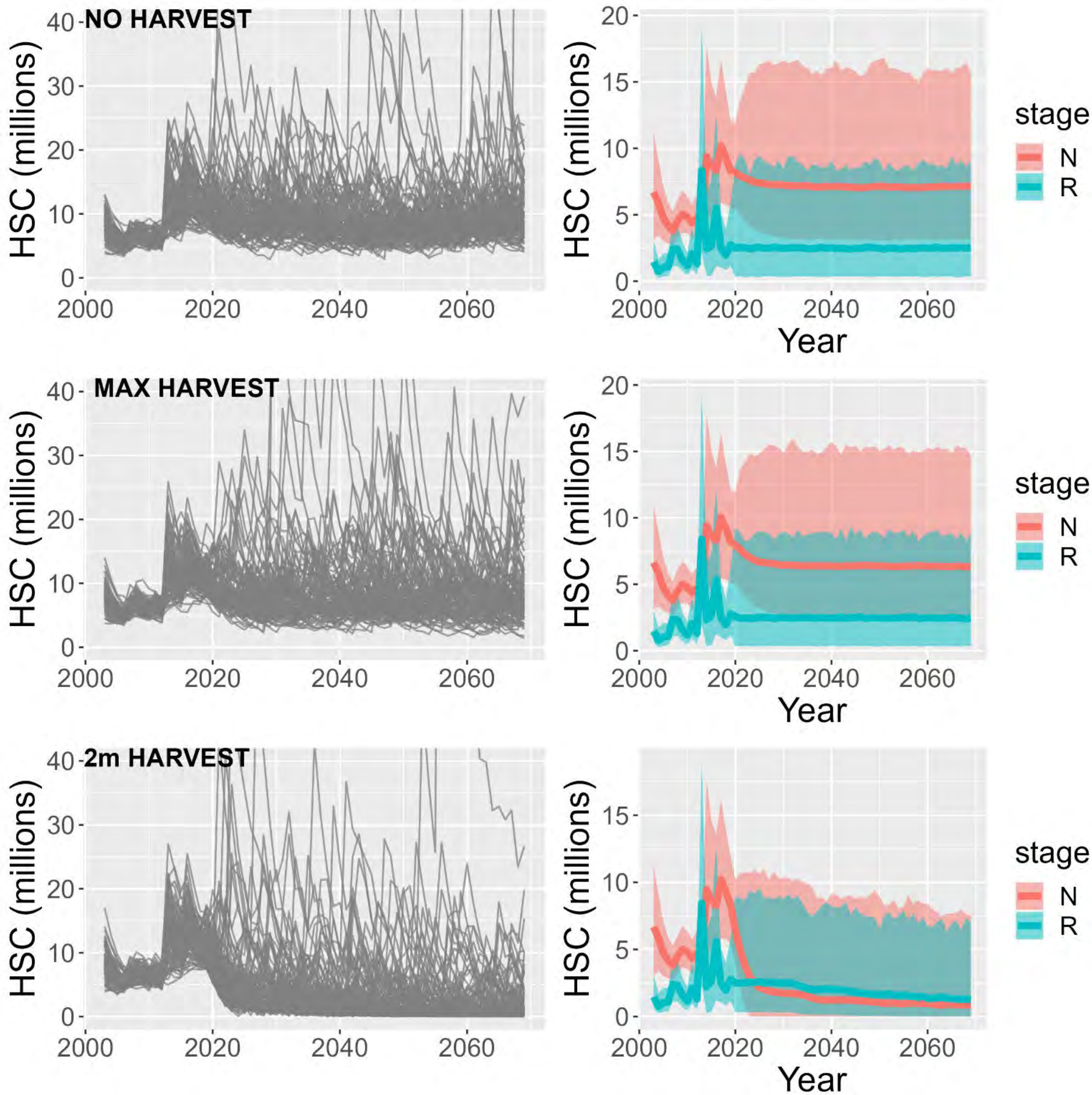

***Figure 4**. Female HSC population simulations run using fitted parameters (joint posterior distribution) from a Bayesian CMSA model, with uncertainty propagation performed in a manner analogous to the REKN projection model. The top row depicts simulations run under a no exploitation scenario (no bait harvest nor biomedical/discard mortality), the middle row depicts maximum allowable harvest rates (but also without biomedical and discard mortality), and the bottom row depicts an extreme harvest scenario (2 million females, 2 million males harvested annually). The left-hand panels depict trajectories of total abundance (primiparous and multiparous) for individual simulation replicates. Right-hand panels depict the 95% credible intervals for primiparous abundance (R) and multiparous abundance (N). None of these scenarios include biomedical or discard mortality.*

3. The Catch Multiple Survey Analysis (CMSA) appears to exhibit poor fit to both training and independent data, raising concerns about its use in projecting future HSC abundance

The CMSA model explains little (and, in at least one case, none) of the variation in the data sources used to train this model (comprising three different trawl surveys conducted in and around Delaware Bay; here I present results for the female CMSA only) (Fig. 5). Notably, the CMSA performs worse than a statistical null model (all variation is assumed to be random "noise") for predicting the multiparous female abundance estimated from the VT trawl surveys, with R^2 of -0.42 for the full time series (negative R-squared value indicates the CMSA model performs worse than the null model). In contrast, the CMSA results appear to exhibit relatively good fit ($R^2 > 0.5$) to the recruitment data (primiparous abundance) from the VT trawl surveys (Fig. 5; ARM Fig. 21). However, this is not a fair test; with only one source of data for estimating annual primiparous abundance (the VT trawl surveys) – and with a separate recruitment parameter fitted for each year – the CMSA recruitment results are practically guaranteed to resemble the observed recruitment data.

For the remainder of the datasets used to train the CMSA (DE and NJ trawls), it is instructive to note that the majority of the observed variance 'explained' can be attributed to the apparent difference in mean HSC abundance before and after the period 2013-2016 (during which the Virginia Tech trawl surveys were not conducted and therefore no estimates of recruitment were available; hereafter, "VT gap", see below). Indeed, for the DE surveys the R-squared value drops to negative values for the periods before (R^2 = -0.07) and after (R^2 = -0.03) the VT gap period (versus R^2 = 0.14 for the full time series). Similarly, for the NJ trawl survey, the R-squared value drops to 0.11 for the period before the gap and falls below zero for the period after the VT gap (R^2 = -0.05; compared to R^2 = 0.57 for the full time series). More concerningly, the CMSA can "explain" the apparent increase in the HSC population after the VT gap period only by estimating extremely high recruitment during the VT gap period (during which no recruitment information was available; see below for more details). Because no data were available for fitting recruitment (primiparous abundance) during the VT gap, the CMSA model was free to "fill in" whatever recruitment estimates produced the best match to available data (DE and NJ surveys were the only available data sources during this period)—even if these recruitment estimates were unrealistically high or low (with no data available for comparison, there was no penalty for producing unrealistic estimates). If the CMSA is only able to fit the training data via unrealistic estimates of recruitment (see below), this strongly suggests a poorly specified model and raises serious doubts about using the CMSA results to represent and forecast the HSC population in Delaware Bay.

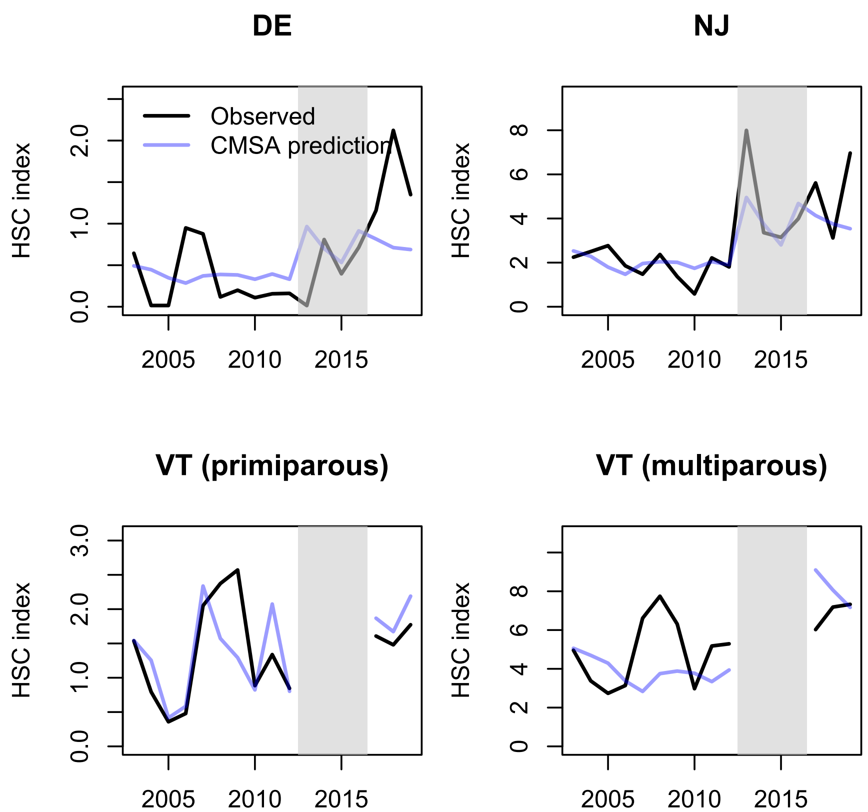

Figure 5*. Illustration of the fit of the CMSA model to data on female HSC abundance derived from three trawl surveys: DE, NJ, and VT (the same sources of data that were used to fit the CMSA model). This figure presents the same information as ARM Fig. 21/4. The CMSA model performs well in predicting primiparous abundance (bottom left) but exhibits poorer performance for predicting adult (multiparous) abundance (bottom right) or total abundance (top row). The CMSA predicts little to no variation in adult/total abundance besides the difference in apparent mean abundance before and after the "VT gap years" (gray regions).*

Given the lack of fit to training data, the HSC simulation model is unlikely to perform well when predicting to independent validation data (data not used to fit the model). Indeed, when the CMSA results are challenged against the Delaware Bay HSC Spawning Surveys (e.g., Zimmerman et al. 2020; https://www.delawarebayhscsurvey.org/), which provides an independent estimate of relative HSC abundance for this region, there is no detectable relationship between these two independent estimates of HSC abundance (Fig. 6). This lack of fit to both training and validation data raises doubt about the utility of the CMSA results, which are central to all aspects of the proposed ARM, from fitting the HSC/REKN relationship to forecasting HSC abundance, to guiding annual decisions about HSC bait harvest.

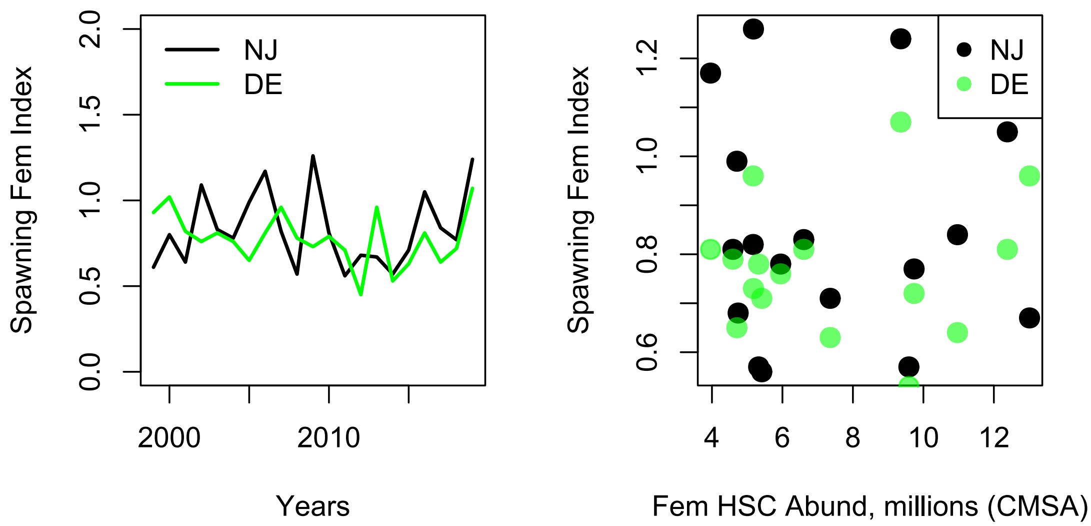

***Figure 6**. Comparisons of standardized HSC spawning female counts from DE and NJ beaches (an index of relative female HSC abundance analogous to trawl surveys) with (left) each other and (right) with the CMSA estimates of female HSC abundance in Delaware Bay (in millions). The two spawning surveys exhibit very little correlation between the NJ and DE sides of Delaware Bay from 1999 to 2018 (left panel; correlation = 0.25). In addition, there is no detectable relationship between spawning counts (on either the NJ or DE sides) and CMSA estimates of female HSC abundance (right panel).*

In summary, the CMSA model does not perform well when predicting to the training data (the three sources of data used to fit the model). Although the model can explain some of the apparent difference in mean HSC abundance before and after the 'VT gap years', this 'ability' is driven by inflated recruitment rate estimates during the VT gap years that cannot be verified empirically (see below). Furthermore, the CMSA model explains virtually none of the observed variation in HSC spawning abundance from the same period, which represents an independent index of HSC population size. The poor performance of the CMSA model in predicting observed variations in HSC abundance in Delaware Bay calls into question the utility of this model – which is central to all aspects of the ARM model – as a robust system for characterizing and predicting the HSC population in Delaware Bay.

4. The "gap years" in the VT trawl survey data raise concerns about HSC recruitment estimates from the Catch Multiple Survey Analysis (CMSA)

As noted previously, the CMSA is fundamental to the proposed ARM framework. For the HSC population simulation models, the primary role of the CMSA is to parameterize HSC recruitment rates (which are the most consequential empirically derived inputs for the HSC simulation model). Unfortunately, of the three trawl surveys used to fit the CMSA models, the only survey that provides information for estimating recruitment – the Virginia Tech (VT) trawl surveys – was not conducted during a critical four-year period from 2013 to 2016 (referred to in this report as the "VT gap", during which no direct information was available for estimating annual HSC recruitment; note that the missing survey years were actually 2012-2015, but the VT results were lagged forward within the CMSA to ensure comparability with the DE and VT trawls). The lack of information on primiparous abundance during the VT gap years leads to several nonsensical results in the CMSA model. For example, in one year (2013; the first VT gap year) the estimated number of new female recruits is near 10 million – approximately 8 times larger than the average estimated recruitment rate from the 10-year period from 2003 to 2012 and 4 times larger than the maximum estimate during this 10-year time frame (ARM Supplemental Table 3). The following year (2014), the point estimate for primiparous abundance goes down to 2, i.e., 2 primiparous female individuals across Delaware Bay. Furthermore, the standard error estimates for primiparous abundance during the VT gap years are very large – in fact, the upper bound on the confidence intervals approaches infinity for one year (2014).

The CMSA results suggest that the HSC population underwent a substantial state transition during the VT gap years in which the population was small but stable prior to the gap, and larger and more variable after the gap. In the fitted CMSA model, this state transition appears to be driven by extremely high recruitment rates during the VT gap years. Concerningly, the CMSA model (including the Bayesian version of the CMSA model described above) predicts much higher mean annual recruitment rates during the VT gap (for which no data are available for estimating recruitment) than at any single year before or after (Fig. 7). Specifically, mean annual recruitment during the VT gap years was estimated at 4.2 million (using the arithmetic mean, per the ARM report), versus 1.2 million before the gap and 1.9 million after the gap (using the geometric mean to represent the median of a lognormally distributed sample, per the ARM report). The inflated mean recruitment rates during the VT gap period are subsequently used for estimating the average HSC recruitment rate for the HSC simulation models (thereby increasing estimated population resilience to harvest) – but unfortunately these high recruitment rates cannot be verified empirically.

In summary, the CMSA model estimates abnormally high annual recruitment rates during the VT gap years (Fig. 7). These very high estimates are unverifiable, as no data on HSC recruitment was collected during these years. In the original ARM report, the average annual recruitment used in the HSC simulation model relied heavily on the inflated estimates of recruitment during the VT gap years, discounting the pre-gap years entirely. After peer-review, the ARM was altered to consider all years instead of discarding lower estimates from the pre-gap years. Nonetheless, the revised ARM model continues to treat the mean recruitment rate during the VT gap as reliable, allowing these inflated estimates to contribute to the estimate of average annual HSC recruitment used for the HSC simulation models (which are highly sensitive to the estimate of average recruitment; ARM Fig. 33). If the extremely high recruitment estimates during the VT gap years were to be excluded from this estimation process out of precaution, the average annual HSC recruitment rate would drop substantially (Fig. 7), further reducing the expected resilience of this population to harvest pressures. Ultimately, the inflated estimates of recruitment during the VT gap years are likely to be an artifact of the CMSA model specification (and the lack of data on recruitment for those years) and are unlikely to be reflective of true HSC recruitment rates. However, there remains no way to verify HSC recruitment rates during this period. Given this uncertainty, a conservative (precautionary) approach would be to exclude the VT gap years when computing recruitment for the HSC population simulations (Fig. 7).

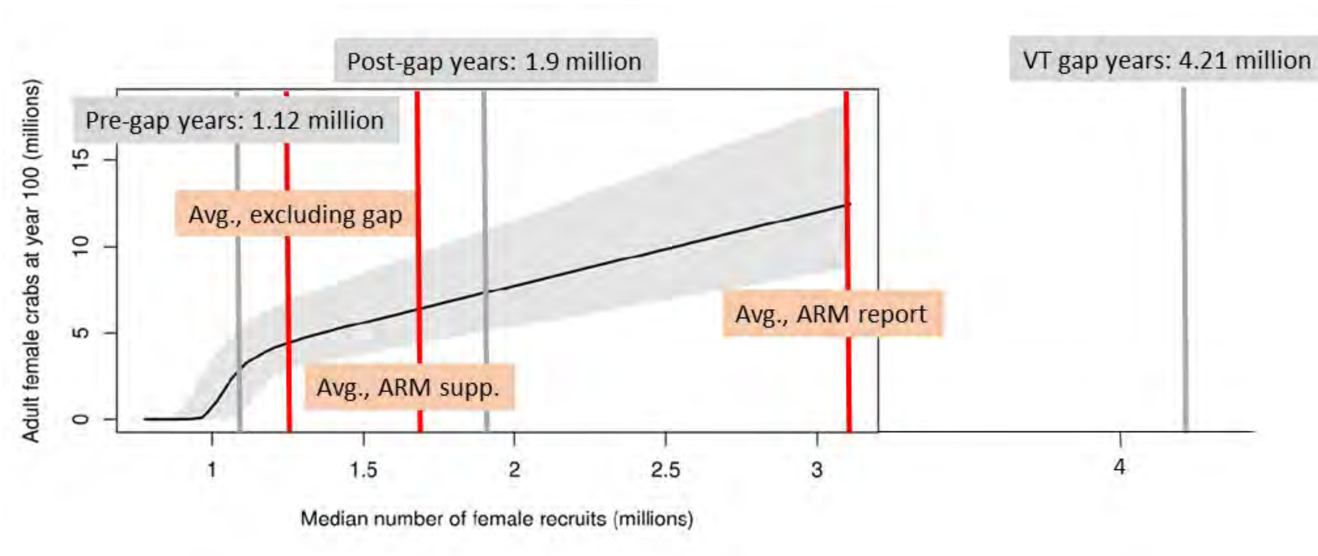

***Figure 7**. Annotated version of ARM Fig. 33, which (in its original form) illustrates the sensitivity of HSC simulation results to changes in average HSC recruitment rates. Annotations reflect the average female recruitment before, after and during the VT gap years (in gray), the average recruitment value used in the original 2021 ARM report (red, far right), the value used in the supplemental report produced after peer-review (red, middle) and the analogous estimate computed by excluding the VT gap years (red, left). Average recruitment estimated for the VT gap years (arithmetic mean of 4.21 million based on the latest CMSA results) falls well outside the range of estimates during years for which recruitment was an observable process (and well outside the range of the x-axis of the original figure). The ARM report ignored recruitment estimates from the pre-gap years, giving very high weight to the inflated estimates during the VT gap years. Based on the peer-review, which suggested that the pre-gap years should not be excluded from the estimation of average recruitment rates, the current proposed value (described in the ARM supplement) is much lower than the value used in the ARM report (1.67 million vs. 3.1 million). However, the new proposed value continues to include unverifiable estimates from the VT gap years. If the VT estimates were excluded out of precaution, the average annual HSC recruitment would drop to 1.26 million, perilously close to the sustainability threshold identified in this figure (i.e., ARM Fig. 33).*

5. The proposed ARM framework lacks 'null model' benchmarks and independent performance validation

Null models are simplified representations of a system that lack many or all the explanatory mechanisms hypothesized to operate in the system. In statistics (e.g., linear regression analysis) the typical null model assumes all system variation is a result of unexplained variance in the form of random noise (often a single random error process). In other contexts, null models may include additional processes/mechanisms but omit a key focal mechanism, enabling researchers to test whether that focal mechanism contributes usefully to predictive performance. In the context of adaptive harvest management, a null model would at least omit consideration of the impacts of harvest processes on system dynamics, which ultimately informs management decisions (Koons et al. 2022). By comparing complex models such as those used in the revised ARM with one or more null-model benchmark(s), researchers can determine whether the more complex models represent useful learned knowledge about a system (Koons et al. 2022). If a complex model fails to outperform a null model in terms of bias or precision (typically using independent validation data), the complex model is likely to be improperly specified or "overfitted" (whereby parameters are fitted to "noise" rather than true signal; Radosavljevic and Anderson 2014) and therefore not useful for prediction.

In the context of the HSC fishery in Delaware Bay, it would be informative to compare the performance of the HSC simulation model against a null model that omits all information about HSC harvest from the model fitting process; this would enable assessment of our current understanding of how estimated rates of harvest affect the HSC population. Given the poor fit of the HSC simulation model to training and validation data (see above), the HSC simulation is unlikely to outperform simpler null models. In fact, the CMSA model fails to outperform the simplest standard null model (single intercept term with sampling error) for at least one data source (the VT swept-area estimate of female multiparous abundance) despite its complexity (~20 parameters for the CMSA vs 1 parameter for describing expected abundance each year). If the HSC simulation model fails to outperform a model in which population dynamics are driven by noise instead of harvest, it should prompt managers to acknowledge that our current understanding of the effects of harvest on HSC populations remains insufficient for robust forecasting (Dietze 2017).

For the REKN component of the revised ARM, it would be informative to compare the performance of the REKN simulation model against a null model that omits any effect of female HSC abundance. It was recently demonstrated (Koons et al. 2022) that the ARM framework for guiding North American mallard harvest was unable to outperform a null model, and it would be instructive to pose a similar challenge to the REKN simulation model. Given that all the deterministic processes (fixed effects) included in the IPM model were very weak (i.e., the HSC effect on survival and fecundity; see above) or "non-significant", it is already apparent that random noise overwhelms most signal in the training data regarding how the HSC population affects REKN population dynamics. Therefore, it is likely that information about the HSC/REKN relationship would explain little if any of the variation in independent validation data. Furthermore, the lack of a relationship between the HSC model (CMSA) and the number of spawning females observed on coastal beaches (see above) makes it even more unlikely that the current REKN population model would outperform a null model that excludes any effect of HSC abundance (since the HSC/REKN relationship is based on the consumption by REKNs of HSC eggs deposited by spawning females).

In summary, null model benchmarks should be incorporated into the ARM framework to ensure that effective learning is occurring and that managers acknowledge uncertainty about how their decisions affect the populations they are charged with managing (Koons et al. 2022). If one or both simulation models that form the core of the revised ARM framework fail to outperform null models, it would strongly suggest that the ARM framework's current level of understanding about how management decisions are likely to affect the HSC and REKN populations is insufficient for robust forecasting of population-level risk to either species from HSC harvest. Although the ARM process is designed to treat management actions as opportunities for learning – updating harvest recommendations as new data become available (Nichols et al. 2007) – the fact that one of these species is federally threatened (USFWS 2014) justifies a more precautionary approach for risk management.

6. Lack of transparency

The public still has no access to the data and code used for (1) estimating REKN population parameters via a Bayesian integrated population model (IPM), (2) simulating REKN and HSC population dynamics, and (3) running the optimization routines via approximate dynamic programming (ADP). The CMSA code and data were made available, which enabled me to re-analyze the HSC survey data and run informative scenario tests (see above). Without the data and code for other components of the ARM model, it is not possible to re-analyze the data, test key assumptions, or simulate population dynamics under different hypothetical scenarios. Given the substantial concerns generated by the data and code that has been made publicly available to date (discussed above), such further re-analysis, testing, and simulation is warranted. If granted access to the code and data, there are several important questions that could be addressed more thoroughly, including but not limited to:

1) How would HSC abundance projections change – and how would harvest functions change – under the lower mean recruitment estimate produced by excluding anomalous estimates from the VT gap years?
2) What would happen to the REKN population projections if female HSC abundance were set to zero?
3) Does the REKN projection model outperform a null model that excludes any effect of HSC abundance?
4) In the REKN IPM, does the effect of HSC abundance disappear (or flip sign to become a negative relationship) under alternative plausible model specifications?
5) What proportion of variation in apparent survival in the REKN IPM model is explained by the HSC effect vs. random among-year variation?
6) Does an index of HSC spawning or HSC egg densities explain more variation in REKN survival and fecundity than the CMSA-derived estimate of HSC abundance?

CONCLUSION

In this report I have outlined six major concerns about the revised ARM. First, the modeled relationship between REKN vital rates and HSC abundance does not appear to be strong enough to induce an expected decline in the REKN population even under a catastrophic collapse of the HSC population. The apparent inability of the model to predict a major population response of REKNs to the depletion of the Delaware Bay HSC stock invalidates the premise of including a REKN population model within the ARM framework, which implicitly assumes that (1) HSC eggs are a critical resource for REKN populations and (2) HSC harvest could inhibit or slow the recovery of the REKN population, at least under some circumstances. The apparent inability of the ARM model to show a strong population-level effect of HSC harvest on REKN populations is inconsistent with the observed decline of the REKN population in recent decades, which many researchers have attributed to increased HSC harvest rates in the 1990s. Therefore, the REKN model included as part of the revised ARM does not appear to be a useful tool for assessing and managing risks to the REKN population from HSC harvest – or for promoting recovery of the REKN population.

In addition, I have identified several concerns about the HSC data analysis and simulation models. First, the HSC model in the revised ARM does not appropriately address key sources of uncertainty – particularly with respect to HSC fecundity (the source of potential harvest resilience). When these sources of uncertainty are addressed, the outlook for the HSC population is more uncertain than indicated in the ARM report. My analyses indicate that harvest at the maximum allowable levels could put the population in jeopardy (~11% risk) of decline below 3 million females – well below the minimum level previously recorded – within the next 50 years. In addition, the Catch Multiple Survey Analysis (CMSA), which is central to all aspects of the ARM, appears to exhibit poor fit to both training and independent data. I was unable to detect any correlation between the CMSA estimate of female HSC abundance and the estimated number of spawning females on coastal beaches in Delaware Bay. Finally, the estimate of HSC recruitment (which determines harvest resilience in the projection models) used in the revised ARM incorporates questionable (and highly inflated) estimates from a four-year period during which direct information on HSC recruitment was not available. Taken together, the above concerns strongly suggest the ARM model is not a valid tool for managing risk to the HSC population in Delaware Bay.

My final concerns are more general. First, I suggest that both the REKN and HSC models should be subjected to more rigorous evaluation, including tests for whether these models are able to outperform "null model" benchmarks that assume no useful learned knowledge about population dynamics and population response to harvest and harvest management. Ecological null models provide a useful benchmark for gauging the degree to which knowledge is accrued through the adaptive management process, and a mechanism for keeping modelers and managers "honest" by acknowledging an incomplete or inadequate understanding of the systems they are charged with managing. My analysis demonstrates that the CMSA model fails to outperform the simplest statistical null model for at least one data source. Finally, I was not provided access with much of the data and code used to generate the models used in the revised ARM (except for the CMSA code and data). Given the concerns that are apparent based on analysis of the limited code and data made available to date, it seems prudent to, at a minimum, delay implementation of this framework until the public and outside experts have had adequate time to scrutinize the statistical and simulation models that play such a central role in this proposed decision-making framework.

Despite the lack of transparency, I was able to run several informative re-analyses and scenario tests with the information provided in the ARM report and supplement, and with the CMSA code and data. Based on my analysis, there is sufficient evidence to conclude that the ARM framework is not useful for assessing the resilience of the HSC population to harvest pressures, nor for managing risk to the REKN population due to HSC harvest.

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EXPERT REPORT

Romuald N. Lipcius, Ph.D.

29 September 2022

Contents

1 Scope of Work

I was asked by representatives of EARTHJUSTICE to evaluate the Atlantic States Marine Fisheries Commission's Report and Supplemental Report to the 2021 Revision to the Adaptive Resource Management (ARM) Framework dealing with horseshoe crab (*Limulus polyphemus*) fishery management and implications for red knot (*Calidris canutus*) conservation. The red knot (RK hereafter) has been listed as "threatened" under the Endangered Species Act, and relies on horseshoe crab eggs buried along beaches of Delaware Bay to feed as it migrates along North and South America. The conclusions in the ARM report relate to an amendment proposed through the Atlantic States Marine Fisheries Commission (ASMFC) that would likely allow female horseshoe crab (HSC hereafter) harvest in Delaware Bay for the first time since 2012 and thereby potentially reduce food provisions (HSC eggs) needed by migrating RK. My primary goal is to evaluate the evidence in favor of the amendment objectively and determine if the amendment is justified.

In forming my opinions, I reviewed and considered various data sources regarding the HSC fishery and RK conservation along the Mid-Atlantic coast, with emphasis on Delaware Bay. My opinions are also based on my extensive experience conducting research and providing technical advice on fishery management and conservation of various marine species (see Section 8). My compensation is not contingent upon the conclusions or outcome of my review.

2 Summary Opinion

Based on my analysis and my expertise in conservation, fisheries and fishery management, I conclude to a reasonable degree of scientific certainty that:

The proposed amendment that would allow harvest of female horseshoe crabs is not justified by the available scientific evidence, due to various *risk-prone* decisions and assumptions that underlie the Adaptive Resource Management framework and model. The proposed amendment thereby poses a significant risk both to the Horseshoe Crab population and Red Knot recovery.

3 Abbreviations and Definitions

ARM: Adaptive Resource Management framework
HSC: Horseshoe Crab (*Limulus polyphemus*)
RK: Red Knot (*Calidris canutus*)
VTS: Virginia Tech HSC survey
DES: Delaware HSC survey
NJS: New Jersey HSC survey
Risk-prone: Conservation or management actions based on overly optimistic assumptions about the status of a population. The assumptions may be about data sources, observations or data, and often involve ignoring information to the contrary of optimistic conclusions about population status. For endangered or threatened species, a risk-averse, rather than risk-prone, strategy based on the precautionary principle is critical for population recovery, population conservation, and sustainable resource management.

4 Opinions

The following specific opinions describe various lines of evidence indicating that the HSC population is not in a healthy state and has not fully recovered despite a prohibition on female harvest since 2012. The different lines of evidence are effectively "red flags" leading to the conclusion that the current and proposed management strategies are risk-prone, such that harvest restrictions should not be relaxed at present. To the contrary, further management actions or improvements to the current management plan are necessary to stimulate HSC recovery. Furthermore, due to the lack of *substantial* improvement of the HSC spawning stock (i.e. mature females), the existing HSC management strategy has not significantly enhanced food availability for the threatened RK and therefore its recovery. A shift to risk-averse management based on the precautionary principle is essential for HSC and RK recovery.

4.1 Low Newly Mature Female, Recruit and Spawning HSC Abundance

An expectation from the female harvest prohibition is a rebound in young mature females and recruitment of immature males and females into the HSC population. In 2019 and 2020, abundance of newly mature females was at an all-time low; recruitment of immature females and males was extremely low and unchanged since before the prohibition; and female abundance in the spawning survey dropped sharply in 2019. These are warning signs that the HSC population has not fully recovered and may even be declining. Thus, female harvest should not be raised.

4.2 Smaller Body Size of Mature Female HSC

An expectation of the female harvest prohibition is that female body size would increase, given constant recruitment, which is a typical response in fisheries worldwide when harvest pressure on older, larger females is reduced. On the contrary, mean size of mature female HSC was smallest in the last 3 years (2018 to 2020) and of newly mature females in the last 2 years of the time series from 2002 to 2020, despite the prohibition on female harvest since 2012. These data are inconsistent with the previous expectation and the premise that the female segment of the HSC population has rebounded.

4.3 Loss of Large Mature Female HSC and Lower Egg Production

Population egg production is a function of spawning stock (= mature females) biomass (i.e. weight). Hence, changes in size distribution of mature females will affect total egg production, particularly the loss of large HSC females which contribute disproportionately to total egg production. Consequently, using only HSC abundance to estimate reproductive output and egg production is ignoring main biological drivers of population egg production–size structure and biomass–of the HSC spawning stock. Size distribution of mature females has shifted to smaller females. Abundance of females larger than 300 mm prosomal width (i.e. females with the highest egg production) has dropped recently, particularly from 2018 to 2020. Recent low recruitment means that smaller mature females are not compensating for the loss of larger mature females. Consequently, total reproductive (egg) output has likely not improved, which hampers recovery of the HSC and RK populations.

4.4 HSC Sex Ratio

When HSC harvest has been restricted to males, the ratio of males to females should have decreased. In contrast, male:female sex ratios have actually increased from 1999 to 2019. This represents another warning sign that the current management strategy has not been effective, that population dynamics are not well understood, and that harvest of females should not be increased.

4.5 High Mature Female HSC Mortality

The combination of discard mortality and bait harvest mortality for females has increased substantially in recent years and is comparable to levels before the prohibition. Assuming that the prohibition has worked is therefore risk-prone. The collective bait harvest and discard mortality is not being controlled effectively and inhibits HSC recovery.

4.6 Reliance on HSC Density as the Indicator of HSC Population Status

Female density (catch per unit area) is a primary variable used in HSC surveys and the ARM framework model. Reliance solely on HSC density or abundance ignores other variables that commonly produce warning signs about the status of a stock, such as female size, female size-frequency distribution, spawning stock biomass and female:male sex ratio. These variables are often more sensitive indicators of problems in a population, meaning that they can detect problems more effectively than abundance estimates. Hence, the current management strategy is risk-prone by ignoring these more sensitive indicators.

4.7 Low HSC Egg Density

Recent data indicate that HSC egg densities in HSC spawning habitats and RK feeding grounds remain an order of magnitude below densities when RK and HSC were relatively abundant. The ARM process has decided to ignore patterns in HSC egg density because of methodological "uncertainty" in the data. Under conditions where a population is not in danger, this may be acceptable, but absolutely not when it represents a potential warning sign about a population in danger, such as the RK. Thus, lack of use of HSC egg density data, as a proxy for RK food availability, amounts to a failure to incorporate all available scientific information into the analysis to guide management decisions in a risk-averse manner.

4.8 Lack of Correlation of HSC Surveys

Data from the DES and NJS of HSC in Delaware Bay are assumed to be correlated with the VTS and used to fill in survey gaps in the VTS. Survey data when all three surveys were conducted are not correlated, and data from the DES and NJS were relatively higher than that from VTS. These results lead to an overestimation of HSC abundance during VTS gap years, which is indicative of a risk-prone assumption.

4.9 Degraded HSC Spawning Habitat and RK Feeding Grounds

Spawning habitat (e.g. beaches) for HSC and feeding grounds for RK have been lost throughout the stopover range of RK in the Mid-Atlantic. Loss of habitat is an additional stress that demands risk-averse management of mortality sources (e.g. fishing) which management can control. There may be variables that are beyond ASMFC's control, but that means they should be more precautionary with variables they can control, and it's certainly not a valid basis for ignoring warning signs like reduced HSC egg density and abundance.

5 Evidence for Opinions

The VTS is based on robust experimental design principles, and is the only spatially widespread survey that includes the coastal zone along Delaware and New Jersey, as well as Delaware Bay. In addition, the VTS collects much more comprehensive demographic data, which enables more types of analysis. Thus, the VTS serves as a robust and independent measure of HSC population status. The remainder of the analysis therefore focuses on data from the VTS and other published information on horseshoe crabs and the red knot. All analyses were conducted using the statistical software package R, version 4.1.2 (2021).

5.1 Low Newly Mature Female, Recruit and Spawning HSC Abundance

An expectation from the female harvest prohibition is a rebound in young mature females and recruitment of immature males and females into the HSC population. In 2019 and 2020, abundance of newly mature females was at an all-time low; recruitment of immature females and males was extremely low and unchanged since before the prohibition; and female abundance in the spawning survey dropped sharply in 2019. These are warning signs that the HSC population has not fully recovered and that female harvest should not be raised.

Data from the VTS on abundance of newly mature female HSC in 2019 and 2020 were at the lowest levels in the time series since 2002, indicating low influx of young mature females into the spawning stock (Figure 1). Similarly, abundance of immature female and male HSC, representing future recruitment to the adult segment and spawning stock of the population, were at extremely low levels and unchanged from those before 2013 (Figure 1). Moreover, female abundance in the Delaware Bay Horseshoe Crab Spawning Survey dropped sharply in 2019 (Figure 2), despite the prohibition of female harvest since 2012.

5.2 Smaller Body Size of Mature Female HSC

An expectation of the female harvest prohibition is that female body size would increase, given constant recruitment, which is a typical response in fisheries worldwide when harvest pressure on older, larger females is reduced (Beverton and Holt, 1956; Gedamke and Hoenig, 2006). On the contrary, mean size of mature female HSC was smallest in the last 3 years (2018 to 2020) and of newly mature females in the last 2 years of the time series from 2002 to 2020, despite the prohibition on female harvest since 2012. These data are inconsistent with the previous expectation and the premise that the female segment of the HSC population has rebounded.

VTS data were examined in two ways (mean and mode of size-frequency histograms) to evaluate this expectation. First, the time series of mean size in the VTS (Figure 3) indicated that mean sizes of mature female HSC and of newly mature females from 2016 to 2020 were the smallest in the time series from 2002 to 2020, despite the prohibition of female harvest since 2012.

Given that the mean of a sample can be influenced by outliers, the size data were also examined using a non-parametric statistic, the mode. The median could not be calculated because the raw data were unavailable for this analysis. The mode for each year was visually estimated from the size-frequency histograms of mature females (Appendix Figures 10 and 11). As with the mean, modal sizes of mature females from 2018 to 2020 were the lowest in the time series (Figure 4). In contrast, modal sizes of mature males were relatively unchanged (Figure 4).

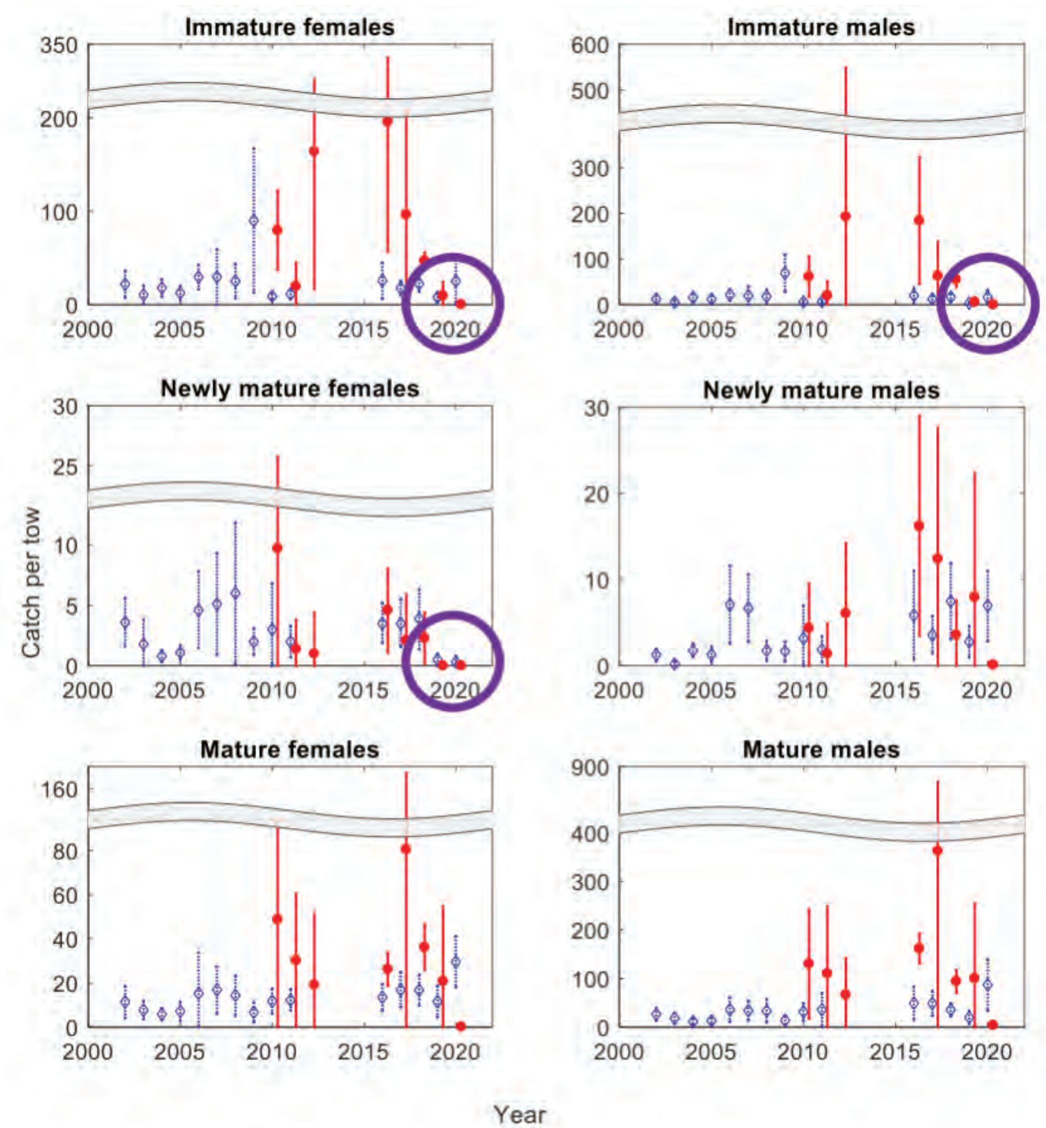

Figure 1: Densities of HSC males and females from Figure 3 of the VTS report (Hallerman and Jiao, 2021). Purple circles have been added to highlight the warning signs that the HSC population has not fully recovered.

Mean body size of spawning females could decrease over time if there was high recruitment of smaller, newly mature females shifting down the average size. However, the opposite (weak recruitment) appears to be the case, as described in section 5.1.

5.3 Loss of Large Mature Female HSC and Lower Egg Production

Population egg production is a function of spawning stock (= mature females) biomass (i.e. weight). Hence, changes in size distribution of mature females will affect total egg production, particularly large HSC females which contribute disproportionately to total egg production. Consequently, using only HSC abundance to estimate reproductive output and egg production is ignoring the main biological drivers of population egg production–size structure and biomass–of the HSC spawning stock. Size distribution of mature females has shifted to smaller females. Abundance of females larger than 300 mm prosomal width (i.e. females with the highest egg production) has dropped recently,

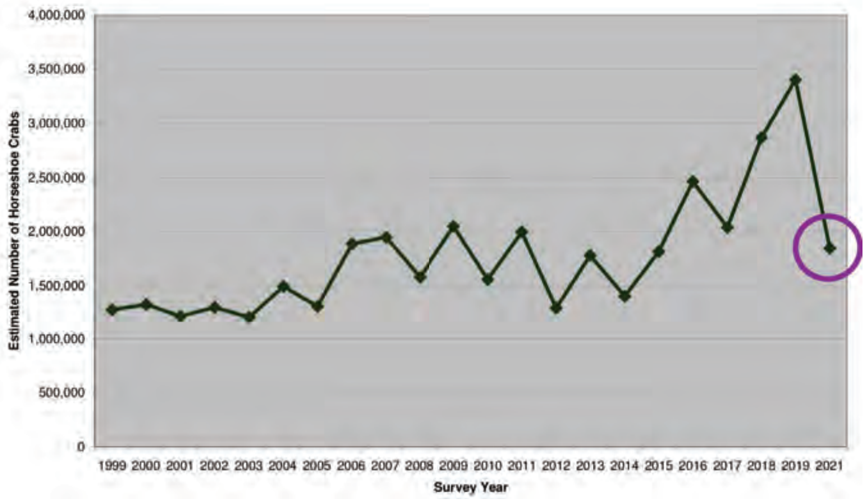

Figure 2: Spawning horseshoe crab survey data, highlighting low abundance of spawning horseshoe crabs in 2021 Swann and Hall (2019).

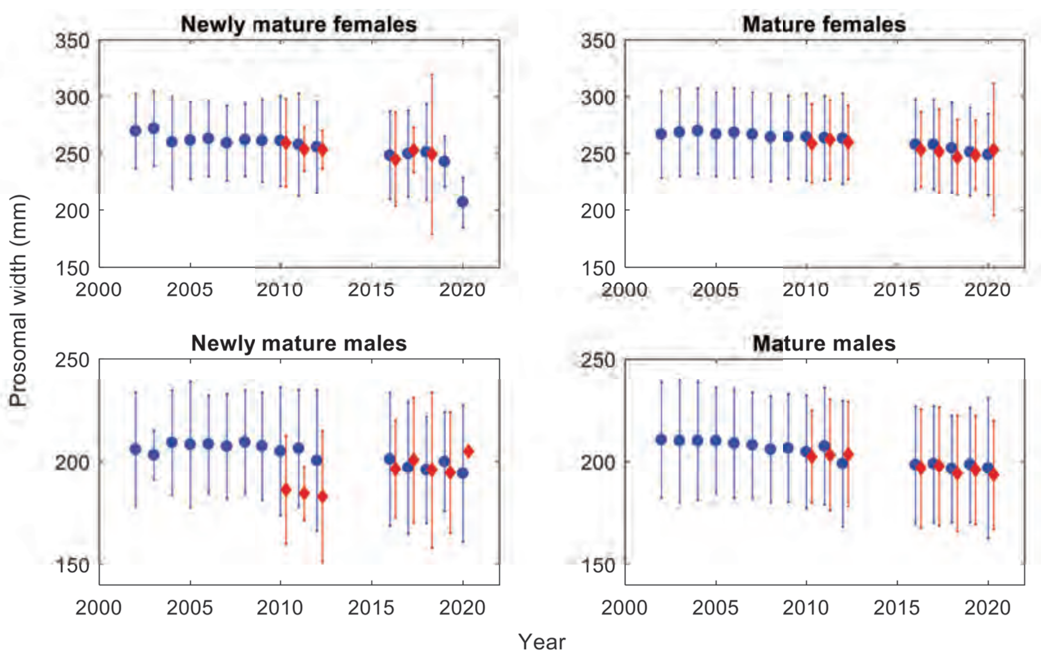

Figure 3: Mean sizes of newly mature and mature female and male horseshoe crabs over 2010 to 2020, with gap years from 2012 to 2015, from the VT survey in the coastal Delaware Bay area (Hallerman and Jiao, 2021).

particularly from 2018 to 2020. Recent low recruitment means that smaller mature females are not compensating for the loss of larger mature females. Consequently, total reproductive (egg) output has likely not improved, which hampers recovery of the HSC and RK populations.

For an individual HSC female, her egg production is directly proportional to individual weight, which is an exponential (not linear) function of prosomal width (Figure 5), as in other species of horseshoe crabs (Chatterji, 1995) and marine species in general (Barneche et al., 2018).

Changes in size distribution of mature females, particularly large HSC females which contribute disproportionately to total egg production due to the exponential increase in weight with size (Figure 6), will reduce population egg production. This was validated for an HSC population by

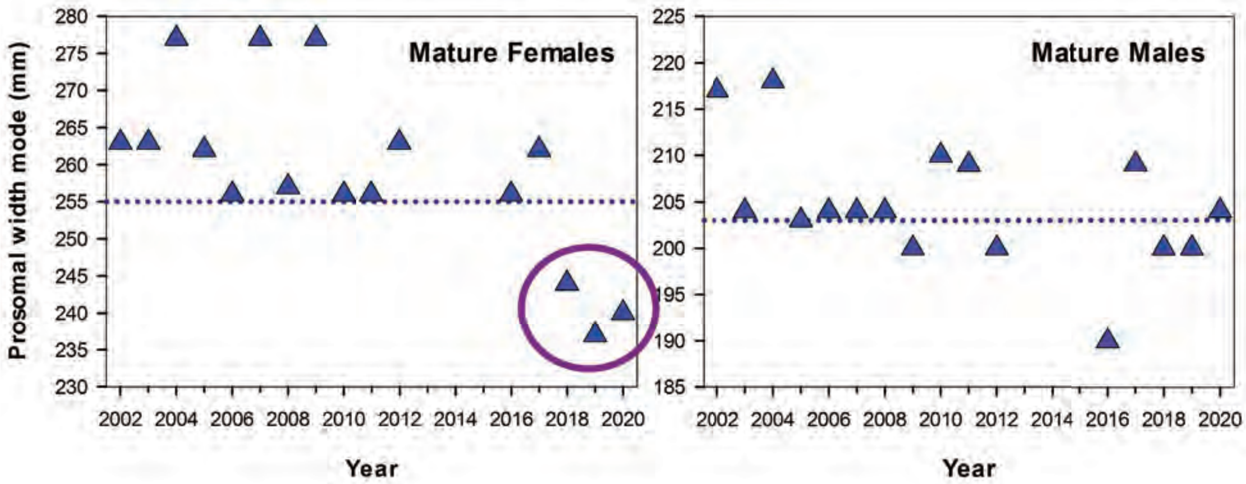

Figure 4: Size modes of mature female and male horseshoe crabs over 2002 to 2020 (gap years from 2013 to 2015) from the VTS in the coastal Delaware Bay area. Mode sizes were estimated from Figures 10 and 11.

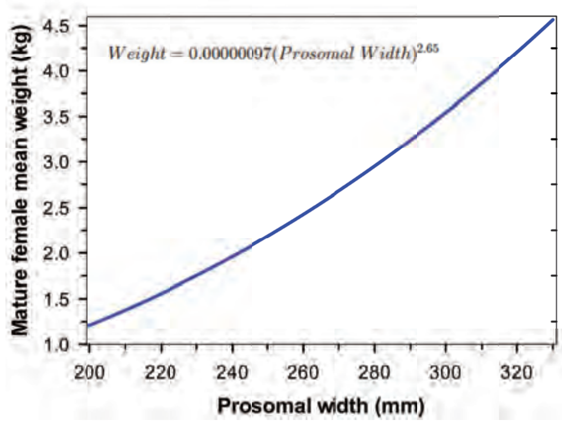

Figure 5: Exponential relationship between mature female HSC weight (kg) and prosomal width (mm) derived from Table 3 in Graham et al. (2009).

Leschen et al. (2006), who concluded that "larger females held a larger number of eggs (63,500) than smaller females (14,500) [and] laid a higher percentage of the eggs they contained. Thus they not only contain more eggs, but are more effective at laying them as well."

Using only HSC abundance to estimate reproductive output and egg production is ignoring the main biological drivers of population egg production–size structure and biomass (weight)–of the HSC spawning stock. Abundance is a reliable proxy of HSC egg production only if size structure of the spawning stock is unchanged over time, which is not the situation with the HSC spawning stock. Size distribution of mature females has shifted to smaller females (Figures 3 and 4), and recruitment does not account for the recent shift in size distribution because abundance of newly mature and immature females in the past few years has been well below average (Figure 1).

Abundance of females larger than 300 mm prosomal width (i.e. females with the highest egg production) has dropped recently, particularly from 2018 to 2020 (Appendix Figures 10 and 11), which has substantially reduced egg production. Note in Figures 10 and 11 that females larger than 300 mm prosomal width were apparent in 6 of 8 years from 2002 to 2009 (Figure 10), but only in 1 of 8 years from 2010 to 2020 (Figure 11). Moreover, the recent low recruitment means that

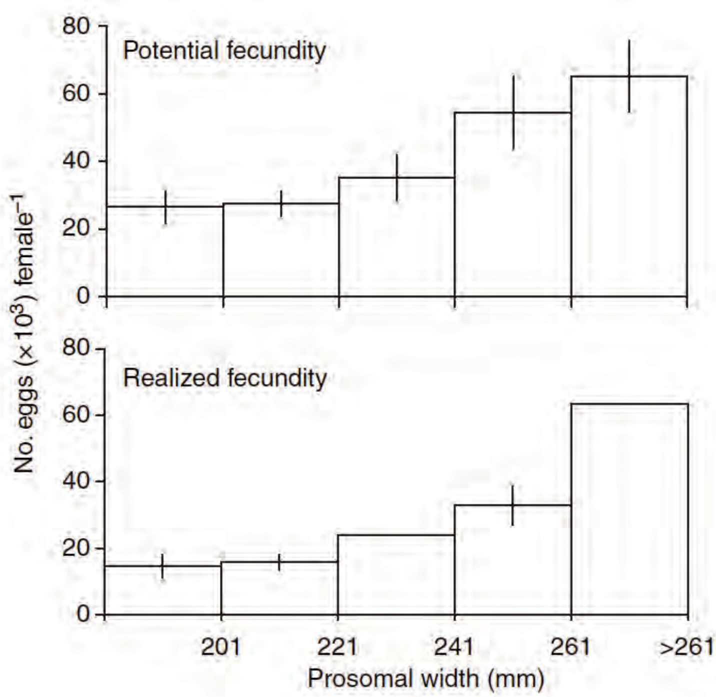

Figure 6: Positive relationship between HSC female fecundity and prosomal width (Leschen et al., 2006).

smaller mature females are not compensating for the loss of larger mature females. Consequently, total reproductive (egg) output has likely not improved, which hampers recovery of the HSC and RK populations.

5.4 HSC Sex Ratio

When HSC harvest has been restricted to males during the prohibition, the ratio of males to females should have decreased. In contrast, male:female sex ratios have actually increased from 1999 to 2019. This represents another warning sign that the current management strategy has not been effective, and that harvest of females should not be increased.

To assess HSC sex ratio over time, particularly since the prohibition on female harvest, I examined sex ratio data from the 2019 Delaware Bay Horseshoe Crab Spawning Survey, Table 5 (Figure 7). The time series shows an initial drop in the ratio of males to females during 2013, shortly after the prohibition on female harvest began. However, the ratio of males to females has increased since 2014 and even reached the highest ratios in the time series during 2018 and 2019.

5.5 High Mature Female HSC Mortality

The combination of discard mortality and bait harvest mortality for females has increased substantially in recent years and is comparable to levels before the prohibition. Assuming that the prohibition has worked is therefore risk-prone. The collective bait harvest and discard mortality is not being controlled effectively and inhibits HSC recovery.

Total mortality of females due to the bait fishery and its discards has increased substantially in recent years and is comparable to levels before the prohibition (Figure 8). Note that there is still a small amount of direct mortality due to the bait fishery (Figure 8), possibly due to inaccurate identification of female HSC by fishers. Thus, the prohibition on female harvest has not been

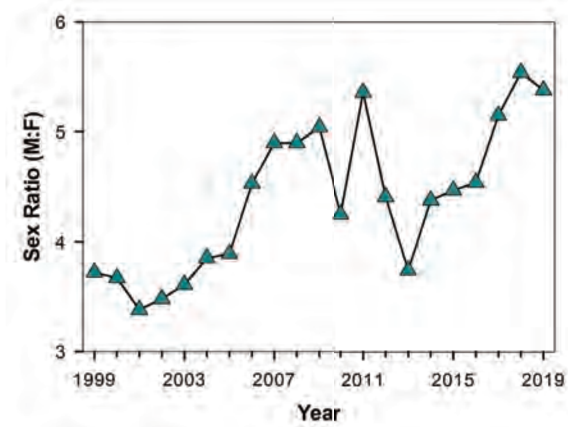

Figure 7: Sex ratio from the Delaware Bay Horseshoe Crab Spawning Survey Swann and Hall (2019).

effective in reducing female HSC mortality, and any further increase in female harvest is risk-prone and a danger to the HSC population and RK recovery.

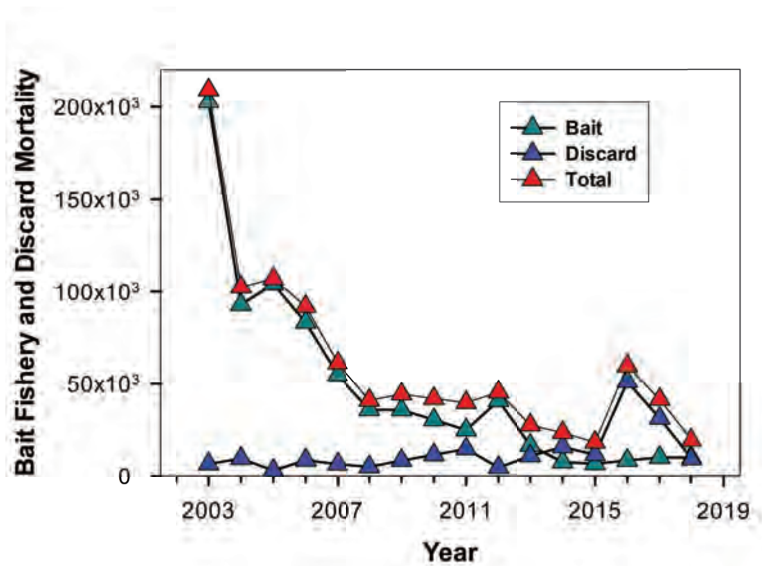

Figure 8: HSC mortality due to the bait fishery and discards (Adaptive Resource Management Subcommittee, 2022).

5.6 Reliance on HSC Density as the Indicator of HSC Population Status

Female density (catch per unit area) is a primary variable used in HSC surveys and the ARM framework model. Reliance solely on HSC density or abundance ignores other variables that commonly produce warning signs about the status of a stock, such as female size, female size-frequency distribution, spawning stock biomass and female:male sex ratio (Free et al., 2020; Punt et al., 2020). These variables are often more sensitive indicators of problems in a population, meaning that they can detect problems more effectively than abundance estimates alone. Hence, the current management strategy is risk-prone by ignoring these more sensitive indicators.

5.7 Low HSC Egg Density

Recent data indicate that HSC egg densities in HSC spawning habitats and RK feeding grounds remain an order of magnitude below densities when RK and HSC were relatively abundant. The ARM process has decided to ignore patterns in HSC egg density because of methodological "uncertainty" in the data. Under conditions where a population is not in danger, this may be acceptable, but absolutely not when it represents a potential warning sign about a population in danger, such as the RK. Thus, lack of use of HSC egg density data, as a proxy for RK food availability, amounts to a failure to incorporate all available scientific information into the analysis to guide management decisions in a risk-averse manner.

To assess changes in HSC egg density over time, I compared data for egg density before the peak of HSC harvest during 1985, 1986, 1988 and 1990 with data after the peak of HSC harvest from 1999 to 2021 (Smith et al., 2022). While the time series from 1999 to 2021 shows egg density increasing from an average of about 3,000 eggs per m^2 in 2000 to 9,000 eggs per m^2 in 2021 (Figure 6), egg density remains over an order of magnitude lower than that before the peak of HSC harvest during 1985 to 1990 (Figure 6).

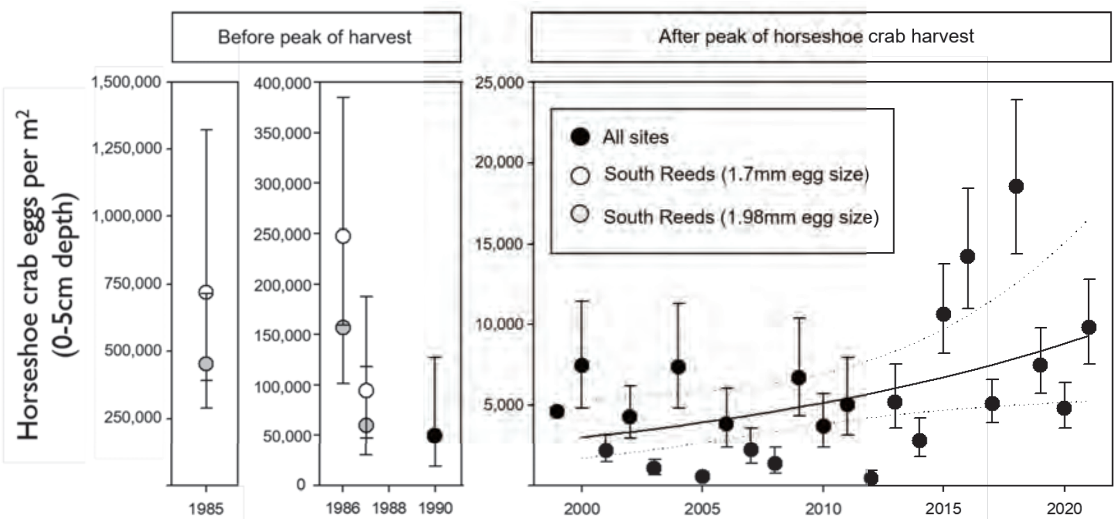

Figure 9: HSC egg density from spawning beaches, emphasizing the order of magnitude lower egg densities in recent years relative to historical levels in the spawning beaches. Note the different range of values in the left and right graphs. Figure from Smith et al. (2022).

5.8 Lack of Correlation of HSC Surveys

Data from the DES and NJS of HSC in Delaware Bay are assumed to be correlated with the VTS and used to fill in survey gaps in the VTS. Survey data when all three surveys were conducted are not correlated, and data from the DES and NJS were relatively higher than that from VTS. These results lead to an overestimation of HSC abundance during VTS gap years, which is indicative of a risk-prone assumption.

To evaluate the assumption of coherence between the three surveys, and justification for use of the DES and NJS in the four years when VTS data were unavailable, correlation between the three surveys was investigated. Data used in the analysis are those in Tables 1 and 2 from Adaptive Resource Management Subcommittee (2022) for indices VTS Multiparous Females, DES Adult and

NJS Ocean Trawl from 2003 to 2012, when indices were available for all three surveys prior to the 2012 prohibition.

Data for female and male HSC abundance from the three surveys were not correlated (Table 1), such that the use of data from two surveys (NJS and DES) to estimate data from the VTS survey during gap years when the VTS did not collect data is invalid. Furthermore, the NJS and DES produced data that were relatively higher than data from the VTS (positive intercepts in Table 1), indicating that the replacement data for the VTS using DES and NJS overestimate HSC abundance from the VTS.

Table 1: Correlation analysis for mature female HSC from VTS, NJS and DES.

Parameter	Estimate	Standard Error	t value	P
Females				
DES as a function of VTS: $r^2 = 0.01$				
Intercept	0.23	0.37	0.61	0.56
Slope	0.02	0.07	0.28	0.79
NJS as a function of VTS: $r^2 = 0.001$				
Intercept	1.96	0.67	2.91	0.02
Slope	-0.01	0.13	-0.07	0.95
Males				
DES as a function of VTS: $r^2 = 0.12$				
Intercept	0.03	0.23	0.12	0.91
Slope	0.02	0.02	1.03	0.34
NJS as a function of VTS: $r^2 = 0.03$				
Intercept	2.25	0.71	3.15	0.02
Slope	-0.03	0.06	-0.52	0.62

5.9 Degraded HSC Spawning Habitat and RK Feeding Grounds

Spawning habitat (e.g. beaches) for HSC and feeding grounds for RK have been lost throughout the stopover range of RK in the Mid-Atlantic. Loss of habitat is an additional stress that demands risk-averse management of mortality sources (e.g. fishing) which management can control. There may be variables that are beyond ASMFC's control, but that means they should be more precautionary with variables they can control, and it's certainly not a valid basis for ignoring warning signs like reduced HSC egg density.

A major threat to horseshoe crab population involves habitat degradation and loss, and is expected to worsen in the future due to sea level rise (Botton et al., 2022). Spawning habitat loss has been significant due to various factors such as shoreline management (e.g. bulkheading), coastal disturbances and sea-level rise (Smith et al., 2017, 2020). In some cases, whole beaches have been lost (Smith et al., 2017). Given that habitat loss is not under control by ASMFC, precautionary management demands consideration of such stressors to the population by control of fishery harvest to compensate for external stressors.

5.10 Appendix Figures

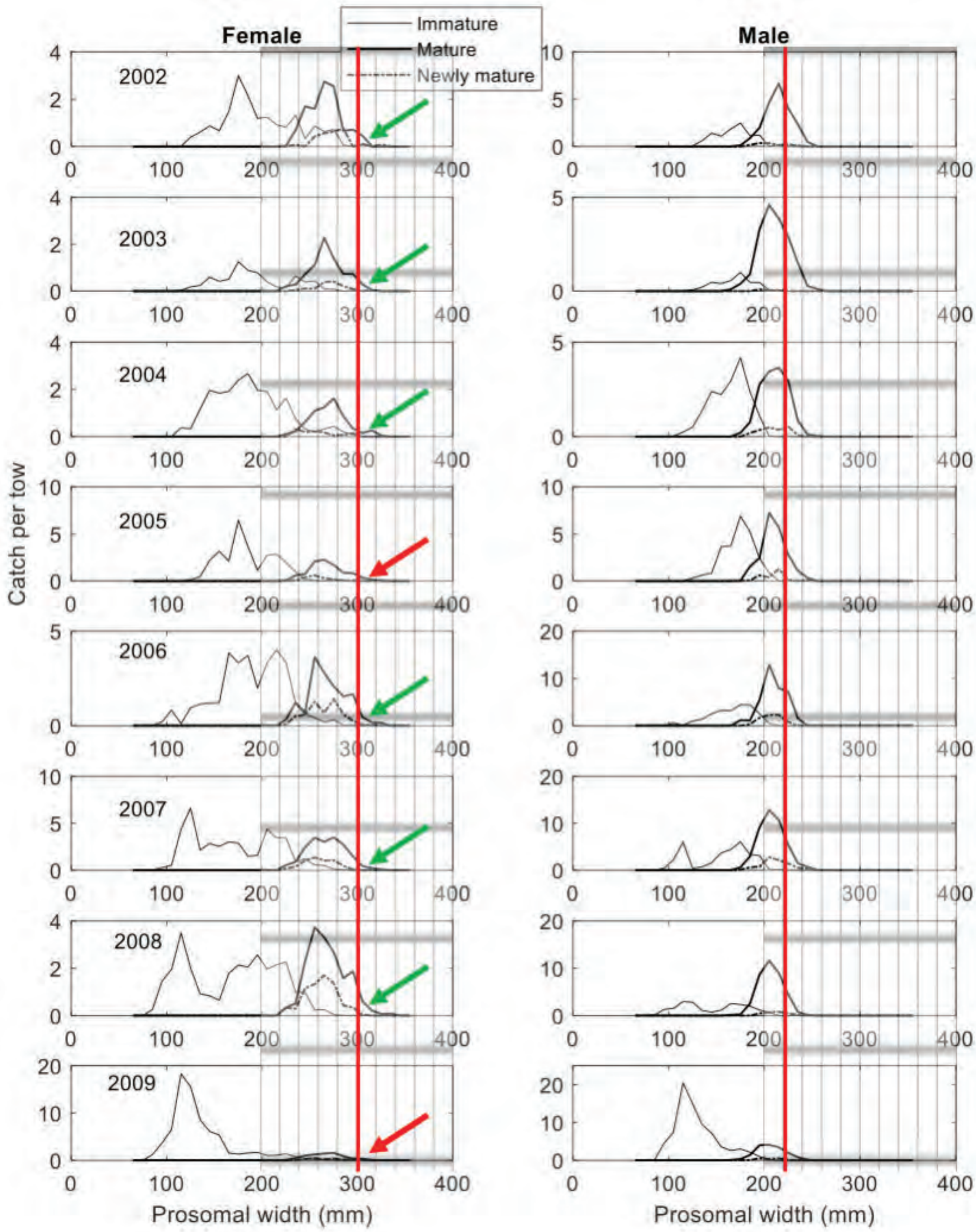

Figure 10: Size frequencies of mature female and male horseshoe crabs over 2002 to 2009 from the VT survey in the coastal Delaware Bay area (Hallerman and Jiao, 2021). Vertical red lines and grid cells were added for reference. Green arrows indicate years when mature females larger than 300 mm prosomal width were apparent, and red arrows when not.

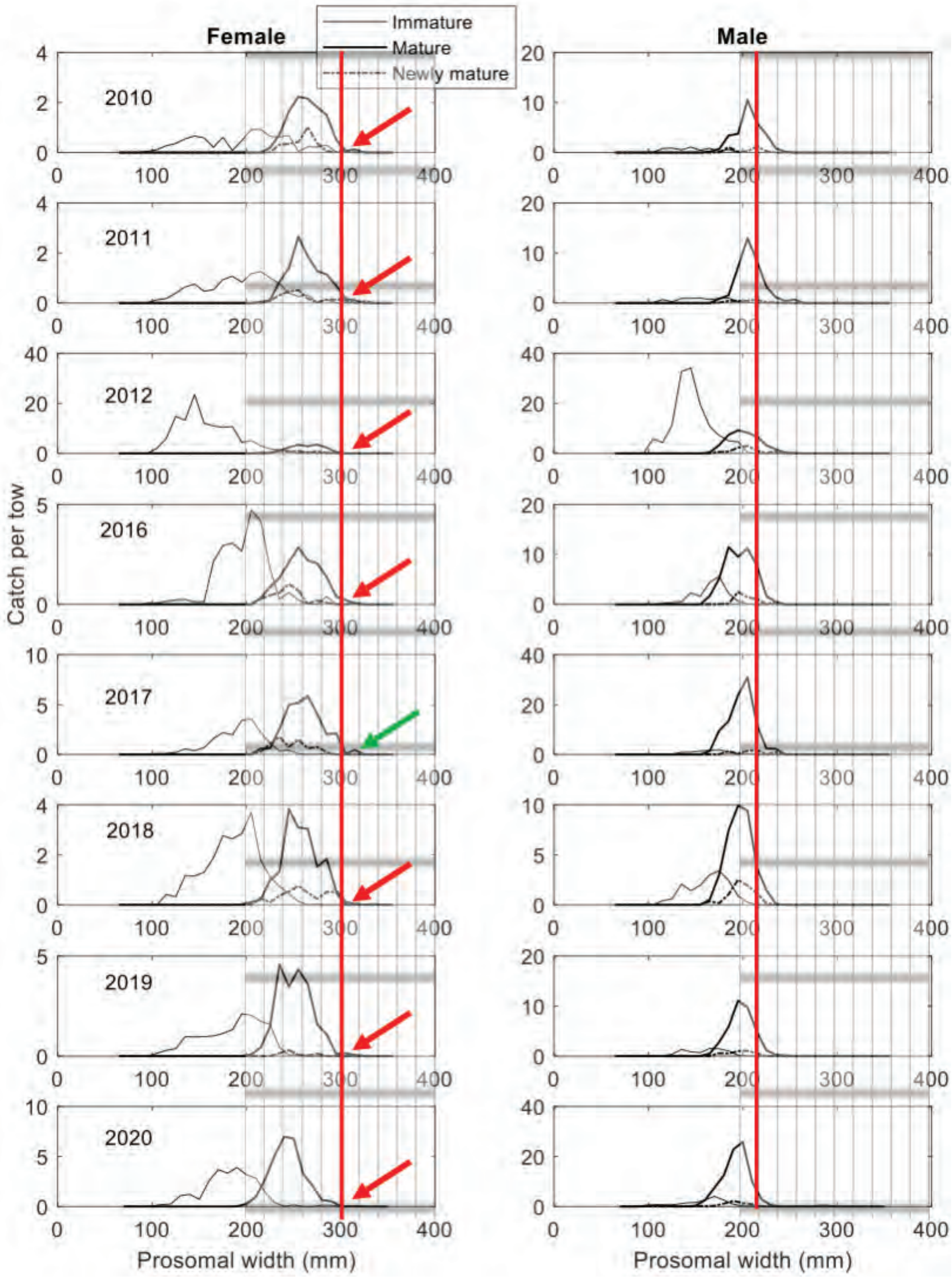

Figure 11: Size frequencies of mature female and male horseshoe crabs over 2010 to 2020, with gap years from 2013 to 2015, from the VT survey in the coastal Delaware Bay area (Hallerman and Jiao, 2021). Vertical red lines and grid cells were added for reference. Green arrows indicate years when mature females larger than 300 mm prosomal width were apparent, and red arrows when not.

6 Acknowledgements

I am extremely grateful to Dr. John Hoenig for his ideas and comments which greatly improved this report.

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8 Qualifications & Credentials

The qualifications, experience and scientific recognition that allow me to provide an informed, expert opinion on this matter are described below. My academic and professional credentials include: Professor (2000-present), Associate Professor (1993-2000), and Assistant Professor (1986-1993) of Marine Science, Virginia Institute of Marine Science, William & Mary, Department of Fisheries Science; Senior Postdoctoral Fellow, Smithsonian Institution (1997-1999); Postdoctoral Fellow, U.S. National Research Council (1985-1986); Adjunct Professor, Anne Arundel Community College (1984-1985); Postdoctoral Fellow, Smithsonian Institution (1984-1985); and Assistant Professor, Florida A & M University (1981-1984; while Ph.D. student at FSU). I received my Ph.D. from Florida State University in 1984 (major: Biological Science; minor: Statistics).

My scientific expertise and research specialties include Marine Conservation Ecology, Fisheries Management, Mathematical Biology, Ecological Statistics, and Ecology and Management of Crustaceans and Molluscs. Over the span of my career, I have 121 publications in peer-reviewed scientific journals, numerous technical reports, and 80 research grants totaling over $20 million from agencies including the National Science Foundation, National Oceanic and Atmospheric Administration, U.S. Army Corps of Engineers, National Undersea Research Program, Department of Defense, and various others.

I have 45 years of experience with eastern oyster, blue crab, Caribbean spiny lobster, queen conch, Nassau grouper and various marine bivalves; 36 years experience as the Commonwealth of Virginia's expert on blue crab ecology and fishery management; provision of formal opinions to Virginia Marine Resources Commission, Chesapeake Bay Commission, Chesapeake Bay Stock Assessment Committee, and Chesapeake Bay Program Fisheries Goal Implementation Team; 18 years experience as scientific advisor on oyster restoration to U.S. Army Corps of Engineers, NOAA Chesapeake Bay Office, and Chesapeake Bay Program Fisheries Goal Implementation Team; 33 years as Chief Scientist of the Blue Crab Winter Dredge Survey; Co-Principal Investigator of the Blue Crab Stock Assessment in Chesapeake Bay; and member of technical teams for Gulf of Mexico and Chesapeake Bay oyster and blue crab stock assessment, conservation and restoration.

Scientific honors, recognition and awards include: (i) Coastal America Partnership Award from the Executive Office of the President of the U.S., (ii) Kavli Fellowship from U.S. National Academy of Sciences, (iii) Aldo Leopold Leadership Fellow Award, (iv) Outstanding Faculty Award for Advisory Service, Virginia Institute of Marine Science, and (v) Outstanding Faculty Award for Research, Virginia Institute of Marine Science.

CENTER for BIOLOGICAL DIVERSITY Because life is good.

September 30, 2022

Atlantic States Marine Fisheries Commission
Attn: Caitlin Starks, Senior FMP Coordinator
1050 N. Highland St., Suite 200 A-N
Arlington, Virginia 22201
comments@asmfc.org

Re: Horseshoe Crab Draft Addendum VIII

Dear Atlantic States Marine Fisheries Commissioners:

On behalf of our 1.7 million members and supporters, the Center for Biological Diversity encourages the Atlantic States Marine Fisheries Commission (ASMFC) to reject the proposed Addendum VIII to the Interstate Horseshoe Crab Fishery Management Plan, which would increase the number of horseshoe crabs harvested for use as bait and potentially reopen the harvest to include female horseshoe crabs.

Populations of male horseshoe crabs and federally threatened *rufa* red knots are well below recovery thresholds. Thresholds are firm minimum requirements that cannot be incrementally and prematurely undercut by increased horseshoe crab harvests.

The Adaptive Resource Management (ARM) model used for Addendum VIII excludes key data, including horseshoe crab egg densities, spawning counts, climate impacts, *rufa* red knot field surveys, ecological carrying capacities, and impacts on other rare and endangered species. The model's lack of transparency and public availability raises significant concerns about its accuracy as well.

Increasing horseshoe crab harvests will jeopardize millions of dollars of investments and decades of dedicated restoration efforts for horseshoe crabs and *rufa* red knots. We urge the commissioners to vote no on Addendum VIII.

I. Horseshoe crab populations have not recovered.

Horseshoe crab harvests rapidly increased in the 1990s. Annual harvests climbed from 100,000 in 1991 to 3 million in 1998.[1] Female horseshoe crabs were especially targeted by commercial fisheries. Because of the dramatic reduction of crabs from the breeding population, horseshoe crab numbers crashed along the Atlantic Coast.

Harvest quotas established in the late 1990s helped to stop the decline, but in the past 25 years, horseshoe crab populations have not come close to recovering. More than 1.2 million horseshoe crabs spawned in the mid-Atlantic in 1990. In 2020, only 335,000 spawned.[2]

Spawning data provides important insights into the population status of horseshoe crabs, especially since horseshoe crabs do not reproduce until nine years of age. Alarmingly, spawning data was not used in the ARM model. Spawning data is essential in gauging the health and trajectory of horseshoe crab populations and their ability to sustain the federally threatened red knot.

Any increase in horseshoe crab harvests would be premature and would jeopardize decades of restoration efforts and millions of dollars of investments.

The proposed Addendum VIII revision also threatens to resume the harvest of female horseshoe crabs, which would make recovery of the species virtually impossible. Under the current ASMFC framework, there is no female crab harvest until female abundance reaches 11.2 million crabs or until the Delaware Bay total red knot stopover population reaches 81,900 birds. Neither red knot nor horseshoe crab populations are anywhere close to satisfying either metric. Yet under this addendum, female harvest could be allowed.

The proposed Addendum VIII relies on the flawed argument that incremental increases in harvest will not have an impact. In fact, even modest increases in horseshoe crab harvests, especially harvests that include female horseshoe crabs, will likely result in significant declines of horseshoe crabs and horseshoe crab eggs for endangered *rufa* red knots.

Thresholds are established to serve as firm minimum requirements. Incremental increases that occur before these thresholds are met will result in the take of federally listed species.

II. *Rufa* red knot populations have not recovered

The *rufa* red knot *(Calidris canutus rufa*) is a federally threatened migratory bird protected under the Endangered Species Act. *Rufa* red knots rely on the horseshoe crab eggs along the Atlantic Coast to fuel their annual migration. *Rufa* red knots overwintering in Tierra del Fuego

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[1] Smith 2017.

[2] Delaware Bay Horseshoe Crab Survey 2021.

travel nearly 20,000 miles roundtrip each year to and from their breeding grounds in the Canadian Arctic.[3]

The horseshoe crab eggs along the Atlantic Coast provide a critical source of nourishment. *Rufa* red knots double their body weight during their two weeks on Atlantic coast beaches consuming horseshoe crab eggs. Red knot populations have fallen by 75% since the 1980s, largely the result of overharvesting horseshoe crabs.[4]

Red knot field data shows that red knot populations are at population levels well below the thresholds that led them to being listed as threatened under the Endangered Species Act. In the 1990s, more than 90,000 could be found along Delaware Bay. This year, only 12,000 were counted along the bay, and in 2021, the number was estimated at an all-time low of 6,800.[5] *Rufa* red knot populations are nowhere close to the recovery threshold of 81,900 red knots established by ASMFC.

Alarmingly, the ARM model does not include field survey data for *rufa* red knots. The ARM model must include red knot survey data to adequately evaluate impacts of increased horseshoe crab harvests on *rufa* red knots.

Recent studies show that red knots are stopping in Delaware Bay for shorter periods. This could have far-reaching effects on breeding success and survival. Red knots departing from Delaware Bay in higher relative body condition migrate up to a month later than individuals in lower condition, suggesting that the availability of horseshoe crab eggs leads to higher breeding success. Moreover, red knots leaving Delaware Bay with a lower relative body condition had a lower probability of being detected in autumn, suggesting greater mortality compared to individuals with higher relative body condition.[6]

The relationship between horseshoe crab egg availability, red knot feeding behavior, mass gain, and overall fitness is clear. During the Delaware Bay stopover period, red knots track horseshoe crab egg availability. Alternative food resources available during the Delaware Bay stopover, such as blue mussels and coquina clams, do not provide the necessary nutritional content that support rapid and significant mass gain.

As a result, Delaware Bay horseshoe crabs are more important than ever for ensuring the survival and breeding success of *rufa* red knots. *Rufa* red knots seeking food elsewhere will not find any other food sources elsewhere that are as protein-rich as horseshoe crab eggs. And if *rufa* red knots shift their migration patterns further north, there are even fewer horseshoe crabs whose populations are even less stable.[7]

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[3] USFWS 2014.
[4] McGowan 2011.
[5] Delaware Audubon 2022.
[6] Dujins *et al.* 2017.
[7] Smith 2017.

More than 90 percent of the *rufa* red knot's diet along the Atlantic Coast is horseshoe crab eggs.[8] Increasing horseshoe crab harvests, including the harvest of female horseshoe crabs, would directly result in take of federally listed *rufa* red knots.

III. The ARM model lacks key inputs and transparency.

The ARM model used to support Addendum VIII is missing key inputs. The model does not use any spawning count data. The model also fails to include ecological carrying capacity for horseshoe crabs and *rufa* red knots. And the model does not include readily available egg density data. Horseshoe crab egg density is the strongest predictor of *rufa* red knot fitness and breeding success.

In addition, the model fails to include climate impacts on horseshoe crabs and *rufa* red knots, and it fails to evaluate the impacts of increased horseshoe crab harvests on other rare and endangered species that depend on horseshoe crabs and their eggs.

The Center is deeply concerned that the model and its inputs remain unnecessarily inaccessible to the public. This model proposing to increase horseshoe crab harvests cannot be accurately verified without independent analysis. ASMFC seems to be hiding the ARM model behind an unsupported interpretation of the Magnuson-Stevens Act. The so-called Rule of Three clause in the Magnuson Stevens Act was intended to protect individual fishers' locations, not conceal the operations of multinational corporations.

The Center encourages ASMFC to make the model available for independent scientific analysis and public comment as required by law. The model provides the sole basis for Addendum VIII. Without independent verification, his model and its recommendation must be rejected by the Commission.

IV. Horseshoe crab egg density studies are a key dataset that should be central to the model.

Egg density data is the most reliable indicator of the horseshoe crab population, and importantly, is the most valuable index of egg availability for red knots and other shorebirds. Yet ASMFC has never included these surveys in its modeling.

Egg density data is also the most reliable and important indicator of horseshoe crab population health. Horseshoe crabs reach sexual maturity at nine years of age. Population estimates of

[8] Smith 2017.

horseshoe crabs fail to capture critical metrics, including reproduction success of sexually mature horseshoe crabs and quantity of eggs produced. This data is essential to any decisions regarding horseshoe crab populations, trajectories, and harvests—and their impacts to the federally threatened *rufa* red knot.

Eggs are the nexus between horseshoe crabs and the endangered *rufa* red knot. Egg density is the most important indicator of *rufa* red knot health during its migration. Egg density is also important for the sustenance of endangered sea turtles, shorebirds, terrapins, and fish, including key species of sport fish. Egg density data should be prioritized in the model and the primary basis for decision making.

Based on ongoing field work, including egg density studies conducted by the Delaware Bay Shorebird Project and other organizations, horseshoe crab populations are not recovering from their population crash in the 1990s.[9] Due to overharvest in the 1990s, egg densities have dropped from 40,000 per square meter to 5,000 per square meter. Over the past 25 years, they have shown little signs of recovery.[10]

Poor egg availability on Atlantic Coast beaches results in emaciated red knots and other shorebirds. Declining egg densities on Atlantic Coast beaches increases the red knots' risk of death during their journey. Undernourished *rufa* red knots are also less likely to breed successfully.[11]

V. Climate impacts to horseshoe crabs and *rufa* red knots are not adequately addressed by the model.

The model and Addendum VIII reflect a lack of understanding of how climate impacts and severe weather will affect crabs and birds.

The model only includes one climate input: Arctic snow cover. While important, this single dataset is insufficient to address the multiple threats of climate change to horseshoe crabs and *rufa* red knots. Sea level rise, hydrologic thresholds, increasing ocean surface temperatures, ocean acidification, extreme weather events, change in seasonal and migration timing, inundation, exposure of horseshoe crab nests, and impacts of increased temperatures on horseshoe crab eggs are just a few of the factors not considered.

VI. The model fails to address impacts to other rare and endangered species.

[9] Smith 2022 (in press).
[10] Red Knot Recovery Coalition 2021.
[11] *Ibid.*

In addition to the *rufa* red knot, endangered sea turtles, terrapins, fish, and shorebirds also rely on horseshoe crabs and their eggs.

The Delaware Estuary is the largest staging area for shorebirds in the Atlantic Flyway and is the second largest staging site in North America.[12] More than 1.4 million migratory shorebirds converge on the Delaware Bay to feed and rebuild energy reserves prior to flying an additional 4,000 kilometers to complete their northward migration.[13] At least 14 species of migratory birds use horseshoe crab eggs to replenish their fat supply during their trip from South American wintering areas to Arctic breeding grounds. These species make some of the longest known migrations and rely on horseshoe crab eggs along the Atlantic Coast. These bird species include the ruddy turnstone (*Arenaria interpres*), sanderling, dunlin (*Calidris alpina*), and semipalmated sandpiper (*Calidris pusilla*).[14] The semipalmated sandpiper is listed as near threatened by the IUCN Red List and has been declining at a rate of 5% per year.[15]

Endangered sea turtles also feed extensively on horseshoe crabs. The NOAA Fisheries Sea Turtle Stranding and Salvage Network identified horseshoe crabs in 75 percent of loggerhead sea turtle (*Caretta caretta*) gut contents.

Diamondback terrapins (*Malaclemys terrapin*)—listed as vulnerable by the IUCN with decreasing populations—also feed on horseshoe crab eggs.[16]

In addition, horseshoe crab eggs and larvae are a seasonal food item of American eel (*Anguilla rostrata*), white perch (*Morone americana*), killifish (*Fundulus spp*.), silver perch (*Bairdiella chrysoura*), weakfish (*Cynoscion regalis*), kingfish (Menticirrhus saxatilis), silversides (M*enidia menidia)*.[17] All crab species and several gastropods, including whelks, feed on horseshoe crab eggs and larvae. Leopard sharks (*Triakis semifasciatum*) have also been documented preying on adult horseshoe crabs.[18]

Sport fish, including striped bass (*Morone saxatilis*), summer flounder (*Paralichthys dentatus*), and winter flounder (*Pleuronectes americanus*), feed on horseshoe crab eggs and larvae.[19]

VII. Increasing horseshoe crab harvests is not economically justified.

No economic justification exists for increasing horseshoe crab harvests at this time. Male horseshoe crabs rarely bring more than $1 each, according to the Delaware Division of Fisheries

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[12] Delaware Bay Horseshoe Crab Survey 2021.
[13] Wander and Dunne, 1982.
[14] Lyons 1995.
[15] IUCN 2022.
[16] *Ibid.*
[17] Schuster 1982.
[18] *Ibid.*
[19] *Ibid.*

and Wildlife.[20] In addition, the eel and whelk fisheries, which use horseshoe crabs for bait, are already plummeting. Eel populations have declined by more than 50% over the past three decades.[21] The IUCN listed American eels an endangered species in 2014.[22] Whelk populations are also in steep decline due to overharvesting.[23] Massachusetts Division of Marine Fisheries considers channel whelks "to be depleted throughout their range," and the State of New York recently implemented new limits on whelk harvests.[24]

Populations of sport fish such as striped bass and flounder also have plummeted—largely because of fewer horseshoe crabs and eggs available.

Overharvesting has depleted key fisheries that depend on horseshoe crabs. Increasing horseshoe crab harvests and potentially including female horseshoe crabs harvest at this time would further jeopardize these fisheries. It also would negate millions of dollars in investments toward horseshoe crab recovery.

Any meager benefits to increasing horseshoe crab harvests would be dramatically outweighed by the costs to taxpayers and ecosystems.

VIII. Any horseshoe crab harvest increases should be postponed beyond 2030 to verify the model's accuracy and ensure the recovery of horseshoe crab and red knot populations.

The ARM model predicts that horseshoe crab populations will reach dynamic equilibrium within 10 years. If this is accurate, this projection aligns well with the next ARM evaluation scheduled for 2032. No horseshoe crab harvest increases should occur in the next decade. This will allow ASMFC to test the model's accuracy over the next decade to ensure that horseshoe crab populations and red knot populations fully recover.

Horseshoe crabs are one of the most flagrant and notorious examples of overharvest by commercial fisheries. This resulted in substantial overharvest of horseshoe crabs in the 1990s, and 25 years later, horseshoe crab populations still have not come close to fully recovering.

The dangers of overharvesting are even more significant with the dependence of a federally threatened species on horseshoe crab eggs. Populations of the horseshoe crab and the dependent *rufa* red knot must reach their recovery thresholds before any premature harvest increases are considered.

Over the next decade, we recommend adding spawning surveys, egg density, and *rufa* red knot field surveys to the ARM model. Additional research in the next 10 years can also strengthen

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[20] ASMFC Public Hearing 2022.
[21] Haro et al. 2000.
[22] IUCN 2021.
[23] Massachusetts Division of Marine Fisheries 2022.
[24] NY DEC 2022.

the model. Research is needed to understand the impacts of horseshoe crab harvests on other species, including fish, endangered turtles, and other shorebirds of conservation concern. Research can also help elucidate the impacts of climate change on horseshoe crabs and the species which depend on their eggs.

IX. Conclusion

The Center for Biological Diversity encourages the Commission to abandon this scientifically unsupported proposal and restart the planning process by incorporating datasets that provide a more robust and accurate assessment of the population status of horseshoe crabs and *rufa* red knots. These datasets include readily available horseshoe crab egg density surveys, *rufa* red knot field surveys, additional climate data points, and impacts to other rare and endangered species. It is imperative that the Commission publicly share the model and its inputs to allow independent analysis of its accuracy.

We urge the Commission to vote no on Addendum VIII and postpone any proposed horseshoe crab harvest increases until after 2032 to verify and improve the model's accuracy and to ensure the recovery of horseshoe crab and *rufa* red knot populations.

Sincerely,

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Sources

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Testimony to the Atlantic States Marine Fisheries Commission Public Hearing on the Draft Addendum to the Horseshoe Crab Fishery Management Plan

September 19, 2022

Part of this testimony was provided verbally at the DNREC hosted public hearing on the addendum held on SEP 8th, 2022. The testimony provided here was expanded after the hearing.

Introduction and Background

The Center for the Inland Bays is a National Estuary Program responsible for developing and facilitating the implementation of the stakeholder-based Inland Bays Comprehensive Conservation and Management Plan (CCMP). Delaware's Inland Bays are three interconnected Atlantic Coastal lagoons that support a significant population of horseshoe crabs.

The Inland Bays CCMP focuses on reversing eutrophication and restoring key habitats and populations of keystone species such as the horseshoe crab. Water quality of the Bays is highly impaired due to nutrient pollution with some areas experiencing severely degraded aquatic habitat. Baygrass meadows and natural oyster reefs have been nearly eliminated due to disease and pollution. Over a quarter of the estuaries' saltmarshes have been eliminated and marshes continue to degrade due to sea level rise. An important objective of the CCMP is to "to enhance and restore fish populations and their habitats" in part through the advocacy for ecosystem based fisheries management.

The Center also develops and oversees the implementation of the Inland Bays Environmental Monitoring Plan which includes actions related to horseshoe crabs. Since 2008, the Center has conducted the Inland Bays horseshoe crab spawning survey. The survey of five sandy beaches has found the population to be stable and slightly lower than those of the Delaware Bays survey (on the Delaware side). The survey confirms the importance of the Inland Bays as an important spawning area for the crabs. The Center also participates in the USFWS Cooperative Horseshoe Crab Tagging Program. In 2018, the Center used data from the Program to demonstrate that the Inland Bays population of crabs is indistinct from the Delaware Bay population as a whole (McGowan 2018)[1].

While the Inland Bays do not host the large aggregations of shorebirds found along Delaware Bay, the crabs and their eggs remain an important food source for dozens of economically and ecologically important species of finfish, shellfish, and birds of the estuary.

These comments we provide on the horseshoe crab management plan addendum are consistent with the Inland Bays CCMP.

Comments and Recommendations

Harvest

We commend the ASMFC for including more empirical data from the Delaware Bay into the management model. We acknowledge the remarkable deliberations and analysis that produced the framework revision and research recommendations. And we are thankful for the impressive amount of supporting data collected by a wide variety of agencies with the cooperation of the fishing community and volunteer groups. We acknowledge the direct and indirect economic value of the horseshoe crab fishery and the crab's contribution to the value of wildlife viewing, a healthy ecosystem, and other fisheries. We understand the purpose of the horseshoe management to do the following: *"Manage harvest of horseshoe crabs in the Delaware Bay to maximize harvest but also to maintain ecosystem integrity, provide adequate stopover habitat for migrating shorebirds, and ensure that the abundance of horseshoe crabs is not limiting the red knot stopover population or slowing recovery."*

Female horseshoe crabs are a particularly important resource for the integrity of the regions' estuaries including the Inland Bays due to their fecundity and egg production. The Center does not support the harvest of female horseshoe crabs at this time due to 1) the observed trends in the overall horseshoe crab population from the Delaware Bay region, 2) the need for more information about the abundance and distribution of horseshoe crab eggs and their relationship with the horseshoe crab population, 3) the potential for the limitation of the red knot's stopover population by horseshoe crab abundance, 4) the lack of understanding how rapidly developing climate impacts including severe weather and spawning habitat change could affect the populations of both crabs and birds.

Trends in the horseshoe crab population

While trends from the New Jersey and Delaware fisheries independent population surveys are clearly increasing, the data from the Virginia Tech survey does not show a clearly increasing trend. All of these surveys are rightly utilized in the model to estimate population. However, only the Virginia Tech survey was designed specifically for the crab. The Center values this as

[1] McGowan, A. Horseshoe Crab (Limulus polyphemus) Movements Following Tagging in the Delaware Inland Bays, USA. Estuaries and Coasts 41, 2120–2127 (2018). https://doi.org/10.1007/s12237-018-0406-7

the most important survey from a design and analytical approach. Its lack of trend should be valued as a factor in harvest decisions.

Relation of Horseshoe Crab Eggs and Horseshoe Crab Abundance

Counts of horseshoe crab eggs and not the crabs themselves are the most proximate indicator of food for shorebirds and many other predators. In the absence of a long term standardized egg data set, crab abundance should serve as a good indicator of egg availability. However, multiple historical sources of information suggest the occurrence of much higher densities of eggs in the past. The first is an anedectdocal account in Goode (1887)[2] as reported in Kreamer and Michels (2009)[3] that describes "deposits of eggs so thick on bay beaches that farmers shoveled them up by the wagonload to use as chicken feed". The second dataset presented in Smith et al. (2022 *in press*)[4] suggest egg densities occurred an order of magnitude greater than present day estimates. Both pieces of evidence should be interpreted with caution: the historical account for its qualitative nature, and comparisons drawn in Smith et al. for their lack of a standardized collection method and focus on a single site.   However, the evidence is of sufficient value to warrant establishment of a representative program of egg density monitoring for inclusion in the model. This research should confirm the relationship between horseshoe crab numbers and egg density as well as increase understanding of the relationship between egg densities and shorebird abundance. Available data show a moderate increase in egg abundance from 2015 to 2021.

The Center also feels that sufficient evidence exists to suggest that establishment of a baseline horseshoe crab population level near the peak of a second successive overharvest in the late 1990s (following industrial overharvest from the mid 1800s to mid 1900s) could have led to an under-valuation of the ecological carrying capacity of the crab population and its benefits to the integrity of the the region's estuaries. The stock assessment presents a status of "neutral" for the crab population based upon the index based reference point of the 1998 fishery-independent population survey. Encouragingly, the model suggests that the horseshoe crab population should reach a dynamic equilibrium in about ten years under levels of harvest resulting from the current harvest levels. We request that after ten years of no female harvest the validity of those projections be evaluated in an attempt to ascertain the actual ecological carrying capacity of the region for the crab. This period would also allow another generation of horseshoe crabs to mature. Should dynamic equilibrium become apparent after this period, and the results of additional research on key questions support it, a female harvest should once

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[2] Goode, GB (1887) The fish and fisheries of the United States. Section V. History and methods of the fisheries, Vol II. US Commission of Fish and Fisheries, Washington, pp 652–657.

[3] Kreamer, G. and S.E. Michels 2009. History of horseshoe crab harvest in Delaware Bay. Pages 299-313 in J. T. Tanacredi, M. Botton, and D. R. Smith, editors. Biology and Conservation of Horseshoe Crabs. Springer, New York.

[4] Smith et al. 2020. Horseshoe crab egg availability for shorebirds in the Delaware Bay: dramatic reduction after unregulated horseshoe crab harvest and limited recovery after 20 years of management. Aquatic Conservation: Marine and Freshwater Ecosystems. *In press.*

again be considered. This aligns well with the timing of the next ARM framework revision of the proposed management cycle under Option B.

As colonizers, we have often demonstrated a tendency to unintentionally bottom out a living resource population, as we apparently did with the crab after a century of industrial overharvest for fertilizer and livestock feed. Our proposed approach complements and makes reparations for this overharvest and the one that followed by intentionally allowing the return of the population to its maximum abundance, dynamic as that may be, for the benefit of the entire ecosystem; thus validating the limits of the population on both the lower and upper end, then managing from there.

In the meantime, to provide greater potential benefits to the horseshoe crab fishery additional males could be harvested without impacts to recruitment due to the population's high and stable male to female ratio.

Research

The Center supports the research recommendations of the framework revision that has informed the proposed addendum. While they all have merit, we particularly encourage data collection to support 1) inclusion of egg density into the management model and 2) research on the effects of climate change on spawning and breeding habitat for the crabs and birds.

We also request the development of additional long term research questions to further the ecosystem based management approach in preparation for the next framework revision. The questions should focus on elucidating the predator-prey relationships between crabs (and their eggs) and additional predator species in the Delaware Bay region. We note that these research recommendations appear to be lacking, while the original management plan clearly identifies the importance of continued use of the crab for "other dependent species including fish and wildlife," apparently reaffirmed/restated as "ecosystem integrity" under the current framework. We believe the ultimate goal should be for a dynamic food web model that will estimate the effect of the crab harvest on species in addition to the red knot, thus providing greater information for harvest decisions and tradeoffs. We recognize that this incremental approach would likely require the eventual development of management goals for additional focal species found to be significantly dependent upon the crab under conditions of a rapidly changing environment. At the minimum, this would be particularly important to prevent the management of the crab from falling back to single species management in the instance that the red knot goes extinct; which given the astounding levels of greenhouse gasses in the atmosphere appears very possible.

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September 29, 2022

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RE: Horseshoe Crab Draft Addendum VIII

Dear Ms. Starks:

Thank you for the opportunity to comment on the Atlantic States Marine Fisheries Commission's (ASMFC) proposed management options related to the horseshoe crabs on the East Coast. These comments are submitted on behalf of the Board of Directors and members of One Hundred Miles (OHM), a nonprofit, non-governmental organization working to protect and preserve Georgia's 100-mile coast through education, advocacy, and community engagement (OneHundredMiles.org).

We are writing to oppose the use of Draft Addendum VIII, which would implement the 2021 Revision to the Adaptive Resource Management (ARM) Framework. Specific to this comment period, we oppose the adoption of Option 2 supporting changes based on the 2021 ARM Framework, including setting annual bait harvest specifications for horseshoe crabs of Delaware Bay-origin. Additionally, as an active member of the Horseshoe Crab Recovery Coalition, OHM fully supports the comments submitted to you by that organization on September 28, 2022. **Changing the regulations will prematurely remove restrictions on female horseshoe crab harvests and will have a cascading negative affect on many species.**

Georgia's 100-mile coast has a long history of wildlife conservation. Earlier this spring, in partnership with the Horseshoe Crab Recovery Coalition, OHM launched a series of horseshoe crab spawning surveys on barrier islands across the coast. The goal was to collect baseline data of spawning activity during the full and new moon spring tides - information needed to monitor changes in horseshoe crab populations and inform regulations and management decisions.

Altogether, thirty-five volunteers were organized into 29 teams to survey each known spawning area throughout the 100-mile coast. After attending a training session, each group of volunteers were encouraged to visit their assigned sites three times during high tide windows in April and May. Sixty-six individual site surveys were conducted by boat, kayak, and foot. In total, 2777 horseshoe crabs were counted. Most surveyors reported very low numbers, with 35 surveys detecting no crabs at all. This patchy spawning activity is likely due to the highly dynamic conditions of Georgia's coast, where erosional and accretional processes are constantly shifting the coastal bars and barrier islands where crabs are known to spawn.

This year's survey of the Georgia coast was a pilot project. In coming years OHM will work with our partners to expand the research to collect important information regarding HSC spawning, and in future years more egg density studies. The studies critical and demonstrate the important role horseshoe crabs play in the survival of so many species. In particular, the data helps documents the important role horseshoe crab eggs as a primary food source for many other species, including red knot. Each year, over 360,000 migrating shorebirds make their way through Georgia and other Atlanta-coast states in flight to the Arctic—stopping along our coast to refuel for their journeys. The *rufa* red knot is a critical species that is dependent on both feeding grounds in Georgia and in Delaware Bay.

The ASMFC asserts that there is a less than one-percent chance of a red knot population decline due to the implementation of female harvest under the 2021 ARM Framework revision. Yet the ASMFC has not released the data supporting the increase in female harvest. Making matters worse, ASMFC also does not include the most recent field survey data for red knots, which suggest historically low numbers of red knot feeding through the spring season in Delaware Bay. In the 1990s, more than 90,000 could be found along Delaware Bay during aerial surveys. This year, only 12,000 were counted, and in 2021, the number was estimated at an all-time low of 6,800. This could indicate that red knots are bypassing the Delaware Bay stopover altogether in search of life-sustaining food sources elsewhere. Further, it makes their migratory journey all the more perilous, which could further impact the population recovery. Given this uncertainty in the status of red knot in Delaware Bay, extreme caution should be taken in making any management decisions that could negatively affect them.

Under the current ASMFC framework, there is no female horseshoe crab harvest until female abundance reaches 11.2 million crabs or until the Delaware Bay total red knot stopover population reaches 81,900 birds. The proposed revision would allow the resumption of the female harvest, even though neither the red knot nor female horseshoe crabs of Delaware Bay are close to satisfying either metric.

Field work and studies, including egg density surveys conducted by the Delaware Bay Shorebird Project and other organizations, do not support the assertion that horseshoe crab populations are recovering from their population crash in the 1990s. Egg density data is the most reliable indicator of the horseshoe crab population, and importantly, it is the most reliable index of value for red knots and other shorebirds. Yet ASMFC has never included these surveys in its modeling.

Management decisions that affect endangered species must be scientifically justified and offer the assurance that the changes will have a positive impact on the species. The ASMFC must provide the data and a sound scientific basis before any change to the horseshoe crab bait harvest specification is considered. Allowing for greater numbers of female horseshoe crabs to be harvested all but assures that red knot population levels will never rebound.

Again, we strongly oppose the use of Draft Addendum VIII which would implement the 2021 revision to the Adaptive Resource Management (ARM) Framework. We ask that you adopt the "no action" option and reject the 2021 ARM Framework to set new horseshoe crab harvest standards.

Thank you for considering these comments.

Sincerely,

Alice M. Keyes

Alice M. Keyes
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One Hundred Miles

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RE: Comment on Horseshoe Crab Draft Addendum VIII September 27, 2022

Ms. Starks:

Thank you for allowing us this opportunity to comment on the Horseshoe Crab Draft Addendum VIII currently before the Atlantic States Marine Fisheries Commission (ASMFC).

As a coastal state and the lowest-lying state in the country, Delawareans rely upon a healthy coastal ecosystem and responsible coastal resource management decisions. Not only is this important for our physical and environmental health, but our economic health as well. Our Inland Bays contribute $4.5 billion yearly into our economy and over 35,000 jobs through tourism, recreation, the real estate market, and our emerging commercial aquaculture industry.[1] Outdoor recreation alone contributes $202 million yearly into the local economy and supports more than 2,300 jobs.[2]

All of this is to highlight that a broad ecosystem approach to resource management is imperative. The Adaptive Resource Management (ARM) Framework approach to managing the horseshoe crab bait fishery takes into account population models for horseshoe crabs and the endangered red knot shorebird as there is a special relationship between these species. The objective of the ARM Framework is stated as:

> *Manage harvest of horseshoe crabs in the Delaware Bay to maximize harvest but also to maintain ecosystem integrity, provide adequate stopover habitat for migrating shorebirds, and ensure that the abundance of horseshoe crabs is not limiting the red knot stopover population or slowing recovery.*[3]

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[1] Hauser, C. A. and Bason, C. W. (2022). *The economic value of the Delaware inland bays.* Delaware Sea Grant College Program, Delaware Center for the Inland Bays, p.21.
[2] Id., p. 19.
[3] Atlantic States Marine Fisheries Commission (ASMFC). (September 2022). Draft addendum VIII: Implementing recommended changes from the 2021 ARM revision and peer review report [PowerPoint slides]. Retrieved from: https://register.gotowebinar.com/recording/7478982971381519119

Our concern is that the ARM Framework is too narrow in its focus and does not approach the issue of what constitutes a healthy population of horseshoe crabs from the right direction. Its concern is largely with maximizing harvest for the commercial fishing industry that uses horseshoe crabs as bait (the conch (whelk) and eel fisheries) while doing no further damage to the crab and red knot populations, not with developing a healthy eco-system made up of many interdependent species. There are many other species, some threatened or endangered like our new state sea turtle, the Loggerhead, and other Diamondback terrapins that depend upon horseshoe crab eggs for their survival. Impacts to the recreational fishing industry, such as a decrease in sport fish like striped bass and flounder, which also depend upon horseshoe crab eggs, should be taken into consideration.[4] We need to take a more holistic view of what any increase in horseshoe crab harvesting, particularly for females, means to the entire ecosystem. The ARM Framework objective of "maintaining ecosystem integrity" is only meaningful when the entire ecosystem has been taken into account and there is agreement that the current state of the ecosystem is ecologically optimal.

Also, even though the number of horseshoe crabs is stable or slightly increasing, this number is far from where we were in the 1990's when the commercial fishing industry was unregulated, resulting in harvests of over 2 million crabs a year and a decline of about 88% of the species.[5] We need a better understanding of what our target number of horseshoe crabs in our waters should be and we need to base that target on what is holistically, ecologically optimal while *also* balancing the needs of a sustainable fishing industry.

In addition, we believe that there is important information not adequately accounted for in the ARM Framework related to the mortality of horseshoe crabs associated with vaccine development. Pharmaceutical companies in the United States still primarily utilize horseshoe crab blood in the production of many human medical products such as vaccines, insulin, and intravenous devices.[6] With the recent increase in the need for vaccines to address the COVID-19 pandemic, the harvesting of horseshoe crabs by pharmaceutical companies and the associated mortality with that practice has also increased. In 2018, the estimated number of horseshoe crabs harvested by biomedical companies for bleeding was 510,407 with a 15% mortality of 77,459 crabs. This increased dramatically in 2020 to 697,025 crabs harvested and a mortality of 106,339.[7] Given the continued need for vaccine development into the future, the unverifiable nature of the mortality percentage (some estimate this percentage to be closer to 30%),[8] and the lack of research on the health and fecundity of the female horseshoe crabs after bleeding, we believe that increasing the harvest of horseshoe crabs, particularly females, is unwise.

Lastly, the ARM does not take into account important issues of climate change such as sea level rise and warming water temperature and effects those factors have on the crabs' spawning and survivability, nor any increase in mortality due to increasing storms and their severity. The need to take issues of climate

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[4] Arnold, C. (2020, July 2). Horseshoe crab blood is key to making a COVID-19 vaccine—but the ecosystem may suffer. *National Geographic*. Retrieved from: https://www.nationalgeographic.com/animals/article/covid-vaccine-needs-horseshoe-crab-blood.

[5] Niles, L. J., et al. (2009, January 1). Effects of horseshoe crab harvest in Delaware Bay on red knots: Are harvest restrictions working? *BioScience, 59*(2). 10.1525/bio.2009.59.2.8

[6] Maron, D. F. (2022, August 4). Horseshoe carb blood saves lives. Can we protect these animals from ourselves? *National Geographic*. Retrieved from: https://www.nationalgeographic.com/animals/article/horseshoe-crab-blood--can-save-lives-can-we-protect-these-animals-from-ourselves

[7] Id.

[8] Id.

change into account has been supported by research published in the scientific journal Molecular Ecology over a decade ago and presented in Science Daily.[9] Specifically, it was recognized that the population is under threat from over-harvesting for use as bait, by the pharmaceutical industry, and by the destruction of habitats around the beaches that are the breeding grounds for horseshoe crabs, but "the most decisive factor may be future changes in sea level and water temperature."[10]

In conclusion, we believe that ASMFC should revise the ARM Framework to place greater emphasis on the recovery of the horseshoe crab species using an ecosystem-based approach, more closely account for the increasing use of the crabs and the associated mortality in the pharmaceutical industry, and give greater consideration to the effects of climate change on the health and reproduction of the species. Until that analysis occurs, we do not agree that an increase in the harvest of horseshoe crabs is appropriate or that female horseshoe crab harvesting is supported.

Sincerely,

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cc:
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[9] University of Gothenburg. (2010, October 6). Climate change affects horseshoe crab numbers. *Science Daily.* Retrieved from: https://www.sciencedaily.com/releases/2010/10/101004101330.htm
[10] Id.

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September 27, 2022

Comments Regarding the Atlantic States Marine Fisheries Commission's (ASMFC) proposed Addendum VIII Interstate Horseshoe Crab Fishery Management Plan

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Dear Ms. Starks;

Thank you for the opportunity to submit comments on the proposed changes to the Interstate Horseshoe Crab Fishery Management Plan. Manomet, Inc. is a non-profit organization, committed to using science to address pressing conservation challenges, particularly those that impact shorebird populations across the Western Hemisphere. As such, we are writing to explain how we believe the proposed Addendum VIII Interstate Horseshoe Crab Fishery Management Plan has the potential to deleteriously impact imperiled coastal wildlife, particularly shorebirds like the federally threatened red knot (*Calidris canutus rufa*), and the habitats that they depend upon.

The relationship between horseshoe crab spawning and shorebird migration has evolved over millennia. The eggs laid by horseshoe crabs every spring nourish the coastal ecosystem, including Arctic-nesting shorebirds who travel thousands of miles to reach important spawning sites along the US Atlantic coast to feed. Shorebirds are one of the fastest declining groups of birds, with measured losses in many populations of over 50%, and a staggering 94% loss estimated for the population of red knot that depends on the Atlantic Coast since 1970 (Smith et al. in review). Of these shorebirds, long-distance, Arctic-nesting migrants have some of the steepest population declines. Red knots are the most notable, but at least 16 other Arctic-nesting species are also showing significant population declines (Rosenberg et al. 2019). While numerous factors can be attributed to these declines, such as habitat loss and climate change, anthropogenic disruptions to the accessibility of food resources almost certainly impacts the survival of these species. The leading shorebird biologists at Manomet do not think this is a time to be increasing harvest pressure on shorebird food resources.

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There are several important points to consider prior to making any major management decisions that could have far-reaching impacts on coastal ecosystems and potentially catastrophic results for highly imperiled species. These include: 1) metrics that focus on spawning need to be incorporated into the Adaptive Resource Management (ARM) model to better predict how harvest would impact shorebirds, 2) the most current estimates of Red Knot populations need to be incorporated in the ARM model, 3) greater transparency and time for review of data included in the model is critical for balanced decision-making, 4) current population thresholds of horseshoe crabs and red knots have not been met to allow harvest increases, and 5) red knot critical habitat designations need to be included in management decision-making. These points are outlined below.

1) The revisions to the ARM model prioritize maximizing horseshoe crab abundance and high red knot abundance. While this would seem to be an ideal win-win scenario, the reality is that there are still many unknowns and variables that the ARM model does not account for, including how climate change is destabilizing red knot populations, and the true impacts of biomedical harvest on horseshoe crabs. While we support implementing an updated ARM model that includes parameters specific to Delaware Bay, and allows for more modern and efficient software, we believe that the commission needs to consider additional information before allowing increased harvest of horseshoe crabs, particularly females. For instance, trawl surveys may not adequately account for how harvest impacts spawning or approximate spawning populations- they simply approximate abundance of crabs offshore along survey routes (Hata and Berkson 2004). Egg density and spawning surveys should be included in the model (Botton et al. 2021), since this is a critical component of the linkage between horseshoe crab spawning density and the ability to support migrating shorebirds (Karpanty 2006).

2) The model revision relies on red knot abundance from mark-resight and count data from New Jersey and Delaware from 2011 to 2020, which shows a fairly stable population of approximately 45,000 birds. However, if we look to historic surveys in the 1990s, more than 90,000 red knots were observed in the Bay. Recent spring surveys in 2021 and 2022, which are not included in the data set used in the ARM model revision, showed significant and alarming declines, indicating that there may be additional variability in abundance trends, or even a potential reduction in the population. Surveys this year counted 12,000 red knots, and in 2021 only 6,800-- a historic low number of birds observed. Statistical analysis of red knot numbers for 2020 and 2021 that account for turnover and detection

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of marked individuals estimated 40,444 (95% credible interval: 33,627-49,966) and 42,271 (35,948 – 55,210) birds in the larger population (Lyons 2022). These estimates are lower than previous years, and the confidence interval is wider, indicating greater uncertainty. Given these uncertainties and the lower number of red knots estimated, it would be prudent to incorporate more data into modelling efforts.

3) All data sets that are used in the revised ARM model should be made available for the review by the public and interested scientific communities. The confidential data surrounding the harvest of horseshoe crabs by the biomedical industry will be added to this model, but the lack of transparency with this source of mortality is of concern beyond the scope of the revisions to the ARM. There is still considerable debate about the true mortality rate linked to biomedical harvest of crabs (Krisfalusi-Gannon et al. 2018); transparent and open reporting could help to alleviate these concerns.

4) There are additional concerns that we have with the proposed changes that could result from the addendum. The current framework that exists for the harvest of horseshoe crabs stipulates that there should be no harvest of female crabs until female abundance reaches 11.2 million crabs, or until the total population of Red Knots in the Delaware Bay reaches 81,900 birds. Neither of these criteria have been met, so changes to the harvest regulations would not follow with previously set guidelines. The Integrated Population Model (IPM) that is incorporated into ARM management demonstrates a positive relationship between female horseshoe crab abundance and red knot survival. Given the alarming population declines in red knots, as well as other Arctic-nesting shorebird species which are not represented in the ARM, it would be prudent to continue to move forward with the most conservative harvest recommendations.

5) Finally, horseshoe crab harvest activities in the Delaware Bay have far reaching impacts along the entire Atlantic Flyway. Efforts are currently underway by the USFWS to outline critical habitats for red knots to move forward with effective conservation and to reduce population declines. Critical Habitat designation has not been finalized or released by the USFWS yet, and changes to the ARM model, which could result in altering harvest limits, should not be considered until that information is released. While horseshoe crab spawning was not explicitly included in the Critical Habitat designation, the ability of knots to feed in areas that are undisturbed by harvest activity is critical for the success of both migration and nesting. Not only are the numbers of spawning horseshoe crabs impacted when harvesters physically remove them from beaches, but birds are also

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flushed from feeding sites. It is well documented that ample feeding opportunities improved body condition, which influences the chances for a successful migration and even a successful breeding season (Duijns et al. 2017). Therefore, due to the relationship between horseshoe crab spawning and red knot habitat, any changes to the ARM model should not occur until the Critical Habitat Designation process is complete.

Red knots and many other migratory shorebirds are declining at an unsustainable rate. Universal and collaborative action is needed to slow and reverse those declines. The actions of the Atlantic States Marine Fishery Commission could have a significant negative impact on shorebird populations, including the Federally ESA listed red knot. Changes to the existing regulations should only be considered with a more transparent and expansive process to consider other sources of data for the model, as well as incorporating comments from the public and the larger scientific and conservation communities. At this stage, when so much is at stake, we encourage the ASMFC to act in the most risk-averse manner, and follow all the best science available before making major management decisions with far reaching implications.

Thank you for your consideration,

Brad Winn, Vice President
Resilient Habitats

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September 30, 2022

Caitlin Starks, Senior FMP Coordinator,
1050 N. Highland Street,
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Arlington, VA 22201
E-mail: Comments@asmfc.org

Re: Horseshoe Crab Draft Addendum VIII

Dear Ms Starks,

Thank you for the opportunity to comment on the Horseshoe Crab Draft Addendum VIII currently under consideration by the Atlantic States Marine Fisheries Commission (ASMFC).

Audubon Mid-Atlantic (AMA) is one of 22 state and regional programs of the National Audubon Society with more than 71,000 members in Maryland, Washington DC and Pennsylvania. AMA strongly opposes Draft Addendum VII, which recommends raising quotas on the harvest of horseshoe crabs for use as bait by potentially reopening the harvest to include female horseshoe crabs. Our concern is that increasing the horseshoe crab harvest, particularly in the Delaware Bay region, will have negative impacts on the population of the federally threatened *rufa* subspecies of the red knot (*Calidris canutus*), which depends upon an abundance of horseshoe crab eggs as food to fuel its spring migration to its Arctic breeding grounds.

Draft Addendum VIII is a revision to the Adaptive Resource Management (ARM) framework that guides recommendations for the bait harvest of horseshoe crabs in the Delaware Bay region. The current framework (which would be replaced by Draft Addendum VIII) allows for no female crab harvest until female abundance reaches 11.2 million crabs or until the Delaware Bay stopover population of red knots reaches 81,900 birds. Although the population of female crabs has increased in recent years it is still below the 11.2 million threshold. The red knot stopover population in Delaware Bay has not recovered at all since the species was listed as threatened under the Endangered Species Act (ESA), with estimated numbers still approximately 40,000, and the latest counts from 2021 and 2022 indicating sharp population declines. This is clearly not a time to increase the harvest of horseshoe crabs in the Delaware Bay, and further reduce a crucial food supply for red knots.

The recommendation under Draft Addendum VIII to increase the horseshoe crab harvest and allow the taking of female crabs appears to defy both the biological evidence of the lack of recovery in the Red Knot population and the principle of risk aversion adopted by stakeholders in the current ARM framework (Addendum VII). The new proposed ARM framework is based on linked Integrated Population Models (IPM) for horseshoe crabs and red knots, which use empirical data from the Delaware Bay. ASMFC claims that these models show no effect of horseshoe crab abundance on red knot population recruitment. This model result contradicts the finding by US Fish and Wildlife Service in its Draft Recovery Plan for the *rufa* Red Knot that reduced food availability in the Delaware Bay was the driving factor behind the red knot declines that led to its listing under the ESA. The IPMs may be drawing the wrong conclusion from the fact that a recent increase in the horseshoe crab population has not led to a similar increase in red knot numbers, particularly if the models fail to include data from the earlier years of sharp correlated declines in horseshoe crabs and red knots.

Unfortunately the public cannot evaluate the models used to justify the new proposed harvest regulations for horseshoe crabs because these models are still under review and are being kept hidden from public view. The ASMFC commissioners should certainly not vote to approve Draft Addendum VIII until the models on which it is based have been subject to public review.

The *rufa* red knot is still very much at risk of extinction because its populations have not recovered after the precipitous declines in the 2000s, which were largely due to reductions in a critical food supply. The draft recovery plan for this threatened species includes “safeguarding ample food supplies” as a key element of the recovery strategy for red knots. The proposed recommendations in Draft Addendum VIII run counter to this recover strategy, and will likely propel the red knot faster toward extinction.

Audubon’s 71,000 members in the Mid-Atlantic region care passionately about the present biodiversity crisis and do not want to see the red knot slide toward extinction. We urge the commissioners to vote against the proposed ARM Framework revision.

Sincerely,

David Curson

David Curson, Ph.D
Director of Bird Conservation (Maryland)

James D Brown

Jim Brown
Director of Policy

Sept 30, 2022

Mr. J. Clarke, Chair
Horseshoe Crab Management Board
Atlantic States Marine Fisheries Commission
comments@asmfc.org

Re: Delaware Bay Horseshoe Crab Proposed Framework Revision – Abandon Effort to Undermine Protections by Allowing Female Crab Harvest

Dear Mr Clarke:

Delaware Riverkeeper Network operates throughout the Basin and is providing this comment on behalf of over 30,000 members. We have helped monitored and tag and rescue horseshoe crabs along the Bay for over 22 years and were a key player in having the red knot listed through the FWS. Any move as indicated by the presentations at the two hearings we were a part of and testified at would be reckless. The ASMFC should not allow the consideration of a female harvest take to the crabs. Its about eggs on the beach in short and the science is not there to allow such a reckless move – by pushing the ARM forward to allow the fishing industry to determine crab fate as early as November is unacceptable.

Horseshoe crabs play a vital role to the Delaware Bay ecosystem, as their eggs provide nourishment for imperiled shorebirds such as the federally threatened red knot. Each year, thousands of red knots fly over 9,000 miles from Tierra del Fuego at the southern tip of South America to breeding grounds in the Arctic Circle. The Delaware Bay is a major stopover point during this long journey, where the red knots feast on horseshoe crab eggs in order to gain the necessary weight to have the energy to make it the remainder of the way to the Arctic Circle. The overharvesting of horseshoe crabs by the bait and biomedical industries has put a severe strain on the ecological connection between horseshoe crabs and red knots. Fewer spawning crabs means fewer eggs and therefore fewer red knots. In 1998, the Atlantic States Marine Fisheries Commission (ASMFC) adopted a fishery management plan for the horseshoe crab harvest. Since the 2013 fishing season, the ASMFC has set harvest quotas using an ARM Framework that links the allowable harvest to the red knot stopover population.

Each year, the ASMFC has selected the same allowable harvest totals based on this framework, which is 500,000 males and zero females. It was agreed that the prohibition on harvesting female horseshoe crabs would not be lifted until the Delaware Bay region hosts at least 81,900 red knots or 11.2 million female horseshoe crabs. Despite the fact that neither of these scenarios has occurred yet, the ASMFC has recently proposed changes that would result in lifting the prohibition on harvesting female horseshoe crabs, further imperiling the food supply for the remaining red knots. This is coming at a time when red knots are far from stable. The average red knot count at Tierra del Fuego for 2018-2020 declined more than 75 percent from average counts in the 1980s and 2000. In 2021, only 6,800 red knots were counted, which is by far the lowest count since surveys began. By allowing female horseshoe crabs to be harvested, there will be less available eggs and that will put further strain on an already delicate red knot population.

The ASMFC must provide the raw data, modeling, and analysis that justifies the expansion of the harvest of female horseshoe crabs for the public to thoroughly review before any action can be taken. This fundamental change in policy and risk to the recovery of the red knot is being done behind closed doors without robust and engaged public consideration. The interests of the public and other stakeholders cannot be undermined by the short-term fishery interests and lack of precautionary principle by the ASMFC.

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Thank you for your consideration.

Sincerely,

Maya K. van Rossum

Maya K. van Rossum
the Delaware Riverkeeper

PINELANDS PRESERVATION ALLIANCE

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September 27, 2022

Caitlin Starks,
Senior FMP Coordinator,
1050 N. Highland St.,
Suite 200 A-N,
Arlington, Virginia 22201

To the Atlantic States Marine Fisheries Commission,

We are writing to urge the Commission to take a more conservative approach to horseshoe crab population management than the proposed updates to the ARM framework would effectuate. We are concerned that the accompanying management implications represent a paradigm shift in how the population is managed that unnecessarily increases the risk to the Rufa Red Knot.

The supply of horseshoe crab eggs in the Delaware Bay is one of the few factors affecting the Red Knot's survival that the State of New Jersey has the power to influence. The ecological connection between these species is inherently valuable and helps to support the local ecotourism industry in southern New Jersey. The overwhelming sentiment from the New Jersey public and our state legislators (see NJ Senate Resolution 67) is that we should adopt the most conservative approach possible. The passage of SR67 indicates that the New Jersey moratorium on female harvest will likely remain in effect, regardless of whatever changes are made to the ARM framework. However, we feel that it is important for the affected states to act in unison to manage our shared resources. We hope that other Atlantic states will join New Jersey by erring on the side of conservation.

For these reasons, we ask that the Commission raise the utility thresholds at which female harvest can be allowed and lower the maximum quota for harvest. We hope that technical updates to the framework can be achieved without abandoning the conservation principles upon which the Commission was founded. To the extent that it is possible, the Commission should further discourage horseshoe crab harvest for both bait and biomedical uses by 1) encouraging states to mandate bait-saving technology by fishermen and 2) urging changes at the national level to make the requisite changes to the US Pharmacopeia that can facilitate the widespread adoption of LAL alternatives in the biomedical industry. Horseshoe crabs and their derivatives have served an important function in modern society; however, we now have the technology needed to significantly reduce our impact upon this species, as well as the wildlife that depend upon them.

Sincerely,

Heidi Yeh

Heidi Yeh, Policy Director
Pinelands Preservation Alliance

HORSESHOE CRAB RECOVERY COALITION

Caitlin Starks, Senior FMP Coordinator
1050 N. Highland Street
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Email: Comments@asmfc.org
RE: Comment on Horseshoe Crab Draft Addendum VIII September 28, 2022

Dear Ms. Starks:

As members of the Horseshoe Crab Recovery Coalition, a diverse group of nearly 50 conservation organizations dedicated to ensuring the future of the American horseshoe crab, we vigorously oppose the Atlantic States Marine Fisheries Commission's (ASMFC) proposed Addendum VIII Interstate Horseshoe Crab Fishery Management Plan, which would increase the number of horseshoe crabs harvested for use as bait and potentially reopen the harvest to include female horseshoe crabs.

While the decline in horseshoe crab populations is problematic throughout the Atlantic Coast, further creating concern over cumulative impacts to the species, it is especially concerning along Delaware Bay, given its importance as a horseshoe crab spawning area and a critical stopover for migrating red knots, a Federally threatened shorebird. Several indicators show that both horseshoe crab populations and the population of red knots, that depend on their eggs as a source of food, are well below recovery thresholds.

Therefore, we urge the commissioners to vote no on Addendum VIII.

We base our opposition on three factors:

- We have yet to see the model upon which the proposed revision is based, so there is no way of objectively verifying its accuracy.
- Horseshoe crab populations remain at historic lows, and their ongoing use both for bait and biomedical purposes all but ensures they will not recover to their historic population levels.
- *Rufa* red knot populations are at all-time lows from both a changing climate and the increasing scarcity of the food needed to fuel their 9,000-mile migration.

Among the most worrisome aspects of the proposed addendum is that the public has yet to see the model upon which it is based. Even if granted access at this late date, we do not believe the September 30, 2022, comment deadline would be sufficient time to independently analyze its accuracy. Such a release would serve the interests of science and spur important public debate about your proposed actions and should have been a prerequisite for ensuring fully informed public commenting.

We are also highly concerned that the proposed revision would likely trigger a resumption in the harvest of female horseshoe crabs, which would make recovery of the species virtually impossible. Under the current ASMFC framework, there is no female crab harvest until female abundance reaches 11.2 million crabs or until the Delaware Bay total red knot stopover population reaches 81,900 birds. Neither red knot nor horseshoe crab populations are anywhere close to satisfying either metric, or yet, under this addendum, female harvest could be allowed.

Based on ongoing field work, including egg density studies conducted by the Delaware Bay Shorebird Project and other organizations, we do not see signs that horseshoe crab populations are recovering from their crash in the 1990s (Smith et al. *in press*). The coalition believes that egg density data is the most reliable indicator of the horseshoe crab population, and importantly, is the most reliable index of value for red knots and other shorebirds. Yet ASMFC has never included these surveys in its modeling.

In addition, ASMFC does not include field survey data for red knots, and these data show that red knot populations are at population levels well below the thresholds that led them to being listed as threatened under the Endangered Species Act. In the 1990s, more than 90,000 could be found along Delaware Bay. This year, only 12,000 were counted along the bay, and in 2021, the number was estimated at an all-time low of 6,800. Evidence is now emerging that red knots are stopping in Delaware Bay for shorter periods (Lyons 2022) or could be bypassing the Delaware Bay stopover altogether in search of life-sustaining food sources elsewhere. This could have far-reaching effects on breeding success and survival (Duijns et al. 2017).

The relationship between horseshoe crab egg availability, red knot feeding behavior, mass gain and overall fitness is clear. During the Delaware Bay stopover period, red knots track horseshoe crab egg availability on sandy beaches bay wide and little in the way of alternative food resources are available (Botton et al. 1994, Karpanty et al. 2006). Importantly, alternative food resources available during the Delaware Bay stopover (e.g., blue mussels, coquina clams) do not provide the necessary nutritional substrates that support rapid and significant mass gain (Haramis et al. 2007). Importantly, red knots departing from Delaware Bay in higher relative body condition migrated south up to a month later than individuals in lower condition, suggesting that the former were more likely to have bred successfully (Duijns et al. 2017). Moreover, individuals leaving Delaware Bay with a lower relative body condition had a lower probability of being detected in autumn, suggesting greater mortality compared to individuals with higher relative body condition (Duijns et al. 2017).

Many of our conservation organizations have sounded the alarm about the global diversity crisis and the specific threats facing shorebird populations, which have plummeted more than 70 percent over the past 50 years. Their declines represent the world's number one conservation crisis facing birds today. Allowing the killing of female horseshoe crabs at this critical moment all but assures that the population of shorebirds like the red knot will never recover.

The joint collapse of red knots and horseshoe crabs is not inevitable. But the draft addendum propels them closer to that grim reality. We urge you to abandon this scientifically unsupported proposal by voting no on Addendum VIII, and instead urge you to begin the process anew by:

- Incorporating into the model datasets that show a more robust picture of population status for horseshoe crabs and red knots, including horseshoe crab egg density surveys and red knot field surveys.
- Publicly sharing the model behind the proposal, allowing for sufficient time for independent analysis before public commenting.

Respectfully signed by members and friends of the Horseshoe Crab Recovery Coalition,

American Littoral Society
Audubon Mid-Atlantic
Audubon South Carolina
Center for Biological Diversity
Charleston Audubon and Natural History Society
Defenders of Wildlife
Delaware Audubon
Delaware Riverkeeper Network
Forest Keeper
Georgia Audubon
Humane Society International
Jenkinson's Aquarium
League of Women Voters of New Jersey
Maryland Bird Conservation Partnership
Maryland Ornithological Society
Mass Audubon

National Audubon
National Wildlife Federation
North Carolina Wildlife Federation
New Jersey Audubon
Revive and Restore
Save Coastal Wildlife
South Carolina Wildlife Federation
Southeastern Massachusetts Pine Barrens Alliance
The Humane Society of the United States
The Safina Center
Wildlife Restoration Partnerships

Smith, J., A. Dey, K. Williams, T. Diehl, S. Feigin, and L. Niles. *In press*. Horseshoe crab egg availability for shorebirds in the Delaware Bay: dramatic reduction after unregulated horseshoe crab harvest and limited recovery after 20 years of management. Aquatic Conservation: Marine and Freshwater Ecosystems.

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Karpanty, S.M., J.D. Fraser, J. Berkson, L.J. Niles, A. Dey and E.P. Smith. 2006. Horseshoe crab eggs determine Red Knot distribution in Delaware Bay. Journal of Wildlife Management 70:1704-1710.

Botton, M.L., R.E. Loveland and T.R. Jacobsen. 1994. Site selection by migratory shorebirds in Delaware Bay and its relationship to beach characteristics and abundance of horseshoe crab (*Limulus polyphemus*) eggs.

SOUTH JERSEY
BAYSHORE COALITION

September 28th, 2022

South Jersey Bayshore Coalition
Karla Rossini
CU Maurice River
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Atlantic States Marine Fisheries Commission
1050 North Highland St.
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To whom it may concern:

The mission of the South Jersey Bayshore Coalition (SJBC) is to preserve the cultural heritage and environmental integrity of the South Jersey Bayshore. The Coalition builds state and local awareness and appreciation of southern New Jersey's Bayshore Region, leading to its protection.

The SJBC strongly opposes the Atlantic States Marine Fisheries Commission's (ASMFC) proposal to reverse the current framework for horseshoe crab management. The ASMFC is proposing to increase the allowable harvest of horseshoe crabs and to lift the longstanding moratorium on the harvesting of females. This proposal contradicts ASMFC's established regulatory precedents, fails to consider relevant data, and ignores the will of local stakeholders.

- Under the current management framework, ASMFC prohibits the harvesting of female horseshoe crabs until the Delaware Bayshore hosts at least 81,900 red knots or 11.2 million female horseshoe crabs. Neither of these quotas have been reached. Nevertheless, the ASMFC is proposing to allow the harvest of female horseshoe crabs and to raise horseshoe crab harvest limits. The reversal of ASMFC's current regulatory precedent will imperil the food supply for red knots and other shorebirds, and destabilize the bayshore ecosystem.

- This proposal fails to consider the most relevant data in its revisions. Red knot counts from Tierra del Fuego for 2018-2020 show a 75% decline in comparison to historic population data gathered between 1980-2000. The proposal also does not consider egg density data, which is the most important indicator for horseshoe crab populations.

- The abandonment of the current management framework and the resulting decline of horseshoe crab and shorebird populations will have a negative impact on overburdened Bayshore communities. Southern New Jersey relies on ecotourism; an industry that generates an estimated $35-50 million annually in the State.The horseshoe crab spawning season draws large numbers of ecotourists from around the country and the world. According to ReTurn the Favor and tagging program data, well over 15,000 community scientists have visited Bayshore beaches since 2013 to assist in horseshoe crab management projects. In addition, SJBC organizations run many other spring migration outdoor awareness programs; each of them well attended. Program success is a clear measure of community and stakeholder investment in a healthy Bayshore ecosystem.

If the ASMFC implements the proposed changes, Bayshore ecology will be weakened and local economies negatively impacted. For these reasons, the SJBC urges the ASMFC to retain the established management framework, maintain the current limits on horseshoe crab harvesting, and continue the moratorium on harvesting female horseshoe crabs.

Sincerely,

Karla Rossini
Coalition Chair
Karla.Rossini@CUMauriceRiver.org

September 30, 2022

1050 N. Highland St.
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Ref: Proposed Addendum VIII to Horseshoe Crab Fishery Management Plan

Dear ASMFC Commissioners,
We, a group of individuals dedicated to horseshoe crab conservation, write to urge the Atlantic States Marine Fisheries Commission (ASMFC) to vote against Option B for Addendum VIII which would change the Adaptive Resource Management (ARM) model for horseshoe crab harvest. Using current data inputs, the new model would recommend opening a limited female harvest.

We understand that an update is necessary for the ARM model, as data availability has changed and the modeling software is outdated. We also understand that the Delaware Bay horseshoe crab population is stable and in recent years there has been some evidence of recovery. We even understand that some harvest is necessary to allow watermen access to the bait they need to maintain their livelihoods. However, we are challenged to understand why it is necessary to use a model that recommends female harvest.

As volunteers for reTURN the Favor, a multi-partner program working to rescue overturned or impinged horseshoe crabs stranded on New Jersey's Delaware Bay beaches, we are acutely aware of the vulnerability of the horseshoe crabs. We work to protect the lives of horseshoe crabs and expect a valid mechanism when the mortality of horseshoe crabs is at stake. Addendum VIII does not provide that justification.

Insufficient time and opportunity for review
Several stakeholders, including those with significant statistical expertise, have requested the new models with a Freedom of Information Act request, but it has not been provided. Federal agencies claim that the size and complexity of the new ARM model is the reason it cannot be shared. The confidential data from the biomedical industry are also cited as a barrier to access. However, horseshoe crabs are a public resource, and as the mechanism that provides harvest recommendations, the ARM model needs better opportunity for access and review.

Horseshoe crab numbers have not reached pre-decline abundance.
In the 1990s, there was a rapid increase in horseshoe crab harvesting to supply fisheries with bait. This led to a dramatic drop in the crab population as well as other species that rely on horseshoe crab eggs including the *rufa* Red Knot. Restrictions in the harvest in the early 2000s has helped the population to stabilize and even increase according to the Horseshoe Crab Benchmark Stock Assessment and Peer Review Report.

Increased, but not recovered, the horseshoe crab population has not reached the pre-decline population. The previous ARM model set a threshold of 11.2 million adult female horseshoe crabs, with no female harvest until this population is reached. The new model disregards that number, recommending female harvest before horseshoe crabs reach this carrying capacity, an action that will slow recovery.

Data used in model does not reflect the activity on the beach.
The new model has added biomedical mortality data to the trawl survey data, an important dataset to include. However, the new model does not incorporate any surveys that reflect the actual spawning activity on the beach like the Delaware Bay Spawning Survey data or egg density data. These datasets provide important information on the actual availability of eggs for Red Knots, shorebirds, and other wildlife, as this is the critical variable for the ecosystem. Before changes are made to the model, the concerns with these surveys should be addressed and a model developed that incorporates these data.

Lack of understanding on the potential impacts of climate change to horseshoe crab population.
We currently have very limited understanding of the full impact that climate change will have on horseshoe crab habitat and life cycle. We already know that there will be impacts to habitat from sea level rise and extreme storms as those impacts are actively occurring now. When facing the uncertainty of climate change, resiliency is the key to maintaining ecosystems. We must ensure that all other threats to the species are minimized so the population is strong and capable of recovery when in the face of climate change impacts. A female harvest would greatly reduce the resiliency of the species.

Disregard for investments in restoration and other conservation actions.
Setting the precedent to open a female harvest would undermine the millions of dollars of investments that have been made and continue to be made to protect and restore horseshoe crabs spawning habitat in both Delaware and New Jersey. These investments increased significantly in 2013 to repair beaches after Superstorm Sandy, and large-scale restoration projects have continued since. These projects were determined to be a necessary part of the recovery of horseshoe crabs and Red Knots by federal, state, and local agencies; community members; and conservation partners, specifically because the species is not recovered.

Horseshoe crabs are a critical part of the ecosystem. They also play an important role in the identity of coastal communities. We have dedicated many hours to rescuing horseshoe crabs, because this keystone species is important to us personally. Female harvest would threaten this identify and threaten the core of what makes our communities unique.

We urge that the precautionary principle is observed and Option A approved. Option A reverts back to older harvest recommendations in Addendum VI and is less than ideal, but it is preferred over Option B. We ask that Option B of Addendum VIII is not approved until the ARM model changes have been thoroughly reviewed by the public, include comprehensive survey data, and consider an appropriate threshold population.

Females carry the future of the species – the future for the ecosystem, the future of harvest, and the future for us – the residents and visitors of these coastal communities. The horseshoe crab population is showing some signs of recovery, but it is not fully recovered. It is only on the path to recovery. It is a dangerous precedent to suggest that a female harvest could be reopened.

Sincerely,

Susan Rotella, Villas, New Jersey

Deb Finelli, New Haven, Connecticut
Please leave these beautiful harmless prehistoric creatures alone to live their natural lives on earth.

John H. King, Cape May, New Jersey

Jill Connell, Villas, New Jersey

Stephen Hamersky Jr., Hillsborough, New Jersey
It is time (which is quickly running out) for everyone to stand up for the environment and for endangered life forms, rather than catering to special interests for their selfish short term. Please have the courage to do so.

Eileen Halko, High Bridge, New Jersey
Please help protect the horseshoe crabs.

Joseph C Halko, High Bridge, New Jersey

Bonnie Kolber, Trenton, New Jersey

Wendy Latzgo, Fogelsville, Pennsylvania
I strongly urge you to continue to prohibit the harvesting of female horseshoe crabs and not raise the quotas for males. As a volunteer with Return the Favor and the American Littoral Society, I work hands on with these wonderful creatures, rescuing and tagging them. Currently their habitat is diminishing with coastal erosion and sea level rise. Locals that live in the area tell me the number of crabs has plummeted in their lifetimes. That’s why we’re doing everything we can to save every one of them. Their future is also unsure with the changes of the ocean ecosystem with climate change. Right now is a critical time for this species. Please do the right thing and keep the quotas as they are.

Amy Vasquez, Burlington Township, New Jersey

Joseph Burger, Forked River, New Jersey

Marcy Fiorentino, Burlington Township, New Jersey

Ruth Bergstrom, Villas, New Jersey

Emily Ochitill, Yorktown, Pennsylvania

Eric Baratta, Beverly, New Jersey

Kevin Knutsen, Barnegat, New Jersey

Diane Lee-Smith, Mansfield, Ohio
Also urge the FDA to approve the use of artificial LAL for testing.

Lisa Burger, Forked River, New Jersey

Allison Anholt, Cape May Court House, New Jersey

John Gfrorer, Wenonah, New Jersey
Please – think about future generations. These majestic creatures need to be around for another 5 million years. Don't be the reason why they disappear.

Barbara Bennett, Jamison, Pennsylvania
Please stop this proposal!

Kathy Horn, Villas, New Jersey

Gail Howarth, Maple Shade, New Jersey

Please do not allow the female horseshoe crab harvest to be reopened. We have worked diligently to save and protect this unique species which is so valuable to our birds, beaches, culture and even our human existence! Thank you.

PATRICIA A HARPER, Cape May, New Jersey

Maranell Estadt, Millville, New Jersey

Judy Pizarro, Maple Shade, New Jersey

Kelly Grassi, Basking Ridge, New Jersey

Ron Smith, Merchantville, New Jersey

For over ten years I have been an active community scientist participating in horseshoe crab rescues on the Delaware Bayshores. During this time our group has rescued over 70,000 horseshoe crabs. We have witnessed storms, tides and many human structures and habitat alterations that pose serious risks to spawning horseshoe crabs. At the same time I have witnessed and participated in restoration, education and collaboration that represents a more optimistic future for horseshoe crabs and the bay ecosystem. Loosening restrictions would only serve to undermine the successes of the last decade and threaten the future of this keystone species.

Faith Zerbe, Drexel Hill, Pennsylvania

Dayalan Srinivasan, Collingswood, New Jersey

The Atlantic horseshoe crab population is simply not ready for the catch limits to be lifted. My hundreds of hours of volunteer time rescuing horseshoe crabs in the Delaware made it clear that egg densities and number of female crabs remain woefully low. This is the time to rededicate to restoring this declining population, not for declaring victory.

Mary Beth Kohler, Mount Laurel, New Jersey

I have been working with Return the Favor NJ to rescue overturned horseshoe crabs for two migrating seasons. Female horseshoe crabs are larger and heavier than males, and from my data, there are fewer of them compared to the amount of males we rescue. Including females in a harvest is a dangerous, short-term measure. Please consider the testimony of those of us who are out there working to help the horseshoe crabs.

Susanna Burlage, Clementon, New Jersey

Denise Marconi, Woodstown, New Jersey

Skip the change and keep the current protections to help protect horseshoe crabs, especially females.

June Karp, Wildwood, New Jersey

As someone who has worked to rebuild the dwindling horseshoe crab population on the Delaware Bay for seven years, I was shocked to learn that the progress we have made could be thwarted and even more shocked that it would target females that the species needs to survive as well as other species in the ecosystem of the bay who utilize their eggs for survival. Not only does research bear this out but common sense tells me that if females are targeted as expendable in any species, their species is considered expendable along with other dependent species. Even to those who chose not to consider the fragility of the ecosystem, this would be a choice to make expendable what the fishing industry appears to need. The outcome of targeting females would be self defeating for the fishing industry without sustainability of the horseshoe crab population.

Robert E. Coifman, M. D., Millville, New Jersey

Karen Thompson, Cape May, New Jersey

Gerry Barsotti, Ocean City, New Jersey

Dennis J. Funaro, Billerica, Massachusetts
We should have learned a lesson with the devastation of the Atlantic Sturgeon in the Delaware. Do not do change the horseshoe crab numbers so that the current efforts to restore the crab numbers can continue.

Patricia A Haines, Pitman, New Jersey

Lynne Riley, Woodstown, New Jersey
This is clearly not the time to reduce protective regulations for horseshoe crabs. So much is at stake.

Andrea Olenik Hipkins, Woodbine, New Jersey
The future of this species and the others it supports rests on those female crabs thus their protection is crucial to survival for humans, red knots and the species itself. Humans are the only ones who can make this happen. Please protect their future and ours.

Robert Hofstrom, Medford, New Jersey
I am one of those individuals who have worked hard to make the horseshoe crab recovery at least a partial success. I hope that those efforts aren't thrown away.

Jill Mortensen, Millville, New Jersey
Please protect horseshoe crabs.

DonaLee Milner, Pitman, New Jersey

Marian Jordan, Linwood, New Jersey
The 'for profit' biomedical request for privacy should not be paramount in this situation. The animals are a public and natural resource that demands a higher level of consideration. Though the animals have been relatively steady in breeding for the past few years, their numbers are far lower than historically. The drop is because of the over harvesting by both marine and biomedical entities. One doesn't value them and uses them as cheap bait for fishing and the other is making so much money from their harvest and poor management of bleeding techniques that they are willing to deplete the population until it crashes - only then will they make use of the synthetic product that is in use in other countries.

Dawn Payne, Woodbine, New Jersey
I think it is imperative to save the horseshoe crabs. We should not be allowing more to be killed, especially the females. The only way their numbers will increase is if every female is able to lay eggs for the next generation. It would be incredibly foolish, near-sighted, and against all common sense to let the females be killed along with males.

Megan Kately, Villas, New Jersey

Guillaume Laurent, Villas, New Jersey

Elzbieta Frydel, Franklinville, New Jersey

Carolyn Richards, Cape May, New Jersey

Devin Griffiths, Ocean View, New Jersey
I find it distressing that the ASMFC is failing to share its data or data models with all affected parties, and that you are considering opening up a female horseshoe crab harvest when the status of both the horseshoe crab and Red Knot populations is tenuous at best. In the face of serious uncertainty and grave threats, prudence and caution must rule the day. Please reject Option B of Addendum VIII.

Amanda Lyons, Wildwood, New Jersey

Kelianne O'Shea, Cape May, New Jersey

Daniel Bruce, Mount Laurel, New Jersey

Victoria Tyran, Franklinville, New Jersey

Wendy Tyran, Franklinville, New Jersey

Maria Delayo, Franklinville, New Jersey

Michelle Piazza, Yorktown Heights, New York

Jeffrey Hipple Jr, Moorestown, New Jersey

Amanda Miduski, Clayton, New Jersey

Melinda Talley, Clayton, New Jersey

Cassandra Vasta, Clayton, New Jersey

Michelle Barbaro, Franklinville, New Jersey

Ruth Maina, Moorestown, New Jersey

Janine Bruce, Mount Laurel, New Jersey

Stacy Milazzo, Moorestown, New Jersey

Kevin Pyles, Blackwood, New Jersey

Monling Li, New York, New York

Mai H., Moorestown, New Jersey

Carol Wyland, Avalon, New Jersey
Please vote AGAINST Option B!

Scott Hearn, Moorestown, New Jersey

Jacqueline Clark, Williamstown, New Jersey

Marta Gancarz, Mooresville, North Carolina

Victoria J Gordon, Palmyra, New Jersey

DEREK FRYDEL, Franklinville, New Jersey

Maria Reyes, Moorestown, Pennsylvania

Angela Trout, Clayton, New Jersey

Lisa Ferguson, Stone Harbor, New Jersey

Ben Eggink, Franklinville, New Jersey

Michele Cole, Marlton, New Jersey

Cole Good, Mullica Hill, New Jersey

Jessi S., Sicklerville, New Jersey

Mason Miller, Franklinville, New Jersey

Carol, Mount Laurel, New Jersey

Kimberly Spiegel, Millville, New Jersey

LAURIE L WILLIAMS, Fortescue, New Jersey

Liz Cowley, Fortescue, New Jersey

Meghan Kolk, Villas, New Jersey

Peter Manzelmann, Mauricetown, New Jersey
Horseshoe crabs are vital to our ecosystem for so many reasons. If we destroy the ecosystem we will be destroyed too. Do not raise the quotas for horseshoe crabs. Thank you.

Olivia Chen, Franklinville, New Jersey

Karla Rossini, Millvilee, New Jersey

John Custer, Newtown Square, Pennsylvania

Robert C Cowperthwait, Millville, New Jersey

Susan Rossi, Millville, New Jersey

Mary E Wood, Monroe Township, New Jersey
With the red knot population in steep decline, it defies logic to allow more harvesting of horseshoe crabs on which their survival depends. Please do not do this.

Helena Grin, Millville, New Jersey
We must do everything we can to support the diversity of our marine environments. Thank you.

John Newman, Weehawken, New Jersey

Wilma Greisman, Sea Isle City, New Jersey

Adina LoBiondo, Northfield, New Jersey

Janice Molloy, Greenwich, New Jersey
Please save the horseshoe crabs for all

Robin Spurlino, Dowingtown, Pennsylvania

Dennis Palmer, Blackwood, New Jersey

Patricia Rossi, Levittown, Pennsylvania

Martha Torpey, Cape May, New Jersey

Michael Torpey, Cape May, New Jersey

Annette Kissell Nestler, Villas, New Jersey
Health of Our Ecosystem and Horseshoe Crabs must be Maintained!

Thomas Bellia, Mullica Hill, New Jersey
Yes, we rely on a healthy Delaware Bay , the crab and red knots are and integral part of our environment

Donna C Dailey, Millville, New Jersey

Geri Ferrara, Port Elizabeth, New Jersey

Suzanne Hauselt, Cape May, New Jersey

Doreen b Homan, Newfield, New Jersey

Carl k Homan, Newfield, New Jersey

Susan Whitehouse, Elmer, New Jersey

Cheryl Fox, Franklinville, New Jersey

Jessica WoodKelley, Philmont, New York

Laura Chamberlin, Chestertown, Maryland

Vicki Dodson, Baltimore, Maryland

Kathleen M Haines, Pitman, New Jersey

Gabriele Schmitt, Bergenfield, New Jersey
I am very concerned that harvesting of Horseshoe Crabs will be increased, putting not only their population at risk but all the shore birds that depend on the crabs' eggs for their survival.

David Golden, Egg Harbor, New Jersey

Susan M Miles, Bryan, Pennsylvania

Jan Dwyer LoBiondo, Vineland, New Jersey
Our environment continues to be at risk and yet we as the stewards of its gifts like the pollinators, the endangered species, the plants and food sources need legislative support. The data speaks clearly to me: read the scientific data and devote energy to guarantee this earth to our children and grandchildren. That is why I volunteer to Return the Favor with my CU Maurice River team from mid May to mid July and also cook for 20+ International scientists who devote time and travel to gather that important and current data on horseshoe crabs and red knots. PLEAE READ THE DATA. Please do not threaten the horseshoe crabs. Please do not threaten the red knots. Thank you for reading. I'm putting my faith IN YOU.

Elaine Whitaker, Avalon, New Jersey

Erin Oswald, Hammonton, New Jersey

Bette McCarron, Ocean City, New Jersey

Joan Lawrence Rhoads, Millville, New Jersey
Leave the female horseshoe crabs to spawn. The crabs all already at a great life cycle disadvantage, taking females will further deplete the population resulting fewer crabs for all Bird and Human Resources.

Lisa, Williamstown, New Jersey

Clay Sutton, Cape May Court House, New Jersey
The ecotourism value of the crabs is far greater than the fisheries value!

Carolyn Quinn, Gibbsboro, New Jersey

Lisa McDeemott, Mauricetown, New Jersey

Lee Varian, Princeton, New Jersey

John McDermott, Mauricetown, New Jersey

Matthew Stock, Egg Harbor, New Jersey

Erik Mollenhauet, Pitman, New Jersey

Jackie Kehrmann, Richland, New Jersey

John Wojtowicz, Bridgeton, New Jersey

Diane Salek, Nutley, New Jersey

Elizabeth Daversa, Plainfield, New Jersey

Marla Jimenez, Millville, New Jersey

Susan Linder, Woodridge, New Jersey

Eileen Epley Wiggins, Mauricetown, New Jersey

Lisa McNichol, Avalon, New Jersey

Horseshoe crabs are integral to the successful migration of many birds. Reducing their numbers would significantly impact their migration.

Pamela W Hull, Bernardsville, New Jersey
In our increasingly fragile world,, a vote against Option B of Addendum VIii is critical.

Stephen Byrne, Fortescue, New Jersey
Please don't. Maybe later when the numbers are good...

Lisa Stewart Garrison, Bridgeton, New Jersey
We've worked so hard to achieve horseshoe crab recovery but we are not there yet. Voting against Option B and incorporating surveys of spawning activity and egg density into the new ARM model is the prudent and sensible course of action for ASMFC to take at this time.

Meghan Martin, Bridgeton, New Jersey

Cathy Davies, Millville, New Jersey

Mr. Anthony Klock, Port Norris, New Jersey
This makes zero sense! No!

Cynthia Staehle, Vineland, New Jersey
There is no good reason whatsoever to harvest horseshoe crabs.

Joan Deckman, Barnegat, New Jersey

Peter Deckman, Barnegat, New Jersey

Diana Deckman, Basking Ridge, New Jersey
As someone in research and sustainable supply chain management, I respect the balance of advancement, supply, and resourcing. We know too much to put our heads in the sand. Do the right thing and listen to your experts early and often.

Susan Cobb, Moorestown, New Jersey

Lenore Tedesco, Stone Harbor, New Jersey
Horseshoe Crabs should be recognized as the keystone species that they are for the entire ecosystem that should far outweigh their value as bait. More information needs to be included in population models to more appropriately account for their role.

Joan J. Purchase, Cape May Court House, New Jersey
The amount of horseshoe crabs must improve.

Sandra Anderson, Vineland, New Jersey
Humans have depleted the numbers of these incredible creatures for years. We have to try and reverse the damage we have already done. Please save them - they have already saved us and continue to do so with their amazing blue blood. Strictly monitor the blood harvesting companies and raise the fines and penalties for illegally harvesting them. Thank you.

Ellen Pedersen, Vineland, New Jersey
Horseshoe crabs have not sufficiently recovered to change harvesting, please don't change the ARM management.

Susan Michniewski, Hopewell, New Jersey

Jeanne Parkinson, Millville, New Jersey

Rita Barthold, Millville, New Jersey
I join CU Maurice River and the South Jersey Bayshore Coalition in opposing the Atlantic States Marine Fisheries Commission's proposal to reverse the current framework for horseshoe crab management.

Stacey Staman, Williamstown, New Jersey

Lynn Parker, Stratford, New Jersey

George d. Howarth, Maple Shade, New Jersey
First, I disagree with using/killing living creatures for fertilizer, especially Horseshoe crabs. Second, our watermen do not need to use Horseshoe crabs as bait to catch Els to be used as delicacies for other countries. Third, there is a silicone that can be used effectively
for medical purposes instead of Horseshoe crab blood. Lastly, Opening the harvest of female Horseshoe crabs makes even less sense to me especially since neither the male or female population has reached the pre-decline numbers. We need to protect these unique and purposeful creatures. Thank you for your time and consideration.

Mark Werley, Greenwich, New Jersey

Priscilla Bonsell, Hatfield, Pennsylvania
Please protect the female horseshoe crabs.

Judith Davis, Elmer, New Jersey

Sally B Conyne, Stockton, New Jersey

Jessica Davis, Doylestown, Pennsylvania

ROBERT DANIEL ROSSI, Levittown, Pennsylvania

Marie Victor, Villas, New Jersey

Patrick March, Doylestown, Pennsylvania
Protect horseshoe crabs. Many species, including our own, depend on them.

Rebecca Pedersen, Buena, New Jersey

Kathleen Hooper-Milositz, Bethlehem, Pennsylvania

Kenneth Foulke, Warminster, Pennsylvania

Elizabeth Loyle, Millville, New Jersey

Mary Ann Smith, Fort Washington, Pennsylvania
Females horseshoe crabs carry the future of the species – the future for the ecosystem and the future of harvest. The Red Knot depends on her eggs to put on the necessary weight it needs to migrate to its nesting ground. The number of Red Knots have already declined dramatically and are threatened for its survival.

Sharon Furlong, Trevose, Pennsylvania
Now is not the time to allow anything except preservation of this and related species. period.

Phyllis Rosenbaum, Warminster, Pennsylvania

Diann Ewan, Millville, New Jersey

Kathleen Fitzgibbon, Pipersville, Pennsylvania

Catharine Flaherty, Elmer, New Jersey

Kathy Klusman, Douglassville, Pennsylvania

David Kutish, Chalfont, Pennsylvania

Will Stollsteimer, Keene, New Hampshire

Anne Meibohm, Lafayette Hill, Pennsylvania
As a biostatistician as well as a citizen interested in conservation of endangered species, it is important that the model be reviewed by external statisticians. Also there are synthetic alternatives instead of horseshoe crabs for the biomedical industry (PLoS Biol. 2018 Oct; 16(10): e2006607.)

Jewel Rufe, Perkasie, Pennsylvania

Barbara Kristina Beck, Quakertown, Pennsylvania
Please vote against Option B for Addendum VIII which would change the Adaptive Resource Management (ARM) model for horseshoe crab harvest.

Vinobha Karthik Panner Selvam, Warrington Township, Pennsylvania
Let's save horseshoe crabs and Delaware bay!

Patrick McNamara, Media, Pennsylvania
Conservation efforts are showing positive returns, don't stop the effort too soon.

Kerry Loux, Langhorne, Pennsylvania

Tim McFadden, Southampton, Pennsylvania

Larissa Smith, Cape May Court House, New Jersey

Barbara Stollsteimer, Newtown, Pennsylvania

Susan A Harrison, Morrisville, Pennsylvania
Saving the planet - one species at a time.

Anne Poole, Pemberton, New Jersey

John L. Wheeler, Ocean View, New Jersey

Gregory Staman, Williamstown, New Jersey
Action towards bettering our environment and the species within it is a priority for all of us, and we need to approach these issues responsibly.

Edward R. Bonsell, Hatfield, Pennsylvania
Please don't increase the number of Horseshoe Crabs allowed to be harvested until their numbers return to historic levels. Some things are worth more than money. We need our migratory birds. Thankyou, Edward R. Bonsell

Rachel Adler, Morrisville, Pennsylvania

Kathy Pearce, Bensalem, Pennsylvania

Philip Stollsteimer, Newtown, Pennsylvania

Susan Sherman, Doylestown, Pennsylvania
It's bad enough that you want to increase the taking of Horseshoe Crabs, but taking the females is the worst thing you can do. It will all but guarantee the collapse of the Red Knot and other shorebird populations that depend on their eggs to fuel their migration. If there are no eggs when the birds arrive, exhausted and all but starving, they will be unable to make the rest of their journey, and as a result will die off.

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September 22, 2022

Public comment on the Atlantic States Marine Fisheries Commission's Draft Addendum VIII to the Horseshoe Crab Fishery Management Plan: Implementation of the 2021 Adaptive Resource Management Framework Revision

The Wetlands Institute has a long history of stewarding the Delaware Bay population of horseshoe crabs (*Limulus polyphemus*) through programs in research, conservation, and education. Since 1991, our staff and volunteers have contributed annually to the Delaware Bay spawning surveys and, since 2013, we have organized hundreds of volunteers to rescue nearly one million stranded horseshoe crabs on Delaware Bay beaches in New Jersey through the reTURN the Favor program. Our staff monitor birds, reptiles, and fish that inhabit southern New Jersey and depend on a robust population of horseshoe crabs. We engage and educate our membership, visitors, and surrounding communities in this work through public programs, field trips, and school group programs.

The horseshoe crab population plays a critical role in the resiliency of the Delaware Bay ecosystem. Threatened and at-risk species from near and afar rely on the eggs deposited by spawning horseshoe crabs amassed on Delaware Bay beaches during critical life history stages. Famously, red knots (*Calidris canutus rufa*) make a hemispheric journey to nesting grounds in the Arctic aided by a stopover on the Delaware Bay to gorge on abundant and accessible crab eggs. Local breeding fish, crabs, birds, and reptiles consume these eggs, creating ecological linkages of impact that extend far beyond the Delaware Bay. Though the connection and value of horseshoe crab eggs to a multitude of species is clear, the extent and repercussions from a reduced population of horseshoe crabs are not fully understood. Incorporating additional data, particularly annual measures of horseshoe crab egg densities, would strengthen the models for potential impacts of horseshoe crab harvest to numerous species fueled by their eggs.

The Wetlands Institute supports updates and improvements to the Adaptive Resource Management (ARM) modeling approach, inputs of new data, and continuation of multispecies management models proposed in Addendum VIII revisions, however safeguards are lacking for the uncertainty inherent in the population models that underpin the ARM model, and in the ARM model itself. These uncertainties extend to the recommendations in the proposed revision to horseshoe crab management in Amendment VIII. While the proposed adaptive management cycle will provide opportunity to improve the models over time, disclosure of data inputs and threshold setting is critical for initial stakeholder support and precautionary approach for untested revisions in the revised framework. Further, prior thresholds set for female horseshoe crabs (11.2 million individuals) and *rufa* red knot (81,900 individuals) have not been reached and should not be disregarded in Addendum VIII.

Finally, public concern that prompted the original ARM and Amendment VII persists. Strong concern for the population of horseshoe crabs, critically low population levels of *rufa* red knot and other long-distance migratory shorebirds, and the health of the Delaware Bay ecosystem as it faces increasing threats from rising sea level and climate change are top concerns among The Wetlands Institute's staff, volunteers, and community members.

For these reasons, The Wetlands Institute opposes Option B of the Revised Addendum VIII. We ask that Option A of the Revised Addendum VIII be adopted until the Atlantic States Marine Fisheries Commission addresses these concerns to aid the recovery of the Delaware Bay population of horseshoe crabs and health of the Delaware Bay ecosystem.

Sincerely,

Lenore Tedesco

Lenore P. Tedesco, PhD
Executive Director

Delaware
Ornithological
Society

PO Box 4247
Wilmington, DE 19807

September 30, 2022

Caitlin Starks, Senior FMP Coordinator
1050 N. Highland Street
Suite 200A-N
Arlington, VA 22201
Email: Comments@asmfc.org

RE: Comment on Horseshoe Crab Draft Addendum VIII

Dear Ms. Starks:

The Delaware Ornithological Society (DOS) is an all-volunteer, 501(c)3 nonprofit representing hundreds of members in Delaware and adjacent states. Our mission is the promotion of the study of birds, the advancement and diffusion of ornithological knowledge, and the conservation of birds and their environment. Our small grassroots organization has helped lead collaborative conservation efforts for bird habitat over the past decade, raising well over half a million dollars in private matching funds for habitat acquisition through our annual Delaware Bird-a-Thon fundraiser, working with our State and NGO partners to leverage these funds to help purchase habitat along the Delaware Bayshore.

DOS opposes the adoption of Draft Amendment VIII to the Horseshoe Crab FMP and urges the Horseshoe Crab Management board to adopt the No Action alternative at this time, based on the following concerns:

Inappropriate Management Objectives / Harvest Functions for Ecological Integrity

While we appreciate the tremendous amount of effort that has gone into the ARM Revision process (especially moving the model from a software-package based approach to open source and industry standard R programming environment, which should make public review and future model revision easier), we have significant concerns about the adoption of the Revised ARM to set harvest quotas for horseshoe crabs. The revised ARM model has a number of important flaws, the most critical being that it does not include as a management objective the timely increase of either the horseshoe crab (HSC) or *rufa* Red Knot (REKN) populations toward any metric related to an estimate of ecological carrying capacity, as the original ARM had done.

In fact, rather than estimating carrying capacity (as the previous ARM did, albeit from limited data and literature) and setting as a goal a metric related to that estimate, this model seeks only to achieve a long-term equilibrium in HSC that would actually be significantly *lower* than the current model-based female population estimates for Delaware Bay. (7.3 million female HSC at ARM projected equilibrium vs. the current population estimate of 9.4 million female HSC) (Figure 15 of Supplemental Peer Review Report). This equilibrium point in the projection would have no real relationship to the concept of ecological integrity. While we appreciate that the prior carrying capacity estimate from the original ARM was based on limited data, we find it extremely concerning that the *objective* of meeting 80% of an estimated carrying capacity for DE bay area

HSCs has been abandoned in the Revised ARM and by extension the Proposed Draft Addendum and that this change in objective has been couched in terms of improved science, when it is in fact a change in management philosophy. The Peer Review Panel echoed this when they stated that "The new utility and harvest functions are a representation of values." The fact that the original ARM model involved a so-called "knife-edge" threshold vs. continuous harvest recommendation is not a valid reason for a major change in the philosophical underpinnings of the model with respect to ecological integrity. In fact, the knife-edge concern is not at all relevant when the Revised ARM projection levels out at over 2 million fewer female crabs than currently estimated.

The Revised ARM model would have allowed female HSC harvest throughout recent years even though female HSC abundance is positively correlated with REKN adult survivorship (β_1 =0.37 95% CRI: 0.12, 0.6) in the model, thereby unnecessarily extending the timeline to REKN population rebound. Given the Red Knot stopover population trend uncertainty described below, and with the increasingly unpredictable effects of climate change on both survival and recruitment, no avoidable delay in recovery of this federally Threatened bird is acceptable.

ARM Model Uncertainties and Narrow Ecological Lens

The valid scientific concerns about the data upon which the model is based have been detailed extensively by others. We remain concerned that the only HSC-specific trawl survey, the VA Tech Swept Area survey, indicates a less robust population rebound than the DE and NJ trawl data. It is also our understanding that the unpublished study by Smith et al. for egg density at a NJ site shows similar general trends to the VA Tech trawl survey for the corresponding time frame (Arnstead per comm.).

Important methodological concerns brought up with the ARM by the peer review panel must be carefully considered prior to adopting the Revised ARM. E.g. "The Panel noted the estimated primiparous and multiparous HSC abundances have large uncertainties for 2012-2015 when the VT data are not available. In particular, the primiparous estimates for these years are not reliable, potentially introducing large uncertainties (and biases) in the projection model and ARM. The Panel agrees that such uncertainty will be reduced when more years of survey catch data become available in future."

Just as important, while the concept of the ARM model for multi-species adaptive management was a great start a decade ago, that foundation should have been built upon by incorporating into the model available population data for other migratory shorebirds of conservation concern that heavily utilize HSC eggs on migration stopover, including Semipalmated Sandpiper, Sanderling, and Ruddy Turnstone (Tsipoura and Burger 1999). If this is not currently possible a more conservative approach to selecting acceptable HSC population endpoints is warranted to account for the importance of HSC eggs to bird species of concern other than the Red Knot, as well as other important aquatic species in the food web supported by the keystone HSC.

Red Knot Population Uncertainty

Recent shorebird project mark/recapture data has shown extremely wide variance in 95% confidence intervals for the actual REKN population estimates due in part to reduced banding and resighting effort during the COVID pandemic. "While the number of birds detected in 2021 was similar to the number detected in 2020, this number of individuals resighted within a season is lower than recent (pre-COVID-19) years given the limited use of volunteers for safety reasons. The number of marked birds detected and available for analysis in 2021 was approximately 48% lower than the number in the 2019 analysis (n = 3,072 birds) and 58% lower than the number detected and used for analysis in 2018 (n = 3,820)" (Lyons 2021).

This reduced *n* value for resighted birds, perhaps also due to reduced resighting probability associated with apparently shorter stopover times (Lyons 2021), has resulted in 95% confidence interval widths for the Red Knot stopover population estimate of 16,339 and 19,262 for 2020 and 2021, respectively, the first time since the model began that CI width exceeded 7.000 in two successive years (<7,040 in 7 of the prior 9 years from 2011 to 2019). At the same time, the lower end of the confidence interval for the population estimate dipped well below 40,000 birds for the first time since the initiation of the model (2013 was the only other year with a CI endpoint below 40,000).

The Draft Addendum states that "If Option B is selected, implementation of the ARM Framework Revision would likely occur for the 2023 fishing season" We feel that it is highly imprudent to implement female HSC harvest at a time when we have some of the poorest recent data on the REKN population, with 95% Confidence Intervals spanning 40-45% of the population estimate. This is unacceptable data upon which to base an increase in female HSC harvest under any circumstances.

Failure to Incorporate Climate Change

While the Revised ARM model includes an input for Arctic snow cover on the Red Knot breeding range, it does not include any other climate related inputs (such as trends in water temperature, etc.) and it cannot account for stochastic events related to climate change, such as storm events.

In fact, the Peer Review Panel recommended that the WG "Evaluate the effect of climate change on horseshoe crabs and red knots. This includes the effects of warming temperatures, sea level rise, and storm frequency and intensity on the timing and duration of spawning, movement of crabs into and out of Delaware Bay, and effects on spawning habitat."

With the rapidity of current climate change, harvest should remain appropriately conservative until this research has been initiated and relevant data is available. Opening female harvest while REKN populations are not recovered, and with a known significant possibility of stochastic events that may affect HSC spawning and/or REKN survival is not a conservative approach to managing this sensitive resource.

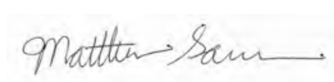
Limited Stakeholder Engagement

As stated in Draft Addendum VIII, "A goal of the ARM Framework is to transparently incorporate the views of stakeholders along with predictive modeling to assess the potential consequences of multiple, alternative management actions in the Delaware Bay Region." However, this ARM revision was conducted with minimal outreach effort to stakeholders and did not incorporate the views of conservation stakeholders in determining acceptable model endpoints and harvest functions. We agree with Walsh who states in her minority report that "The proposed new utility function [harvest function as corrected by the PRP] substitutes very different values and risk attitudes under the umbrella of technical updates, outside of a forum for meaningful stakeholder input and absent any process to solicit updated stakeholder viewpoints."

The Peer Review report states that "the Panel also understands the inability of the WG to convene a truly representative group of stakeholders for this revision, and therefore also recommended the WG use the outcomes of the sensitivity analyses to confirm the harvest function itself does truly represent the previously-articulated desires of stakeholders from the original ARM Framework (2009)." We would argue that revisiting stakeholder desires is a necessary aspect of the ARM Revision, because of turnover in stakeholder representatives and the tremendous amount of additional data and information available to those stakeholders over the past decade. Stakeholder values and opinions change over time and basing harvest functions being presented to the public on stakeholder input from 12 years earlier is questionable at best. There is no reason that the ASMFC HSC WG could not have virtually/remotely convened stakeholders to inform what amounts to major changes in harvest philosophy and values within this revision.

In summary, we urge the ASMFC Horseshoe Crab Management Board to select the No Action alternative at this time. It would be imprudent at present to open a female HSC harvest in Delaware Bay and the ARM should be revisited with broad ecological sustainability and population restoration goals in mind, and with significantly increased public and stakeholder engagement in the process, in keeping with the ARM objectives.

Sincerely,



Matthew Sarver, DOS Conservation Chair

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THE HUMANE SOCIETY
OF THE UNITED STATES

September 28, 2022

Atlantic States Marine Fisheries Commission
1050 N. Highland St., Suite 200 A-N
Arlington, Virginia 22201
comments@asmfc.org

RE: Horseshoe Crab Draft Addendum VIII

Dear Commissioners,

As a member of the Horseshoe Crab Recovery Coalition, the Humane Society of the United States (HSUS) stands in strong opposition to the Atlantic States Marine Fisheries Commission's (ASMFC) plan to change its Horseshoe Crab Fishery Management Plan, a move that would raise quotas on the killing of horseshoe crabs for use as bait by potentially reopening the harvest to include female horseshoe crabs.

With the absence of the underlying data which supports the new draft addendum being released to the public, conservation groups and concerned citizens have no way to truly understand the science on which the new proposal is based.

HSUS is gravely concerned that allowing female horseshoe crabs to be harvested will have a significant impact on the federally threatened red knot and other shorebirds that depend on horseshoe crab eggs during spring migration stopovers in Delaware Bay, which will put them at risk of further population decline.

In addition, HSUS has an overarching concern about the continued reliance on a component of horseshoe crab blood, Limulus amoebocyte lysate (LAL) for endotoxin testing of medical products. Horseshoe crabs are taken from the wild, drained of a portion of their blood, and released back into waterways after they are bled. However, studies have shown that at least 10-15% of the crabs die as a result of this process. With effective synthetic and human cell-based alternatives to this type of endotoxin testing, there is no scientific need to continue the biomedical use of horseshoe crabs.

With horseshoe crab populations at historic lows due to biomedical use and the harvest of horseshoe crabs as bait, opening up the possibility of female horseshoe crabs being killed for bait is misguided and puts the red knot population in further danger.

Due to these reasons, HSUS opposes the proposed plan to increase the killing of horseshoe crabs which are a vital part of the Atlantic coast ecosystem and remain a critical food source and means of survival to the red knot and other shore birds.

Respectfully,

Vicki Katrinak

Vicki Katrinak
Director, Animal Research & Testing

1255 23rd St. NW, Suite 450, Washington, DC 20037
P 202-452-1100 F 202-778-6132 humanesociety.org

WHSRN Executive Office
P.O. Box 1770
Manomet, MA 02345
United States

30 September 2022

Atlantic States Marine Fisheries Commission
1050 N. Highland St.
Suite 200 A-N
Arlington, Virginia 22201

Ref: Proposed Addendum VIII to Horseshoe Crab Fishery Management Plan

Dear ASMFC Commissioners,

On behalf of the Executive Office of the Western Hemisphere Shorebird Reserve Network (WHSRN) I write to urge the Atlantic States Marine Fisheries Commission (ASMFC) to vote against Option B for Addendum VIII which would change the Adaptive Resource Management (ARM) model for horseshoe crab harvest. Using current data inputs, the new model would recommend opening a limited harvest of female horseshoe crabs.

WHSRN is a site-based shorebird conservation initiative launched in 1985 whose mission is to conserve shorebirds and their habitats through a network of key sites across the Americas. The network is comprised of hundreds of partners working at 114 sites in 18 countries to conserve and manage over 38 million hectares of critical habitats for shorebirds.

Delaware Bay, WHSRN's first site, is one of the most important sites for shorebirds in the Americas, especially for the *rufa* Red Knot (*Calidris canutus*) as horseshoe crab eggs on beaches provide important food during spring migration that covers 9,000 miles from southern South America to the Arctic. In the 1990s, there was a dramatic decline in horseshoe crabs in Delaware Bay which led to a subsequent dramatic decline of the shorebirds that rely on horseshoe crab eggs for food. This was one of the factors that led to the *rufa* Red Knot's listing as threatened under the Endangered Species Act. This critical connection between horseshoe crabs and shorebirds is not just true at Delaware Bay, but also at other spawning beaches along the entire Atlantic coast of the United States, including four other WHSRN sites. Without horseshoe crabs in spring, there are very few options for shorebird refueling from Florida to New England.

Due to concern about horseshoe crab recovery, reTURN the Favor (RTF) was founded in 2013 to address the mortality of adult horseshoe crabs while spawning. Coordinated by the WHSRN Executive Office, The Wetlands Insituite, and seven other organization, this large-scale citizen science project has volunteers walk transects of spawning beaches, rescuing horseshoe crabs that have been stranded, overturned, or trapped in natural or manmade impingement hazards. In the past ten years, nearly 940,000 horseshoe crabs have been rescued by volunteers in over 5,500 walks and over 18,500 volunteer hours. This massive effort illustrates the passion and dedication that local residents and visitors have for Delaware Bay, horseshoe crabs and shorebirds. These volunteers recognize that each crab, is an invaluable part of the ecosystem, and especially the females which can carry 80,000 eggs each, and they are honored to play a small part in their conservation. They expect a harvest to be managed with the same goal of recovery first and foremost.

While we support implementing an updated ARM model, there is a need to incorporate additional data sets and to use new modeling software. We have several concerns with the proposed model:

Insufficient time and opportunity for review

Several stakeholders, including those with significant statistical expertise, have requested the new models with a Freedom of Information Act request, but it has not been provided. Federal agencies cite the size and complexity of the new ARM model as the reason it cannot be shared. Additionally, confidential data from the biomedical industry are another barrier to access. Horseshoe crabs are a public resource and the mechanism that provides harvest recommendations needs sufficient opportunity for access and review.

Horseshoe crab numbers have not reached pre-decline abundance.

Restrictions in the harvest in the early 2000s stabilized the population, and it has even shown an increase in recent years, according to the 2019 Horseshoe Crab Benchmark Stock Assessment and Peer Review Report. Increased, but not recovered, the horseshoe crab population has not reached the pre-decline population. The previous ARM model set a threshold of 11.2 million adult female horseshoe crabs, with no female harvest until this population is reached. The new model disregards that number, recommending female harvest before horseshoe crabs reach this carrying capacity, an action that will slow recovery.

Data used in model do not reflect the activity on the beach.

The new model has added biomedical mortality data to the trawl survey data, an important dataset to include. However, the new model does not incorporate any surveys that reflect the actual spawning activity on the beach, such as the Delaware Bay Spawning Survey data or egg density data. These datasets provide important information on the actual availability of eggs for Red Knots, shorebirds, and other wildlife, as this is the critical variable for the ecosystem. Before changes are made to the model, the concerns with these surveys should be addressed and a model developed that incorporates these data.

Lack of understanding on the potential impacts of climate change to horseshoe crab population.

There is currently limited understanding of the full impact that climate change will have on horseshoe crab habitat and life cycle. Loss of suitable spawning habitat is already occurring each year due to sea level rise and extreme storms. Climate change could also bring changes to water temperature and it is unknown how these changes will impact horseshoe crabs through each phase of their life cycle. When facing the uncertainty of climate change, resiliency is the key to maintaining ecosystems. It is necessary to ensure that other threats to the species, like harvest, are minimized so the population remains strong and capable of recovery when faced with climate change impacts. A female harvest would greatly reduce the resiliency of the species.

Disregard for investments in restoration and other conservation actions.
Setting the precedent to open a female harvest would undermine the millions of dollars of investments that have been made and continue to be made to protect and restore horseshoe crab spawning habitat in both Delaware and New Jersey. These investments increased significantly in 2013 to repair beaches after Superstorm Sandy, and large-scale restoration projects have continued since. These projects were determined to be a necessary part of the recovery of horseshoe crabs and Red Knots by federal, state, and local agencies; community members; and conservation partners, specifically because the species is not recovered.

Aside from local Delaware Bay restoration, many countries along the Atlantic Flyway have made significant investments in habitat restoration, management, and protection to ensure that they are providing the best habitat for shared species. They have made these investments because communities across the Americas receive cultural and economic benefits from a diverse ecosystem that includes shorebirds especially the *rufa* Red Knot. One of the most important things that the United States can do to contribute to this international effort is ensure an energy-rich habitat for spring migration.

The WHSRN Executive Office urges that the precautionary principle be observed and Option A approved. Option A reverts back to older harvest recommendations in Addendum VI and is less than ideal, but is preferred over Option B. We recommend that Option B of Addendum VIII not be approved until the new ARM model has been thoroughly reviewed by the public, incorporates spawning and egg density data, and includes an appropriate threshold population.

Sincerely,

Rob P. Clay, Ph.D
Director, Executive Office
Western Hemisphere Shorebird Reserve Network
rclay@manomet.org

MARYLAND ORNITHOLOGICAL SOCIETY

September 21, 2022

Attention: Caitlin Sparks
Atlantic States Marine Fisheries Commission
1050 N. Highland St. Suite 200A-N
Arlington, VA 22201

SUBJECT: Horseshoe Crab Draft Addendum VIII

Dear Commissioners,

The Maryland Ornithological Society (MOS) is grateful for the opportunity to comment on draft Addendum VIII to the Atlantic States Marine Fisheries Commission (ASMFC) Interstate Horseshoe Crab Fisheries Management Plan.

MOS is a statewide nonprofit organization established in 1945 and devoted to the enjoyment, study and conservation of birds, with special focus on birds which spend all or part of their lives in our state. Currently we have 15 chapters and approximately 1,800 members. Birding is one of the nation's fastest-growing outdoor recreational activities; new birders come from all backgrounds and age groups.

We conduct annual trips to Delaware Bay to observe the shorebird migration, during which the Red Knots are among the most cherished species. We have been saddened by the decrease in their numbers in recent years. But this year's survey of the Red Knot's populations on its staging grounds along the Delaware shore revealed a precipitous decline of this epic migrant species. Last year's Delaware Bay count yielded only 6,880 birds while this year saw 12,000, both down precipitously from the more than over 90,000 that were recorded in the 1990s[1].

MOS is strongly opposed to the adoption of draft Addendum VIII. Our opposition is based on the following.

1. The Addendum would increase the harvest of crabs for bait and could allow the resumption of a female crab harvest. This is despite the numbers of crabs being low and those of the red knot being at record lows. Under the existing ASMFC, no females can be harvested until there are 11,200,000 such crabs or when there are 81,900 red knots on the Delaware Bay. Neither number has been reached, but the proposed Addendum VIII could still allow the harvest of female crabs. This counter-intuitive action would be based upon an updated version of the Adaptive Resource Management Framework (ARM), about which we have concerns.

2. We are concerned that the updated ARM does not rely upon crab egg densities, the most directly relevant measure of the nutritional potential of the crab population to the red knots[2]. Nor does it use data from field surveys of red knots, the most reliable measure of their numbers.

3. The data used by ARM is not open for public inspection, we are therefore being asked to accept its conclusions without knowing how they were derived. In particular these conclusions are so counter-intuitive (especially that the probability that implementing the ARM would resulting in reduced numbers is <1%), that we cannot accept them without knowing their basis.

4. The tone of the addendum is that all will be well with crab and red knot numbers and that we should not worry.

The bait and medical industries should strongly consider easing up on their crab harvests to allow crab populations to rebound. Failure to reign in these harvests could result in the loss of both the crabs and knots. It would be tragedy if the Red Knot went the way of the Passenger Pigeon and the Eskimo Curlew.

We respectfully, recommend that ASMFC take the following steps:

i) Release the data underlying the ARM for public inspection.
ii) Incorporate data on crab egg densities and surveys on red knot number in the next version of the ARM.
iii) Delay a decision on Addendum VIII until a reasonable time after actions 1) and ii) have been taken.

Yours sincerely,

Robin Todd, PhD
Conservation Chair
Maryland Ornithological Society
10174 Green Clover Drive
Ellicott City, MD 21042
410-313-8154
robintodd1948@gmail.com www.mdbirds.org

[1] Hurdle, J. Delaware Bay no longer a global hotspot for shorebird migration? 2022/ NJ Spotlight News (https://www.njspotlightnews.org)
[2]Karpanty, S.M., J.D. Fraser, J. Berkson, LJ. Niles, A. Dey and E.P. Smith. 2006. Horseshoe Crab eggs determine Red Knot distribution in Delaware Bay. Journal of Wildlife Management 70:1704-1710.

September 30, 2022

To: Caitlin Starks, Fishery Management Plan Coordinator
Atlantic States Marine Fisheries Commission
1050 N. Highland St. Suite 200A-N Arlington, VA 22201
Email: comments@asmfc.org

From: Southeastern Massachusetts Pine Barrens Alliance, Inc.

Re: Horseshoe Crab Draft Addendum VIII

Dear Ms. Starks and Members of the Atlantic States Marine Fisheries Commission:

The Southeastern Massachusetts Pine Barrens Alliance (SEMPBA) is an all-volunteer group dedicated to conserving and restoring what remains in Massachusetts of the once vast Atlantic Coastal Pine Barrens.

Since 2018, SEMPBA volunteers have participated in the Massachusetts Department of Marine Fisheries Spawning Horseshoe Crab Survey. Through this program, we have developed a high regard for these ancient creatures, but we have grown alarmed in discovering that horseshoe crabs, which once covered Massachusetts' beaches in such great numbers that communities paid bounties to rid beaches of them, have now become a rarity on most of these same beaches.

Our concerns extend beyond Massachusetts to every state along the Atlantic coast where migrating birds stop to feed on horseshoe crabs. Therefore, SEMPBA appreciates the opportunity to comment on the proposed Addendum VIII to the horseshoe crab Interstate Fishery Management Plan. However, we do not support Addendum VIII and are writing to urge the Atlantic States Marine Fisheries Commission (ASMFC) to reject Addendum VIII.

SEMPBA is of the opinion that the ASMFC should rethink the taking of horseshoe crabs in Delaware Bay and elsewhere for any purposes other than biomedical until the Commission develops a coordinated, coastwide monitoring and regulatory management plan that includes all the states along the Atlantic Coast, and until horseshoe crabs return in numbers great enough to effect an increase in migrating bird populations to pre 1990 levels and the Red Knot is no longer listed as "threatened" under the Endangered Species Act.

SEMPBA, and a growing number of citizens in Massachusetts, understand that overharvesting is driving horseshoe crab populations everywhere dangerously close to functional extinction. It is incomprehensible to us why many state fisheries allow the harvest for bait of these animals that take 12 years to reproduce, and whose blood is crucial to human health and necessary to sustain migratory birds in their epic journeys from pole to pole.

The Ontario, Canada *Red Knot rufa subspecies recovery strategy* (2018), is clear about the cause of the Red Knot decline: "A primary threat to the subspecies lies with the management of the horseshoe crab fishery along the Atlantic seaboard of the United States. Overharvesting of horseshoe crabs has deprived migrating knots of an essential food resource required for birds to recover from long flights, to store nutrients, and to increase their body mass in preparation for further migration to the Arctic as well as to provide extra stores for survival after arrival on the breeding grounds (Morrison 2006; Morrison et al. 2007). Limited harvesting of horseshoe crabs should allow their recovery that may concurrently support the recovery of Red Knot numbers because survival of Red Knots has been linked to body masses at departure from Delaware Bay."

The ASMFC must do more to help horseshoe crabs recover.

Recognizing the intrinsic value of horseshoe crabs, we are asking the Commission to:

- Restrict bait harvesting of horseshoe crabs in Delaware Bay (ARM Model Package 1) and extend the restriction to all states along the Atlantic coast.
- Continue the moratorium on the harvest of female horseshoe crabs in Delaware Bay and extend the moratorium to all states along the Atlantic coast.
- Continue the restrictions above until horseshoe crabs increase in number to levels seen prior to the 1990s crash and the population of red knot meets the 81,900-threshold set in 2013.
- Call for an end to the "Confidentiality" laws that preclude the public from access to data and information as to the numbers of horseshoe crabs that are captured, released, and/or die because of blood extraction by biomedical labs.
- Research and evaluate biomedically bled crabs' mortality rates, egg reproduction and effects on spawning behavior.
- Track and report biomedical mortality using independent observers. Hold biomedical companies accountable for exceeding mortality limits.
- Establish an independent agency to regularly inspect biomedical labs and holding tanks, pens, and ponds.
- Institute regulations that make bleeding horseshoe crabs for biomedical uses a more sustainable practice by requiring humane treatment of horseshoe crabs before, during and after blood extraction and includes pre and post bleeding nutrient infusions prior to release.
- Support phasing out the use of horseshoe crab blood.
- Identify, quantify, monitor, and restore suitable spawning beaches and marsh habitat known to support juvenile horseshoe crabs in Delaware Bay. Extend the recovery program to all states along the Atlantic coast.
- Coordinate with the Ministry of the Environment, Conservation and Parks, Ontario, Canada to implement a strategy to restore horseshoe crab and red knot populations.

Again, with horseshoe crabs remaining at historically low numbers under the current regulations, we urge you to do more to protect these creatures and not make a bad situation worse by lifting the moratorium on harvesting female horseshoe crabs and allowing the harvesting horseshoe crabs for bait in Delaware Bay. And please extend the regulations to Massachusetts and all states along the Atlantic coast. Thank you for the opportunity to comment.

Sincerely,

Sharl Heller

Sharl Heller, President

Dear Atlantic States Marine Fisheries Commission (ASMFC),

The Safina Center is very concerned with the status of the horseshoe crab population in Delaware Bay and beyond. As such, we oppose the ASMFC's proposed addendum VIII in the Horseshoe Crab Fishery Management Plan to increase the horseshoe crab quota for the bait industry. We also oppose the potential lift of the ban on taking female horseshoe crabs in the region.

We are concerned that the data influencing the changes in the draft addendum has not been released to the public, making it impossible for concerned citizens and advocacy groups to properly inform themselves on the information at the base of this decision. With both horseshoe crabs and red knots at historically low numbers, now is not the time to increase the killing of horseshoe crabs in Delaware Bay, one of the last places where horseshoe crab numbers are high enough to attract migrating red knots in large numbers.

In the *2021 Revision to the Adaptive Resource Management Framework and Peer Review Report*, the reviewers write, "Because the changes would lead to harvest of female HSC [horseshoe crabs], which has been restricted since the implementation of the original ARM [adaptive resource management] Framework, **the Panel cautions the WG [working group] to fully consider if the new reward function truly represents the values articulated by stakeholders in the 2009 ARM Framework.**" We believe that the values of stakeholders do not support increasing the number of horseshoe crabs killed in the Delaware Bay Region. The ASMFC should listen to the Panel of reviewers and consider these values before increasing quotas.

Too often, managers fail to take action to protect a species until the species is so reduced it is on the brink of extinction. We urge the ASMFC not to make this mistake in the case of the horseshoe crab.

Sincerely,

Carl Safina

Carl Safina, PhD
Founding President, The Safina Center
Endowed Professor for Nature and Humanity, Stony Brook University
Cell: 631 838 8368

AMERICAN LITTORAL SOCIETY

18 Hartshorne Drive, Suite 1, Highlands, NJ 07732

Mr. J. Clarke, Chair
Horseshoe Crab Management Board
Atlantic States Marine Fisheries Commission

By Email

Mr. Clarke,

I am writing to express the deep concerns of the American Littoral Society regarding the possible action by ASMFC at its Summer Meeting of the Horseshoe Crab Management Board to substantially modify the policies and approaches to protecting the crabs and red knots of Delaware Bay through a highly-technical modification to the Adaptive Resource Model (ARM) utilized by the Commission, through the initiation of Addendum VIII.

The impact of the central parts of the revisions – to change the harvest restrictions and reopen the bait fishery's access to female horseshoe crabs despite the lack of recovery to date of the red knot populations which depend on the eggs they produce – is buried under hundreds of pages of technical discussions. Leading members of the ASMFC's own advisory committee have tried raise this concern to the primacy it deserves, and even the Peer Review Committee urged caution. Further, this fundamental change in policy and risk to the recovery of the red knot is being done behind the closed doors of the modeling committees without robust and engaged public consideration of the acceptability of the risk to important stakeholders including the broader public and conservation community. Requests by leading members of the conservation and environmental communities for access to the models have been denied.

Even the outside Peer Review Committee raised concerns about the shift in policy embedded in technical changes and the adequacy of how well public and stakeholder concerns were taken into account. I doubt that the public's tolerance to the possibility of red knot extinction is as high as this new ASMFC direction envisions. In the Peer Review report, the experts advised:

> "Because the changes would lead to harvest of female HSC, which has been restricted since the implementation of the original ARM Framework, the Panel cautions the [Working Group] to fully consider if the new reward function truly represents the values articulated by stakeholders in the 2009 ARM Framework."

I strongly urge the Commission to not approve the proposed Framework Revision before you for consideration on August 3, 2022.

Under the current framework, no female crabs can be harvested in Delaware Bay for bait until the female population reaches 11.2 million crabs or the total red knot stopover population reaches 81,900 birds. Neither metric has yet been attained.

Under the proposed management revision, 175,000 to 190,000 females could be harvested as soon as 2023, according to some experts. In reaching this decision, the ASMFC disproportionately relied on surveys it has long considered biased and of dubious accuracy, which "reduces the scientific credibility" of the proposed revision, according to committee members and former proponents of the ARM framework (Niles, Burger, Mizrahi, & Dey, 2021).

The *only* horseshoe crab-specific survey thought historically reliable—the Virginia Tech trawl survey—continues to indicate that female horseshoe crabs are in trouble.

I would request that the Board hold the draft addendum until it can be amended to reinclude the original, stakeholder based protections regarding recovery levels prior to reopening female crab harvest, and that the fundamental modeling and other technical analyses foundational to the addendum's recommendations be publicly shared and fully made available and reviewed by interested stakeholders.

Thank you for your attention to these comments.

Sincerely,

Tim

Tim Dillingham, Executive Director

Los Angeles Audubon Society
P.O. Box 931057
Los Angeles, California 90093-1057

LOS ANGELES AUDUBON

September 24, 2022

Via email (comments@asmfc.org)

Caitlin Starks
Atlantic States Marine Fisheries Commission
1050 N. Highland St. Suite 200A-N
Arlington, VA 22201

Re: Horseshoe Crab Draft Addendum VIII

Dear Ms. Starks:

Los Angeles Audubon Society has been a voice for birds and conservation in Los Angeles for over 100 years. Our mission is to promote the study and protection of birds, other wildlife, and their habitats throughout the diverse landscapes of the Los Angeles area. We have over 3,500 members and supporters, most of whom live in the City of Los Angeles, although we have some members in New York and elsewhere on the East Coast. The fate of the Atlantic horseshoe crab (*Limulus polyphemus*), and the intersecting plight of the *rufa* Red Knot (*Calidris canutus rufa*), is, however, of hemispheric importance and concerns all those who care about the exploitation of wildlife and the catastrophic loss of birds in the Americas.

From the data available, it appears that the overharvest of horseshoe crabs that occurred in the late 1990s created a population crash from which the species has not recovered. The *rufa* Red Knot population similarly crashed and has not recovered. We certainly understand and approve in concept of the adaptive resource management approach that has been taken to manage the horseshoe crab bait fishery. The underlying model, however, does not set the density of horseshoe crab eggs on shores of the Delaware Bay as a management goal, and this density still falls an order of magnitude lower than pre-crash conditions. When a program governed by adaptive resource management is not resulting in desired outcomes (population recovery) then it is time to revisit either the model or the values placed on different outcomes. Frankly, it seems that here too much value has been placed on maintaining the bait fishery.

The Commission seeks input on the level of rounding for the optimal harvest recommendation. Rounding is necessary because the level of take for the biomedical industry is, for some reason, confidential. We question the need for confidentiality on the level of take for a public resource. If, as some authors assert (Botton et al. 2022), take for medical purposes is dwarfed by the adverse impacts of other factors, there should be no reason to need to keep said numbers confidential. Furthermore, the numbers of crabs bled in the Delaware Bay have been published for 2001–2017 (Botton et al. 2022). If rounding is indeed necessary and the secrecy of private corporations benefiting from exploitation of public resources outweighs the public's right to know the data upon which its agencies base their decisions, then the conservative approach of rounding to the nearest 50,000 should be taken.

The revised adaptive resource management process under consideration is a weakening of protections for horseshoe crabs and by extension for Red Knot. Neither population has recovered under the current management plan. This may arise in part from the long time to maturity for horseshoe crabs (11–12 years) and the high sensitivity to first-year survival (Sweka et al. 2007). But recovery is not assured, because the "ecological void" left by the crash of the horseshoe crab population may be filled by competitors that inhibit recovery (Hata and Hallerman 2022).

The Commission should act with caution and not loosen take restrictions prematurely. Neither species in the system is anywhere approaching pre-2000 numbers and the noise in the data suggesting even the start of a recovery is too great to draw any conclusion. For the birds, the key factor for recovery, horseshoe crab egg density on the shore, has not recovered and the *rufa* Red Knot remains imperiled. Birders and bird conservationists are watching the Commission's decision and hoping that instead of weakening protections, that stronger limitations on take of horseshoe crab are adopted.

Respectfully,

Travis Longcore, Ph.D.
President and Conservation Co-Chair

Literature Cited

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Hata, D. N., and E. M. Hallerman. 2022. Relative abundance of horseshoe crabs in the Delaware Bay region: a critical factor for adaptive resource management. Pages 415–433 *in* J. T. Tanacredi, M. L. Botton, P. K. S. Shin, Y. Iwasaki, S. G. Cheung, K. Y. Kwan, and J. H. Mattei, editors. International Horseshoe Crab Conservation and Research Efforts: 2007–2020. Springer, Cham, Switzerland.

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Valley Forge Audubon Society

The Valley Forge Audubon Society joins NJ Audubon in opposing the Atlantic States Marine Fisheries Commission's (ASMFC) proposal to increase the harvest of horseshoe crabs, including a possible renewed harvest of females. Horseshoe crab eggs provide essential food for migrating federally-threatened Red Knots, whose numbers along Delaware Bay have plummeted from more than 90,000 in the 1990s to only 12,000 this year and an estimated all-time low of 6,800 in 2021. Increasing the harvest will have a significant negative impact on Red Knots and other shorebird species that depend on horseshoe crab eggs during spring migration stopovers in Delaware Bay, putting them at risk of further population declines.

We hope to enjoy visiting the Delaware Bay for many years to experience the Red Knot stopover on their amazing 9,000 mile migration from the southernmost tip of South America to their nesting area in the middle- and high-Arctic areas of northern Canada. Help ensure that these remarkable birds get all the horseshoe crab eggs they need to thrive and grow as a species for generations to come. Please do not increase the harvest of horseshoe crabs.

Sincerely,

Vincent Smith, President
Valley Forge Audubon Society

1201 Pawlings Road, Audubon, PA 19403
Valleyforgeaudubon.org

From:	Mark Nardone
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Thursday, September 8, 2022 4:38:57 PM
Attachments:	image001.png

Delaware Nature Society (DNS) joins the National Wildlife Federation in opposing the Atlantic States Marine Fisheries Commission's (ASMFC) proposed Addendum VIII of the Interstate Horseshoe Crab Fishery Management Plan. We urge the commissioners to reject it as written.

Several indicators show both horseshoe crab populations and the population of a Federally threatened shorebird, the Red Knot, which depends on
horseshoe crab eggs for their survival, are well below recovery thresholds. ASFMC's proposal could reduce the populations further.

The model Addendum VIII is based on has not been made public, so Delaware Nature Society and other concerned parties cannot be assured the proposed change would protect a healthy, sustainable population of horseshoe crabs. Even if the supporting data were to be shared today, there is not enough time to analyze it for accuracy before the public comment period ends on September 30.

Delaware Nature Society is also gravely concerned that ASMFC's plan would raise quotas on the killing of horseshoe crabs for use as bait by allowing for the harvest of female horseshoe crabs.

Under the current ASMFC framework, there is no female crab harvest until the female population reaches 11.2 million or until the Delaware Bay total Red Knot stopover population reaches 81,900. Neither the red knot nor female horseshoe crab populations of Delaware Bay are close to those numbers. We therefore believe female harvest would make recovery of the species virtually impossible.

Red Knot populations have also reached historic lows. In the 1990s, more than 90,000 a year could be found along Delaware Bay. The number was estimated at 6,800 in 2021—an all-time low. Though 12,000 were counted in 2022, the meager increase, given the dramatic population crash over time, does not inspire hope for species.

Shorebird populations have plummeted more than 70 percent over the past 50 years. That decline is the world's number one conservation crisis facing birds. Permitting harvest of female horseshoe crabs at this critical moment virtually ensures the population of shorebirds such as the Red Knot will never recover.

We therefore respectfully urge the commissioners to reject proposed Addendum VIII of the Interstate Horseshoe Crab Fishery Management Plan.

Thank you,

Mark Nardone

Director of Advocacy, Delaware Nature Society
Mark.Nardone@DelNature.org | 302.500.2559 M

Together we envision a healthy and sustainable environment.

From:	Jim Myers
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Wednesday, September 21, 2022 4:08:14 PM

To whom it may concern:

Washington Crossing Audubon Society (WCAS) is opposed to the Atlantic States Marine Fisheries Commission's (ASMFC) proposal to increase the harvest of horseshoe crabs used for bait. This action could allow the harvesting of female horseshoe crabs to resume, threatening the Red Knot that relies on the horseshoe crab eggs during its migration stop along the Delaware Bay.

The Red Knot migrates from southern Argentina to the Arctic Circle. The Delaware Bay migratory stop is essential for putting on enough weight to complete the journey. Horseshoe crab eggs are the vital source of food for the migrating birds. Female horseshoe crab harvest was stopped because egg density studies showed that there were not enough eggs to sustain the Red Knots and other shorebirds during the migratory stop at the Delaware Bay. The egg density continues to be too low to sustain the migrants.

Under the current management plan, female horseshoe crab harvest is not permitted until female crab numbers reach 11.2 million crabs or the Red Knot stopover population reaches 81,900 birds. There is no data indicating that these numbers have been reached. On the contrary, only 12,000 Red Knots were counted along the Delaware Bay in 2022. The numbers clearly show the population has not recovered to a healthy level that would allow the harvesting of its primary food source.

WCAS urges the ASMFC to reject the proposed change in the horseshoe crab harvest. Such a change is not scientifically justifiable and could lead to devastating declines in Red Knot populations, a species already under serious survival pressures.

Sincerely,

Jim Myers
President
Washington Crossing Audubon Society
https://www.washingtoncrossingaudubon.org/

This letter was submitted by 25,948 individuals.

From:
To:
Subject:
Date:

Dear Senior Fishery Management Plan Coordinator Caitlin Starks,

I am writing to urge ASMFC to protect red knots by rejecting Addendum VIII to the fishery management plan for horseshoe crabs.

Delaware Bay is a linchpin for one of the most epic migrations on Earth. Every year, red knots fly from as far south as Tierra del Fuego to their breeding grounds in the Arctic Circle. They reach Delaware Bay just as horseshoe crabs emerge from the water to lay eggs upon the beach. These eggs provide crucial nourishment for red knots to complete their journey and breed successfully.

In recent decades, overfishing has decimated the horseshoe crab population at Delaware Bay, leading to a sharp decrease in red knots, which are now listed as “threatened” under the Endangered Species Act. Under the current management program, horseshoe crabs have not recovered, and red knots have continued to decline. Rather than taking steps to reverse this trend, Addendum VIII would open the door to resuming the harvest of female horseshoe crabs, further imperiling red knots and potentially violating the Endangered Species Act.

Red knots face an uncertain future and require a precautionary management approach. ASMFC should reject Addendum VIII, which would put red knots at even greater risk.

Sincerely,
XXXXXXXXXXXXX
XXXXXXXXXXXXX

This letter was submitted by 4,010 individuals.

From:
To:
Subject: [External] Oppose Amendment VIII to the Horseshoe Crab Management Plan
Date: Thursday, September 22, 2022 1:20:27 PM

The Atlantic States Marine Fisheries Commission should reject any proposed management of horseshoe crabs that would lead to the increase in harvest of horseshoe crabs, particularly if that increase includes the harvest of female horseshoe crabs.

Under the existing management framework, the commission has said that it would not allow harvest of female horseshoe crabs unless the crab population was 11.2 million crabs or the threatened rufa red knot stopover population reached 81,900 birds. Neither threshold has been met, and yet the commission is insisting on changing the population modeling that would allow a harvest increase, including the first harvest of female horseshoe crabs in decades.

With red knot counts of 12,000 birds this year, up from only 6,800 last year, it defies common sense that horseshoe crab harvest should be increased. More worrisome is that the public has yet to see the full details of the scientific model that justifies this harvest increase.

I urge the commission to abandon Amendment VIII to the Horseshoe Crab Management Plan, share the full scientific details of the model with the public, and include other scientific data sources such as horseshoe crab egg density and red knot aerial surveys into the model before recommending any changes to harvest.

Thank you,
XXXXXXXX

This letter was submitted by 15 individuals.

From:
To: Comments
Subject: [External] Horseshoe Crab Draft Addendum VIII Tuesday,
Date: September 27, 2022 9:42:14 AM

Dear Ms. Starks:

I strongly oppose adopting the 2021 ARM Framework revisions under Draft Addendum VIII as a standard for setting horseshoe crab bait harvest specifications. The value of migratory birds and the need to manage these resources across jurisdictions has been recognized in the United States for more than a hundred years. I am very concerned that adopting the changes proposed in the 2021 ARM Framework revision will not only setback decades of conservation efforts to protect migrating shorebirds, but, that this change could also cause irreparable damage to shorebird and horseshoe crab populations.

The underlying data supporting the new draft addendum to the plan has still not been released to the public, so conservation groups and concerned citizens have no way to understand the science on which the new proposal is based. When will the data supporting this plan be released?

Making matters worse, ASMFC also does not include the most recent field survey data for red knots, which suggest historically low numbers of red knot feeding through the spring season in Delaware Bay. In the 1990s, more than 90,000 could be found along Delaware Bay during aerial surveys. This year, only 12,000 were counted, and in 2021, the number was estimated at an all-time low of 6,800. This doesn't necessarily mean the population has crashed, but could indicate that red knots are bypassing the Delaware Bay stopover altogether in search of life-sustaining food sources elsewhere. This makes their migratory journey all the more perilous, which could further impact the population recovery. Given this uncertainty in the status of red knot in Delaware Bay, extreme caution should be taken in making any management decisions that could negatively affect them.

Horseshoe crabs are a vital part of their ecosystem . There is much that we still need to learn about their role in their world and in our world. The conservation of our shorebirds, such as Redknots,also needs to be a priority. We are losing our bird populations at an alarming rate and we need to protect them now and into the future for our children and grandchildren.

I strongly oppose the use of the 2021 ARM Framework as the basis for setting horseshoe crab harvest regulations. I urge the ASMFC to make no change to the regulations.

Sincerely,

XXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXX

This letter was submitted by 289 individuals.

From:
To: Comments
Subject: [External] Horseshoe Crab Draft Addendum VIII
Date: Tuesday, August 30, 2022 3:40:09 PM

Dear ASMFC,

As a resident of the Delaware River and Bay and an active volunteer monitor who has helped assess and count horseshoe crabs over the years during crab spawning surveys, I urge the Atlantic States Marine Fisheries Commission (ASMFC) to not backtrack and allow for the killing of female horseshoe crabs for fishing bait. I urge the ASMFC to keep protections in place and if anything, to strengthen protections - as the situation is dire in our beloved Delaware Bay for the shorebirds and the horseshoe crabs. Please abandon any attempts to weaken the current moratorium on horseshoe crab harvest.

• The threats to these animals are graver than ever. Now is not the time to weaken protections for these imperiled species and the critical ecosystem role the horseshoe crab provides for the Delaware Bay.
• Based on field work, including egg density studies conducted by the Delaware Bay Shorebird Project and other organizations, we do not believe that horseshoe crab populations are recovering from their population crash in the 1990s. Egg density data is the most reliable indicator of the horseshoe crab population, and importantly, it is the most reliable index of value for red knots and other shorebirds. Yet ASMFC has never included these surveys in its modeling. Making matters worse, ASMFC also does not include field survey data for Red Knots, and these show that Red Knot populations are at historic lows. In the 1990s, more than 90,000 could be found along Delaware Bay. This year, only 12,000 were counted, and in 2021, the number was estimated at an all-time low of 6,800. Evidence is now emerging that Red Knots are bypassing the Delaware Bay stopover altogether in search of life-sustaining food sources elsewhere. This makes their migratory journey all the more perilous.
• The Cornell Lab of Ornithology says that shorebirds like the red knot are plummeting toward catastrophe, with their declines representing the world's number one conservation crisis facing birds today. And the killing of female horseshoe crabs all but assures that their population levels will never rebound.
• The joint collapse of red knots and horseshoe crabs is not inevitable. But your proposal propels them closer to that grim reality.
• The Ecotourism dollars the Delaware Bay receives because of the crabs and shorebirds that flock there cannot be undermined by short term fishery interests and lack of the precautionary principle by the ASMFC.
• The ASMFC must provide the raw data, modelling and analysis which justifies the expansion of the harvest of female horseshoe crabs for the public to thoroughly review before any action can be taken.
• I remain concerned that the underlying data supporting the new draft addendum to the plan has still not been released to the public, so that conservation groups and concerned citizens have no way to truly understand the science on which the new proposal is based.
• There is no way to meaningfully comment on a proposal when you are not releasing the data supporting the types of increases you propose. With both red knots and horseshoe crabs at historically low numbers, we cannot take your assertions on faith.
• Under the current framework there is no female crab harvest until female abundance reaches 11.2 million crabs or until the Delaware Bay total red knot stopover population reaches 81,900

birds. The proposed revision would allow the resumption of the female harvest, even though neither the red knot nor female horseshoe crabs of Delaware Bay are close to satisfying either metric.

• The ASMFC should ensure that the original safeguards in their harvest policies prohibiting female horseshoe crabs from being harvested until red knot numbers recover are included in any new policies.

I request that any future public meetings on the horseshoe crab harvest I be notified directly so I may be able to better defend the crabs from the very agency that should be protecting this species in the first place.

Thank you for your time and consideration.

Sincerely,
XXXXXXXXXXXXXX
XXXXXXXXXXXXXX

This letter was submitted by 674 individuals.

From:	
To:	Comments
Subject:	[External] Subject line: Horseshoe Crab Draft Addendum VIII.
Date:	Sunday, September 11, 2022 11:03:46 AM

I join NJ Audubon in opposing the Atlantic States Marine Fisheries Commission’s (ASMFC) proposal to increase the harvest of horseshoe crabs, including a harvest of females for the first time in over a decade. This action will have a significant impact on the federally threatened Red Knot and other shorebirds that depend on horseshoe crab eggs during spring migration stopovers in Delaware Bay, putting them at risk of further population declines.

Thank you!

XXXXXXXXXXXXXXX

XXXXXXXXXXX

This letter was submitted by 2,987 individuals.

From:
To: Comments
Subject: [External] Horseshoe Crab Draft Addendum VIII
Date: Friday, September 16, 2022 10:32:02 AM

Greetings,

I am writing to encourage the Atlantic States Marine Fisheries Commission to reject draft Addendum VIII to the fishery management plan for horseshoe crabs. With the threatened red knot inching closer to extinction, the species cannot afford further regulatory concessions.

Red knots rely on horseshoe crab eggs for fuel during their global migration. They time their trip to coincide with the crab's annual spawn, in one of the East Coast's most cherished wildlife spectacles. During a brief pitstop, each knot must consume roughly 400,000 nutrient-rich eggs before departing for the Arctic. So great are the stakes, the birds that fail to acquire such reserves are less likely to survive and reproduce.

In Delaware Bay, horseshoe crabs have failed to recover from decades of severe overharvesting. Red knots also remain at historic lows. Despite these obvious trends, Addendum VIII would allow the resumption of killing of female crabs at a time when emergency measures are needed.

Under the current framework, no female crabs can be harvested in Delaware Bay for bait until the female population reaches 11.2 million crabs or the total red knot stopover population reaches 81,900 birds. Neither metric has yet been attained.

I encourage the ASMFC to not only reject Addendum VIII but to recommit to true recovery measures, in accordance with the Endangered Species Act.

Thank you,
XXXXXXXX

This letter was submitted by 4 individuals.

From:	
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Sunday, September 25, 2022 8:43:38 AM

Dear Atlantic States Marine Fisheries Commission,

Proceeding with the implementation of the 2021 Adaptive Resource Management Framework Revision would be detrimental to red knots and a host of other species that rely on horseshoe crab eggs to fuel their migration. I support a full moratorium on horseshoe crab harvest until their population has had a chance to recover.

Barring a full moratorium on horseshoe crab harvest, Option A under section 3.0 (Management Options) would be preferable to either possibility of Option B.

Thank you for your time and consideration,

XXXXXXXXXXXXXXXXXX
Member, Delaware Audubon Society

This letter was submitted by 5 individuals.

From:
To: Comments
Subject: [External] Horseshoe Crab Draft Addendum VIII
Date: Wednesday, September 28, 2022 6:59:38 PM

To whom it may concern,

I join CU Maurice River and the South Jersey Bayshore Coalition in opposing the Atlantic States Marine Fisheries Commission's (ASMFC) proposal to reverse the current framework for horseshoe crab management. This proposal contradicts ASMFC's established regulatory precedents, fails to consider relevant data, and ignores the will of local stakeholders.

If the ASMFC increases the allowable harvest of horseshoe crabs and lifts the longstanding moratorium on the harvesting of females, Bayshore ecology will be weakened and local economies negatively impacted. For these reasons, I urge the ASMFC to retain the established management framework, maintain the current limits on horseshoe crab harvesting, and continue the moratorium on harvesting female horseshoe crabs.

Sincerely,
XXXXXXXXXXXX

This petition recieved 412 signatures.

We, the undersigned, believe the horseshoe crab population and the shorebird population, which feeds on the horseshoe crab eggs, should be protected. Therefore, we strongly urge the Atlantic States Marine Fisheries Commission to *OPPOSE Horseshoe Crab Addendum VIII*, which would remove these protections.

	NAME	ADDRESS
1	Ellen Meyer	2 Longworth Ct. Cedar Run NJ 08092
2	Sarah Fabiano	59A Bayview Dr Long Beach Township, NJ 08008
3	Olivia Smith	172 Concord Ave Hamilton NJ 08619
4	LISA Bonavita	102 W. New Jersey Ave, Long Beach Township, NJ 08008
5	Rebecca Dondero	1 Jonathan Dr., BHW 08050
6	[illegible]	7 S Colfax Rd Springfield 07081
7	Joe Langley	4350 Lehigh Dr. Walnutport PA 18088
8	Devon Goddard	6 Colony Ct. Woolwich NJ 08085
9	Nikole Goddard	510 montana Dr. Lincoln University 19352
10	Cait Nitschmann	4 Independence Dr. Bordentown NJ
11	Cindy Nitschmann	4 Independence Dr. Bordentown, NJ
12	Alli Daly	13 Village Dr. W Yardville, NJ
13	Nicole Gerdes	1 Erin Ct Robbinsville NJ 08691
14	Karen Bergmuller	428 Engleside Ave Beach Haven NJ 08008
15	Diane Zoraian	17 Linda Dr., Allendale NJ 07401
16	Janice Nilsen	906 Oceanfront Ship Bottom, NJ
17	Jill Stier	1400 South Ave #403 Plainfield NJ 07062
18	Christine Gardner	148 Miller Rd. Kinnelon NJ 07405
19	Liz + Tom Goldy	406 Thomas Ave Lyndhurst NJ 07071
20	Roselle Tazza	Wyckoff. NJ. 07481
21	Susana Perez	5036 245th St Douglaston NY 11362
22	Alison Sapers	1 S. Lincoln Ave, Newtown, PA 18940
23	Chris Mirsky	100 West 16th St. Beach Haven NJ 08008

We, the undersigned, believe the horseshoe crab population and the shorebird population, which feeds on the horseshoe crab eggs, should be protected. Therefore, we strongly urge the Atlantic States Marine Fisheries Commission to *OPPOSE Horseshoe Crab Addendum VIII*, which would remove these protections.

	NAME	ADDRESS
24	Deb Cumming	20 Macintosh Rd Branchburg NJ 08876
25	Amy Pinto	31 Mea Lane, Brant Beach NJ
26	Lynn Falcone	126 Chatsworth Avenue, Beach Haven, NJ
27	Lisa Damore	3 Fallow Way, Monroe Twp, NJ 08831
28	Alexa Aquino	34 W sailboat Lane, Long Beach Twnship
29	Sarah Sobotor	48 Miriam Drive Warwick NY 1099.
30	[illegible]	23 E 30th Street Beach Haven Gardens
31	[illegible]	125 Engleside Ave Beach Haven NJ
32	[illegible]	271 Wells Ave RE NJ 07661
33	Susan Pajunas	98 Charlestown Rd Hampton, NJ 08827
34	Jackie Forsberg	1355 Paul Blvd., Manahawkin. NJ 08050
35	Esther O'Donnell	68 Norris Ave, Metuchen, NJ 08840
36	PEGGY McGOVERN	9 COLUMBIA AVE, LONG BRANCH, NJ 07740
37	Donna Evleth	219 Dolphin Ave Beach Haven
38	April Michal	11 Mary Alice Rd Manahawkin NJ 08050
39	CORINE Chiarello	7 Mary Alice Rd Manahawkin NJ 08050
40	Pamela Fertitta	419 Engleside Ave Beach Haven NJ 08008
41	Noreen Labenne	328 Essex Ave BH NJ 08008
42	Margaret Cambridge	891 Jennifer Lane Manahawkin NJ 08050
43	KARIN STROUD	166 SCHLUETER DR. HOPEWELL JCT. NY 12533
44	M. Hudson	23 Beach Haven Way, Waretown 08758
45	Sue Saccenio	303 Sunflower Dr. EHT, N.J. 08234
46	Rob Longley	4350 Lehigh Dr. Walnutport PA. 18088

We, the undersigned, believe the horseshoe crab population and the shorebird population, which feeds on the horseshoe crab eggs, should be protected. Therefore, we strongly urge the Atlantic States Marine Fisheries Commission to *OPPOSE Horseshoe Crab Addendum VIII*, which would remove these protections.

	NAME	ADDRESS
47	George Premizari	26 Hazelwood Terrace, Totowa Falls 07??
48	Brad ?	2345 Country Inn Rd Gettysburg PA
49	Grace Amodeo	824 E Grand Ave, #2, El Segundo CA 90245
50	Cristin LaMere	17 W Cape Cod LBI
51	Rummins Worth	12 Munanie Rd. Morris Plains NJ 07950
52	Lori Pacansky	1600 Long Beach Blvd LBT NJ 08008
53	Jay Bowman	1703 Beach Ave N. Beach Haven
54	Elissa Kurland	14 Sunnyside Place Irvington, NY 10533
55	Shannon Pikula	170 Prospect Ave Apt 16J Hackensack, NJ 07601
56	Reanna Ventresca	3200 Long rockcress dr Jamison pa 18929
57	Robert Salvo	1676 Rockcress Dr, Jamison, PA 18929
58	Gavin Ventresca	6095 W mill road Flourtown PA 19031
59	Mary Gravata	39 Cooper Rd Oak Ridge NJ 07438
60	Lynn Nielsen	172 Southard Dr. Manahawkin NJ
61	Mariann Burnosky	37 Bradley Lane, Bridgewater NJ 08807
62	Kayla Foley	105 E 21st St Beach Haven NJ 08008
63	Carol Nepvesky	281 Hazlitt Way Somerset NJ 08873
64	Jesse Kleinman	14 Westgate Rd Livingston NJ 07039
65	Trisha Ogden	25 Meadow Ave Unit 52 Monmouth Beach NJ 07750
66	Marian Redmond	900 N. Beach Ave. #19 Beach Haven N.J.
67	Evie Wildonger	100 West 16th St. Beach Haven N.J.
68	Anne Pereira	39 Limoli Ln Clark NJ 07066
69	Joe Pereira	39 Limoli Lane Clark NJ 07066

We, the undersigned, believe the horseshoe crab population and the shorebird population, which feeds on the horseshoe crab eggs, should be protected. Therefore, we strongly urge the Atlantic States Marine Fisheries Commission to *OPPOSE Horseshoe Crab Addendum VIII*, which would remove these protections.

	NAME	ADDRESS
70	Dorothy Meehan	5401 West Ave. Holgate N.J 08008
71	DENNIS J. MEEHAN	5401 WEST AVE HOLGATE N.J. 08008
72	Shay Connolly	30 ELEVENTH ST., BEACH HAVEN, NJ
73	ADRIANA DIAZ	101 JEREMY LN. MANAHAWKIN NJ 08050
74	Nick D'Apr[illegible]	155 Roseland ave, Caldwell, NJ 07006
75	Meg Quinlisk	807 S. Beach Ave.. Beach Haven 08008
76	Joe Hoffman	5 Congress Court Somerset, NJ 08873
77	[illegible] HETZ	2225 MEMPHIS St., PHILADELPHIA 19125
78	Deanne Melloy	2750 Marion Way Doylestown PA 18902
79	Carol [illegible]	4 EAST 17th STREET, LBT 08008
80	Kelly Minard	240 Prospect St Apt 1 Cambridge, MA 02139
81	Katherine Lilley	1105B Long Beach Blvd North Beach, NJ 08008
82	Bailey Schilling	2 Teakwood drive, Little Egg Harbor, NJ 08087
83	Denise Groze	1052 Maple Ave., Roebling, NJ 08554
84	Maya Vasquez	476 PULASKI ST, BROOKLYN, NY 11221
85	Izzy Snow	191 Claremont Ave Apt 34 10027
86	Brittny Drigan	435 Amber Street, Beach Haven, NJ
87	[illegible]	18 FOXCROFT Dr Doylestown PA
88	Christine Sommers	6147 Mulberry Ct. Pipersville, PA 18947
89	Lauren Schmalz	832 Lombard St. Philadelphia, PA, 19147
90	Lara Good	150 east 87th St 5C NewYork New York 10128
91	Jim [illegible]	1208 Sea Girt Ave., Sea Girt, NJ 08750
92	MARISA LUMINO	5031 EDWIN AVE #1A FORT LEE NJ 07024

We, the undersigned, believe the horseshoe crab population and the shorebird population, which feeds on the horseshoe crab eggs, should be protected. Therefore, we strongly urge the Atlantic States Marine Fisheries Commission to *OPPOSE Horseshoe Crab Addendum VIII*, which would remove these protections.

	NAME	ADDRESS
93	Lorie Reeped	50 Campbell St. Waldwick NJ 07463
94	Sarah Reeped	50 Campbell St. Waldwick NJ 07463
95	Tina Lumino	11 Jackson Ave #56 Scarsdale NY 10583
96	Dana Jeffas	55 Manitoba Trl Shamong NJ 08088
97	Nina Primas	1 Knoll Ct Stratford NJ 08084
98	Jayne Guarino	1405 Durham Ave South Plainfield NJ 07080
99	Rebecka Guarino	1405 Durham Ave. South Plainfield, NJ 07080
100	Wendy Cikot	109 Inboard Ave Manahawkin NJ 08050
101	J Mattiello-Ferrara	49 Portsmouth Ln, Tuckerton, NJ 08087
102	Jayne Kaldrano	133 Four Winds Dr. Middletown, NJ 07748
103	[illegible]	59 [illegible] Mill Circle Doylestown PA 18901
104	[illegible]	300 Liberty Ave, Beach Haven 08008
105	Sami Mognni	1221 Brookfield Lane Waterford NJ 08089
106	Lizzie Magnoni	1221 Brookfield lane Waterford NJ 08089
107	[illegible] MacNamara	254 Willow St. Macungie, PA 18062
108	[illegible]	522 N. Maple Ave Ridgewood NJ 07450
109	Ginny Williams	929 Oceanfront, Ship Bottom, NJ
110	Laura Koshel	921 Bermuda Dr., Branchburg, NJ 08853
111	Pam Horstmann	764 Benge Rd Hockessin, De 19707
112	SARAH McGINTY	556 W LOCUST ST OXFORD PA 19363
113	Karen Jackowski	60 Belton St. Stanhope NJ 07874
114	Cathy Colangelo	670 Wallace Way Weatherly PA 18255
115	Emma Horn	5047 High Terrace Rd. Stroudsburg, PA 18360

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	NAME	ADDRESS
116	J Westvik	10 Inlet Rd Holgate NJ
117	David Fuhe	1902 Meadow Ln. Wyomissing, PA 19610
118	Jessica Minana	227 Page Ave Lyndhurst NJ, 07071
119	teresa Minana	" " " "
120	Donna Lyon	203 Valleyview Rd, Riegelsville, PA 18077
121	Barbara Ahner	1695 Rockcress Dr Jamison Pa 18929
122	Rose Declet	2 Applegate Dr., Florence, NJ 08518
123	LISA Ulmer	277 St David Ct Mt Laurel NJ 08054
124	Madison Smith	8 Frances Lane Monroe NY 10950
125	Michelle Ridge	196 Marienstein Rd UBE PA 18972
126	Chantal Reffler	3 Inglee St. Green Brook NJ 08812
127	LISA Jones	128 Killarney Dr, Burlington VT 05408
128	Michele McGuire	3244 Country Lane, Bethlehem PA 18017
129	Elizabeth Miller	3009 Bath Pk. Nazareth, Pa. 18064
130	Mickie Disston	8831 Montgomery Ave Wyndmoor PA 19038
131	Cathy Polizzi	1 Inlet Rd. Long Beach Twp NJ
132	Linda Mosco	17 Royce Ct Mayetta NJ
133	Barbara Kubler	118 E. Maryland Ave Beach Haven Terr.
134	Swilder	135 W Maryland Ave " " "
135	Kim THOMAS	107 GREENWOOD AVE, HASKELL NJ 07420
136	Paula Haughey	3127 Marshall Dr Melbourne, FL
137	R Haughey	3127 MARSHALL DRIVE MELBOURNE, FL 32901
138	Martha B. Mayer	11 Allen Circle Boxford MA 01921

We, the undersigned, believe the horseshoe crab population and the shorebird population, which feeds on the horseshoe crab eggs, should be protected. Therefore, we strongly urge the Atlantic States Marine Fisheries Commission to OPPOSE Horseshoe Crab Addendum VIII, which would remove these protections.

	NAME	ADDRESS
139	KATHY ECCLESTON	38 BAYBERRY DR. SOMERSET NJ 08873
140	BARBARA PERRICONE	64 FALLEN TIMBERS TR., Rockaway, NJ. 07866
141	Carly Harrison	2716 NE Flanders Street Oregon 97232
142	Mary Traynor	10513 School St, Fairfax Va 22030
143	Eric Evans	3679 Nottingham Way Suite A Hamilton NJ 08690
144	Susan Scangarello	P.O. Box 172, Barnegat Light, NJ. 08006
145	Kathryn Burket	225 Woodlands Dr. Tuxedo Park NY 10987
146	B Pisano	162 Sunny Dr New Rochelle, NY 10804
147	S Willett	3616 Jonna Ct. Monrovia, MD 21770
148	Kate McNee	90 Seneca Road Belleville PA 17004
149	John [illegible]	08033 / 08057
150	Karli Griggs	42 Haddock dr. Sewell, NJ 08080
151	Maggie Aftanis	110 Berkeley Ave Beach Haven NJ 08008
152	Theresa Cardella	2 E 27th St Long Beach township, NJ. 08008
153	Carol Lukaas	2014 Beach Ave, LBI, NJ 08008
154	Kristen Loprestri	" " "
155	Lynne North	6 Bennet Ln Marlton NJ 08050
156	Joann Polashock	1310 Woodgreen Lane Hainesport NJ 08036
157	Doreen Ciborowski	8389 Riverdale Ln Davenport, Fl 33896
158	Erin Ciborowski	11 Washington Place East White Plains NY 10603
159	Drew Perez	1569 Pine Wind Dr. 18011
160	Kevin Cavanagh	2 Harding Road. Glen Rock, NJ 07452
161	Kristin Cavanagh	2501 Beach Ave Spray Beach, NJ 08008

We, the undersigned, believe the horseshoe crab population and the shorebird population, which feeds on the horseshoe crab eggs, should be protected. Therefore, we strongly urge the Atlantic States Marine Fisheries Commission to *OPPOSE Horseshoe Crab Addendum VIII*, which would remove these protections.

	NAME	ADDRESS
162	Jimmy Donnelly	207B Shutr Ave Seaside Heights, NJ 08751
163	Kathryn Nicusanti	707 10th Ave Belmar NJ ~~08774~~ 0872
164	Patricia Gage	46 Elfman Dr. Doylestown, PA 18901
165	Joan Gautreau	9025 S.W. Sawgrass Way, Palm City, FL 34990
166	DIANNA IVANA	45 Nancy lane Barnegat NJ 08050
167	Sue Lucier	1051 theodore Rd - Sch'dy NY 12303
168	Danna Lopez	585 Trinity Place, P, Westfield, NJ 07090
169	Amy Certa	2204 Salt Wind Way Mt Pleasant SC 29466
170	Beth Temey	485 Stonegun St. Collegeville, PA 19426
171	YOLANDA UYTHERO	1035 SHEPARD DR. BLUE BELL, PA 19422
172	Mollie Stone	21 Ship Channel Rd, South Portland, ME 04106
173	Donna Hoder	254 Evergreen Dr. Bay Head, NJ 08742
174	NANCY KAERICHER	108 Shell Bark Dr Milford PA 18337
175	ELVA ZINGARO	611 5TH STREET MILFORD PA 18337
176	Sandra Kapp	115 Kapp Dr Cowansville PA 16218
177	Mary Shannon	318 Conerty Rd Chicora, Pa 16025
178	LINDA KAPLAN	8 LEEWARD Passage, Hilton Head, SC 29928
179	Rosemary Leone	18 Snowden Lane Princeton NJ 08540
180	CAROL McPhillips	8 PORTOFINO DR. ROBBINSVILLE, NJ 08691
181	Noel Burch	400 Fairview Avenue Beach Haven 08008
182	Pamela Dlung	40 Fairwood Blvd Pleasant Ridge Mi 48069
183	Diane Bonsworth	2966 Foxhall Rd Charleston SC. 29414
184	[illegible]	318 Leeward Ave BH - 08008

We, the undersigned, believe the horseshoe crab population and the shorebird population, which feeds on the horseshoe crab eggs, should be protected. Therefore, we strongly urge the Atlantic States Marine Fisheries Commission to *OPPOSE Horseshoe Crab Addendum VIII*, which would remove these protections.

	NAME	ADDRESS
185	Leslie Daly	101 East 27th St Freehold, N.J. 07728
186	Laura Casey	11411 Potomac Rd, Lorton VA 22079
187	Robin Gunia	319 Stamets Rd - Milford NJ 08848
188	Emily Gunia	604 5th Ave Belmar, NJ 07719
189	Kathy Kierce	356 Fiddlers Point Dr St Augustine Fl 32080
190	Ed Bennett	1605 Partridge St. Toms River, NJ 08753
191	[illegible]	11306 Beach Ave Haven Beach
192	Jeanne Parker	517 Adams St, Pittsburgh, PA 15237
193	Jeff Wat	48 Rossmore PL Belleville NJ. 07109
194	Deborah Jimenez	64 Shore Ave Moonachie NJ 08050
195	Joan Gallegan	124 Marine St. Beach Haven, NJ 08008
196	[illegible]	123 Coral St, Beach Haven NJ 08008
197	Susan Sheppard	112 W. Ship Bottom Ave. Ship Bottom, NJ 08008
198	Sonny Adoni	8 Beatrice St Beach Haven
199	Claire Hunley	183 Saddle Drive, Furlong, PA 18925
200	Jane von Oehsen	455 Cherry Valley Rd, Princeton, NJ 08540
201	Wendy Reichard	18 Jami Beth Dr. Mertztown PA 19539
202	Helen Goodwin	339 Windsor Dr. Cherry Hill NJ 08002
203	Cheri Lane	18 Cardinal Ct Kendall Park NJ 08824
204	Susan Bergquist	371 Elm Ave Bogota, NJ 07603
205	[illegible]	52 Orchard St, Pleasantville NY 10570
206	Lee DeStefano	216 Fairview Ave Beach Haven
207	Allison Chieffo	6 W Susan Ave, Holgate, NJ 08008

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	NAME	ADDRESS
208	Ashley Eimer	17 4th Ave Bluffton, SC 29910
209	Carolyn Elmer	1470 Paul Blvd, Manahawkin NJ 08050
210	Laura [illegible]	840 Ivy Rd Ambler PA 19002
211	Joma Elery	9507 Wheelpump Ln Phila PA 19118
212	TARA SUTPHEN	12 Laga Ct., Ringoes, NJ 08551
213	P Slaven	489 Clinton Ave Toms River NJ 08753
214	Rothenberg	741 Drum Point Rd Brick
215	Linda Rowinski	607 Nelson Rd, Johnson City NY 13790
216	Eden Cnerry	113 Hadleys Mill Kennett Square PA 19348
217	Christine Lepre	4312 Orbitare Blvd, Voorhees, NJ 08043
218	Gianna Bonto	10 Plymouth Ct. Mt Holly NJ 08060
219	CAROL CZARNECKI	82 Winsor Place, Rear Cottage, Glen Ridge, NJ 07028
220	Mom [illegible]	132 Woodland Ave Gloversville NY 12078
221	Alyssa [illegible]	31 Seneca St. Troy, NY 12189
222	Deliliet Closson	2826 Princeton Pk Lawrenceville, NJ 08648
223	Jennifer Clum	2826 Princeton Pike Lawrenceville NJ
224	[illegible]	20A Kirschbaumweg, Bottmingen, Switzerland 4103
225	Marilyn	428 School Str, Lansdale PA 19525
226	Barb Garfield	14 Ramshorn Rd Milford NJ 08848
227	Mary Nieman	15 Marvin St Dover NJ 07801
228	Susanne Kesper	40 Deal Lane, Waretown, NJ 08758
229	Cindy Witthoeft	10 E Sand Dune Ln. L.B. Twp NJ 08008
230	Dawn Keen	11 Pine trail medford NJ 08055

We, the undersigned, believe the horseshoe crab population and the shorebird population, which feeds on the horseshoe crab eggs, should be protected. Therefore, we strongly urge the Atlantic States Marine Fisheries Commission to *OPPOSE Horseshoe Crab Addendum VIII*, which would remove these protections.

	NAME	ADDRESS
231	[illegible]	Clintondale, N.Y. 12515
232	Naomi Servis	NYC 10025
233	ANDREA LEVINE	GALLOWAY, N.J. 08205
234	Linda Chadwick	Galloway, NJ 08205
235	PAT TROCANO	JUPITER FL 33477
236	Cynthia Kipple	Jupiter, FL 33477
237	Judi Kruscavage	Yardley, PA 19067
238	Jessica Kruscavage	Philadelphia, PA 19118
239	R Cipolloni JR	10 Carriage Hill Ln Columbus NJ 08022
240	KATE Commarato	55 WEHRLI Rd Long Valley NJ 07853
241	Marisa Rosveck	1745 Park ave, Washington, Pa 15301
242	Tracy Sommers	Hendersonville, NC
243	Alison [illegible]	116 W. 17th St. Beach Haven, NJ
244	Debbi Kumpf	SILVER SPRING, MARYLAND
245	Abby Brennan	Westfield, NJ
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OPPOSE Horseshoe Crab Addendum VIII, which would remove these protections.

NAME	ADDRESS
Rob Meyer	2 Longworth Ct. Cedar Run NJ. 08092
Leile Sullivan	17 E 40th St Beach Haven NJ 08008
Del Hente	5210 S Long Beach Blvd Holgate
Sally Potts	5616 Holly Ave, Harvey Cedars, NJ
THOMAS JACOBSON	128 ROWAN CT. MANAHAWKIN, NJ

We, the undersigned, believe the horseshoe crab population and the shorebird population, which feeds on the horseshoe crab eggs, should be protected. Therefore, we strongly urge the Atlantic States Marine Fisheries Commission to *OPPOSE Horseshoe Crab Addendum VIII*, which would remove these protections.

	NAME	ADDRESS
1	Linda Kelly	13209 Beach Ave, LBT, NJ 08008
2	Rita R. DiAntonio	1109 Childs Ave; Dryel Hill, PA 19026 (314 Essex BH)
3	Amy Robinson	1650 Monte Vista Dr. Reno, Nevada 89511
4	Penelope Reardon	3371 Forest View Ln Reno Nevada 89511
5	Pinky NILSEN	P.O. Box 2027 LONG BEACH TOWNSHIP. NJ. 08008
6	Cheryl Schrader	19 Joshua Dr. Mahahawken NJ 08050
7	Kathy Thomas	151 Chelsea Rd, White Plains, NY 10603
8	Melissa Perlstein	111 Clive Street, Edison, NJ 08820
9	Anne Hodson	40 Weston Ave Chatham, NJ 07928
10	Courtney Durham	11 W. McKinley Ave. LB. Twnship 08008
11	Steve Eisenberg	12914 Pacific Ave BHT
12	Danielle Adams	130 3rd Street Centre Hall, PA 16828
13	Carly Shanken	18 Judith Ave, Beach Haven
14	Lori Dougherty	5 E Texas Ave Long Beach Township.
15	[illegible]	[illegible]
16	Tami Moriarty	[illegible] 20 [illegible] Ln. LBI
17	AvaGuardino	136 W end ave pompton plains NJ 07444
18	Ali Guardino	136 W end ave pompton plains NJ 07444
19	[illegible]	Roelofs Rd Yardley PA
20	Brenda Griffin	2055 S. Bay BH
21	[illegible]	140 West Ave BH
22	Katie Quinlisk	807 S Beach Ave, Beach Haven, NJ
23	Jim Malloy	40 West Park Place #309, Morristown, NJ 07960

Thank you!

We, the undersigned, believe the horseshoe crab population and the shorebird population, which feeds on the horseshoe crab eggs, should be protected. Therefore, we strongly urge the Atlantic States Marine Fisheries Commission to *OPPOSE Horseshoe Crab Addendum VIII*, which would remove these protections.

	NAME	ADDRESS
24	Danielle Malloy	40 WEST PARK PLACE #309, MORRISTOWN NJ 07960
25	Dana Richter	925 Minisink Way Westfield NJ 07090
26	Camille Kaiser	8322 Greenslope Dr. Unit A 78759, ATX
27	Scott Hutchinson	8322 Greenslope Dr. Unit A Austin TX 78759
28	Emma Desiderio	1178 Beach Lane, Manahawkin NJ 08050
29	Kim Peoples	5 Wine St. Chatsworth, NJ 08019
30	Karen Dietert	101 Cedar ln Barnegat NJ 08005
31	Cathleen Sims	102 W. Roosevelt Avenue #3 Holgate 08008
32	Rebecca Josephson	407 Coral St.-Unit A, Beach Haven, NJ 08008
33	Sarah Clark	4 Garden Place Cranford, NJ 07016
34	Ann Barry	39 Garden Path Barnegat NJ 08005
35	Yumara Hernandez	233 2nd. St. 2nd Fl Beach Haven, NJ 08008
36	Pat Walls	Mt Laurel NJ 08054
37	[illegible]	10 William St. North Beach
38	Kristin [illegible]	2005 S Bay Ave, Beach Haven, NJ 08008
39	[illegible]	154 N. Lovett Ave L.S. NJ
40	[illegible]	20 Cove Rd. Moorestown 08057
41	Joseph Cavanagh	40 Greenwood Ave Madison NJ 07940
42	Doris Kosiba	2 W Jeffrey - Holgate NJ
43	Jackie Wolf	26 e. Kansas ave - BHP
44	Elizabeth Wolf	26 e. Kansas ave - BHP
45	Omer Noam	26 e. Kansas ave - BHP
46	Barbara Higdon	2 Gerald Place, Rockaway, NJ 07866

☆ Thank-you ☆

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	NAME	ADDRESS
47	Caitlin Wallace	219 Nelson Ave, Beach Haven
48	MARY KANE	34 JEFFREY CT., BASKING RIDGE, N.J.
49	Jessica Horowitz	55 Orchard lane Colts Neck, NJ 07722
50	John O'Connor	55 Orchard lane Colts Neck, NJ 07722
51	Leticia Gil	16 48th Street Apt. 1 Weehawken, NJ 07086
52	Robert Profitera	156 Orangeburgh Road Old Tappan, NJ, 07675
53	Valerie Murphy	30 Sylvan Way, West Caldwell, NJ 07006
54	[illegible]	8 [illegible] LBI
55	Noel Mahon	43 White Oak Ln, LEH NJ 08087
56	Michele Royen	13 W 15th ST. B.H. 08008
57	Shirley Costello	213 Amber St. Bch. Hvn. NJ 08008
58	Debra Leigh	14 Janet Rd Holgate, NJ 08008
59	Amy Mutz	P.O. Box 540 McAfee NJ 07428
60	Sandi Levow	10 W. Roosevelt Ave Holgate, NJ 08008
61	Meghan McDermott	62 E Linden Ave Dumont NJ 07628
62	Emily McAlpine [illegible]	620 E LINDEN AVE APT 3 ENGLEWOOD NJ 07631
63	LINDA BOSSE	7 OTIVA DR KATONAH NY 10536
64	Reece Goodson	436 Second St. Beach Haven NJ
65	ERIKA Marchiondo	3204 South Long Beach Blvd Holgate, NJ
66	Susan Gross	122 YARMOUTH CT. HOLGATE
67	Jean Genievich	228 Kentford Ave Beach Haven
68	Lorraine Fabiano	21 Kilroy Rd Newton NJ 08008
69	Donna Livingstone	7827 farnsworth St Phila Pa 19152

Thank-you

We, the undersigned, believe the horseshoe crab population and the shorebird population, which feeds on the horseshoe crab eggs, should be protected. Therefore, we strongly urge the Atlantic States Marine Fisheries Commission to *OPPOSE Horseshoe Crab Addendum VIII*, which would remove these protections.

	NAME	ADDRESS
70	Linda Colgan	llcolgan@msn.com
71	Miriam LoStuto	miriamlostuto22@gmail.com
72	Kurt Russell	kingkurt609@gmail.com
73	Alexa Paul	a.paul2018@icloud.com
74	NANO GOYETTE	nano_goyette@BMC.COM
75	Kim Pierce	kimberlyspeidel@hotmail.com
76	Kaylan Pierce	kaylanpierce72@gmail.com
77	Siobhan Walsh	siobhan-burns20@gmail.com
78	Linda Elm	lindaelm@comcast.net
79	[illegible]	
80	Laura Bowie	Lbiforshore@aol.com
81	Richard Bowie	Richardbowie@aol.com
82	Elizabeth D'Errico	bethderrico@gmail.com
83	Steph Spano	steph.spano@gmail.com
84	Michelle Paulin	mmpaulin@gmail.com
85	Mary Anne Rivellis	xbcl-girl@verizon.net
86	Joe Maffney	1060 Gaylord Mountain Rd Hamden CT
87	Mary Ann Maffney	Jgaffney4@Gmail.com
88	Laura Boyd	lboyd805@yahoo
89	Merrianne McLoughlin	merrianne.mcloughlin@gmail.com
90	Katelyn McLoughlin	kmcloughlinn@gmail.com
91	Lorraine Shuman	jslshuman82@verizon.net
92	Susan Hillegass	susanmhillegass@gmail.com

Please Sign

We, the undersigned, believe the horseshoe crab population and the shorebird population, which feeds on the horseshoe crab eggs, should be protected. Therefore, we strongly urge the Atlantic States Marine Fisheries Commission to *OPPOSE Horseshoe Crab Addendum VIII*, which would remove these protections.

	NAME	ADDRESS
93	Pam Carr	16 Canal St, New Hope, PA 18938
94	Melinda Wadsworth	23 Messenger Ln Ringoes NJ 08551
95	Debi MacDonald	401 Buoy Ave Pompano Bch FL 33062
96	RUTH D. McLAUGHLIN	4 WEST STANTON AVE LONG BEACH TOWNSHIP, N.J. 08008
97	Barbara C Marcus	115 East 21st Street Spray Beach, Long Beach Twp, NJ 08008
98	Kym Pearce	105 W Roosevelt Ave, Long Beach Township NJ 08008
99	Ginny Williams	929 Oceanfront, Ship Bottom, NJ
100	Maurine Cavanaugh	425 2nd St. Beach Haven, NJ 08008
101	Greg Gyenody	424 Centre St. Beach Haven, NJ 08008
102	NEAL VAN DEUSEN	30 JOSLEN PLACE, HUDSON, NY 12534
103	Robert Strohl	1211 S Conkling St Balt MD 21224
104	Karen Jachowski	60 Belton St. Stanhope NJ 07874
105	Jan McDermott	900 Vista Dr. West Chester, PA 19380
106	Emily Guglielmo	1140 N Wells unit 206 Chicago, IL 60610
107	Sally Guglielmo	23600 Via Las Palmas Bonita Springs FL 34134
108	Alison Coyle	PO Box 422, Suffern NY 10901
109	Shay Connolly	30 Eleventh St, Beach Haven, 08008
110	Melissa Wall	17 E 92nd St Beach Haven 08008
111	Sandra Allebach	4873 Spencer Dr., Schwenksville, PA 19473
112	Jane Manthorne	286 Continental Dr, Pottstown, Pa 19464
113	Colleen Skrzat	220 Paperbirch Dr Collegeville PA 19426
114	Denise Barrugas	112 Astor Dr. Harleysville, PA 19438
115	[illegible]	209 North Atlantic Beach Haven, NJ 08008

★ THANK YOU ★

PLEASE SIGN

We, the undersigned, believe the horseshoe crab population and the shorebird population, which feeds on the horseshoe crab eggs, should be protected. Therefore, we strongly urge the Atlantic States Marine Fisheries Commission to *OPPOSE Horseshoe Crab Addendum VII*, which would remove these protections.

	NAME	ADDRESS
116	STEPHANIE DeSisto	174 PROSPECT AVE REVERE MA 02151
117	BARBARA HARRIMAN	144 Old Woods Ct Mahwah NJ 07430
118	ALLAN HARRMAN	4175 DAVIS Cup Dr. Huntington Beach CA 92649
119	Lori Carroll	6 Janelle Drive Barnegat NJ 08005
120	Krysten Germain	75 Saint Andrews Dr. L.E.H., NJ 08087
121	Emily Stires	49 Putnam St. Unit 1 Somerville MA 02143
122	Nancy Wendt	12 Weygant Hill, Highland Mills, NY 10930
123	Loren Brewi	116 Peaceable Hill Rd. Ridgefield CT 06877
124	Jayne Resetar	27 Allison St South Plainfield, NJ 07080
125	Corinne Schreiber	6 Everett DR. Medford NJ 08055
126	Steph Tell	210 East 17th St, Long Beach Township 08008
127	Andrea Ryan	582A Amber St. Beach Haven NJ
128	Janice Baswind	551 Marlin Ave Manasquan NJ 08736
129	Sharon Rappaport	37A Forsbee Circle Montvale, NJ 07645
130	Ellen Tondler	251 ELM Ave Cedar Run, NJ 08092
131	Deborah DAVIS	2505 Hopewood Lane, Monroe, NC 28110
132	Marilyn Kaufman	4303 S Long Beach Blvd Holgate NJ 08008
133	Patty Marchetti	11 Frank Dr Beach Haven NJ 08008
134	Claudia Couch	41 Rockwood Road Florham Park, NJ 07932
135	Veronica Conolly	521 Ocean Terrace 10301
136	Susan Schreiber	1011 N Atlantic Ave, Beach Haven NJ 08008
137	Rita R. Silverberg	3 Wright Rd Yorktown Heights NY 10598
138	Barb Cutler	811 Waverly Ave Beach Haven NJ 08008
139	Dena Noone	260 Magnolia Ave, Hillsdale, NJ 07642

THANK YOU!

PLEASE SIGN ♡

We, the undersigned, believe the horseshoe crab population and the shorebird population, which feeds on the horseshoe crab eggs, should be protected. Therefore, we strongly urge the Atlantic States Marine Fisheries Commission to *OPPOSE Horseshoe Crab Addendum VIII*, which would remove these protections.

	NAME	ADDRESS
140	Alicia Brennan	14 Greenland Ct Princeton NJ 08540
141	Julie Rivera	490 Chestnut Street, Twp of Washington 07676
142	Danielle Kirsch	7 Veteri Place, Wayne NJ 07470
143	Iraida O'Callaghan	275 Engle St., D-3, Englewood, NJ 07631
144	Terry Jacobe	12 Roosevelt Ave Trenton NJ 08620
145	Judy Bass	31 Forge Hill Rd Glen Gardner NJ 08826
146	Karl Bass	" " " " " " " "
147	Allison Bahr	15 Village Green, Budd Lake, NJ 07828
148	CAROL MARKHAM	10361 BRADIGAN RD. FORESTVILLE, NY 14062
149	LAURA HARTIGAN	37 LANAI CIR. NAPLES FL 34112
150	Nympha Cole	248 Valley Forge Dr LEH NJ 08087
151	Susan Baptiste	32 Lincoln Ave Blackwood NJ 08012
152	Karen Sherwood	3160 E. 4th Ave Apache Junction AZ 85119
153	Emi Jordan	2354 W University Dr, Mesa, AZ 85201
154	Danica Jordan	604 S Washington Sq #1606 Philadelphia, PA 19106
155	Stephanie Aebretsen	658 Thompson Ave. Bound Brook NJ 08805
160	Chris Bolella	246 Knoll Dr. Park Ridge NJ 07656
161	Thomas Bolella	" " " " " " "
162	Jean O'Neill	211 West Ave, BH 08008
163		
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THANK YOU!! ★

STEPHANIE HANSEN
STATE SENATOR
10th District

SENATE
STATE OF DELAWARE
411 LEGISLATIVE AVENUE
DOVER, DELAWARE 19901

COMMITTEES
Environment & Energy, **Chair**
Transportation, **Vice-Chair**
Elections & Government Affairs
Executive
Health & Social Services
Rules & Ethics
Legislative Oversight & Sunset

VIA ELECTRONIC MAIL

Atlantic States Marine Fisheries Commission
1050 N. Highland Street, Suite 200 A-N
Arlington, VA 22201
Comments@asmfc.org

January 24, 2022

RE: Comment on "Revision to the Framework for Adaptive Management of Horseshoe Crab Harvest in the Delaware Bay Inclusive of Red Knot Conservation"

Dear Commissioners:

Thank you for the opportunity to provide comments for the record. I am the State Senator for the 10th Senate District in Delaware and also the Chair of the Delaware Senate Environment and Energy Committee. Prior to serving in this capacity, I was an environmental scientist and hydrologist for the Delaware Department of Natural Resources and Environmental Control (DNREC) for approximately eight (8) years and an environmental attorney in private practice for approximately nineteen (19) years.

As an elected official, I understand how important it is to balance all of the varied interests in any environmental regulatory matter. It is also critically important that all scientific data be made available for review and analysis prior to changing key elements of any management plan affecting critically important species.

I have been following the discussion regarding the harvesting of horseshoe crabs within the Delaware Bay. To that end, I have had a number of discussions with DNREC Fish & Wildlife personnel as well as other environmental organizations in order to do my due diligence in assessing whether a moratorium on horseshoe crab harvesting is warranted within the State of Delaware. Since I have found that there is a split of opinion within the environmental community on whether additional restrictions on horseshoe crab harvesting is necessary, I have asked for additional data from DNREC.

Currently, I am waiting on a report jointly developed by DNREC, the U.S. Geological Survey, and the New Jersey Department of Environmental Protection containing an assessment and estimate of the red knot population that utilized the entire Delaware Bay area during the spring 2021 migration. My understanding is that this report will become available within a few weeks. I am also waiting on data from DNREC regarding red knot body weights in Delaware during spring 2021. As you know, since the red knot bird species is dependent on a healthy horseshoe crab population for food, these are two important criteria for assessing the health of the horseshoe crab population in the Delaware Bay.

Even though Delaware does not allow horseshoe crab harvesting for biomedical purposes, this harvest occurs in other states. This harvest is of critical importance to our country during this unprecedented time of needing vaccines for our COVID 19 response. Your latest publication with data on the number of horseshoe crabs harvested for this purpose and their mortality is the 2020 Fishing Year, "Review of the Interstate Fishery Management Plan" approved on October 21, 2021. On page 8 of the report, it states:

The 1998 FMP established a biomedical mortality threshold of 57,500 crabs that, if exceeded, requires the Board to consider management action. <u>This threshold was exceeded in 2020</u>. Results of the 2019 Benchmark Stock Assessment indicate that levels of biomedical mortality prior to 2017 (the terminal year of data used in the assessment), which were relatively consistent between 2013-2018 (with the exception of 2016), did not have a significant effect on horseshoe crab population estimates or fishing mortality in the Delaware Bay region. However, the average biomedical mortality in the last three years has been about 40% higher than the 2013-2017 average. (Underlining added).

As the pandemic has raged through 2021 with a concomitant need for more vaccine, it should be expected that the harvest and the mortality will also be significantly increased, although we do not yet have that data. This has been a year of very unusual demand for horseshoe crab blood, much more so than 2020. In order for us not to make a mistake in underestimating the effect of the biomedical industry on the crab population and the future demand on the biomedical industry as we make our way through this unpredictable pandemic, caution is best at this point.

On behalf of the residents in the 10th Senate District and as the Chair of the Delaware Senate Environment and Energy Committee, I would like to respectfully request that any decision to revise the ARM to be less restrictive on the harvesting of horseshoe crabs in the Delaware Bay be delayed until such time as all of the data necessary to assess the health of the horseshoe crab population has been developed and reviewed.

Sincerely,

Stephanie L Hansen

Senator Stephanie Hansen, 10th District

Legislative Hall, 411 Legislative Avenue, Dover, Delaware 19901
Senate Office: (302) 744-4138 Senate Fax: (302) 739-6890 Email:
Stephanie.Hansen@delaware.gov

Ravi Grover
PO Box 802103
Chicago, IL 60680

S SUBURBAN IL 604
8 SEP 2022 PM 7 L

Re: Horseshoe Crab Draft Addendum VIII

Please protect red knot shorebirds by rejecting Addendum VIII to the fishery management plan for horseshoe crabs.

Not doing so opens the door to violations of ESA given the low # of red knots that have decreased because of less crabs.

Thank you.

ASMF
1050 N Highland Ste 200
Arlington, VA
22201

22201-219650

The Valley Forge Audubon Society joins NJ Audubon in opposing the Atlantic States Marine Fisheries Commission's (ASMFC) proposal to increase the harvest of horseshoe crabs, including a possible renewed harvest of females. Horseshoe crab eggs provide essential food for migrating federally-threatened Red Knots, whose numbers along Delaware Bay have plummeted from more than 90,000 in the 1990s to only 12,000 this year and an estimated all-time low of 6,800 in 2021. Increasing the harvest will have a significant negative impact on Red Knots and other shorebird species that depend on horseshoe crab eggs during spring migration stopovers in Delaware Bay, putting them at risk of further population declines.

We hope to enjoy visiting the Delaware Bay for many years to experience the Red Knot stopover on their amazing 9,000 mile migration from the southernmost tip of South America to their nesting area in the middle- and high-Arctic areas of northern Canada. Help ensure that these remarkable birds get all the horseshoe crab eggs they need to thrive and grow as a species for generations to come. Please do not increase the harvest of horseshoe crabs.

Sincerely,

Vincent Smith, President
Valley Forge Audubon Society

1201 Pawlings Road, Audubon, PA 19403
Valleyforgeaudubon.org

AMERICAN LITTORAL SOCIETY

18 Hartshorne Drive, Suite 1, Highlands, NJ 07732

January 24, 2022
Mr. Joseph Cimino, Chair
Horseshoe Crab Management Board
Atlantic States Marine Fisheries Commission

By Email

Mr. Cimino,

I am writing to express the deep concerns of the American Littoral Society regarding the possible action by ASMFC at its Winter Meeting of the Horseshoe Crab Management Board to substantially modify the policies and approaches to protecting the crabs and red knots of Delaware Bay through a highly-technical modification to the Adaptive Resource Model (ARM) utilized by the Commission.

The impact of the possible technical revisions – to change the harvest restrictions and reopen the bait fishery's access to female horseshoe crabs despite the lack of recovery to date of the red knot populations which depend on the eggs they produce – is buried under hundreds of pages of technical discussions despite the efforts of leading members of the ASMFC's own advisory committee to raise this concern to the primacy it deserves. Further, this fundamental change in policy and risk to the recovery of the red knot is being done behind the closed doors of the modeling committees without robust and engaged public consideration of the acceptability of the risk to important stakeholders including the broader public and conservation community.

The fact that the representative of the agency charged with protecting the red knot under the Endangered Species Act was forced to write a "minority report" to ensure her concerns – substantially ignored during the process - were on the record is an indictment of the process. Truly, how can your committee consider this process appropriate to move forward when the professionals entrusted to protect the species of concern find it unacceptable? Even in the face of warnings that the course the ASMFC is setting upon may not satisfy its legal obligations under the Endangered Species Act, the originating technical committees have simply countered the concerns with their perspectives and moved ahead. Even the outside Peer Review Committee raises concerns about the shift in policy embedded in technical changes and the adequacy of how well public and stakeholder concerns were taken into account. I doubt that the public's tolerance to the possibility of red knot extinction is as high as this new ASMFC direction envisions.

I strongly urge the Commission to not approve the proposed Framework Revision before you for consideration on January 26, 2022.

Sincerely,

Tim

Tim Dillingham, Executive Director

From: Robert Szuter
To: Comments
Subject: Horseshoe Crab Draft Addendum VIII

Dear ASMFC,

I urge the Atlantic States Marine Fisheries Commission (ASMFC) to not backtrack and allow for the killing of female horseshoe crabs for fishing bait. I urge the ASMFC to keep protections in place and if anything, to strengthen protections - as the situation is dire in our beloved Delaware Bay for the shorebirds and the horseshoe crabs. Please abandon any attempts to weaken the current moratorium on horseshoe crab harvest.

• Under the current framework there is no female crab harvest until female abundance reaches 11.2 million crabs or until the Delaware Bay total red knot stopover population reaches 81,900 birds. The proposed revision would allow the resumption of the female harvest, even though neither the red knot nor female horseshoe crabs of Delaware Bay are close to satisfying either metric.
• The ASMFC should ensure that the original safeguards in their harvest policies prohibiting female horseshoe crabs from being harvested until red knot numbers recover are included in any new policies.

I request that any future public meetings on the horseshoe crab harvest I be notified directly so I may be able to better defend the crabs from the very agency that should be protecting this species in the first place.

Thank you for your time and consideration.

Sincerely,
Robert Szuter
robo.szuter@yahoo.com

135 Lenox Avenue
Hamilton Township, NJ 08620
United States

Position Statement on ASMFC Horseshoe Crab Draft Amendment VIII

September 2022

- The Horseshoe Crab Recovery Coalition strongly opposes the Atlantic States Marine Fisheries Commission's (ASMFC) plan to change its Horseshoe Crab Fishery Management Plan, a move that would raise quotas on the killing of horseshoe crabs for use as bait by potentially reopening the harvest to include female horseshoe crabs.

- We remain concerned that the underlying data supporting the new draft addendum to the plan has still not been released to the public, so that conservation groups and concerned citizens have no way to truly understand the science on which the new proposal is based.

- Under the current framework there is no female crab harvest until female abundance reaches 11.2 million crabs or until the Delaware Bay total red knot stopover population reaches 81,900 birds. The proposed revision would allow the resumption of the female harvest, even though neither the red knot nor female horseshoe crabs of Delaware Bay are close to satisfying either metric.

- How can we comment meaningfully on a proposal when you are not releasing the data supporting the types of increases being proposed? With both red knots and horseshoe crabs at historically low numbers, we cannot take the commission's assertions on faith.

- Based on field work, including egg density studies conducted by the Delaware Bay Shorebird Project and other organizations, we do not believe that horseshoe crab populations are recovering from their population crash in the 1990s. Egg density data is the most reliable indicator of the horseshoe crab population, and importantly, it is the most reliable index of value for red knots and other shorebirds. Yet ASMFC has never included these surveys in its modeling. Making matters worse, ASMFC also does not include field survey data for Red Knots, and these show that Red Knot populations are at historic lows. In the 1990s, more than 90,000 could be found along Delaware Bay. This year, only 12,000 were counted, and in 2021, the number was estimated at an all-time low of 6,800. Evidence is now emerging that Red Knots are bypassing the Delaware Bay stopover altogether in search of life-sustaining food sources elsewhere. This makes their migratory journey all the more perilous.

- Shorebirds like the red knot are plummeting toward catastrophe, with their declines representing the world's number one conservation crisis facing birds today. And the killing of female horseshoe crabs all but assures that their population levels will never rebound.

- The joint collapse of red knots and horseshoe crabs is not inevitable. But this proposal propels them closer to that grim reality.

Caitlin Starks, Senior FMP Coordinator

1050 N. Highland Street

Suite 200A-N

Arlington, VA 22201

RE: Comment on Horseshoe Crab Draft Addendum VIII 30 September 2022

Dear Ms. Starks, and ASMFC Commissioners,

I am writing to express my concern over the possible acceptance of Draft Addendum VIII to the Horseshoe Crab Management Plan. I work as part of the Delaware Bay Shorebird Project, rescue horseshoe crabs as part of reTURN the Favor, have been helping conduct horseshoe crab spawning surveys and tagging for the past 9 years, measure horseshoe crab egg density on the NJ side of Delaware Bay, and work for the Horseshoe Crab Recovery Coalition. My comments today are not in affiliation with any of the aforementioned organizations, but instead are my own concerns as an individual and observer, who has been working, in the field, directly, with horseshoe crabs, in many respects.

I am opposed to Option B to implement the revision to the Adaptive Resource Management (ARM) Framework, and ask that commissioners vote no on Addendum VIII.

In your slides for the Horseshoe Crab Draft Addendum VIII Hearing Presentation, you state: "The ARM Framework … provides … sufficient resources to maintain viable populations of red knots." Oxford Languages defines viable as "capable of working successfully." In biological applications, it defines viable as "capable of living successfully." To cite more than one source, the Cambridge Dictionary defines viable as "able to succeed."

Being that the *rufa* Red Knot subspecies has been listed as Threatened under the Endangered Species Act since 2015, it is clear that the population of red knots that migrate through and feed in Delaware Bay are not living successfully. One might classify a species which is living successfully as one not included on the International Union for Conservation of Nature's Red List of Threatened Species, as a species at risk for becoming extinct.

In an article printed in NJ Spotlight News on 6/14/22, the Commission was quoted as saying the passage population of red knots is "fairly stable but lower than desired." What percentage of the red knot population of Delaware Bay were above the 180g weight to successfully make the trip to the Arctic breeding grounds? The estimation of P180 (the percentage of birds that gain enough weight to breed in the Arctic successfully) has not broken 45% in the last 5 years. When horseshoe crab egg densities were higher, over 80% of red knots reached good weight.

You also state that one of the objectives of the ARM Framework is to maintain ecosystem integrity. The horseshoe crab is a keystone species of the ecosystem, supplying a vital food source not only to migrating red knots, but also to shorebirds, and many species of (sport)fish, such as Weakfish, Tautog, Striped Killifish and Atlantic Silversides, who in turn are eaten by Striped Bass and Summer Flounder. Since the new model is capable of allowing a female harvest, depletion of the food source of horseshoe crab eggs (which can only be provided by females) crucial for so many species, is bound to have a deleterious effect on the integrity of the Delaware Bay ecosystem, at multiple levels. Since the decline of the horseshoe crab population in the 1990s, there has been a resultant decline in sportfishing. This would only decrease further with implementation of the new model and a female harvest.

The Commission counts red knot numbers at around 43,000, using a model-based assessment. You admit that this is a “best estimate.” Scientists with the Delaware Bay Shorebird Project are in the field, collecting data that is ground-**truth**, not an estimate, and not a model. Tet you refuse to use these population numbers. You quiet the voices on the advisory committee who speak the voice of truth in minority reports. You say that your estimate of 43,000 red knots is “a level that is consistent with state quotas for harvesting horseshoe crabs.” This only shows that the harvest quotas are excessive, as there hasn’t been 43,000 red knots on Delaware Bay since the 1990s.

In addition to my comments listed above, I will state that there has been no opportunity for the model to be made available to be reviewed by those requesting to do so. The reason being given that it takes three computers to run is absurd. Certainly, you recognized this limitation when you chose the cumbersome model.

Under the current ARM framework, females would not be harvested until the population meets a threshold of 11.2 million female horseshoe crabs, or the total red knot stopover reaches 81,900 birds. However, neither of these conditions have been reached. In addition, the Virginia Tech trawl survey, recognized by the Commission to help estimate the horseshoe crab population, shows that the population of female horseshoe crabs is depleted.

For these reasons, I ask the Commission not to approve the proposed Framework Revision of Draft Addendum VIII at this time.

Respectfully Submitted,

Susan Linder

From:	John Askildsen
To:	Comments
Subject:	[External] Horseshoe Crab Harvest
Date:	Sunday, September 11, 2022 5:24:27 PM

To whom it may concern,

I oppose Horseshoe Crab harvests until the Delaware Bay crab population and Red Knot population are rebounded. To allow this event to happen, would be a detriment to the Horseshoe Crab and Red Knot population, and also financially counter productive to aims of the Endangered Species Act and any other federal programs aimed at rejuvinating the red knot population in the Delaware Bay region. We cannot afford to allow this harvest to happen. Please count me in as being opposed to any such harvest.

John Askildsen
70 Daheim Road
Millbrook, NY 12545

From:	Jen Zarcone
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Friday, September 30, 2022 4:26:14 PM

To whom it may concern,

As a board member of a local wildlife conservation non-profit who has been collecting data with my own two hands and eyes for many years on the New Jersey shore, I am writing to say that I vigorously oppose the Atlantic States Marine Fisheries Commission's (ASMFC) proposed Addendum VIII Interstate Horseshoe Crab Fishery Management Plan, which would increase the number of horseshoe crabs harvested for use as bait and potentially reopen the harvest to include female horseshoe crabs. I urge the commissioners to vote no on Addendum VIII because I believe several indicators show both horseshoe crab populations themselves and the population of a Federally threatened shorebird, the red knot that depends on horseshoe crabs, are well below recovery thresholds.
I base my opposition on three factors:
● I have yet to see the model upon which the proposed revision is based, so there is no way of objectively verifying its accuracy.
● Horseshoe crab populations remain at historic lows, and their ongoing use both for bait and biomedical purposes all but assures they will not recover to their historic population levels.
● Rufa Red Knot populations are at all-time lows from both a changing climate and the increasing scarcity of the food needed to fuel their 9,000-mile migration.

Among the most worrisome aspects of the proposed addendum is that the public has yet to see the model upon which it is based. Even if granted access at this late date, we do not believe the September 30, 2022, comment deadline would be sufficient time to independently analyze its accuracy. Such a release would serve the interests of science and spur important public debate about your proposed actions, and should have been a prerequisite for ensuring fully informed public commenting.

I am also highly concerned that the proposed revision would likely trigger a resumption in the harvest of female horseshoe crabs, which would make recovery of the species virtually impossible. Under the current ASMFC framework, there is no female crab harvest until female abundance reaches 11.2 million crabs or until the Delaware Bay total red knot stopover population reaches 81,900 birds. Neither red knot nor horseshoe crab populations are anywhere close to satisfying either metric, and yet, under this addendum, female harvest could be allowed.

The joint collapse of red knots and horseshoe crabs is not inevitable. But the draft addendum propels them closer to that grim reality. I urge you to abandon this proposal by voting no on Addendum VIII, and instead urge you to begin the process anew by:

● Incorporating into the model datasets that show a more robust picture of population status for horseshoe crabs and red knots, including horseshoe crab egg density surveys and red knot field surveys.
● Publicly sharing the model behind the proposal, allowing for sufficient time for independent analysis before public commenting.

Thank you,

Jennifer Zarcone

--
Jennifer Zarcone
Save Coastal Wildlife
Board of Directors
jen.zarcone@gamil.com
917-857-7751
www.savecoastalwildlife.com

From:	Zach Piper
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Tuesday, September 27, 2022 1:30:51 PM

Dear ASMFC,

Please protect the Delaware Bay by not allowing the harvest of female horseshoe crabs for bait. I work as a fisheries biologist in Middletown, Delaware for Environmental Consulting Services, Inc. and have been an avid hunter and fisherman since moving to the area a little over 5 years ago. In speaking to lifelong residents and colleagues, it is my understanding that the horseshoe crab population in Delaware would not be able to sustain the harvest of females being proposed. In my opinion, the trade-off between using these keystone species as bait and allowing their numbers to recover could not be any more stark. With red knot and other migratory bird populations hurting, it would be a poor decision to remove even more horseshoe crabs from the ecosystem and decrease spawning numbers for a whelk fishery that does not carry the same magnitude of importance as healthy horseshoe crab numbers. I know you have difficult decisions to make managing our coastal fisheries but this seems like a no-brainer.

Thank you and have a great day,
Zach Piper

From: A Piatek
To: Comments
Subject: [External] Proposed Increase in Horseshoe Crab Harvesting
Date: Sunday, September 11, 2022 4:14:59 PM

Dear Officials of ASMFC,

I urge you to oppose the increase of female horseshoe crab harvesting. Research has shown that neither the horseshoe crab nor the Red Knot have viably increased their population. The Red Knot experiences an exhaustively long and perilous journey from the Southern Hemisphere, resting and restoring their depleted reserves in the Delaware Bay, before continuing their journey further North. The Red Knot depends on the sustenance of the horseshoe crab. In turn, they are important to the health of our ecosystem. They continue to present in decreased numbers and the increase in harvesting will only add to the fragility of these creatures and their and our ecosystem. We humans are interdependent upon the natural systems. I strongly urge the organization to oppose this folly in judgement.

Respectfully Submitted,
A Very Concerned Citizen,
Alice Piatek
Oak Ridge NJ 07438

From:	Amanda MacKaye
To:	Comments
Subject:	[External] Protect Horseshoe Crabs
Date:	Thursday, September 29, 2022 7:18:09 PM

Hello,

When I was a child I would routinely see Horseshoe crabs both on the beach and in the water. My 22 year old son has never seen one, nor has even seen a shell remaining after birds have feasted.

Please do not change quotas on how many Horseshoe crabs can be killed. In fact, I ask you to please ban the killing of Horseshoe crabs to be used for fishing bait.

Sincerely,
Amanda MacKaye
Arlington, VA

Sent from Yahoo Mail for iPhone

From: Andrea Kerin
To: Comments
Subject: [External] Horseshoe Crab Draft Addendum VIII
Date: Tuesday, September 27, 2022 2:10:55 PM

Dear Commissioners,

I write in objection to the Atlantic States Marine Fisheries Commission's (ASMFC) proposed changes to the Adaptive Resource Management (ARM) model which seek to resume harvest of female horseshoe crabs and raise the quotas on killing horseshoe crabs for bait in commercial fisheries.

The current ARM model framework advises no female crab harvest until female abundance reaches 11.2 million crabs. The prosed changes to the model will estimate a higher population of female crabs and likely allow female harvest to resume.

The current ARM model also advises no female crab harvest until the Delaware Bay stopover population of Red Knot, a federally threatened shorebird species that depends on horseshoe crab eggs to survive, reaches 81,900 birds. A 2021 superpopulation estimate puts the Red Knot population at 42,271 – less than half of ASMFC's current recommended threshold for female horseshoe crab harvest to continue. *Independent assessments estimate the Red Knot population to be even lower.*

Despite a stagnant Horseshoe Crab population and a record low stopover population of the Red Knot, the ASMFC is set to open the door to an even more damaging horseshoe crab harvest.

The ASMFC has not released the data behind the proposed changes, preventing meaningful public review before a decision for approval is made.

Commercial fisheries pressure must not dictate resource management policy. With such low numbers of horseshoe crabs it is not a stretch to also predict population collapse in sport fish like striped bass and summer flounder that consume horseshoe crab eggs as well as other fish that are more heavily reliant on horseshoe crab eggs, like weakfish, American eel, and striped killifish.

Please do the right thing by our fragile environment and protect horseshoe crabs properly. Do not resume harvest of female horseshoe crabs and do not increase quotas on killing horseshoe crabs.

Sincerely,

Andrea Kerin
801 Eleven O'Clock Road
Fairfield, CT 06824

From:	Andrew Ashburn
To:	Comments
Subject:	[External] Comment on Horseshoe Crab Draft Addendum VIII
Date:	Friday, September 30, 2022 9:05:03 AM

To whom it may concern (dear commissioners),

Horseshoe crabs are vital to our Delaware Bay ecosystems. As such, female Horseshoe crabs are even more essential, as it is their deed & duty to provide all the necessary energy & efforts to create the next generation, with brief input from males. As Horseshoe crab populations are not nearly recovered to historical records from pressures of pollution, habitat loss, and overfishing, it is imperative that we not remove their progenitors. This is doubly true if the reason for their harvest is simply to supply means of further extraction from Our bay and its estuaries.

These beings have been part or Earth's marine ecosystems for millions of years. How could we creatures of recent emergence possibly understand their profound importance. They're lifecycle is inextricably linked to a myriad of now rare and otherwise endangered species who depend on their habits & services.

It would be a total failure to ourselves & future generations to risk losing functionally sound populations of Horseshoe crabs for short sighted profits. Our bay's food-chains cannot survive the depletion or eliminations of Horseshoe crabs

Thank you for your time & attention,
Andrew Ashburn
Lewes, DE 19958

From:	Andrea Bonette
To:	Comments
Subject:	[External] Protecting Horseshoe Crabs
Date:	Thursday, September 1, 2022 10:02:17 AM

Sent from Mail for Windows

Please do not allow the current protections for horseshoe crabs to be weakened. They may not be as pretty to look at as other endangered species, but they still hold a key place in the Atlantic Ocean's ecosystem. I was so happy years ago when New Jersey outlawed catching them for bait at a time when literally truckloads of them were carted away every spring. It's partly about the migrating red knot birds but the larger issue is the whole system which faces so many human-made dangers.

It's very disappointing that Delaware has not done the right thing but I know you have no control over that.

Thank you.

Andrea M Bonette

From: Andrew Dorman
To: Comments
Subject: [External] Horseshoe Crab Draft Addendum VIII
Date: Friday, September 9, 2022 2:43:30 PM

To whom it may concern,

I am writing you as a concerned citizen and resident of New Jersey where Horseshoe crabs have enjoyed miles of our coastlines to breed and keep their species going strong for millions of years. Additionally Red knots, a now threatened species, rely on horseshoe crabs eggs for the survival of their own species.

The ASMFC has been right to observe the moratorium of fishing horseshoe crab females. While the public is open to exploring new scientific models, we should not risk adversely impacting the populations of these two species.

Please ensure that any plans for harvesting horseshoe crabs maintains a full moratorium for against harvesting females and perhaps considering other alternatives as bait.

I support sustainable fisheries an the ASMFC's efforts to do that. But we must not do so at the cost of other species like the horseshoe crab or the red knot!

Sincerely,
Andrew Dorman
3 Bedford Ct
East Brunswick, NJ 08816

Sent from my iPhone

From:	Andrew Sharo
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Wednesday, September 14, 2022 9:58:37 PM

Dear Ms. Caitlin Starks,

I am a postdoctoral fellow with the NSF, currently working in conservation genetics at the University of California, Santa Cruz. I urge the commissioners to vote no on Horseshoe Crab Draft Addendum VIII. Horseshoe crabs are still below their recovery population goals, and we should do everything we can to reduce the killing of horseshoe crabs. A federally threatened seabird, the red knot, also depends on the horseshoe crab. Please vote no to preserve the horseshoe crab, a valuable part of the Atlantic ecosystem.

Best Regards,
Andrew Sharo, PhD

From: Ann Harmer
To: Comments
Subject: [External] Horsehoe Crab harvest
Date: Thursday, September 15, 2022 11:03:36 AM

To whom it may concern:

Horseshoe crabs have been around for millions of years. Are we the species who will cause their extinction? For SO many reasons, please stop over-harvesting these animals and allow them, and the many other critters that depend on them for survival, to survive as well.

These critters have been around for--quite literally--hundreds of millions of years. Will we be the species that makes them extinct? I certainly hope we have more sense, but I'm beginning to doubt it--given the state of the nation. Please, for SO many reasons, stop the harvest--or at least severely limit it--before it is too late.

Ann Harmer
Professor Emeritus, Biological Sciences
Orange Coast College
Costa Mesa, CA 92626

From:	Ann Bastian
To:	Comments
Subject:	[External] Horseshoe Crab Protection Addendum VIII
Date:	Thursday, September 15, 2022 7:41:57 PM

I join thousands in urging you to oppose any increase in the horseshoe crab harvest. Please join us in protecting the red knot and other shorebirds that depend on horseshoe crab eggs. Extinction is irreversible.

Sincerely, Ann Bastian, 21 Ballantine Ln., Skillman NJ 08558

From:	Optimum
To:	Comments
Subject:	[External] Horse shoe crabs
Date:	Monday, September 12, 2022 8:46:03 AM

Please do not allow more harvesting of these crabs. Studies indicate that the crabs have not recovered enough to warrant an extension. Red knot populations that rely on crab eggs to replenish their nutrition during migration are down. There must be pressure from fisherman to allow more harvesting of crabs. They must look elsewhere for their bait.
Ann Orsillo

Sent from my iPad

From:	Anna Kularski
To:	Comments
Subject:	[External] Horseshoe Crab Harvest
Date:	Friday, September 30, 2022 7:04:51 AM

What is wrong with you people!

Horseshoe crabs? What are you going to do with them; catch conch? Give me a break.

Horseshoe crabs are possibly the most ancient form of animal life gracing this planet. They've managed to survive for hundreds of millions of years - through 5 extinction events and now you are basically proposing to wipe them off the face of the earth.

Please; think again.

Anna Kularski

From:	Anne Hoban
To:	Comments
Subject:	[External] Harvesting Female Horseshoe Crabs
Date:	Tuesday, September 6, 2022 1:21:37 PM

I am writing regarding the preservation of existing harvest levels of female horshoe crabs. Removing the threshold will be detrimental to the red knot population and their successful migration.

I don't need to say more. You know the issue. It is up to you to make the right decision.

Anne Hoban
463A New Haven Way
Monroe Township, NJ 08831
215-962-5894

From: Douglas Price
To: Comments
Subject: [External] Horseshoe Crab Draft Addendum
Date: Sunday, September 11, 2022 2:56:44 PM

I oppose the Atlantic States Marine Fisheries Commission's proposal to increase the harvest of horseshoe crabs. I oppose the harvest of female horseshoe carbs. THese actions will have a significant impact on the population of Red Knots (a federally protected bird species) as well as other shoebirds that rely on horseshoe crab eggs to fuel their migration. You are putting the populations of these species at risk. Please stop the increase in the harvest and please formally ban the harvest of all female horseshoe crabs.
Sincerely,
Anne Price, Monroe Township, NJ

From:	Anne Sturm
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Sunday, September 11, 2022 7:45:42 PM

I am a member of the NJ Audubon Society living in Maryland. A life long bird conservationist, now at eighty years of age, it seems we have always been worried about the horseshoe crab over harvesting. Surely, we can put science into duplicating what we drain from the crabs every year and save them as well as the federally threatened Red Know and other shorebirds that rely on the horseshoe crab eggs during spring migration stopovers on the Delaware Bay. We know that most birds are in decline but particularly shore birds like Red Knots. I oppose the Atlantic States Marine Fisheries Commission's proposal to increase the harvest of horseshoe crabs, including the harvest of females for the first time in over a decade. Please deny this request.

Sincerely,

Anne Sturm
P.O. Box 341
Barnesville, MD. 20838

From: The Dinosaur Specialist
To: Comments
Subject: [External] Horseshoe Crab Draft Addendum VIII
Date: Wednesday, August 31, 2022 8:35:22 AM

Hello,

I kindly request you not to harvest female horseshoe crabs, as they are a vital part of the Red Knot's diet. Please wait until the red knot population is stable, which it will be in a few years. I know that your economy depends on horseshoe crabs, but do you want a better future or more food? The choice is yours.

Don't do it,
9002birdwatcher

From:	Ari Casalini
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Monday, August 22, 2022 2:09:43 PM

Hi,

I'm writing in protest to ASMFC's proposal to allow harvesting of female horseshoe crabs. Horseshoe crabs are an important part of the coastline ecosystem. By allowing the harvesting of female horseshoe crabs, you would be throwing off an already fragile balance and possibly greatly diminishing the amount of horseshoe crabs in existence. In turn, this would effect the migratory birds who depend on horseshoes crab's eggs to fuel their migration. As well as the medical practices that rely on the blood of horses crabs for important testing. I think ASMFC should rethink their proposal, for the benefit of all the ecosystems reliant on the existence and continual well-being of horseshoe crabs.

Thank you for your time,

- Ari, age 15, and her family

From:	Anthony Klock
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII.
Date:	Monday, September 12, 2022 8:43:03 AM

No!

--
Mr. Anthony Klock
Kresson School
Enrichment Teacher
VTEA President
33rd Year Serving Voorhees Students

From:	turunc A
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Friday, September 30, 2022 9:38:32 PM

Please do NOT include female horseshoe crabs in the new harvesting plan. They lay thousands of eggs every year and are critical for migrating birds as well as ensuring that the horseshoe crabs don't end up being overharvested again.
Thank you!!
~Bahar

•••Wear gratitude like a cloak and it will feed every corner of your life•••

iPhone ... iTypos ... iApologize ...

From:	Barbara Holm
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Thursday, September 29, 2022 1:56:57 PM

I've been surveying the spawning horseshoe crabs on Delaware Bay for the past 20 years. Spawning numbers have risen in the past 2 or 3 years because the animals hatched out the first year of the ban on harvesting them have now reached sexual maturity. It takes 7 years for a male to reach spawning age and 10 years for a female. This is not the time to remove restrictions. Give the population a chance to recover - it will take about 10 more years till the horseshoe crabs hatched out this year are able to reproduce. To relax restrictions now will stop the animals' recovery just as it gets started. Barbara Holm

From:	Arthur SanFilippo
To:	Comments
Subject:	[External] Horseshoe crab protection
Date:	Sunday, September 11, 2022 4:08:16 PM

I oppose opening up the harvest of horseshoe crab at this time. The crab remains a disadvantaged species and it is clear this animal has not made a significant return to healthy population.

There are no advantages to use this animal as a bait animal over other types of bait.

There are no advantages to use this animal as a byproduct for man made materials.

Please recognize that you would irreparably harm the stock of this animal in the Delaware bay by allowing additional harvesting

Arthur SanFilippo
154 Florida Ave
Villas NJ

From:	Barbara Morgan
To:	Comments
Subject:	[External] Horshoe Crab Draft Addendum VIII
Date:	Monday, September 12, 2022 6:16:09 AM

Dear ASMFC:

I am concerned about the dwindling numbers of horseshoe crabs and red knot birds. It makes no biological sense to harvest female crabs until excessive crab eggs and birds return to their 1980's density.
One way we can protect them is to not allow harvests of horshoe crabs because they provide the eggs the birds need.
Please, ASMFC, please keep your current policy protections for female horseshoe crabs.

Thank you.
Barbara Morgan
65 Whitefield
Unit 210
Ocean Grove,
NJ 07756
Barbara.morgan @ gmail.com

Sent from my iPhone

From:	barbara sachau
To:	Comments; info; INFO@nyclass.org; westchesterhumane@gmail.com
Cc:	PETA Info; INFO; Erica Meier; Mercy For Animals; info@sierraclub.org
Subject:	[External] Re: [TAKE ACTION] Oppose Change to Delaware Bay Horseshoe Crab Harvest
Date:	Saturday, August 27, 2022 2:17:45 PM

there should be zero harvesting by profiteers of any horseshoe crabs in the entire region of nj ny delaware and all suchpointjs where redknot birds stop. the fact is the big pharma pfofiteers are not being watched and they are taking and killing the female horseshoe crabs in far far greater quantities than we know about nobody watches them, nobody puta limit on big pharma these days. they cannot be trusted at all. they canmake the solution for testing through artifciial means so they shoudl do that. they shoudl be immediately prohibityed from taking any horseshoe crabs at all. big pharma of course does not want to do this because it will cost them some money and they want to get the horsexhoe crabs for free and pay nothing, which is what they are doing

meanwhile big pharma is ruinng bird populations. that cannot be allowed. stop big pharma from harvesting any horseshoe crabs. save the red knot bird, which is a lovely bird. it deserves full protection. this commetn is for thepublic recor.d please receipt. jekanpublee
jeanpublic1@gmail.com

On Tue, Aug 23, 2022 at 12:56 PM jean public <jeanpublic1@gmail.com> wrote:

> bsa
>
> On Tue, Aug 23, 2022 at 10:10 AM Tim Dillingham <info@littoralsociety.org> wrote:

Dear jean,

TAKE ACTION: Add your voice to ours in opposing the Atlantic States Marine Fisheries Commission (ASMFC) proposal that would endanger Delaware Bay horseshoe crabs and the migratory shorebirds (like the Red Knot) which depend on them.

Overharvesting of horseshoe crabs by the bait and biomedical industries has put a severe strain on the ecological connection between horseshoe crabs and shorebirds like the threatened Red Knot. Although the Red Knot population is perilously low, the ASMFC has proposed allowing the harvest of female horseshoe crabs, whose eggs provide the food that fuels the final leg of the birds' journey to Arctic nesting grounds.

The next step in the ASMFC decision-making process on changing horseshoe crab harvest controls involves public hearings at agencies from the states along Delaware Bay, including New Jersey and Delaware (details below). Anyone can attend the hearings or submit comments via email or mail.

ACT NOW: Here's how to join us in urging the ASMFC to reject the proposed harvest change at public meetings and in writing:

Attend an upcoming public hearing
- Register to join a webinar for the public hearings
- Submit comments by email or in writing

Live webinars of the public meetings will be held on **Wednesday, Sept. 7 at 6 p.m.**, with NJ Department of Environmental Protection; and **Thursday, Sept. 8 at 6 p.m.**, with the Delaware Division of Fish and Wildlife. Although the meetings are being conducted by agencies in those states, anyone can attend and comment.

Register for a webinar.

In order to comment during virtual webinar hearings you will need to use your computer or download the GoToWebinar app for your smart phone. Those joining by phone (audio only) will be limited to listening to the presentation and will not be able to provide input. In those cases, you can send your comments to staff via email, U.S. mail, or fax at any time during the public comment period. To attend the webinar in listen only mode, dial 213.929.4221 and enter access code 667-452-901.

Public comment in writing will be accepted until **11:59 PM (EDT) on September 30** and should be sent to Caitlin Starks, Senior FMP Coordinator, at 1050 N. Highland St., Suite 200 A-N, Arlington, Virginia 22201; or at **comments@asmfc.org** (Subject line: Horseshoe Crab Draft Addendum VIII).

Thank you for you all you do to protect the crabs and birds we love,

Tim Dillingham
Executive Director
American Littoral Society

LEARN MORE ABOUT THIS PROPOSED CHANGE

Our Contact Information
The American Littoral Society
18 Hartshorne Drive
Highlands, NJ 07732
732-291-0055
http://www.littoralsociety.org

Donate

From:	Barry Bendar
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Thursday, September 22, 2022 10:58:24 PM

Hello,

When I was growing up in Monmouth County, NJ, we would go swimming in lower New York Bay, and there were dozens of Horeshoe Crabs all over the beach. Due to the uncontrolled harvesting of these ancient creatures, now that area is completely barren of them. Currently, on the eastern side of New Jersey, there is nary a one to be found. Please do not allow the restrictions on harvesting Horseshoe Crabs in Delaware Bay to be altered in any way. These animals have been on this planet unchanged since dinosaurs shared it with them. Do not risk letting mankind wipe them from existence.

Thank You for your attention,

Barry Bendar
122 Bay Avenue
Forked River, NJ 08731
(609) 276-3183

From: Beate Pohlig
To: Comments
Subject: [External] Horseshoe Crab Draft Addendum VIII
Date: Friday, September 30, 2022 5:19:23 PM

Dear Sir or Madam:

I strongly oppose the proposed addendum to ASMFC's fisheries management plan allowing for the taking of female horseshoe crabs for fish bait.

As noted in the August 4 National Geographic article *Horseshoe crab blood saves lives. **Can we protect these animals from ourselves**?,* the full repercussions of crab harvesting are **still** not understood.

Industry self-reporting is a dubious metric for management purposes, seldom accurate and never objective in protecting the interests of any other entity than the industry itself. I know this well from my professional experience working with global companies on social responsibility programs.

Simply put, the number of horseshoe crabs killed each year by humans is not known.

What is known is that populations of birds that rely on horseshoe crab eggs are sharply declining. That metric is irrefutable.

ASMFC cannot make decisions without reliable data. To trust the reporting of for-profit entities over the information provided by bird and conservation groups is a gamble in the wrong direction.

I urge you to reject the addendum on the basis that the evidence supporting an increase in catch is uncertain.

Thank you for your kind attention and thorough consideration.

Best regards,

Beate Pohlig

509 Mallow Road

Villas, NJ 08251

From:	Beate Pohlig
To:	Comments
Subject:	[External] oppose the proposed addendum
Date:	Friday, September 30, 2022 5:20:25 PM

Dear Sir or Madam:

I strongly oppose the proposed addendum to ASMFC's fisheries management plan allowing for the taking of female horseshoe crabs for fish bait.

As noted in the August 4 National Geographic article *Horseshoe crab blood saves lives.* ***Can we protect these animals from ourselves****?,* the full repercussions of crab harvesting are **still** not understood.

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I urge you to reject the addendum on the basis that the evidence supporting an increase in catch is uncertain.

Thank you for your kind attention and thorough consideration.

Best regards,

Beate Pohlig

509 Mallow Road

Villas, NJ 08251

From:	Bernard Gurman
To:	Comments
Subject:	[External] Horseshoe Crab Genicide
Date:	Sunday, September 11, 2022 12:32:23 PM

I cannot believe that, once again, the destruction of the crab population is at hand. Really? Why should greed take precedence over nature? Given the changes in the environment and the health of the coastal sea, now is certainly not worth endangering any sea-life.

--

More than 38 million people, including 12 million children, in the United States don't have enough to eat, according to the U.S. Department of Agriculture, which oversees the country's food-stamp program.

From:	BETTY BUTLER
To:	Comments
Subject:	[External] Horseshoe crab harvest
Date:	Sunday, September 11, 2022 1:32:21 PM

Under no circumstances increase horseshoe crab “harvest”.
Positive population increase depends upon allowing protected
Population increase.

Sent from my iPad

From: William Marella
To: Comments
Subject: [External] Horseshoe Crab Draft Addendum VIII
Date: Wednesday, September 28, 2022 5:29:59 AM

Please consider adopting the CIB recommendations to prohibit harvesting of female horseshoe crabs. Current practice is not sustainable.

Bill Marella
Lewes, DE

Sent from my iPhone

From:	Bill Leary
To:	Comments
Subject:	[External] Horseshoe crab harvest
Date:	Sunday, September 11, 2022 1:33:55 PM

To whom it may concern,
I am opposed to altering the current regulation on horseshoe crab harvest.
Bill Leary
North Haledon, NJ

Sent from my iPhone

From:	william nierstedt
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Monday, September 5, 2022 4:50:19 PM

I send this email as my comment on the draft Horseshoe Crab Fishery Management Plan Addendum VIII.   Bottom line – I urge the Commission not to change its current regulatory policy which prohibits the taking of female horseshoe crabs until the populations of both horseshoe crabs and red knots return to accepted levels for continuation of the species with reduced harvesting.

I understand that the main point of this addendum is to switch to a new scientific model for assessing horseshoe crab populations that should be more accurate. But, we don't know that it actually is more accurate, do you? You just believe that it is. I do not know if this new model will show a higher or lower population of horseshoe crabs, or even if it is counting red knots, but shouldn't we wait and see if it is more accurate before we allow increased harvesting of female horseshoe crabs? Let's implement the new scientific modeling system, but wait at least a year to amend any harvesting numbers until the new assessment method is field (sea) verified.

Regardless of the assessment method used, I am strongly opposed to the taking of any female horseshoe crabs. As you are aware, the current Management Plan recognizes that horseshoe crab eggs are essential not only to the horseshow crab population, but also to the red knots. The red know population has plummeted in recent years due to overharvesting of horseshoe crab eggs (and probably other factors also (climate change for instance affecting the timing of the red knots getting to the Delaware Bay at the same time the crabs do.), and we cannot allow that to happen again. It is imperative that the quota of female horseshoe crab harvesting remain at zero until red knot population rebounds to 81,000 and the horseshoe crab population returns to its historic 12 million population figure.

Therefore, I recommend that there be no change to the management plan increasing the number of females harvested - it should remain at zero.   I took note that Packages 1 and 2 continue that zero quota, but allow the harvesting of up to 500,000 male horseshoe crabs. Obviously of those two packages, I would recommend package 1. Packages 4 and 5 should be dismissed out of hand as being totally out of sync/inappropriate with already recognized environmental standards that are necessary to allow the horseshoe crab – and eventually the red knot- population -to increase until populations of both species are sustainable.

I thank you for reading my comments. Bill Nierstedt, 320 Hickory Avenue, Garwood, NJ, 07027 – and a property owner in Cape May, New Jersey

Sent from Mail for Windows

From:	bucktail
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Tuesday, August 23, 2022 10:25:08 AM

The HORSESHOE CRAB population has been dropping for several years and there needs to be tougher control to assure we get a population growth... The eggs are critical to migrating birds Commercial crabbers who are sucking these crabs up have several other options for crab bait available

PLEASE PROTECT THE HORSESHOE CRAB IN DELAWARE BAY
BILL SHILLINGFORD EMAIL BUCKTAIL8@AOL,COM

From:	william oneill
To:	Comments
Subject:	[External] Horseshoe Crab Harvest
Date:	Sunday, September 11, 2022 2:33:16 PM

I'm joining the Audubon Society's protest to the renewed harvesting of female Horseshoe crabs. For over a decade this moratorium
has been in place and has helped bring the population back but not in sufficient numbers yet. New Jersey has a big stake in eco-tourism and this will a big mistake if the Horseshoe Crab Population and thus the migratory bird population crashes. Once it does, there may not be any birds to see. It is too soon to end this moratorium.

Bill O'Neill
Ocean City, N.J.

From: Bob Callahan
To: Comments
Subject: [External] Female Horseshoe Crabs
Date: Wednesday, September 28, 2022 9:03:07 AM

Atlantic States Marie Fisheries Commission:

I respectfully submit to you that the harvest of female horseshoe crabs should not be allowed at this time.

--Female horseshoe crabs annually produce thousands of eggs that are essential food for migrating birds.

--Rampant development in coastal Delaware is detrimentally impacting spawning areas.

--The crab population is being managed at a historic low from the 1990s.

--Horseshoe crabs have existed for millions of years and yet within a few hundred years humans have endangered their existence. What does that say about humanity?

Please be on the right side of the environment and history with the revised plan. Our environment truly is a web and once one element is destroyed beyond repair other elements, such as birds, (an important tourist draw), will also implode.

Bob Callahan
38263 Comegys Court
Lewes, DE. 19958

From:	Bartlett, Bjarne
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Wednesday, September 28, 2022 1:26:42 PM

To whom it may concern:

Horseshoe crabs in the Delaware Bay area have play a vital role for shorebirds and the larger ecosystem. Overharvesting of horseshoe crabs as bait has led to a dramatic drop in crab and red knot shorebird populations. Red knots are now listed as threatened under the federal Endangered Species Act. Overharvesting of horseshoe crabs by both the bait and biomedical industries has put a severe strain on the ecological systems in this area. For over 10 years, New Jersey has tried to protect red knots by imposing a moratorium on harvesting horseshoe crabs for bait in state-controlled waters. These animals can still be harvested for their blood, which contains a chemical used by the biomedical industry.

Limulus Amebocyte Lysate (LAL) is used by pharmaceutical and medical device manufacturers to test their products for the presence of endotoxins, bacterial substances that can cause fevers and even be fatal to humans. The LAL test is an important medical product derived directly from a marine organism to benefit humans, to not do everything possible protect this organism is unthinkably short-sighted. This compound coagulates or clumps up in the presence of small amounts of bacterial toxins and is used to test for sterility of medical equipment and virtually all injectable drugs. When you get a vaccine, you know it hasn't been contaminated by any bacteria because of this compound extracted directly from horseshoe crabs. The safety of each injection, vaccination, or surgery you have received depends on the blood of horseshoe crabs.

Horseshoe crabs are critical to shorebird populations, as well as human health. They have much more important uses to use than harvesting for bait. It is certainly not worth it.

Bjarne Bartlett
6 E Essex Ave, Long Beach Island, NJ
--
Bjarne Bartlett, PhD | Postdoctoral Scholar | Oregon State University | Food Science & Technology | 3051 SW Campus Way, Corvallis, OR 97331 | (541) 737-3131 | bjarne.bartlett@oregonstate.edu

From: hopkins@echoes.net
To: Comments
Subject: [External] Horseshoe Crab Draft Addendum VIII
Date: Tuesday, August 23, 2022 7:01:30 PM

Hello and to whom it may concern! Hope and trust all are having a good week.

I would strongly encourage all the staff at the Atlantic States Marine Fisheries Commission (ASMFC) to closely review all data surrounding the harvesting of female horseshoe crabs and dependent migrating birds that feed on their eggs. I'm sure you are doing this already....but there
appears to be many conflicting opinions when one looks at different websites.

I would strongly urge you to err on the side of caution.

The horseshoe crab in the medical world is a lifesaver for all things human. The bird world seems as dependent.

I would encourage you to be the best stewards possible.

Thank you for reading this and have a good week,
Bob Hopkins
Windsor, NY

From:	Bruce Fleming
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Thursday, September 29, 2022 10:05:08 AM

Horseshoe Crab habitat for reproduction along the Delaware coast will certainly continue to come in conflict with human development. Help keep measures that will keep this ancient creature in equilibrium with human activities.

From: Carly Muletz Wolz
To: Comments
Subject: [External] Horseshoe Crab Draft Addendum VIII
Date: Wednesday, September 14, 2022 10:41:30 PM

Several indicators show both horseshoe crab populations themselves and the population of a Federally threatened shorebird, the red knot, that depends on horseshoe crabs, are well below recovery thresholds. Allowing the killing of female horseshoe crabs at this critical moment all but assures that the population of shorebirds like the red knot will never recover.

From:	Boris Kerzner
To:	Comments
Subject:	[External] Please Abandon Attempt to Lift Moratorium on Taking Female Horseshoe Crabs for Fish Bait
Date:	Saturday, September 3, 2022 10:26:27 PM

To whom it may concern:

It recently came to my attention that the ASMFC is planning to lift its moratorium on the harvesting of female horseshoe crabs. This will negatively impact the population of the horseshoe crabs for years to come and will mean less food for the declining population of red knots when they migrate from Tierra Del Fuego to the Arctic Circle, stopping off in the Delaware Bay to eat horseshoe crabs. Please do not lift this moratorium! With the biodiversity crisis being what it is, we should be using as few species as possible and letting them just live. I am sending this comment as part of the public comment period ending Sep 30th.

Thanks,

Boris Kerzner (zip 19027)

From:	Carol S. Stephens
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Wednesday, September 28, 2022 2:32:31 PM

It does not seem appropriate to harvest female horseshoe crabs. The population of horseshoe crabs must be significantly larger than the present level so the food source for red knots and other migratory shorebirds is not negatively impacted. Do not be wreckless by harvesting female horseshoe crabs.

Thank you,

Carol Stephens
23738 Herring Reach Ct
Lewes, DE 19958

From:	Carole Griffiths
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Monday, September 19, 2022 3:14:48 PM

Dr. Carole S. Griffiths
Ocean View, New Jersey
Research Associate, American Museum of Natural History

I join the American Littoral Society and NJ Audubon in opposing the Atlantic States Marine Fisheries Commission's (ASMFC) proposal to increase the harvest of horseshoe crabs, including a harvest of females for the first time in over a decade. I support Option A - NO Action – reverting to provisions under Addendum VI.

Where is the data that shows that an increase is justified. Egg density data is the most reliable indicator of the horseshoe crab population, and the most reliable index of value for red knots and other shorebirds. Yet ASMFC has never included these surveys in its modeling. ASMFC also does not include field survey data for Red Knots, and these show that Red Knot populations are at historic lows. In the 1990s, more than 90,000 could be found along Delaware Bay. This year, only 12,000 were counted, and in 2021, the number was estimated at an all-time low of 6,800.

Currently, there is no female crab harvest until female abundance reaches 11.2 million crabs or until the Delaware Bay total Red Knot stopover population reaches 81,900 birds. The proposed revision would allow the resumption of the female harvest, even though, as indicated above, neither the Red Knot nor female horseshoe crabs of Delaware Bay are close to satisfying either metric and the models used by ASMFC do not include the most reliable data for estimating population size of either the horseshoe crabs or red knots.

The joint collapse of Red Knots and horseshoe crabs is not inevitable. But this proposal propels them closer to that grim reality and the resolution effect of this action will have a significant impact on the federally threatened Red Knot and other shorebirds that depend on horseshoe crab eggs during spring migration stopovers in Delaware Bay, putting them at risk of further population declines. This will also have a significant impact on the tourism industry – thousands of birders visit Cape May in the spring to see the shorebird migration and they spend millions of dollars locally.

Thank you!
Dr. Carole S. Griffiths

From:	Carrie O"Brien
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Sunday, August 21, 2022 10:22:31 AM

Please do not approve the proposed framework revision for harvesting Delaware Bay horseshoe crabs. Under the proposed management revision, 175,000 to 190,000 female horseshoe crabs could be harvested from the Delaware Bay by commercial fishermen as soon as 2023, according to some experts.

Each year since 2013, the ASMFC has selected the same allowable harvest totals for Delaware Bay horseshoe crabs, which is 500,000 males and zero females. It was agreed that the prohibition on harvesting female horseshoe crabs would not be lifted until the Delaware Bay region hosts at least 81,900 red knot shorebirds or 11.2 million female horseshoe crabs. Neither of these scenarios has occurred yet and making these changes now would put a severe strain on horseshoe crabs, red knots, and other shorebirds. In fact, the Virginia Tech trawl survey, which is the only horseshoe crab-specific survey that has been historically reliable, continues to indicate that female horseshoe crabs are in trouble. Similarly, red knot counts have been at historic lows in recent years. The average red knot count at Tierra del Fuego for 2018-2020 declined more than 75 percent from average counts in the 1980s and 2000, and only 6,800 red knots were counted in 2021.

From:	Christi-June Chiu
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Wednesday, September 28, 2022 4:25:54 PM

Atlantic States Marie Fisheries Commission:

As a Delaware Master Naturalist, I feel it is my duty to implore you to reconsider the horseshoe crab harvest update. Allowing the harvest of female horseshoe crabs at this time would be detrimental to the ecosystem.

Horseshoe crabs are a keystone species and are depended upon by many other species in the ecosystem. Several types of shorebirds feast on the fatty and nutrient rich horseshoe crab eggs such as the ruddy turnstone (*Arenaria interpres*) and sanderling (*Calidris alba*) but most notably the threatened red knot (*Calidris canutus rufa*) which use Delaware Bay as a refueling stopover in their approximately 9,000 mile migration from Tierra del Fuego to the Arctic for breeding. Because crab populations have dropped, thousands of migrating loggerhead sea turtles (*Caretta caretta*) have turned to raiding fish nets and crab traps for food.

The population of horseshoe crabs has declined by 90% over the last 15 years, mostly due to overharvesting and habitat degradation. I have personally been a part of the horseshoe crab surveys done annually here at slaughter beach and the data developed to track our crab population does not show a significant increase in crab numbers. This update in the management plan could result in an underestimation of the number of crabs that our coast can support at the expense of the fish and bird species that rely on them for food.

A better alternative to harvesting female crabs is to harvest more male crabs. Because male-to-female ratios are high in our area, harvesting more males would not affect reproduction rates. Allowing females to continue growing and reproducing is the best bet to protect estuary ecosystems recovering from overharvest and facing the impacts of rapid climate change.

Thank you for reading my concerns and I trust you will choose to side with what is best for the environment.

Respectfully,

Christi-June Chiu

17065 Spruce Road

Ellendale, DE 19941

From: Christina Hopkins
To: Comments
Subject: [External] Horseshoe crab harvest
Date: Sunday, September 11, 2022 1:57:24 PM

Hello, I stand with New Jersey Audubon society for limiting the harvest of horseshoe crabs, both male and female. These precious creatures need as much protection as possible. Thank you for listening to my views. Christina Hopkins

From:	Walters, Christopher K.
To:	Comments
Subject:	[External] Horseshoe crab harvest rules
Date:	Sunday, September 11, 2022 11:24:05 AM

I oppose the proposed change in horseshoe crab harvesting rules. The crab populations and Red Knot numbers in Delaware Bay are terribly depressed —allowing renewed harvesting of female horseshoe crabs is an awful idea.

This proposal is a threat to the unique natural environment of Delaware Bay and must be shelved.

Chris Walters

From:	Christopher Anderson
To:	Comments
Subject:	[External] Please do not adjust Management Plan
Date:	Tuesday, August 23, 2022 8:52:06 PM

Hello,

Please do not adjust the Management Plan for the Horseshoe Harvest in the Delaware Bay. The proposed changes would imperil horseshoe crabs and as a result lead to grave risks to the Red Knot population. Red Knots are already at risk and this change would exacerbate those risks. The existing plan requirements have not been met and therefore the proposed changes are premature. Please do not adopt these proposed changes.

Respectfully,

Chris Anderson
1215 Portner Road
Alexandria VA 22314

From: Chris Chech
To: Comments
Subject: [External] Horseshoe Crab Draft Addendum VIII
Date: Saturday, September 3, 2022 11:12:51 PM

Atlantic States Marine Fisheries Commission

September 3, 2022

Dear Atlantic States Marine Fisheries Commission:

I am writing to you today to ask you to continue your policy of not allowing harvesting of female horseshoe crabs.

Population counts for horseshoe crabs and the red knot birds which rely on the horseshoe crab eggs for food are still dangerously low.

Please protect the future of these beautiful birds by maintaining the protections currently in place for female horseshoe crabs.

Sincerely,

Christopher Chech

Sent from my iPhone

From:	Chris Lish
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII -- protect the red knot and its food supply by rejecting this dangerous proposal
Date:	Thursday, September 29, 2022 9:35:34 AM

Thursday, September 29, 2022

Caitlin Starks
Atlantic States Marine Fisheries Commission
1050 N. Highland St. Suite 200A-N
Arlington, VA 22201

Subject: Horseshoe Crab Draft Addendum VIII -- protect the red knot and its food supply by rejecting this dangerous proposal

Dear Atlantic States Marine Fisheries Commission,

I am writing to urge Atlantic States Marine Fisheries Commission (ASMFC) to protect red knot shorebirds by rejecting Addendum VIII to the fishery management plan for horseshoe crabs.

> *"As we peer into society's future, we—you and I, and our government—must avoid the impulse to live only for today, plundering for our own ease and convenience the precious resources of tomorrow. We cannot mortgage the material assets of our grandchildren without risking the loss also of their political and spiritual heritage. We want democracy to survive for all generations to come, not to become the insolvent phantom of tomorrow."*
> *-- Dwight D. Eisenhower*

Delaware Bay is a linchpin for one of the most epic migrations on Earth. Every year, red knots fly from as far south as Tierra del Fuego to their breeding grounds in the Arctic Circle. They reach Delaware Bay just as horseshoe crabs emerge from the water to lay eggs upon the beach. These eggs provide crucial nourishment for red knots to complete their journey and breed successfully.

In recent decades, overfishing has decimated the horseshoe crab population at Delaware Bay, leading to a sharp decrease in red knots, which are now listed as "threatened" under the Endangered Species Act. Under the current management program, horseshoe crabs have not recovered, and red knots have continued to decline. Rather than taking steps to reverse this trend, Addendum VIII would open the door to resuming the harvest of female horseshoe crabs, further imperiling red knots and potentially violating the Endangered Species Act.

Red knots face an uncertain future and require a precautionary management approach. ASMFC should reject Addendum VIII, which would put red knots at even greater risk.

“A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise.”
-- Aldo Leopold

Thank you for your consideration of my comments. Please do NOT add my name to your mailing list. I will learn about future developments on this issue from other sources.

Sincerely,
Christopher Lish
San Rafael, CA

From:	Christine Reel Brander
To:	Comments
Subject:	[External] Horseshoe crabs
Date:	Thursday, September 29, 2022 9:11:16 PM

Please do not raise the quota of the amount of horseshoe crabs killed for bait and do not allow females to be included in the harvest. Horseshoe crabs are vital to their ecosystems and shorebirds and migrating birds are particularly dependent on their eggs for food. Pressure from the biomedical industry and habitat loss have caused populations in the US to decline. Sound management strategies would help prevent further decline but the proposed changes will deplete this valuable species.

Thank you for your consideration,
Christine Reel Brander

From:	Clare Liebhardt
To:	Comments; Caitlin Starks
Subject:	[External] HCFMP***attention***
Date:	Thursday, September 29, 2022 6:09:45 PM

As a supporter of OceanElders
I submit my request to stop the draft addendum from raising Horseshoe crab Fishery Management Plan -catch count.

AND to not ever allow the harvest collecting to include female horseshoe crabs..NEVER! EVER!
Clare Liebhardt, California

From:	Connie Yaqub
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Sunday, September 11, 2022 9:28:22 PM

Now is not the time to step back from protecting horseshoe crabs, red knots, and other migratory birds! Please do not make this disastrous change by lifting restrictions on harvesting. Female horseshoe crabs and the federally threatened red knots need to be protected.

The birds and the crabs draw ecotourists from around the world, bringing an estimated $35-50 million in annual revenue to New Jersey. **I was one of those ecotourists!** Horseshoe crab eggs and larvae are also a seasonal food item of invertebrates and finfish, while the crabs themselves are an important food source for loggerhead turtles.

I understand that the crabs are used by the biomedical industry. **I drove from PA to attend a lecture and a field trip to hopefully spot the red knot. I spent money there because of the crabs and red knots.** I think I recall that other sources are being found and created to replace the blue blood for biomedical uses. Resources should be provided to those seeking alternatives.

I also understand that the crabs are used for bait for commercial American eel and conch fisheries. If you need to cut something, cut this use. I don't want to see fishermen or canneries lose income, but those people can find other jobs. Red knots and other migratory birds cannot survive without the crabs.

It was agreed by ASMFC that the prohibition on harvesting female horseshoe crabs would not be lifted until the Delaware Bay region hosts at least 81,900 Red Knots or 11.2 million female horseshoe crabs.

Neither of these scenarios has occurred. The average Red Knot count at Tierra del Fuego for 2018-2020 declined more than 75 percent from average counts in the 1980s and 2000. In 2021, only 6,800 Red Knots were counted, which is by far the lowest count since surveys began.

Please do the right thing. Female horseshoe crabs and the federally threatened red knots need to be protected.

Thank you.

Connie Yaqub, Ph.D.

From:	Conor Ofsthun
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Monday, August 29, 2022 10:31:14 AM

Please work towards maintaining healthy populations of horseshoe crab to sustain the Delaware Bay ecosystem.
Thank you,
Conor

--
Conor Ofsthun

From:	constance kane
To:	Comments; constance kane
Subject:	[External] Horseshoe crabs
Date:	Friday, September 30, 2022 6:22:23 AM

Please protect these prehistoric creatures. We need to continue all we can do to see that their lives are protected along with their habitat. Every year my son and I find a sense of responsibility and Joy in flipping these creatures to ensure their safe return to the ocean.

Constance Kane and Grant Garrett

From:	D EK
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Wednesday, August 17, 2022 10:32:24 AM

The following is a copy of an email I sent on August 7, 2022. I received an email back stating it was not within the public comment period. I am resending it hoping my comment will be read.

I would not like to see the harvesting of egg laying female horseshoe crabs by commercial fishermen. The new model which is based on empirical data collected from Delaware Bay is a better estimate than the models previously used. Since the data are not derived from purpose design surveys to count horseshoe crabs the accuracy of the surveys is in question. Also why isn't egg density incorporated into the model? I don't feel even the possibility of jeopardizing the Red Knot survival is worth it.

From:	Corey Schade
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Wednesday, August 24, 2022 10:29:14 AM

Dear Sir or Madam:

I am writing to express my opposition to the ASMFC proposal that would endanger Delaware Bay horseshoe crabs and the migratory shorebirds (like the Red Knot) which depend on them.

Overharvesting of horseshoe crabs by the bait and biomedical industries has already put a severe strain on the ecological connection between horseshoe crabs and shorebirds like the threatened Red Knot. Although the Red Knot population is perilously low, the ASMFC has proposed allowing the harvest of female horseshoe crabs, whose eggs provide the food that fuels the final leg of the birds' journey to Arctic nesting grounds.

Please rethink about the importance of horseshoe crabs to our ecology. Please think of future generations. Please withdraw this disastrous proposal.

Thank you for your time and attention.

Respectfully,

Corey Schade

From:	Cynthia Pilot
To:	Comments
Subject:	[External] Horseshoe crabs
Date:	Sunday, September 11, 2022 6:22:08 PM

I feel that increasing horseshoe crab harvest at this time is premature. I think you need to curtail the harvest of menhaden and horseshoe crabs until the birds and fish that rely on them are back to historic or at least healthy populations--
lp12321

From:	jpchurch1@juno.com
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Tuesday, August 23, 2022 2:45:18 PM

I am opposed to any harvest of female horseshoe crabs. Red Knots and other shorebirds are dependent on the eggs for their survival as they migrate to the Arctic. The crash of shorebird populations is linked to overharvesting of female horseshoe crabs in the past. Until the populations of shorebirds recover there should be no female crab harvest. Dana Eglinton 938 Jacksonville Mt Holly Rd Bordentown, NJ 08505

From:	David Burch
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Tuesday, September 6, 2022 11:45:38 AM

I urge the Commission to respect the 2009 Adaptive Resource Model (ARM) Framework and protect the populations of horseshoe crabs and the threatened red knot. The Commission should reject proposed changes to regulations for horseshoe harvesting that would allow harvesting of female horseshoe crabs and thus compromise the essential food supply for the migratory red knot.

Horseshoe crabs play an essential role in Delaware Bay ecology, so protecting the horseshoe crab population should take precedence over any competing uses.

Thank you.

David Burch
Ocean Gate, NJ

bikeburch@hotmail.com

From:	Daniel Daughtry-Weiss
To:	Comments
Subject:	[External] Proposed horseshoe crab harvest changes
Date:	Tuesday, August 23, 2022 9:18:20 AM

As a resident of Maryland I urge the Commission to:

- Provide the modelling and analysis which justifies the expansion of the harvest of female horseshoe crabs for the public to review; and that the Commission
- Ensure that the original safeguards in their harvest policies, which prohibit female horseshoe crabs from being harvested until Red Knot numbers recover, are included in any new policies.

These are common-sense policies that support key objectives of harvest policy.

Daniel Daughtry-Weiss
2244 Belleview Ave
Cheverly, md 20785
301-437-9397
--
Daniel Daughtry-Weiss

From: DAVID TAGGART
To: Comments
Subject: [External] Horseshoe Crab Draft Addendum VIII
Date: Tuesday, August 23, 2022 11:36:11 AM

Please do not allow harvesting of endangered horseshoe crabs.Thank you.

Sent from my iPhone

From:	Caitlin Starks
To:	Comments
Subject:	FW: [External] Horseshoe Crabs
Date:	Friday, September 30, 2022 9:17:32 AM

-----Original Message-----
From: KATHY AND DAVID DEVINE <alohapuako@aol.com>
Sent: Thursday, September 29, 2022 7:08 PM
To: Caitlin Starks <cstarks@asmfc.org>
Subject: [External] Horseshoe Crabs

Aloha Caitlin Starks,   I am writing to express my concern for the draft addendum to the Horseshoe Crab Fishery Management Plan. I'm asking not to pass the addendum. I believe that more protective measures should be taken for the horseshoe crabs. Thank you. Aloha, David Devine

Sent from my iPhone

From: Dawn Zelinski
To: Comments
Subject: [External] Horseshoe Crab Draft Addendum VIII
Date: Tuesday, August 23, 2022 10:37:21 AM

Dear Ms. Starks,

I am writing in opposition to the proposed changes to horseshoe crab harvesting.

Overharvesting of horseshoe crabs by the bait and biomedical industries has put a severe strain on the ecological connection between horseshoe crabs and shorebirds like the threatened Red Knot. Although the Red Knot population is perilously low, the ASMFC has proposed allowing the harvest of female horseshoe crabs, whose eggs provide the food that fuels the final leg of the birds' journey to Arctic nesting grounds.

Apart from its effects on bird populations, horseshoe crabs have an inherent right to their lives and should be left undisturbed. They do not exist for us. They exist for themselves.

Sincerely,
Dawn Zelinski
Middletown, NJ

From: bearles@embarqmail.com
To: Comments
Subject: [External] HORSESHOE CRAB DRAFT ADDENDUM VIII
Date: Wednesday, September 28, 2022 10:39:17 PM

To the Atlantic States Marine Fisheries Commissioners

Thank you for accepting comments on the current female horseshoe crab harvest proposal. We appreciate ASMFC's role in balancing decisions on fisheries. We respectfully request ASMFC to NOT APPROVE the proposal that would lift the current moratorium and allow the killing of female horseshoe crabs. Our house is one block from the Bay beach and we have spent days on this beach for over 25 years. We want to emphasize that our personal observations are that the quantity of horseshoe crabs has steadily declined for years. The same for the Red Knots. It does not make sense to now allow harvesting of female crabs. The harvest of the male crabs should be sufficient, and if not, other sources of bait should be used. Please DO NOT END the moratorium on female crabs. Thank you for considering our opinions.

Debbie and Les Hamilton, North Cap May

From:	Dee O"Reilly
To:	Comments
Subject:	[External] horseshoe crabs
Date:	Monday, September 12, 2022 1:20:05 PM

Please do not change the protections put in place for the horseshoe crab. As a 66 year old life -long NJ resident I can remember a time when the horseshoe crabs were all over the beach..... sadly now I can't remember the last time I saw one. Please DO NOT increase the harvesting and DO NOT allow females to be harvested.

Thank you,
Dee O'Reilly
Cranford, NJ

From:	info
To:	Comments
Subject:	FW: [External] Horseshoe crab Draft addendum VIII
Date:	Monday, September 19, 2022 12:52:08 PM

From: Dawn S <dwnszeker@yahoo.com>
Sent: Monday, September 12, 2022 7:05 PM
To: info <info@asmfc.org>
Subject: [External] Horseshoe crab Draft addendum VIII

Recent declines in the horseshoe crab population have triggered similar and more drastic declines in shorebird populations. Even though immediate action may not be needed to save the Atlantic horseshoe crab from extinction, immediate protection of horseshoe crabs is necessary to protect the species that rely on them.

Pleasse do NOT allow more harvesting of horseshoe crabs!!! Why would You choose to do this knowing their numbers are declining? What will it take to allow our marine life to live peacefully? Please reconsider this change. I am a protector of the ocean and can't believe you would consider this. Please reply with why your doing this. Thank you!
Dawn Szeker

dwnszeker@yahoo.com

Sent from Yahoo Mail on Android

From:	Donna Flesher
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Thursday, September 1, 2022 9:02:34 PM

Dear ASMFC,

I am against lifting the moratorium on harvesting horseshoe crabs for bait.
Please do not lift it. They are precious to the natural chain of life. It is all our responsibility to ensure the protection of all species and to be good stewards of our wonderful Earth.

Sincerely,
Donna Flesher
dmdf123@gmail.com

40 Plennert Road
Flemington, NJ 08822
United States

From:	Donna Hoyt
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Friday, September 30, 2022 2:52:41 PM

Please do not allow the harvest of female horseshoe crabs at this time.

Horseshoe Crabs are being managed at a historic low from the 1990’s.

Red Knots and other migrating birds dependent on horseshoe crab eggs have recently experienced drastic declines in numbers.

Extreme coastal development is decreasing spawning areas as is climate change.

Experiencing this yearly spring migration of birds feeding on horseshoe crab eggs is an awesome sight enjoyed by thousands of birders and tourists, bringing much money to Delaware.

If some limited harvesting of horseshoe crabs is to be allowed, please restrict the harvest to male horseshoe crabs .

Donna Hoyt
311 W 4th Street
Lewes, DE 19958

Sent from my iPad

From: Diane Walker
To: Comments
Subject: [External] Please Stop or drastically limit the harvesting of Horseshoe crabs for bait, especially female crabs
Date: Sunday, September 11, 2022 11:38:17 AM

I agree with the Audubon Society.

We need to increase the population of horseshoe crabs and female crabs to ensure the red knot migratory population will continue to stop at the Delaware Bay in the future and consume some of their eggs.

Please limit the harvesting of these horseshoe crabs for bait, and create high penalties for those who ignore and violate this action.

Thank you!

Diane V. Walker

dianevalerie@comcast.net

Sent from my iPhone

From:	Diane Karluk
To:	Comments
Subject:	[External] re: NO to Horseshoe Crab Draft Addendum VIII
Date:	Monday, September 12, 2022 5:40:14 AM

DO NOT PASS/ACCEPT the Atlantic States Marine Fisheries Commission's (ASMFC) proposal to increase the harvest of horseshoe crabs, including a harvest of females for the first time in over a decade. This will adversely impact Red Knot and other shorebirds that depend on horseshoe crab eggs during spring migration stopovers in Delaware Bay, putting them at risk of further population declines.

Sincerely,

Diane Karluk

19 Rocktown Hill Rd, Ringoes, NJ 08551

From:	Donna Caputo
To:	Comments
Cc:	Donna; SCOTT YAEDE; Scott Mary Jane Yaede
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Monday, August 29, 2022 1:38:59 PM

Dear ASMFC,

Please don't change the current policy to protect the prehistoric and important survival of the horseshoe crabs. It was agreed that the prohibition on harvesting female horseshoe crabs would not be lifted until the Delaware Bay region hosts at least 81,900 Red Knots or 11.2 million female horseshoe crabs.

Neither of these scenarios has occurred, yet the ASMFC proposed changes would result in lifting the prohibition on harvesting female horseshoe crabs, further imperiling the food supply for the remaining Red Knots.

This is coming at a time when Red Knot population is far from stable. The average Red Knot count at Tierra del Fuego for 2018-2020 declined more than 75 percent from average counts in the 1980s and 2000. In 2021, only 6,800 Red Knots were counted, which is by far the lowest count since surveys began.

Thank you for doing the right thing,
Donna Y. Caputo
Cape May NJ

Sent from my iPad

From:	mailagent@thesoftedge.com on behalf of dd66rsb@cox.net
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Thursday, September 29, 2022 1:20:39 PM

Dear Ms. Starks:

I strongly oppose adopting the 2021 ARM Framework revisions under Draft Addendum VIII as a standard for setting horseshoe crab bait harvest specifications. The value of migratory birds and the need to manage these resources across jurisdictions has been recognized in the United States for more than a hundred years. I am very concerned that adopting the changes proposed in the 2021 ARM Framework revision will not only setback decades of conservation efforts to protect migrating shorebirds, but, that this change could also cause irreparable damage to shorebird and horseshoe crab populations.

The underlying data supporting the new draft addendum to the plan has still not been released to the public, so conservation groups and concerned citizens have no way to understand the science on which the new proposal is based. When will the data supporting this plan be released?

Making matters worse, ASMFC also does not include the most recent field survey data for red knots, which suggest historically low numbers of red knot feeding through the spring season in Delaware Bay. In the 1990s, more than 90,000 could be found along Delaware Bay during aerial surveys. This year, only 12,000 were counted, and in 2021, the number was estimated at an all-time low of 6,800. This doesn't necessarily mean the population has crashed, but could indicate that red knots are bypassing the Delaware Bay stopover altogether in search of life-sustaining food sources elsewhere. This makes their migratory journey all the more perilous, which could further impact the population recovery. Given this uncertainty in the status of red knot in Delaware Bay, extreme caution should be taken in making any management decisions that could negatively affect them.

9/29/2022--I cannot believe we allow harvesting horseshoes and other sea creatures for fertilizer and pet food. That should be stopped. Birds and other wild life are disappearing at an alarming rate--please do all you can to protect these ancient sea dwellers. We humans do not want to be the only creatures left on the planet. Thank you. Donnie Powell

I strongly oppose the use of the 2021 ARM Framework as the basis for setting horseshoe crab harvest regulations. I urge the ASMFC to make no change to the regulations.

Sincerely,

Donnie Powell
1556 Sweetwater Drive
Warner Robins , GA 31088

From:	Ed Casson
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Thursday, September 1, 2022 11:18:32 AM

I am writing to urge you to keep your current policy protections for female horseshoe crabs.
Edward Casson
ecasson@gmail.com

From:	Doris Stoner
To:	Comments
Subject:	[External] Increasing the harvest of horseshoe crabs.
Date:	Sunday, September 11, 2022 4:50:57 PM

I am joining NJ Audubon in opposition to the proposal to increase the harvesting of horseshoe crabs.
This is appalling.

Doris M .Stoner

From:	EILEEN FERRER
To:	Comments
Subject:	[External] “Horseshoe Crab Draft Addendum VIII
Date:	Friday, September 2, 2022 5:19:16 AM

It is critical that we stop the harvest of horseshoe crabs in New Jersey until the Red Knot populations rebound. Please! It is our responsibility to save these birds and the scientific evidence is clear that horseshoe crab eggs are the answer.

Eileen Ferrer
Mendham, NJ

Sent from Mail for Windows

From:	Beth B
To:	Comments
Subject:	[External] ASMFC"s Proposal
Date:	Saturday, September 17, 2022 11:37:01 AM

We join NJ Audubon in opposing the Atlantic States Marine Fisheries Commission's proposal to increase the harvest of horseshoe crabs, including the harvesting of females for the first time in over a decade. This action WILL SIGNIFICANTLY impact the federally threatened Red Knot and other shorebirds that depend on horseshoe crab eggs during spring migration stopovers in Delaware Bay by putting them AT RISK of further population declines.

To ignore the field survey data that supports the evidence is unethical.

Regards,
Elizabeth Hoke
Julia Chrisman
Philip and Elizabeth McNamara
Robert and Sisley Daniels
David and Lois Brown

From: Beth Law
To: Comments
Subject: [External] Horseshoe Crab Draft Addendum VIII
Date: Tuesday, September 27, 2022 9:30:49 PM

Please do not allow the harvest of female horseshoe crabs!!! Their eggs are critical for migrating shorebirds, and the horseshoe crab population is nowhere near large enough to support their harvest. Please protect our horseshoe crabs and birds!

Thank you,
Elizabeth Law

Sent from Mail for Windows

From: Eli Dober
To: Comments
Subject: [External] Horseshoecrabs
Date: Monday, August 22, 2022 3:00:35 PM

Only when humanity's circle of compassion is extended to all living things will there be peace.-Albert Schweitzer

E.Dober

From: Eleanor Gruber
To: Comments
Subject: [External] Horseshoe Crab Draft Addendum VIII
Date: Saturday, September 17, 2022 7:58:57 AM

Thank you for the opportunity to comment.

The League of Women Voters is not an environmental organization; we are a public interest organization which believes in the active and informed participation by citizens in Government. In this case, we strenuously object to your Draft Addendum VIII with an increase in horseshoe crab fishing limits.

Our primary objection is the lack of transparency of the modeling data you present. There is no ability for others to examine the basis for the expanded fishing.

Horseshoe Crabs are a keystone species. To grind them up to use for bait not only threatens the migratory birds, but also all marine life that depends on these eggs for food. To increase limits without sharing data flies in the face of scientific examination.

The recovery of the red knot and palminated plovers is nowhere near its higher levels. Statements made that this is a result of climate change does not account for the precipitous drop in both red knot and palminated plovers over the years. There were fewer eggs, thus less food. We are seeing these numbers start to recover, mostly due to a moratorium in NJ and current fishing limits along the Atlantic. But the numbers are still dangerously low. Raising these limits will impede any progress made. .

During the hearing it was stated that demand for both eel and whelk have diminished, but that I did not see that in your presentation,

Before you make your final decision, and in the interest of transparency, we urge you to share the model so that it can be analyzed in full. There can be no harm in sharing the data so that it can be fully examined.

Thank you,
Ellie Gruber
co-chair League of Women Voters or New Jersey Natural Resources Committee
--

Please consider the environment - do you really need to print this email?

From: Ellie Pugh
To: Comments
Subject: [External] Horseshoe Crab Draft Addendum VIII
Date: Saturday, September 17, 2022 1:45:39 PM

Hello,

I strongly oppose the Atlantic States Marine Fisheries Commission's (ASMFC) plan to change its Horseshoe Crab Fishery Management Plan, a move that would raise quotas on the killing of horseshoe crabs for use as bait by potentially reopening the harvest to include female horseshoe crabs. As it stands, there is no female crab harvest until female abundance reaches 11.2 million crabs or until the Delaware Bay total red knot stopover population reaches 81,900 birds, a metric that neither population is near to meeting. Furthermore, based on data obtained through fieldwork, The Horseshoe Crab population, in general, has still yet to recover from its collapse in the 1990s.

As you may know, Red Knot birds are very dependent on the eggs lain by Horseshoe Crabs. It is critical that we do not raise the quotas not only to protect the Horseshoe Crab population but also the population of Red Knots along the coast. Just last year, we saw the number of Red Knot along the Delaware bay drop to an all-time low of 6,800 (a number that was 90,000 in the 1990s). Stopping the joint collapse of these two populations is very doable, but plans such as this changing of the Management Plan move this grim possibility closer and closer to reality.

Please consider this before this change is passed,
Ellie

From: Emelia Oleson
To: Comments
Subject: [External] Horseshoe Crab Harvest
Date: Sunday, September 11, 2022 3:14:33 PM

I stand with NJ Audubon in opposing the Atlantic States Marine Fisheries Commission (ASMFC) proposal to increase the horseshoe crab harvest, including the taking of females for the first time in over a decade. This action significantly and negatively impacts the Federally-threatened Red Knot and other shorebirds that depend on the horseshoe crab eggs to fuel their spring migration. For millennia, these birds have used the Delaware Bay ecosystem as a stopover for resting and refueling on their migration north to their breeding grounds in the Arctic. This increase in harvesting of the horseshoe crabs, especially females, will put the Red Knot and other shorebird populations at risk and will result in further population declines of both the birds and the horseshoe crab.

From:	eric baratta
To:	Comments
Subject:	[External] Comments for "Horseshoe Crab Draft Addendum VIII"
Date:	Friday, September 9, 2022 11:35:32 AM

Dear ASMFC staff,

I was unable to attend webinar hearings related to the proposed changes to ARM Framework for horseshoe crab populations and commercial use or harvest of this species and would like to submit the following comments for consideration by your organization and commission.

I have been volunteering with the Return the Favor NJ program for several years and have kept abreast of developments related to this potential policy change and recent research done in the field related to horseshoe crabs and wildlife such as, but not limited to, the Red Knot migratory bird.

Based on the clear research done in the field by multiple scientific organizations and communities, and the enigmatic process behind the assessment of current horseshoe crab population numbers which are being referenced by the proposed policy change, I am requesting that no change be made to the current prohibition of the taking of female horseshoe crabs for any commercial fishing use. It is a shocking proposition to permit taking of female horseshoe crabs for commercial fishing bait given the decline of migratory birds related to this keystone species, and the already significant environmental challenges faced by horseshoe crabs and migratory birds through climate change, environmental degradation of breeding and spawning areas, other man-made challenges through land use, and pollution. It is impossible to imagine that the reduction of already low numbers of female horseshoe crabs will not result in the finality of the extinction of the Red Knot in the near future, with likely impacts to other threatened and endangered migratory birds, simply for the short-term benefit of the commercial fishing industry. This is myopic policy based on the greed of a few which will likely lead to permanent consequences for wildlife on the East Coast shoreline.

In addition to denial of this policy change, I would ask that all data that is being used in the proposal of this change be made public in its entirety, and that any decision based on this data be delayed until the non-commercial, scientific community and general public has had ample time to review and contest data where applicable.

With respect and sincerity,

Eric Baratta
26 Park Avenue
Beverly, NJ 08010
ericbaratta@hotmail.com

From:	erin martin
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Friday, September 30, 2022 4:50:14 PM

Dear Sir or Madam:

I strongly oppose the proposed addendum to ASMFC's fisheries management plan allowing for the taking of female horseshoe crabs for fish bait.

As noted in the August 4 National Geographic article *Horseshoe crab blood saves lives.* ***Can we protect these animals from ourselves****?,* the full repercussions of crab harvesting are **still** not understood.

Industry self-reporting is a dubious metric for management purposes, seldom accurate and never objective in protecting the interests of any other entity than the industry itself. I know this well from my professional experience working with global companies on social responsibility programs.

Simply put, the number of horseshoe crabs killed each year by humans is not known.

What is known is that populations of birds that rely on horseshoe crab eggs are sharply declining. That metric is irrefutable.

ASMFC cannot make decisions without reliable data. To trust the reporting of for-profit entities over the information provided by bird and conservation groups is a gamble in the wrong direction.

I urge you to reject the addendum on the basis that the evidence supporting an increase in catch is uncertain.

Thank you for your kind attention and thorough consideration.

Best regards,

Erin Martin

503 Mallow Road

Villas, NJ 08251

Erin Martin (she/her)
+1 646 552 9566

From:	Eva Pennock
To:	Comments
Subject:	[External] Proposal
Date:	Sunday, September 11, 2022 12:20:44 PM

In the 1990s and 1980s I enjoyed going to the beaches at Pierce's Point, Cook's Beach and stood at a respective distance and marveled at the abundance of various birds and the horseshoe crabs. They were a sign of spring as well as the red wing blackbird. It was nature in action.

When I moved to Hawaii and taught at the Maui Ocean Center and volunteered at the Pacific Whale Center, I wore a horseshoe crab on my blouse. Children, as well as adults, were fascinated and intrigued by this foreign sea creature and the benefits accrued to humans by this animal. Also, they were saddened by the decimation of them and the decrease in birds that humans inflicted on them.

Upon return to the East Coast, my husband and I ventured to the coast. He being a native of Brigantine and a marine ecologist noticed immediately the decline in the species.

Now I have read about your proposed changes that will deepen the loss of these animals.

You are succumbing to big business and little business. Yet you still want us to pay taxes and support your endeavours. Question: Will they be around for your grandchildren and great grandchildren to enjoy or will they be shown pictorially?

Please do not enact this proposal.

Sincerely,

Eva Pennock

From:	Evelyn Yaari
To:	Comments
Subject:	[External] Re: Thank You For Your Input Regarding Draft Addendum VIII
Date:	Friday, September 2, 2022 2:09:41 PM

Thank you.

In plain English, WHY would responsible people facilitate additional destruction of our natural world?   There is no excuse for doing so. None.

Kind regards,
Evelyn Yaari

On Fri, Sep 2, 2022 at 11:08 AM Comments <comments@asmfc.org> wrote:

> Thank you for providing input on Draft Addendum VIII to the Interstate Fishery Management Plan for Horseshoe Crab.
>
> Your comments will be shared with the Horseshoe Crab Management Board for consideration at the next Board meeting, which will likely occur this Fall.
>
> Upon considering public input, the Board will select final management measures and consider final approval of Addendum VIII.
>
> Caitlin Starks (she/her) | Senior Fishery Management Plan Coordinator
>
> Atlantic States Marine Fisheries Commission
> 1050 N. Highland Street, Suite 200 A-N
> Arlington, VA 22201
> Phone: 703.842.0740 | Fax: 703.842.0741
> cstarks@asmfc.org | www.asmfc.org

From:	Gail Howarth
To:	Comments; Lisa Ferguson; Laura Chamberlin; Caitlin Starks
Subject:	[External] Addendum VIII Horseshoe Crab Management
Date:	Tuesday, September 27, 2022 11:45:21 AM

Dear Sir/Madam:
I write on behalf of the Horseshoe Crabs, the migrating birds, and the Delaware Bay and Beaches, my fellow RTF Volunteers and Leaders and the generations to come.
I have been fortunate to summer at Reeds Beach NJ for the last 67 years and have flipped the Horseshoe Crabs for that amount of time. I have seen them when they were plentiful and I have also seen them hauled away, alive, in tractor trailers for bait and fertilizer, which was horrifying. Thankfully, ReTURN the Favor was set into place and we, as volunteers, are permitted on the beach to turn the HSCs during their spawning season when our beach is closed, May 6 to June 6. Please keep in mind that this is permitted before dawn and after dusk in order to not disturb the migrating birds. So we are diligent and passionate Volunteers, often flipping at 12 midnight and 4:00 a.m.
I can honestly tell you that the Horseshoe Crabs have not yet reached their pre-decline population (nor have the migrating birds) and wholeheartedly and with great passion ask the ASMFC to reconsider their wish to reopen the harvest not only for the males but more particularly for the females.as they carry the future of this magnificent and ancient species. Please let's continue to allow them to recover. We need your help.
Thank you for your consideration.
Sincerely,
Gail C. Howarth, RTF Volunteer.
Reeds Beach NJ

From:	Faith brancato
To:	Comments
Cc:	Bonnie Oconnor; Ted Brancato
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Thursday, September 1, 2022 10:56:42 AM

Please keep your current policy protections for female horseshoe crabs which will protect the red knot birds.

From:	Frederick Weber
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Thursday, August 25, 2022 4:57:16 PM

Please do not approve the harvesting of more Horseshoe crabs in Delaware Bay. The few Red Knots that are left depend on the eggs or they can't make it to their arctic breeding grounds. This is one of the most wonderful migrations on the planet and people are willing to snuff it out for products which have substitutes available. The way we're going driving other species toward extinction is going to backfire on us and we will eventually go extinct. What happens to our wildlife will happen to us!
I remember seeing thousands of Red Knots along the Delaware Bay shore feeding on abundant Horseshoe Crab eggs in the 1970s and 80's. It was beautiful. And now it's almost gone due to human greed.

Fred Weber
Branchville, NJ

From:	G
To:	Comments
Subject:	[External] Horseshoe Crab Draft addendum VIII
Date:	Thursday, September 29, 2022 9:30:23 PM

To Whom It Concerns:

I am someone who enjoys and values the Delaware beaches and it’s fragile ecosystem. I want to say i disagree with the proposal to let female horseshoe crabs be used as bait.

Horseshoe crabs are an invaluable resource for science and vaccines. Since the Delaware area houses and acts for a mating ground for the most horseshoe crabs in the world, we have a special responsibility.

Thank you for reading this!
Gaige L
Delaware resident

From:	Gary Nennstiehl
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Friday, September 30, 2022 4:26:49 PM

I am opposed to changing the current fishery regulations for the harvesting of horseshoe crabs to allow the harvesting of female crabs. The current management plan was developed after the drastic reduction of the horseshoe crab population in the 1990's due to overharvesting for the commercial eel and whelk fishery. As you know, the current plan does not allow for harvesting of female HSC. Unfortunately, we have not seen a significant increase in the horseshoe crab population. One reason for this is the increased use of HSC (horseshoe crabs) for the medical industry. Other factors may also be involved, such as habitat destruction due to over development on our beach and bay fronts, as well as climate changes. Adding the harvest of female HSC would negatively impact the fragile population. Since we have a healthy ratio of male to female HSC, a better solution would be to increase the harvest of male crabs. This protects the female crab allowing her to produce millions of eggs per season. The HSC is vital to the food chain in our bay ecosystems by providing food for shore birds and fish. We can not afford to lose this valuable resource.

Thank you,

Gary Nennstiehl
17251 Birch Ct
Lewes, DE 19958

From: Gaspar Bakos
To: Comments
Subject: [External] Horseshoe Crab Draft Addendum VIII
Date: Sunday, September 11, 2022 10:31:48 PM

Dear Sir/Madam,

I am strongly opposing the increase of the harvest of horseshoe crabs.
In fact, I am shocked that any such harvest is possible at all.

I join NJ Audubon in opposing the Atlantic States Marine Fisheries Commission’s (ASMFC) proposal to increase the harvest of horseshoe crabs, including a harvest of females for the first time in over a decade. This action will have a significant impact on the federally threatened Red Knot and other shorebirds that depend on horseshoe crab eggs during spring migration stopovers in Delaware Bay, putting them at risk of further population declines.

With best regards,

Gaspar Bakos

--
+---+
Gaspar Bakos
Professor of Astrophysics
133 Peyton hall, 4 Ivy lane
Department of Astrophysical Sciences, Princeton University
Princeton, NJ 08544, USA
office: +1-609-258-9926 fax:+1-609-258-8226
+---+

From: Gigi Brisson
To: Comments
Subject: [External] Horseshoe Crab Draft Addendum VIII
Date: Thursday, September 29, 2022 12:16:08 PM

I am writing to firmly express my concern with the proposed management of horseshoe crabs. The bottom line is that the numbers of crabs are down and quotas should be reduced, not increased, until the crabs reach their "high water mark", that is the largest number we have on record. Only under these conditions will they multiply in numbers that can support even the current quotas.

You are all aware of the mass dependence on these crabs; their lifecycles, and their eggs. The red knot is especially dependent, traveling thousands of miles to reach the beaches where these eggs have been laid, only to continue for thousands of miles to breeding grounds. Their numbers are significantly lower and it is your responsibility to not only protect the shores of the Atlantic Ocean and its creatures, but all dependent on them. It is one big ecosystem and if you blow a hole in one part, you will see the other parts cascading downward. These animals enable this ecosystem to work, as the plants and animals are all dependent on each other, and we (humans) get to benefit in the resulting beauty and resilience of our coastline. Yes, do not forget that as these plants and animals intertwine, as they have for millions of years, they build a natural resilience to storms and surges, which is needed now more than ever. Any coastal scientist could connect the dots for you, if you were interested in understanding the critical relationships.

Please think about the LONG TERM. You are to manage this coastline not just for those alive now, but for future generations; your kids, your grandkids, and so on. Further, please consider the elimination of using this critical species as bait. There are other choices. Please be smart and wise and protect what we know and love - our beautiful shoreline. Protecting each participant in this delicate ecosystem will help keep what we love.

Gigi Brisson
Cape May, NJ 08204

From:	Ginger A Rebstock
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Tuesday, September 6, 2022 7:16:09 PM

Dear ASMFC members,

While I agree that updating procedures and statistical models to determine harvest rates is a good idea, I strongly oppose any changes that would increase harvest of horseshoe crabs in Delaware Bay, or allow harvest of females.

Horseshoe crab eggs are essential for several species of shorebirds, not just red knots, and are also essential for the continued population of horseshoe crabs. The use of horseshoe crabs for bait seems like a waste of a resource that is needed by wildlife and biomedical research.

The Draft Addendum VIII states: "Since its implementation in 2013, neither the 81,900 red knot threshold nor the 11.2 million female horseshoe crab thresholds have been met and harvest package 3 has been selected every year by the Framework and specified by the Board for the Delaware Bay bait harvest limit." New regulations should have the goal of managing harvests to meet those thresholds (or other thresholds based on more recent research). Hence if the thresholds are not met, harvest should be reduced continuously until they are met. Harvest package 3 allows the harvest of up to 500,000 males (and 0 females). Perhaps harvest package 1 or 2 should be implemented until the thresholds are met.

I urge you to prioritize long-term preservation of species and ecosystems over short-term profits.

Thank you for considering my comments.
Sincerely,

Ginger Rebstock

Ginger Rebstock, PhD
Center for Ecosystem Sentinels
Dept. of Biology, Box 351800
University of Washington
Seattle, WA 98195-1800
gar@uw.edu
ecosystemsentinels.org

From:	Gordon keen
To:	Comments
Subject:	[External] Horseshoe Crabs
Date:	Wednesday, September 28, 2022 11:11:57 AM

I am opposed to raising the quotas on harvesting horseshoe crabs. You have got to be kidding!
Sincerely, Gordon Keen.

From:	Grant Price
To:	Comments
Subject:	[External] Horseshoe Crabs
Date:	Tuesday, September 13, 2022 5:54:56 PM

We are completely opposed to raising limits on Horseshoe crab harvesting. The birds that depend on them are declining rapidly and some are in danger of extinction. As an example, the Red Knots are for the most part seen only one two beaches, and in low and diminishing numbers.

The harvest is basically for two purposes:

1. Bait for eel pots. Not only does this benefit a very small number of individual people. Furthermore, the eels themselves are quite depleted, and should not currently be fsubjected to increased fishing pressure.

2. Medical uses: No longer necessary, there are functional synthetic methods of achieving the same goals.

We encourage you to do the responsible thing, and not increase take limits for Horseshoe crabs in or around the Delaware Bay.

From:	Caitlin Starks
To:	Comments
Subject:	FW: [External] Draft of addendum to the Horseshoe Crab Fishery
Date:	Friday, September 30, 2022 9:11:22 AM

From: Glen Smith <glenleesmith@yahoo.com>
Sent: Thursday, September 29, 2022 9:44 PM
To: Caitlin Starks <cstarks@asmfc.org>
Subject: [External] Draft of addendum to the Horseshoe Crab Fishery

If raising quotas on the killing of horseshoe crabs would be destructive to our fisheries.

I believe this may in the short term may make fishermen some additional profit may give them a

smile. Would this be a good move for the long term? Shouldn't we be fighting for protection.

The crabs numbers are declining wouldn't this also effect birds that are dependent of the horseshoe

crabs?

I hope you will weigh your decision in favor of your children's world.

Thank You for your consideration,

Glen L. Smith

From:	Guylaine Thom
To:	Comments
Subject:	[External] Horse shoe crabs
Date:	Tuesday, September 27, 2022 2:52:38 PM

We need, now more than ever to protect our oceans and waterways along with the creatures that inhabit them.

Do not allow the overfishing of horseshoe crabs!

Guylaine Thomas

Sent from my iPhone

From:	Holly Dunbar
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Wednesday, September 28, 2022 2:16:41 PM

I am writing to express my strong opposition to lifting the ban on the harvesting of female horseshoe crabs.

Many species of migrating birds, including endangered species, are dependent on the horseshoe crab eggs in spring. Overharvesting of horseshoe crabs has already helped to bring about a decline in the numbers of migrating birds.

I am appalled that we would put so many species and an entire ecosystem at risk simply to harvest and kill these ancient creatures for use as bait.

Holly J. Dunbar
725 Ayres Avenue
North Plainfield, N.J. 07063-1607
hdunbar@verizon.net

From:	Grant Stevenson
To:	Comments
Subject:	[External] Horseshoe Crabs and Red Knots
Date:	Saturday, August 13, 2022 10:03:24 PM

Hi Caitlin and the Commission,

Is is that we need to choose a package we recommend and why given the best of our knowledge, and previous facts plus the modeling in the ARM Framework? I guess I am confused as to how a public commenter can be helpful and contribute most to the process. I have some thoughts as an amateur ornithologist and birder.

I would say, while Package 1 is ideal for birding and the birds, uses of Horseshoe Crabs like fish bait and biomedical are very important, too. So the optimal choice may be two or three, and see what happens with the monitoring. Caution is the better part of valor because of the sensitive life cycles of both organisms and that recent history shows that the wrong quota can have devastating consequences. Then if monitoring and subsequent modeling show increasing or decreasing the annual quota prudent, then the commission can reassess.

My experience as a bird person is it sometimes is best to work on good faith with industry to find common ground even if interests conflict, though I do not see this as so. As long as you continue to keep conservation organizations like the IUCN and NJ Audubon involved, I see no problem with a moderate approach. (I am not an expert at population ecology and conservation, but one I believe can use population energetics to determine many questions on how many animals one needs, a little studied approach. It is touched on in the ARM report.)

If additional comment is allowed, I may like to possibly get back after talking over the framework with professional ornithologists.

Thank you very much for the opportunity and your time and consideration.

Grant Stevenson
Fountain Hill, PA

From:	Gregg Gorton
To:	Comments
Subject:	[External] Proposed Increase in Crab Harvest
Date:	Monday, September 12, 2022 5:01:36 PM

Good people:

I believe it would be a huge mistake for the limit on female horseshoe crab harvesting to be lifted, and for an overall increase in the numbers harvested. Neither the number of Red Knots nor the crab census have achieved anywhere near sustainable numbers. Risk of the Red Knot extinction
persists!!

Please make the wisest decision for these precious animals in what is truly a critical situation for them.

Gregg E Gorton, M.D., DLFAPA (ret.)
President
Delaware Valley Ornithological Club
president@dvoc.org
Narberth, PA, USA

From:	James Leiser
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Tuesday, September 13, 2022 1:56:29 PM

Dear ASMFC,

As a resident of the Delaware River watershed, I believe we need to continue to protect the horseshoe crabs. In particular, the impacts of Blue Catfish as a new invasive species have not been fully seen. They are already decimating the blue crabs, and it is not time to risk lowering the totals of horseshoe crabs until more data is available.

Sincerely,
James Leiser
james.leiser@gmail.com

119 Nitche RD
SHOHOLA, PA 18458-3517
United States

From: ivyandlace51
To: Comments
Subject: [External] Horseshoe crabs
Date: Sunday, September 11, 2022 12:13:22 PM

Do not harvest!
Leave them alone!
Use another bait!
Stop this nonsense...they are prehistoric, for G-d's sake!

Sent from my Verizon, Samsung Galaxy smartphone

From: GWEN RARING
To: Comments
Subject: [External] Increase in horseshoe crab harvest
Date: Monday, September 12, 2022 10:51:15 AM

I believe it would be a mistake to increase the harvest and/or allow the harvesting of horseshoe crabs at this time. J P Hand

Sent from my iPhone

From:	Jamie Johnson
To:	Comments
Subject:	[External] Horseshoe Crab Addendum VIII
Date:	Wednesday, September 14, 2022 11:15:08 AM

I am writing to submit my comments regarding and opposition to Horseshoe Crab Addendum VIII.

The current population of American horseshoe crabs has not recovered from overharvesting in the 1990's, and has declined at least 60% in the last 25 years. As a keystone species that provides calorie dense food for many other species, this is incredibly troubling.

Horseshoe crabs are not counted when they're bycatch from the destructive practice of dredging. When their blood is harvested by the pharmaceutical industry, which is extremely stressful for the animal, upwards of 29% die when returned to the water.

In fact, as a result of overharvesting for use as food, bait and biomedical testing, and because of habitat loss, the American horseshoe crab is listed as **Vulnerable to extinction** and the tri-spine horseshoe crab is classified as Endangered on the IUCN Red List of Threatened Species.

For these reasons, I do not understand how ASMFC could possibly propose to increase bait quotas and include female horseshoe crabs. **The data is showing us that the current methods of management are not working because the population of horseshoe crabs is not stable and is declining.** Why make matters worse by increasing quotas and including females? This simply does not make sense.

The data is showing us that we should be considering ending the taking of any horseshoe crabs at all. Or, at the very least, reducing quotas and protecting females. Certainly, adding to the quotas and including females will be disastrous for this species.

Therefore, I strongly urge you to reject the current proposed quotas and consider reducing quotas and protecting all horseshoe crabs, especially females. Thank you for your consideration.

Jamie Johnson
838 West End Avenue
New York, NY 10025
Tel (917) 834 3336

From:	Jane Wiltshire
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Thursday, September 29, 2022 10:05:40 AM

Hello, last night I emailed my reasons for requesting that you do not end the prohibition on harvesting female horseshoe crabs and decrease the numbers of crabs permitted to be harvested. I would like to add that climate change is creating additional threats to the shorebirds and horseshoe crabs because of increased temperatures on land and in the water and increased violent storms in the Atlantic Ocean. So we need to increase protections of the very vulnerable shorebirds and horseshoe crabs, not decrease them.

Thank you very much for your consideration.

Sincerely,
Jane Wiltshire

From:	Jane Wiltshire
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Wednesday, September 28, 2022 9:32:13 PM

Please do not end the prohibition on harvesting female horseshoe crabs or increase the number of horseshoe crabs permitted to be harvested.

As you know, the numbers of shorebirds whose very lives depend on horseshoe crab eggs are perilously low, and especially the very threatened red knots. I thought the old management plan determined that red knot numbers needed to increase to 81,000 and the female crabs numbers needed to increase to 11 million. Neither species is anywhere close to these numbers, so why is this terrible change even being considered? Our amazing little red knots number less than 7000. This proposed change may very well cause us to lose them completely, and what a terrible tragedy that will be. The shorebirds and horseshoe crabs' existence need less horseshoe crabs to be harvested, not more, and certainly not the females to be harvested at all.

The pharmaceutical industry does not need our help. It is a gazillion dollar industry. But our wildlife need desperately need our help and protection. Please please please do not end the prohibition on harvesting female horseshoe crabs or increase the numbers of horseshoe crabs permitted to be harvested.

Thank you.

Jane Wiltshire
139 Ridgewood Avenue
Villas, NJ 08251

From:	plainfuzz@aol.com
To:	Comments
Subject:	[External] Horseshoe Crab Harvest
Date:	Sunday, September 11, 2022 7:33:26 PM

Please don't increase the harvest on horseshoe crabs and don't allow the fishing of female horseshoe crabs. Our shorebirds are already under a lot of pressure for survival.
Jane J. Wainer, member NJ Audubon.

From: jbergeron@optonline.net
To: Comments
Subject: [External] Horsehoe crab draft addendum
Date: Friday, September 2, 2022 8:47:58 PM

Please do not allow harvesting of female or male horseshoe crabs. When I was growing up, horseshoe crabs were abundant along the Delaware Bay in North Cape May. But horseshoe crabs aren't abundant these days, and neither are red knots. In the 1990s, horseshoe crabs were overharvested as bait, leading to dramatic drops in crab and red knot populations. Red knots are now listed as threatened under the federal Endangered Species Act.

Since 2008, New Jersey has tried to protect red knots by imposing a moratorium on harvesting horseshoe crabs for bait in state-controlled waters.

Although New Jersey bans the harvest of horseshoe crabs for bait within state-controlled waters (three miles or less from the shoreline), there are no limits beyond the three-mile mark and they can be harvested for their blood for pharmaceuticals. As a result, trawlers from many nearby states capture horseshoe crabs off the New Jersey coast. Even on the Delaware side of Delaware Bay, fishermen can still legally harvest male horseshoe crabs as bait.

The ASMFC new model would eliminate a longstanding policy decision not allowing the harvesting of any female horseshoe crabs until the populations of both crabs and red knots return to higher levels. The current ASMFC model recognizes that horseshoe crab eggs are essential to the survival of red knots, and states that no harvesting of female horseshoe crabs will be allowed until the population of red knots rebounds to 81,000 and the population of horseshoe crabs reaches 12 million.

We don't want to take any risks we can avoid. One way we can protect them is to not allow harvests of horseshoe crabs because they provide the eggs the birds need. Horseshoe crab and Red Knot populations have not returned to 1980 levels since their crash even after New Jersey's moratorium on harvesting the crabs. My husband and I don't want to take any risks with the possible extinction of red knots. Using horseshoe crabs for bait is just not worth it.

From:	Janice A Stanton
To:	Comments; Janice Shabib Stanton
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Wednesday, September 28, 2022 12:22:44 PM

Hello,

I am writing to you today to ask that you please continue to keep strong protections for horseshoe crabs in place. These creatures eggs are essential for migrating endangered species such as the Red Knot, among others.

Also, the use of their blood is inhumane and unnecessary given the fact that there is a proven synthetic alternative. We, as humans, have a responsibility to act in a way that allows all creatures to survive, not to be disposable for human needs.

I desperately request that the protections continue and are strengthened for the future. I appreciate your time. Thank you.

Janice A Stanton

From:	Janice Badkin
To:	Comments
Subject:	[External] Horseshoe crabs
Date:	Friday, September 9, 2022 10:16:07 PM

Do not increase horseshoe crab limits!!!

From:	Jason Orans
To:	Comments
Subject:	[External] Regarding horseshoe crab management
Date:	Tuesday, August 23, 2022 10:54:50 AM

Please do **NOT** approve the expansion of harvesting female horseshoe crabs at the ASMFC 2022 Summer Meeting on Wednesday, August 3, 2022.

At minimum, the original safeguards in your harvest policies prohibiting female horseshoe crabs from being harvested until Red Knot numbers recover need to be included in any new policies.

Thank you.

Jason Orans

From: Jennifer B
To: Comments
Subject: [External] Comment on ASFMC proposal
Date: Friday, August 26, 2022 1:54:58 PM

17 Godfrey Dr.
Hamilton, NJ 08610

Caitlin Starks
Senior FMP Coordinator
1050 N Highland St., Suite 200 A-N
Arlington, VA 22201
comments@asmfc.org

8/26/22

Subject: Horseshoe Crab Draft Addendum VIII

Dear Ms. Starks:

I am writing to voice my opposition to the ASMFC proposal to change/lift/remove the horseshoe crab harvest controls protecting female horseshoe crabs from being harvested. These magnificent creatures have survived thousands of years, but in addition to facing environmental stressors like climate change, their numbers are dwindling due to biomedical and bait industries.

Moreover, shorebirds such as the threatened beloved Red Knot, which are heavily dependent on the eggs of the horseshoe crab to fuel their long and epic journey to their nesting grounds in the Arctic, are already at-risk. Allowing female horseshoe crabs to be harvested would decimate the delicate relationship on which the Red Knots survival literally depends. Nature is astonishing, and the journey these small birds undertake is truly impressive, but they need fuel to fly that far. And to diminish that food source further would be an unnecessary tragedy for both the crabs and the shorebirds.

The marvelous, prehistoric horseshoe crabs have been around for centuries and they thrive without interference by man, but their very survival is continually threatened by humans. ***Please*** limit human interference with their essential contribution to the delicate ecosystems in which they participate and do ***NOT*** allow harvesting of the horseshoe crab. I fully oppose changing the Delaware Bay horseshoe crab harvest and sincerely hope the ASFMC will REJECT the proposed harvest change.

Thank you for your time.

Sincerely,

Jennifer Barron

From:	Jennifer Vogt
To:	Comments
Subject:	[External] Don't increase horseshoe crab harvest
Date:	Wednesday, August 24, 2022 5:51:29 PM

Mr. John Clark, Chair
Horseshoe Crab Management Board
Atlantic States Marine Fisheries Commission

Mr. Clark,

I am writing to express my concerns regarding the possible action by ASMFC at its Summer Meeting of the Horseshoe Crab Management Board to substantially modify the policies and approaches to protecting the crabs and red knots of Delaware Bay through a highly-technical modification to the Adaptive Resource Model (ARM) utilized by the Commission, through the initiation of Addendum VIII.

The impact of the central parts of the revisions – to change the harvest restrictions and reopen the bait fishery's access to female horseshoe crabs despite the lack of recovery to date of the red knot populations which depend on the eggs they produce – is buried under hundreds of pages of technical discussions. Leading members of the ASMFC's own advisory committee have tried raise this concern to the primacy it deserves, and even the Peer Review Committee urged caution. Further, this fundamental change in policy and risk to the recovery of the red knot is being done behind the closed doors of the modeling committees without robust and engaged public consideration of the acceptability of the risk to important stakeholders including the broader public and conservation community. Requests by leading members of the conservation and environmental communities for access to the models have been denied.

Even the outside Peer Review Committee raised concerns about the shift in policy embedded in technical changes and the adequacy of how well public and stakeholder concerns were taken into account. I doubt that the public's tolerance to the possibility of red knot extinction is as high as this new ASMFC direction envisions. In the Peer Review report, the experts advised:

"Because the changes would lead to harvest of female HSC, which has been restricted since the implementation of the original ARM Framework, the Panel cautions the [Working Group] to fully consider if the new reward function truly represents the values articulated by stakeholders in the 2009 ARM Framework."

I strongly urge the Commission to not approve the proposed Framework Revision.

Under the current framework, no female crabs can be harvested in Delaware Bay for bait until the female population reaches 11.2 million crabs or the total red knot stopover population reaches 81,900 birds. Neither metric has yet been attained.

Under the proposed management revision, 175,000 to 190,000 females could be harvested as soon as 2023, according to some experts. In reaching this decision, the ASMFC disproportionately relied on surveys it has long considered biased and of dubious accuracy, which "reduces the scientific credibility" of the proposed revision, according to committee members and former proponents of the ARM framework (Niles, Burger, Mizrahi, & Dey, 2021).

The *only* horseshoe crab-specific survey thought historically reliable—the Virginia Tech trawl survey—continues to indicate that female horseshoe crabs are in trouble.

I would request that the Board hold the draft addendum until it can be amended to reinclude the original, stakeholder based protections regarding recovery levels prior to reopening female crab harvest, and that the fundamental modeling and other technical analyses foundational to the addendum’s recommendations be publicly shared and fully made available and reviewed by interested stakeholders.

Thank you for your attention to these comments.
Sincerely,
Jennifer Vogt

Sent from my iPad

From: Graver, Jeffrey
To: Comments
Subject: [External] Horseshoe Crab Draft Addendum VIII)
Date: Tuesday, September 27, 2022 1:20:32 PM

My comment to the commission. I will keep it short and simple. From information gathered from the Delaware Center for the Inland Bays I believe that female horseshoe crabs should not be harvested. A better solution would be to harvest more male horseshoe crabs. If we continue down this path it would end in the collapse of the species.

Thank You,
Jeffrey Graver

From: Jill Mortensen
To: Comments
Subject: [External] Horseshoe crab
Date: Tuesday, September 27, 2022 6:48:30 PM

Please protect horseshoe crabs, especially females. We are working hard to increase horseshoe crab numbers and protect them and their spawning in order to help migrating birds.
It’s the circle of life- we must protect.
Jill Mortensen

Sent from my iPad

From:	Graves, Jessica
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Monday, September 12, 2022 4:41:59 PM

To Whom it May Concern,

I strongly disagree with the addendum that would allow for harvesting of female horseshoe crabs. Not only would this be detrimental to the horseshoe crab population, but bird populations would also suffer, as migrating species rely on the horseshoe crab eggs for food.

This addendum is short-sighted and has far reaching consequences for the animals that live in and visit the Delaware Bay.

Thank you,

Jessica Graves, SHRM-CP
She/Her/Hers
Human Resources Assistant
Carnegie Museums of Pittsburgh
4400 Forbes Avenue
Pittsburgh, PA 15213
412-622-3338
www.carnegiemuseums.org

CARNEGIE MUSEUMS OF PITTSBURGH
Human Resources

From:	Jill Madsen
To:	Comments
Subject:	[External] Horseshoe Crabs & Red Knots
Date:	Saturday, January 29, 2022 2:07:19 PM

Hello,

I'm writing out of concern for 2 very important species that are currently in peril. The Red Knot is especially in peril these days. I'm asking that you reconsider your potential concession to industry at the cost of these wonderful creatures. Please consider the future of these animals and their lack of sustainability if you cave to industry. They need our help now more than ever!

Thank you,

Mrs. Jill Madsen
Colorado Springs, CO

From:	JMAmann
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Wednesday, September 28, 2022 9:07:41 AM

Horseshoe crab harvest should NOT include females.

A better alternative is to harvest more, or even all, male crabs. The male-to-female ratios are high in this area. Harvesting more males would not affect repro8rates. This will allow females to continue growing and reproducing, which is the best way to protect estuary ecosystems recovering from over harvest and facing the negative impact of the rapid climate change we are experiencing.

Thank you for the tremendous amount of science that goes into the management of the crab as well as for your commitment to considering public input.

Kindest regards,
JoAnn

JoAnn Amann
301.655.9235 cell w/voice and text
JMAmann@Comcast.net

"The past is a foreign country; they do things differently there."

Sent via the Samsung Galaxy Note8, an AT&T 5G Evolution capable smartphone

From:	Joan Flaherty
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Wednesday, September 28, 2022 10:09:01 AM

Atlantic States Marine Fisheries Commission,

Thank you for the excellent work you do to manage horseshoe crabs and for inviting public comment on the draft revised management plan. My concern is the harvesting of female horseshoe crabs. It should not be allowed at this time. Why?

- Rapid climate change and rampant coastal development are reducing the quality of the crabs' spawning habitat, which most likely will impact its future population.
- The crab population is being managed at a historic low from the 1990s.

A better alternative to harvesting female crabs is to harvest more male crabs. Because male-to-female ratios are high in our coastal area, harvesting more males would not affect reproduction rates.

Our environment is truly interdependent and once one element is destroyed beyond repair other elements, such as birds, (red knots), will also be impacted. I hope you will consider this concern and support a management practice that protects female horseshoe crabs.

Respectfully,

Joan Flaherty
82 Sussex Street
Rehoboth Beach, DE 19971

From:	James Cohen
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Friday, September 30, 2022 8:17:55 AM
Attachments:	image003.png

Horseshoe crab numbers are not increasing and are reported to be decreasing. The population is already stressed and dimninishing with a resulting strain on the bird population which relies on horseshoe crabs for food. Sea temperature rise seems to not have been researched into its effects on the horseshoe crab and other marine life in the Delaware Bay area but is undoubtedly having negative repercussions.

I strongly urge that Addendum VII NOT be adopted.

Thank you.

Jim Cohen

James Cohen, PE
James Cohen Consulting
PO Box 615
Richboro, PA 18954
O: 215-355-6859
M: 917-733-0204
F: 215-396-8593
JCohen@JCConsultingEngineers.com
https://www.linkedin.com/in/jamescohenpe/
www.JCConsultingEngineers.com

From: Joan Wood
To: Comments
Subject: [External] Horseshoe Crab Harvest
Date: Sunday, September 11, 2022 2:18:33 PM

Really?!! Are you really going to INCREASE the harvest on these strange creatures that feed thousands and thousands of endangered birds that need the food and rest as they migrate? Are you really willing to make New Jersey look that crass and cruel and stupidly unaware of what we would be doing? Maybe you don't care what out state looks like and it's reputation in the world for being crass and cruel and stupid. But for those of us who were forced to move here about 45 years ago, felt despair at the thought, and then came to love the state, its people and nature, this is just...awful. Please don't.

yours truly,
Joan Wood
Lawrenceville, NJ

From:	John Hoyt
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Wednesday, September 28, 2022 12:23:01 PM

I respectfully request that the harvest of female horseshoe crabs should not be allowed at this time.

--Rampant development in the coastal Delaware Bay (DE and NJ) is detrimentally impacting spawning areas.

--The crab population is being managed at a historic low from the 1990s.

--Female horseshoe crabs annually produce thousands of eggs that are essential food for migrating birds such as the Red Knot. Red Knots in eastern North America have declined sharply in recent decades owing in part to the unsustainable harvest of horseshoe crab eggs, and they have become a flagship species for shorebird conservation. It is estimated that over $800 billion is spent a year in outdoor recreation in the United States, with birdwatching having an economic benefit of $41 billion dollars.

Regards,
John Hoyt
311 W 4th St
Lewes, DE 19958

From:	gfrorer@comcast.net
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Thursday, September 29, 2022 6:43:12 PM

As a New Jersey resident and taxpayer, I am writing to you and urge the Atlantic States Marine Fisheries Commission (ASMFC) to vote against Option B for Addendum VIII which would change the Adaptive Resource Management (ARM) model for horseshoe crab harvest. The new model would recommend opening a limited female harvest. I ask you to adopt the "no action" option.

"The horseshoe crab is a critical link to coastal biodiversity. One of their ecological functions is to lay millions of eggs on beaches to feed shorebirds, fish and other wildlife. Its large hard shell serves as microhabitat for many other species such as sponges, mud crabs, mussels and snails. Unfortunately, this ecological link can be broken in areas where population density is low."

I have read your information and conclusions and find some of them to be to be specious at best.

My Experience

In May of 1993 I became a volunteer member of the New Jersey Division of Fish and Wildlife, Endangered and Non-Game Species Program as a beach steward in Fortesque, NJ on the Delaware Bay. I have been there every spring since for about 30 years. In the early years we were asked to estimate and document Red Knot numbers. I would routinely record numbers of knots in groups of 3, 4 and 5 thousand. This year, as in the past few years, there were a few groups numbering only in the hundreds. Likewise with the HS crab, their numbers coming up to spawn is much less than in the early years. While more females may be on the beaches now, this only shows that more females are now mature at egg laying age, not that the numbers of females have increased in the entire population. While my observations may be anecdotal in nature, my anecdotal information is no more or less valuable than your anecdotal observations used for your report. For instance, your report states that*, "Horseshoe crabs are also encountered as bycatch in several other commercial fisheries. Commercial dead discards were* <u>*estimated*</u> *for the Delaware Bay Region as part of this ARM Revision with data from the Northeast Fisheries Science Center's Northeast Fisheries* <u>*Observer*</u> *Program. Commercial dead discards were not considered as a source of removals in the previous ARM Framework but are now included in this ARM Revision.* This is anecdotal information.

Medical Use

In your overview document it states that, "A 15% mortality rate is applied to the number of horseshoe crabs bled and released alive to estimate the number of crabs that die each year. This source of removals was not accounted for in the previous ARM Framework but is now included in the ARM Revision. The biomedical harvest data for the Delaware Bay Region is confidential, so coast wide biomedical data has been used for the revised ARM model development." I believe that the medical information is confidential because it is most likely manipulated data.

"*A 2014 study by researchers at the University of New Hampshire and Plymouth State University found that the bleeding process results in lower activity levels and a decreased expression of tidal rhythms.* <u>*While it is true that further study is required, the data available does suggest the horseshoe crabs that survive bleeding are left disorientated and weak, potentially affecting the ability of female crabs to spawn. Further research has found that the mortality rate of horseshoe crabs post-bleeding is only eight percent for males, but as high as 30 percent for females.*</u>*)*

Your use of 15% mortality is just a guess and not representative of actual mortality. Your report does not account for issues with bled crabs that survive this bleeding process, which would be 100% of the HS crabs used.

Critical Habitat

On 07/15/2021 the U.S. Fish and Wildlife Service (Service), proposed to designate critical habitat for the federally threatened rufa red knot (*Calidris canutus rufa*) under the Endangered Species Act of 1973, as amended (Act). You reference this in your report but fail to mention and account for other issues confronting the HS crab and red knot.

Sea Level Rise

In this report it states that, *However, we also concluded, based on overwhelming evidence, that rates of sea level rise have increased beyond those that have occurred over recent millennia and continue to accelerate (Service 2014, pp. 142-143; Intergovernmental Panel on Climate Change (IPCC) 2013, pp. 11, 25). These conclusions are further supported by newer information evaluated in the SSA report (Service 2020a, pp. 32-36). Over the period 1902 to 2015, global mean sea level rose by 0.5 feet (ft) (0.16 meters (m)) (likely range of 0.4 to 0.7 ft (0.12 to 0.21 m)) (IPCC 2019, p. 42). The rate of sea level rise since the mid-19th century has been larger than the mean rate during the previous two millennia (high confidence) (IPCC 2014a, p. 4). Extreme wave heights, which contribute to extreme sea level events and coastal erosion, have increased in the North Atlantic by around 0.3 in (0.8 cm) per year over the period 1985 to 2018 (medium confidence) (IPCC 2019, p. 42).*

Habitat

When arriving in the Delaware both the HS crab (spawning) and knots (feeding) share the same habitat. According to the critical habitat document, "*The rufa red knot is vulnerable to inundation of tidal flats and erosion of sandy beaches, which are typically caused or accelerated by climate-driven sea level rise (Service 2014, pp. 126-143; Vousdoukas et al. 2019, entire). In most of the rufa red knot's nonbreeding range, shorelines are expected to undergo dramatic reconfigurations over the next century as a result of accelerating sea level rise (USCCSP 2009, pp. 13, 44, 50). Extensive areas of marsh are likely to become inundated, which may reduce foraging and roosting habitats. Marshes may be able to establish farther inland, but the rate of new marsh formation (e.g., intertidal sediment accumulation, development of hydric soils, and colonization of marsh vegetation) may be slower than the rate of deterioration of existing marsh, particularly under the high sea level rise scenarios (Nikitina et al. 2013, p. 11; Glick et al. 2008, p. 6). The primary rufa red knot foraging habitats, intertidal flats, and sandy beaches will likely be locally or regionally inundated or eroded, but replacement habitats are* *likely to re-form along the shoreline in its new position (Scavia et al. 2002, p. 152; USCCSP 2009, p. 186). However, if shorelines experience a decades-long period of high instability and landward migration (i.e., under higher rates of sea level rise), the formation rate of new beach habitats may be slower than the rate of loss of existing habitats (Iwamura et al. 2013, p. 6). Additionally, low-lying and narrow islands, such as those along the U.S. Gulf and Atlantic coasts, may disintegrate rather than migrate (Titus 1990, p. 67; IPCC 2014b, p. 15), representing a net loss of rufa red knot habitat. Galbraith et al. (2002, p. 178) examined several scenarios of future sea level rise and projected major losses of intertidal habitat in Delaware Bay."*

Your report fails to account for these future anticipated detrimental changes and hurdles affecting HS crabs.

<u>Offshore Turbine Wind Power Development</u>

The State of New Jersey and most of the states in the northeast United States are beginning the industrialization of the coast. Your report fails to discuss potential impacts of the wind farms on the HS crab.

<u>General Impacts</u>

According to the Bureau of Ocean Energy Management (BOEM), Ocean Wind 1 Offshore Wind Farm, Draft Environmental Impact Statement, June 2022, *"The Proposed Action would result in **negligible** to **moderate** impacts for finfish, invertebrates, and EFH. The primary impacts on finfish would be from noise during construction and operation of the proposed Project. Long-term impacts on EFH from construction and installation of the Proposed Action would be minor, as the resources would likely recover naturally over time. The Proposed Action would have negligible to minor impacts on invertebrates through temporary disturbance and displacement, habitat conversion, and behavioral changes, injury, and mortality of sedentary fauna. The presence of structures may have a minor beneficial effect on invertebrates through an "artificial reef effect." Despite invertebrate mortality and varying extents of habitat alteration, BOEM expects the long-term impact on invertebrates from construction and installation of the Proposed Action to be minor, as the resources <u>would likely recover</u> naturally over time. The Proposed Action would contribute a noticeable increment to the **negligible** to **moderate** impacts on finfish, invertebrates, and EFH from the combination of the Proposed Action and other ongoing and planned activities."*

<u>3.13.5.1</u> "*Activities associated with construction and installation, O&M, and decommissioning of the Proposed Action alone would have negligible to minor impacts on invertebrates through temporary disturbance and displacement, habitat conversion, and behavioral changes, injury, and mortality of sedentary fauna. The presence of structures may have a minor beneficial effect on invertebrates through an "artificial reef effect." Despite invertebrate mortality and varying extents of habitat alteration, BOEM <u>expects</u> the long-term impact on invertebrates from construction and installation of the Proposed Action to be minor, as the resources would likely recover naturally over time. In general, the impacts are likely to be local on the scale of the benthic invertebrate geographic analysis area, and thus would not be expected to extend to the far larger geographic analysis area (New Jersey LME). The larger invertebrate geographic analysis area was selected to account for migratory movement of mobile species that are predicted to experience negligible impacts with respect to the Proposed Action's contribution to the impacts of individual IPFs resulting from ongoing and planned activities. The primary impacts on invertebrates would be expected to occur as a result of new cable emplacement, the presence of structures, noise from pile driving, and anchoring."*

<u>Electromagnetic Fields – EMF</u>

Naturally occurring Electromagnetic Fields (EMFs) are present everywhere in the oceans. Undersea cables used for power transfer are known sources of EMF. For offshore wind energy projects, the primary sources of EMF are inter-array cables that carry electricity from each wind turbine to the export cables, which carry that electricity to shore.

<u>3.13.5</u> *"Effects of EMF may include interference with navigation that relies on natural magnetic fields, predator/prey interactions, avoidance or attraction behaviors, and physiological and developmental effects (Taormina et al. 2018)."*

As I mentioned earlier, I have read your information and conclusions and find some of them to be to be specious at best. There are many holes with your data since much of it comes from sources who want the crab moratorium lifted for financial reason and are more subjective in nature and less objective. You also fail to account for future issues that will be detrimental to the HS crab, like sea level rise, habitat loss and industrialization of much of the coast for wind farms.

In *Laudato Si'*, his letter to the Catholic Church on caring for the environment, Pope Francis covered a wide array of issues including our treatment and view of animals. "Every act of cruelty towards any creature is 'contrary to human dignity.'"
"If we approach nature and the environment without this openness to awe and wonder, if we no longer speak the language of fraternity and beauty in our relationship with the world, our attitude will be that of masters, consumers, ruthless exploiters, unable to set limits on their immediate needs. By contrast, if we feel intimately united with all that exists, then sobriety and care will well up spontaneously."

Please, think of future generations and the continued survival of the HS crab and red knot. Support the **no action** option.

John Gfrorer, 491 Hamilton Road, Wenonah, NJ, 08090. gfrorer@comcast.net, 856-292-3805

From:	calogero at rockisland.com
To:	Comments
Subject:	[External] Let the horseshoe crabs be
Date:	Friday, September 30, 2022 5:11:56 AM

Hello Caitlin Starks,

Dr. Sylvia Earle has informed us that you and the Atlantic States Marine Fisheries Commission are considering raising quotas of harvesting horseshoe crabs for bait, and potentially harvesting female horseshoe crabs, too.

Have you determined that there are too many horseshoe crabs?

Have you determined that there are too many migrating birds dependent on the eggs of the horseshoe crabs?

I suspect there are alternatives for bait, which would allow the ancient horseshoe crabs continue to mate and in turn support healthy populations of migrating birds as they have done since time immemorial, long before humans interfered with this marvel of life.

Let the horseshoe crabs be.

Sincerely,

John Calogero

From:	joanne Pannone
To:	Comments
Cc:	joanne Pannone
Subject:	[External] Opposing ASMFC lifting moratorium on female horseshoe crabs
Date:	Tuesday, August 23, 2022 10:48:10 AM

My first experience with horseshoe crabs was to attend an outing with the Delaware Riverkeeper on the Moores beach of the Delaware Bay to tag spawning horseshoe crabs by moonlight and there I learned that it takes 7 years to reach maturity!

We can fly to the moon, we need to find a substitute for the horseshoe crab and also save the red knot from being starved out on their migration. The female population is not increasing which could be that those being bled aren’t surviving.

Until then, do not lift the ban!

Joanne Pannone
215 Meadowbrook Rd, Robbinsville, NJ 08691

From:	John Moy
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Wednesday, August 24, 2022 9:41:19 PM

Dear ASMFC:

Please do not allow the harvesting of female Horseshoe crabs. Horseshoe crabs are endangered, as are the Red Knots who depend on their eggs for food.

Using your ARM framework, you should not be allowed to increase harvest. I do not understand how the "Catch every last fish" mindset can persist in this day and age. You have all these management frameworks in place, yet build in loopholes so that they can be effectively ignored. Some day in the not so distant future there will be nothing left.

John Moy
25 Eel Point Road
Nantucket, MA 02554
jmoy@ospf.org
617-784-1872

From: John McCrory
To: Comments
Subject: [External] Horseshoe Crab Draft Addendum VIII
Date: Sunday, September 11, 2022 1:44:30 PM

Atlantic States Marine Fisheries Commission
1050 N. Highland Street, Suite 200 A-N
Arlington, VA 22201
comments@asmfc.org

VIA ELECTRONIC MAIL

Dear Commissioners:

I write to urge you not to approve the proposal to increase the harvest of horseshoe crabs, which includes a harvest of females for the first time in many years. The existing Adaptive Resource Management (ARM) framework, created in response to sharp declines in the population of both Horseshoe Crabs and Red Knots, has not yet enabled these populations to stabilize or to reverse course from their current trajectory toward extinction. Consequently, now is not the time to change the framework to allow harvesting of female Horseshoe Crabs.

As you know, the population of Red Knots that stop at Delaware Bay each spring on their epic journey from Tierra Del Fuego to the Arctic Circle are critically dependent on the eggs of the horseshoe crabs there. There are many factors that endanger the Red Knot such as long-term climate change impacts on their breeding but the annual harvest of horseshoe crabs, if it were to include female horseshoe crabs, is one that could have immediate, near-term impacts on their population. The existing framework's prohibition on harvesting female horseshoe crabs is one of the strongest tools we have to protect the Red Knot population.

As a citizen, a parent, and amateur naturalist, I recognize the Red Knot's special importance. With one of the longest and most challenging migrations of any bird species in the world, it is a key species for understanding migration in general than unlocks an understanding which enables us to understand the needs of many more species, particularly other long-distance migrants. By protecting the Red Knot, we can learn ways to protect many more species of birds, including many other shore birds that rely on the eggs of the horseshoe crab in Delaware Bay. The Red Knot is a keystone in our developing knowledge of the avian world, and hence deserves every effort to reverse its current trajectory towards extinction.

The sharp declines in the populations of Red Knots stopping over at Delaware Bay in recent decades from nearly 94,000 individuals in 1989 have not yet been halted. Despite the current framework's limits on the harvesting of horseshoe crabs, the availability of horseshoe crab eggs to Red Knots remains spotty. Unsurprisingly, though the population counted from year to year has ticked up and down over the past decade, the population of Red Knots remains at historic lows. The increase from an all-time low of 6,800 individuals in 2021 to 12,000 this year is nevertheless far below the 30,000 peak number of 2019. Though that peak suggested cause for hope that might have allowed for a new approach to the horseshoe crab harvest, the data since then clearly point to the need to stay the course with the existing framework at the very least.

I hope you will agree that all the information we have shows conservation efforts in Delaware

Bay still have a ways to go in the case of the Red Knot, and that we should in fact do more to protect and expand the supply of horseshoe crab eggs that Red Knots rely on, not less. The proposed change to the ARM will likely increase the threat to Red Knot right now.

The data clearly show that such a change to the framework is premature and ill-advised at this time. I join New Jersey Audubon and others and strongly urge you to reject the proposal.

Respectfully,
John McCrory
Montclair, New Jersey

--
John McCrory
john@johnmccrory.com
(603) 715-7080

From:	John
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Tuesday, September 27, 2022 4:25:33 PM

Hello with respect to harvesting Horseshoe crabs, females should be off limits of severely curtailed.

thanks,

john mccloskey

From: jfluard@netzero.net
To: Comments
Subject: [External] Horseshoe Crab Draft Addendum VIII
Date: Sunday, August 28, 2022 5:11:04 PM

Please extend all protections for Horseshoe crabs.

Other sources are available for bait.

John Luard
58 Red Coach Lane,
Rumson, NJ 07760

From:	Jon Leland
To:	Comments
Subject:	[External] Extend the prohibition on harvesting female horseshoe crabs
Date:	Wednesday, August 24, 2022 1:01:14 AM

Hi - I'm writing to request that you do not approve the proposal that would end the prohibition on harvesting female horseshoe crabs this week. These horseshoe crab populations are far too important for both human health and other species, like the Red Knot. I would ask that the ASMFC provide the modelling and analysis which justifies the expansion of the harvest of female horseshoe crabs for the public to review, and ensure that the original safeguards in their harvest policies prohibiting female horseshoe crabs from being harvested until Red Knot numbers recover are included in any new policies.

Thank you,

Jon Leland

Jon Leland
Chief Strategy Officer
Head of Sustainability
he/him/his
Kickstarter is a Public Benefit Corporation.
Some projects we love.

From: John Roecker
To: Comments
Subject: [External] Horseshoe Crab Draft Addendum VIII
Date: Wednesday, September 28, 2022 9:56:10 AM

Atlantic States Marine Fisheries Commission:

I respectfully submit to you that the harvest of any gender horseshoe crabs should not be allowed at this time.
I - I have surveyed horseshoe crabs at Cape Henlopen State Park for over 10 years with Richard Julien and Robert Schroeder. I do not know the results of this Spring's count, but it seems to me that the count was considerably lower than previous years.
- Female horseshoe crabs annually produce thousands of eggs that are essential food for migrating birds, particularly the Red Knot which is in decline.
- Rampant development in coastal Delaware is detrimentally impacting spawning areas.
- Please be on the right side of the environment and history by supporting the revised plan. Our environment is truly a web and once one element is destroyed beyond repair other elements, such as birds will also implode.

Respectfully submitted.

Dr. John T Roecker
20451 Mall Center Way
Lewes, DE 19958

Sent from my iPad

From:	Joseph Cunin
To:	Comments
Subject:	[External] Changes to Horseshoe Crab regulations
Date:	Tuesday, August 16, 2022 3:22:19 PM

Horseshoe crabs play a vital role to the Delaware Bay ecosystem, as their eggs provide nourishment for imperiled shorebirds such as the federally threatened Red Knot. Each year, thousands of Red Knots fly over 9,000 miles from Tierra del Fuego at the southern tip of South America to breeding grounds in the Arctic Circle. The Delaware Bay is a major stopover point during this long journey, where the Red Knots feast on horseshoe crab eggs to gain the necessary weight to fly the remainder of the way to the Arctic Circle.

I urge ASMFC **NOT** to adopt new rules that would allow increased harvest of horseshoe crabs. The current restrictions are working and are critical to maintaining shorebird populations.

Thank you,

Joseph Cunin
Brooklyn, NY

From: Joshua Malbin
To: Comments
Subject: [External] Horseshoe Crab Draft Addendum VIII
Date: Wednesday, August 17, 2022 3:47:32 PM

I recently learned of your proposal to expand the harvesting of female horseshoe crabs even though the Red Knot population has not recovered. Red Knots are in serious danger, having reached their lowest total number ever in 2021, and having declined 75 percent in the last 40 years, and female horseshoe crab numbers have not recovered either. The ASMFC must make public any modeling and analysis that justifies any expansion of the catch of female horseshoe crabs. Any new policies must keep in place the original safeguards in place prohibiting the catch of female horseshoe crabs until Red Knot numbers recover. If that means adopting the no action alternative, then that is the alternative you should adopt.

Thank you,

Joshua Malbin
Brooklyn, NY

From:	Joshua Heffron
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Monday, August 29, 2022 4:23:09 PM

STOP OVER FISHING OF THE HORSE SHOE CRABS

From: Josh Corris
To: Comments
Subject: [External] Horseshoe Crab Draft Addendum VIII
Date: Monday, August 29, 2022 10:47:04 AM

Dear Sir or Ma'am,

I am concerned about the consequences of overharvesting of horseshoe crabs on the local environment. I implore you to implement measures to prevent harvesting of horseshoe crabs at harmful levels.

Thank you,
Joshua D Corris

From: JUDY SWITZER
To: Comments
Subject: [External]
Date: Tuesday, September 27, 2022 2:01:57 PM

No to the plan to change the quotas on horseshoe crabs! This would have a devastating effect on crucial migrating birds including the Red Knot already under severe stress.

What are you thinking??

Judith A. Switzer

From: Karen Bacot
To: Comments
Subject: [External] Horseshoe Crab Draft Addendum VIII
Date: Tuesday, August 23, 2022 1:03:02 PM

It annoys me so much that they continue killing so many horseshoe cabs. Don’t the idiots know better??? Very frustrating.

Sent from my iPhone

From:	Julie Callahan
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Wednesday, September 28, 2022 8:57:07 AM

Atlantic States Marie Fisheries Commission:

I respectfully submit to you that the harvest of female horseshoe crabs should not be allowed at this time.

--Female horseshoe crabs annually produce thousands of eggs that are essential food for migrating birds.

--Rampant development in coastal Delaware is detrimentally impacting spawning areas.

--The crab population is being managed at a historic low from the 1990s.

--Horseshoe crabs have existed for millions of years and yet within a few hundred years humans have endangered their existence. What does that say about humanity?

Please be on the right side of the environment and history with the revised plan. Our environment truly is a web and once one element is destroyed beyond repair other elements, such as birds, (an important tourist draw), will also implode.

Julie Callahan
38263 Comegys Court
Lewes, DE. 19958

Sent from my iPhone

From: Judith Weis
To: Comments
Subject: [External] Horseshoe Crab Draft Addendum VIII
Date: Tuesday, August 23, 2022 10:49:27 AM

I am a marine biologist and am concerned about the status of horseshoe crabs, which have been on this planet far longer than most other species. Overharvesting of horseshoe crabs by the bait industry has put an additional severe strain on the ecological connection between horseshoe crabs and shorebirds like the threatened Red Knot, a connection that is already weakening due to climate change. Surely there are other sources of bait for whelks than these special ancient animals! The Red Knots and other shorebirds depend on eggs of horseshoe crabs to sustain them during their long migration. Despite the fact that the Red Knot population is already alarmingly low, the ASMFC has proposed allowing the harvest of female horseshoe crabs, whose eggs provide the food that fuels the birds' journey up to Arctic nesting grounds. One doesn't have to be a biologist to see that such a policy makes no sense at all and will be harmful to the species and the ecosystem. Please do not approve this.

Sincerely,
Judith S. Weis
Professor Emerita

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1880's: "There's lots of good fish in the sea" W.S. Gilbert
1990's: Many fish stocks depleted due to overfishing, habitat loss, and pollution.
2000's: Marine reserves, ecosystem restoration, and pollution reduction MAY help restore populations.

Dr. Judith S. Weis
Dept. of Biological Sciences
Rutgers University
Newark NJ 07102

http://sites.rutgers.edu/judith-weis/

From:	karen barker
To:	Comments
Subject:	[External] horseshoe crab draft addendum VIII
Date:	Sunday, September 25, 2022 8:55:50 AM

Dear Atlantic states marine fisheries commission members,

I urge you to institute a full moratorium on horseshoe crab harvest in the Delaware bay.

I am a 40+ year biology teacher and an avid Birder. I teach my students about the ecology of many ecosystems including marine ecosystems. Birds are connectors to all of those and horseshoe crabs are crucial as the underpinning of this healthy ecosystem.

Sincerely,
Karen Barker
Newark, Delaware
--
"I love my country, by which I mean I am indebted joyfully to all the people throughout its history who have fought the government to make right." - Ani Difranco

From:	Caitlin Starks
To:	Comments
Subject:	FW: [External] horseshoe crab draft addendum Vlll
Date:	Friday, September 23, 2022 1:27:52 PM

From: longokedkk@aol.com <longokedkk@aol.com>
Sent: Friday, September 23, 2022 1:19 PM
To: Caitlin Starks <cstarks@asmfc.org>
Cc: longokedkk@aol.com
Subject: [External] horseshoe crab draft addendum Vlll

Dear Caitlin Starks-

Please reconsider your proposal to harvest female horseshoe crabs (and hopefully also do not increase male harvest)!!!
I am a volunteer with the De Inland Bays group and participate in terrapin studies, horseshoe crab counts and docent at James Farm. This year I participated in the horseshoe crab count at James Farm, and although you may think the numbers are strong, I can tell you from observation that less were seen on the beaches and less eggs were seen as well- have you been out to these counts, or do you just take in the "data" without making observations in the field? It makes me sad to think that any organization would consider harvesting female horseshoe crabs. Many qualified scientists and naturalists have written about your proposal and why it is a BAD IDEA! You stated that YOU see a less than 1% chance of red knot decline based on female harvest…HOWEVER, as mentioned "we are ceding the amount of red knot, and we have NOT even met the goal to restore the red knot population"!! Our surveys do not show a significant increase in crab numbers; an underestimation of horseshoe crabs will be at the expense of fish and birds that need them to survive- IS THIS WHAT WE WANT FOR OUR FUTURE??!! Destabilizing the horseshoe crab and red knot populations in the De bays could have future tragic consequences for the entire ecosystem. There are many reasons not to do this. Why do humans always have to desimate and destroy nature… IT WILL BE THE END OF ALL OF US!
Please reconsider your position on harvesting horseshoe crabs…the species that has been around since the dinosaur.
In closing, I hope you will listen to the many knowledge individuals and organizations who are against this proposal and not allow this change in horseshoe crab harvest to occur!

Thank You,
Karen Longo

From:	kmreinfried@everyactioncustom.com on behalf of Kay Reinfried
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Friday, September 30, 2022 11:33:46 PM

Dear Atlantic States Marine Fisheries Commission,

As a supporter of birds and the places they need to thrive, I am writing to strongly oppose the Atlantic States Marine Fisheries Commission's (ASMFC) proposed Addendum VIII Interstate Horseshoe Crab Fishery Management Plan, which increases the number of horseshoe crabs harvested for use as bait and reopens the harvest to include female horseshoe crabs.

The decline in horseshoe crab populations is concerning along the Atlantic Coast. It is especially important along the Delaware Bay, given its importance as a horseshoe crab spawning area and important stopover point for migrating red knots. Several indicators show that both horseshoe crab populations and the population of red knots, which depend their eggs as a source of food, are well below recovery thresholds.

I urge the commissioners to vote no on Addendum VIII for the following important reasons:

1. Horseshoe crab populations remain at historic lows, and their ongoing use both for bait threatens their ability to recover to their historic population levels.
2. Red knot populations are at all-time lows from both climate change and increasing scarcity of the food needed to fuel their 9,000-mile migration.
3. There are alternatives to using horseshoe crabs for the bait industry
4. Nature-based tourism and associated economic activity in the coastal Mid-Atlantic region is vital to local economies that depend on healthy ecosystems and the abundance of horseshoe crabs and the red knot

It is concerning that the proposed revision would likely trigger a resumption in the harvest of female horseshoe crabs, which would make recovery of the species virtually impossible. Under the current ASMFC framework, there is no female crab harvest until female abundance reaches 11.2 million crabs or until the Delaware Bay total red knot stopover population reaches 81,900 birds. Neither red knot nor horseshoe crab populations are anywhere close to satisfying either metric, nor yet, under this addendum, female harvest could be allowed.

The joint collapse of red knots and horseshoe crabs is not inevitable. However, the draft addendum propels them closer to that grim reality. I urge you to vote no on Addendum VIII in order to protect the red knot and the places they need to survive, protect healthy ecosystems in the Delaware Bay, and to support local economies dependent on nature-based tourism that is such a critical component of the communities surrounding the Delaware Bay.

Sincerely,
Mrs. Kay Reinfried
797 Scott Ln Lititz, PA 17543-8868
kmreinfried@gmail.com

From:	Kathy Sgroi
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Thursday, September 22, 2022 9:01:44 PM

To Whom it may Concern,

I strongly object to the harvesting of female horseshoe crabs. Having participated in a survey this year with the DE Center of Inland Bays, I saw first hand how outnumbered the female population is to the males.

I do not believe that harvesting of females given our current state of climate change and coastal development is a sound strategy.

Kathy Sgroi

From:	Kasia Chmielinski
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Tuesday, August 23, 2022 4:03:28 PM

Dear Caitlin Starks and ASMFC,

I am writing to you as a concerned citizen and the co-founder of a local Feminist Bird Club Chapter to oppose the Atlantic States Marine Fisheries Commission (ASMFC) proposal that would endanger Delaware Bay horseshoe crabs and the migratory shorebirds (like the Red Knot) which depend on them.

Originally, it was agreed that the prohibition on harvesting female horseshoe crabs would not be lifted until the Delaware Bay region hosts at least 81,900 Red Knots or 11.2 million female horseshoe crabs. Neither of these scenarios has occurred, yet the ASMFC has proposed changes that would result in lifting the prohibition on harvesting female horseshoe crabs, further imperiling the food supply for the remaining Red Knots.

This is coming at a time when the Red Knot population is far from stable. The average Red Knot count at Tierra del Fuego for 2018-2020 declined more than 75 percent from average counts in the 1980s and 2000. In 2021, only 6,800 Red Knots were counted, which is by far the lowest count since surveys began. These birds are hurtling towards an uncertain future and you have the power to stop this.

Please do your part in protecting the wildlife and biodiversity that keeps our regional ecosystem rich and balanced.

Thank you,
Kasia Chmielinski

--
Kasia Chmielinski

From:	Kelly Hughey
To:	Comments
Subject:	[External] Horseshoe Crab harvesting limits
Date:	Tuesday, September 27, 2022 2:18:34 PM

To whom it may concern,
Please continue prohibiting female horseshoe crabs' harvesting until the numbers reach 11.2 million.
Thank you,
Kelly Hughey
2412 shamrock Lane Millville NJ 08332

From:	KATHY AND DAVID DEVINE
To:	Comments
Subject:	[External] Horseshoe Crabs
Date:	Thursday, September 29, 2022 6:56:24 PM

To whom it may concern. I am writing to ask you to vote no on the draft addendum to the Horseshoe Crab Fishery Management Plan. At this time I believe there should be more restrictive plans put in place to protect them. Thank you very much. Kathy and David Devine

Sent from my iPhone

From:	kevin kavinsky kavar.
To:	Comments
Subject:	[External] Horseshoe crab comment
Date:	Thursday, September 29, 2022 10:19:45 AM

Totally against allowing harvesting of horseshoe crabs , for gods sake like it’s the only bait for welk ???
Kevin brennan frankford Delaware

From: Ken Gigliello
To: Comments
Subject: [External] Horseshoe Crab Draft Addendum VIII
Date: Friday, September 30, 2022 8:48:13 AM

I oppose the harvest of female horseshoe crabs for the following reasons:

1. Data from the only survey specifically developed to track our crab population does not show a significant increase in crab numbers

2. The population is being managed based on a historic low point set at the peak of crab over harvest in the 1990's.

3. Climate change and coastal development are reducing the quality of the crab's spawning habitat, which will likely impact its future population.

4. A better alternative is to harvest more male crabs. Because male to female ratios are high in our area, harvesting more males would not affect reproduction rates.

5. Allowing female crabs to continue growing and reproducing is the best bet to protect estuary ecosystems recovering from over harvest and facing the impacts of rapid climate change.

Please take these comments into consideration when finalizing the report.

From: Kim Morris
To: Comments
Subject: [External] Horseshoe crabs
Date: Monday, September 5, 2022 2:56:07 AM

Please DO NOT LIFT THE MORATORIUM on harvesting female horseshoe crabs.

Sent from my iPhone

From:	Krisanne Baker
To:	Comments
Subject:	[External] Horseshoecrabs
Date:	Friday, September 30, 2022 7:19:50 AM

We must preserve, as stewards, other species of the planet, not use and abuse them. I have been a volunteer counter for the resurging horseshoecrab population here in Maine ever since the ban to use them as fishing bait. With joy Ive watched the numbers each mating season climb back to what they should be. These prehistoric creatures have endured on this planet for almost forever. It would be shameful if we humans to wipe them out in a couple of decades!
Respectfully submitted,
Krisanne Baker

Ecological Artist and Educator
https://www.krisannebaker.com

Sent from my iPhone

From:	Kristi MacDonald
To:	Comments
Subject:	[External] I oppose increased horseshoe crab harvest
Date:	Monday, September 12, 2022 9:29:15 AM

Dear ASMFC representatives:

The proposed Horseshoe Crab Draft Addendum VIII of the Horseshoe Crab Fishery Management Plan puts the horseshoe crab population, and the many shorebirds (including threatened and endangered species such as the Red Knot), wading birds, and other species that rely upon them as a food resource during migration and the breeding season at risk of further perilous decline. I strongly oppose the proposal to increase the harvest of horseshoe crabs, including a harvest of females for the first time in over a decade. Climate change, bringing sea level rise and ocean acidification, will certainly exacerbate the decline of both Horseshoe Crabs and the many birds that rely upon them so increasing harvest at this time is not acting in the interest of the longterm existence of these species or the fisheries that rely upon them. It is wasteful to increase the use of these ancient animals for bait when they serve such a critical role in the fragile ecosystems of the Delaware Bayshore.

I hope the ASMFC will make the responsible decision of protecting Horseshoe Crabs and the species that rely upon them by not adopting Addendum VIII of the Horseshoe Crab Fishery Management Plan.

Sincerely,
Kristi MacDonald
59 Anderson Hill Rd.
Bernardsvill, NJ 07924

From:	leslie.porter2@verizon.net
To:	Comments
Cc:	hq@njaudubon.org
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Friday, September 30, 2022 2:47:48 PM

Comments submitted to the Atlantic States Marine Fisheries Commission.

Date: Friday, September 30, 2022.

From: Ms. Leslie G. Porter
825 Brice Rd.
Rockville, MD 20852-1001
301-251-5166, home telephone

Re: the proposal to increase harvest quota of horseshoe crabs, also known as *Limulus polyphemus*, for use as bait by potentially reopening future harvests to include female horseshoe crabs.

I, Leslie Gibson Porter of Rockville, Maryland, ask the Atlantic States Marine Fisheries Commission to maintain, ensure, and enforce critical protections for horseshoe crabs.

I am opposed to increasing the quota of harvest of horseshoe crabs for use as bait.

Secondly, I am adamantly opposed to including female horseshoe crabs in any planned or allowable future harvests of horseshoe crabs until the female horseshoe crabs population in the Mid-Atlantic states region reach 11.2 million horseshoe crabs or the Red Knot avian species stopover population in the Delaware Bay reaches 81,900 birds.

Ideally I would prefer to have both scenarios fulfilled before any increase in horseshoe crab harvests are considered.

Going forward, ASMFC must be required to include horseshoe crab egg density data survey numbers collected by the Delaware Bay Shorebird Project and other conservation organizations, as well as field survey data on Red Knots in ASMFC's modeling when considering future increased horseshoe crab harvests.

I join New Jersey Audubon in opposing the Atlantic States Marine Fisheries Commission's (ASMFC) proposal to increase the harvest of horseshoe crabs, including a harvest of females for the first time in over a decade. Allowing this proposal to go forward will have a significant negative impact on the federally threatened Red Knot and other shorebirds who depend on horseshoe crab eggs during their spring migration stopovers in the Delaware Bay, putting them at risk of further population declines.

Thank you.

Sincerely,
/s/
Leslie G. Porter

From:	Lani Hummel
To:	Comments
Cc:	lanihummel@aol.com
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Friday, September 30, 2022 9:08:18 PM

I have been enamored with horseshoe crabs for nearly 6 decades. As a young person, I became fascinated with this ancient species so little changed in hundreds of millions of years. I loved seeing the annual spectacle of thousands of horseshoe crabs mating and providing the food necessary for Red Knot birds to have the energy to reach their Arctic breeding grounds.

Under the current ASMFC management scheme, both the horseshoe crab and the Red Knot bird populations are declining. As a result, the Red Knot has been listed as threatened under the Endangered Species Act, and the horseshoe crab has been labeled as Vulnerable by the International Union for the Conservation of Nature. Scientists have attributed the Red Knots' shrinking populations to a decrease in the supply of horseshoe crab eggs. In the 1980s and early 1990s, there were 50,000 horseshoe crab eggs per square meter in Delaware Bay. Today, there are 8,000 crab eggs per square meter.

It was agreed that the prohibition on harvesting female crabs would not be lifted until the Delaware Bay region hosts at least 81,900 Red Knots or 11.2 million female horseshoe crabs. Neither of these benchmarks has been reached, yet the ASMFC is proposing changes that would remove the prohibition on harvesting female horseshoe crabs, further imperiling the food supply for the remaining Red Knots. For this and many other reasons, I am opposed to the implementation of Addendum VIII.

Thank you for your consideration,

Lani Hummel
901 Bay Ridge Road
Annapolis, MD 21403

From: LeAnn
To: Comments
Subject: [External] Horseshoe crabs
Date: Sunday, September 11, 2022 12:21:36 PM

Please save the female horseshoe crabs from harvesting. These eggs are vital to the red knots.

Sent from my Verizon, Samsung Galaxy smartphone

From: Lloyd Goodman
To: Comments
Subject: [External] female horseshoe crabs
Date: Saturday, September 3, 2022 3:27:11 PM

They are environmentally important, so PLEASE do whatever you can to save them,
Thank you.

Lloyd Goodman
175 King of Prussia Road
Radnor, PA 19087-4521
610-687-4049

From:	Liza Hodskins
To:	Comments
Subject:	[External] Horseshoe crab draft addendum VI I I
Date:	Wednesday, September 28, 2022 11:45:24 PM

Please allow males to be harvested but not females. We rely on the females to continue the population. Thank you.

Liza Hodskins
Rehoboth Beach Pawradise
20502 Washington Street Rehoboth Beach, Delaware 19971

From:	Leslie Pessemier
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Sunday, September 11, 2022 1:02:23 PM

I join the NJ Audubon and oppose the Atlantic State Marine Fisheries proposal to increase the harvest of horseshoe crabs, especially the FEMALES! It will threaten the Red Knot and other shore birds ALL of which are declining. Let’s all make a concerted effort to save the very creatures our survival depends on.

Thank you,

Leslie Pessemier
DENVILLE, NJ 07834

Sent from my iPhone

From:	Liz Flyntz
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Tuesday, August 23, 2022 8:16:36 PM

Hello,

I am writing to express my concern about the planned horseshoe crab harvest. This harvest is leading to declining numbers of the crabs, and to declining numbers of the shorebirds that depend on the crabs for food. Please do not allow the harvest to go forward, and take steps to preserve our shoreline ecology.

Thank you,
Liz Flyntz

--
www.lizflyntz.net

From:	Lisa McNamara
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Wednesday, September 7, 2022 7:32:15 AM

To Caitlin Starks,
Please note that I **strongly oppose** the overharvesting of female horseshoe crabs and urge you to **reject** the ASMFC's proposal now. The results of this act would have catastrophic consequences.
Lisa McNamara

From:	Belinda
To:	Comments
Subject:	[External] Horseshoes crabs
Date:	Sunday, September 11, 2022 12:29:45 PM

I am against the Commission's (ASMFC) proposal to increase the harvest of horseshoe crabs, including a harvest of females for the first time in over a decade. This action will have a significant impact on the federally threatened Red Knot and other shorebirds that depend on horseshoe crab eggs during spring migration stopovers in Delaware Bay, putting them at risk of further population declines.

Linda Ulrich
blulrich31@comcast.net

From: Madison Kitchen
To: Comments
Subject: [External] Horseshoe Crab Draft Addendum VIII
Date: Friday, September 23, 2022 9:49:08 AM

Good morning,

Based on the scientific data presented by the Delaware Center for Inland Bays, I do not support opening horseshoe crab harvest up to female crabs. The intense development pressure that southern Delaware is experiencing is and will continue to adversely affect the water quality of our shores, which in turn impacts habitat for these animals. Female crabs lay millions of eggs which sustains the population currently being harvested, therefore should not be taken out of the system as bait.

Please do not pass this addendum.

Madison Kitchen

From:	Lynn Ebeling
To:	Comments
Subject:	[External] horseshoe crab draft addendum VIII
Date:	Sunday, September 11, 2022 1:10:08 PM

I'm writing to tell you that I oppose the ASMFC's proposal to increase the harvest of horseshoe crabs, including the harvesting of female crabs. Tis increase is irresponsible and will put the red know at risk of further population decline.

Sincerely, Lynn Ebeling

From: Lowell Lysinger
To: Comments
Subject: [External] Horseshoe crab protections
Date: Tuesday, September 27, 2022 2:31:12 PM

To Whom it may concern,
Please take steps to further protect horseshoe crabs in our region.

This summer I participated in a rescue where thousands of the crabs were washed into the marshy areas in the Delaware bay area due to abnormally high tides. The tides created giant washouts that swept them out of the bay and into the marshes. We saved lots of crabs but sadly had to leave hundreds if not thousands behind to bake in the sun and die.

I observed many more male crabs than female crabs and I fear that anything that harms female crabs could definitely impact their population.

The tides are very likely historically big because of climate change and this combined with other human cause threats to their survival - like habitat loss, harvesting for bait, etc. and should be factored into the decision on whether or not they should be harvested without a collapse in their population.

Please take steps to further protect this valuable animal.

Thanks,

Lowell Lysinger Jr. and Family
1551 Pinewind Dr.
Alburtis PA, 18011
215-387-6229

From:	Lonnie Autry Jr.
To:	Comments
Subject:	[External] Horseshoe crabs
Date:	Friday, September 30, 2022 10:02:25 PM

The Atlantic States Marine Fisheries Commission,

Please do not increase, or rather decrease the quotas for horseshoe crab harvesting on your Horseshoe Crab Fishery Management Plan. In these times of declining numbers in crabs and critically dependent birds, it is incredulous that an increase is being considered.

Lonnie Autry Jr.
New Castle, NH

From: Margaret Sisson
To: Comments
Subject: [External] Horseshoe Crab Draft Addendum VIII
Date: Thursday, September 29, 2022 7:35:38 PM

I oppose the Atlantic States Marine Fisheries Commission's (ASMFC) proposal to increase the harvest of horseshoe crabs, including a harvest of females for the first time in over a decade. This action will have a significant impact on the federally threatened Red Knot and other shorebirds that depend on horseshoe crab eggs during spring migration stopovers in Delaware Bay, putting plummeting shorebird populations at risk of further declines and extinction.

There is no compelling need for this increased harvest in the face of killing off other species and harming decimated populations of horseshoe crabs themselves which are an ancient species important to the ecology of the region you are responsible for. There are viable alternatives for medical uses and for inexpensive bait for which crabs are harvested and sold. With this proposed action ASMFC loses its credibility as attempting to protect our coastal biota, including our fisheries, to survive even in the short term.

Margaret Sisson
281 Stow Rd.
Harvard, MA 01451

From:	Margaret McMillen
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Thursday, August 25, 2022 8:41:40 AM

This message adds my voice of concern. I oppose the Atlantic States Marine Fisheries Commission (ASMFC) proposal that would endanger Delaware Bay horseshoe crabs and the migratory shorebirds (like the Red Knot) which depend on them.

"Overharvesting of horseshoe crabs by the bait and biomedical industries has put a severe strain on the ecological connection between horseshoe crabs and shorebirds like the threatened Red Knot. Although the Red Knot population is perilously low, the ASMFC has proposed allowing the harvest of female horseshoe crabs, whose eggs provide the food that fuels the final leg of the birds' journey to Arctic nesting grounds."

What is the matter with you people? Once gone, species cannot be replaced. Industries should NOT be allowed to destroy our world's environment in pursuit of more or higher profits. Humans are not alone on this planet; we are supposed to be "good stewards" of this Earth and the creatures who share it with us!

Margaret McMillen

From:	marciastutzman@netscape.net
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Sunday, September 25, 2022 7:53:36 AM

To whom it may concern:

I oppose the rule change proposed by the Atlantic States Marine Fisheries Commission (ASMFC) that recommends quotas along the Atlantic seaboard relative to the harvesting of Horseshoe Crabs.

Migrating shorebirds, including the threatened Red Knot under the federal Endangered Species Act, depend on Horseshoe Crabs. Each spring Horseshoe Crabs living in the Delaware Bay lay their eggs in the sand along the Bay's beaches. Migrating shorebirds feast on the eggs the Horseshoe Crabs lay in the sand to fuel their journey north to their breeding grounds. Gorging on nutrient-rich horseshoe crab eggs along the Delaware Bayshore allows the exhausted birds to quickly double their body weight and gain enough strength to complete their journey to nest and raise young in the north.

The ASMFC should not be allowed to switch to a new scientific model for assessing Horseshoe Crab populations, one it claims is more accurate, without actual unbiased scientific data input over years. Models are only as good as the data input into them. All models are wrong. All models can be manipulated easily to provide the answer being sought to support a decision. Speculations are not verified and validated data of what actually occurs in nature.

The new model eliminates the longstanding policy decision not allowing the harvesting of any female Horseshoe Crabs until the populations of both Horseshoe Crabs and Red Knots return to higher levels. Although the model was updated, policy safeguards are being removed. This could potentially allow the harvest of female crabs to resume.

The current ASMFC model states that no harvesting of female Horseshoe Crabs will be allowed until the population of Red Knots rebounds to 81,000 and the population of Horseshoe Crabs reaches 12 million. These numbers have not been seen in the Delaware Bay in a long time.

The ASMFC should keep the current policy protections for female Horseshoe Crabs. The ASMFC should not take any risks that may result in the extinction of Red Knots. Allowing the use of Horseshoe Crabs for bait is not worth the extinction of the Red Knot.

The document, "DRAFT ADDENDUM VIII TO THE HORSESHOE CRAB FISHERY MANAGEMENT PLAN FOR PUBLIC COMMENT" should not be approved proposed, but should return to the current policy safeguards in place for Horseshoe Crabs and Red Knots.

Sincerely,

Marcia A Stutzman
3422 Londonleaf Lane
Laurel, Maryland 20724
301-317-9698

From:	Marc Teitelbaum
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum Vlll
Date:	Sunday, September 11, 2022 11:15:13 PM

I oppose the harvest of female horseshoe crabs, which would be the first in over a decade. There was a reason for the ban on harvesting female horseshoe crabs, it could be a serious threat to the Red Knot and other birds that need the horseshoe crab eggs in order to survive. Why take a chance if it could hurt the survival of a species of birds? I also oppose the proposed increase of the harvest of horseshoe crabs in general.

Sincerely,

Marc Teitelbaum

Waretown, NJ

From: MaryEllen Noonan
To: Comments
Subject: [External] Horseshoe crab
Date: Sunday, September 4, 2022 2:33:14 PM

Please do not lift protections for Delaware bay horse shoe crabs. They are an ancient, integral part of the ecosystem that deserves to be protected. They must be protected to ensure their survival and the survival of those other species which are dependent upon them.

Sincerely,
Mary Ellen Noonan

From:	Mary Ann Levan
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Thursday, September 1, 2022 12:06:32 PM

NO NO NO NO NO NO NO NO

The Endangered Species Act provides strict protections for the rufa red knot, which is listed as threatened under the statute. The red knot's peak stopover population at Delaware Bay is at historically low numbers. Horseshoe crabs, whose eggs nourish the red knot at a critical point in its migration, have not recovered from decades of overharvest.

As crab numbers decline and red knots disappear from both Delaware and Argentina, the organization tasked with harvest management should not be toying with new models that accept harvesting of the crucial female crab resource. This is counter to the mandate of the agency, and is a short-sighted management plan. The economic gain from exploiting this resource is trivial, especially as opposed to the risk of extinction of an iconic migratory visitor the agency is bound to protect.

Now is not the time for ASMFC to revise its horseshoe crab management framework in a manner that would allow even greater harvest, including resumption of harvest of the critical female component of the population. Doing so would compound the threats facing the red knot and further jeopardize its recovery, in violation of the ESA. For these reasons, **I urge ASMFC not to approve the proposed Framework Revision.**

Mary Ann Levan
Hockessin, DE 19707

From: Matthew Swanton
To: Comments
Subject: [External] Horseshoe Crab Draft Addendum VIII
Date: Friday, September 30, 2022 1:21:37 PM

Dear Atlantic States Marine Fisheries Commission,

I am writing to you today to ask you to NOT allow female horseshoe crabs to be harvested under the new horseshoe crab management plan.

We need the females to continue to lay thousands of eggs every year to keep the population growing. They are such an important part of our ecosystem. Their eggs are a critical food for so many species of birds.

There is no need to include female horseshoe crabs in this program. It should only include male horseshoe crabs. We must protect the future!

Thank you,
Matthew Swanton
443-875-7477

From:	Maureen Fitzgerald
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Friday, September 30, 2022 8:27:00 AM

I am writing to you today to ask you to NOT allow female horseshoe crabs to be harvested under the new horseshoe crab management plan.

We need the females to continue to lay thousands of eggs every year to keep the population growing. They are such an important part of our ecosystem. Their eggs are a critical food for so many species of birds.

There is no need to include females in this program. It should only include males. We must protect the future.

Thank you,

Maureen Fitzgerald
35200 Seaport Loop
Lewes, DE 19958

From: Mario Ruiz-Mesa
To: Comments
Subject: [External] Horseshoe Crabs Harvesting
Date: Thursday, September 29, 2022 9:02:59 AM

I have a house on Delaware Bay and seen the decline in horseshoe crabs over the last 39 years, harvesting them is a crazy idea, the crabs are a food source for birds and are also used in vaccine research. If they are harvested they will become endangered, and you will have to spend millions trying to bring the population back!

Mario J. Ruiz-Mesa
Vineland NJ

From: Michael Collins
To: Comments
Subject: [External] Red knot population
Date: Friday, September 16, 2022 11:58:43 AM

My wife and I are at the beach nearly every day walking our puppy and i commented only yesterday about the few sand pipers we have seen so far this year. In years past it seems they have been plentiful but this year we saw only half a dozen yesterday. After reading an article by John Watson, Jr. in the Coaster Magazine , we now understand why there has been a reduction in one of our favorite beach birds. Hopefully a law can be passed to stop or curb fishing for horseshoe crabs to help rebuild the population.

Regards,
Michael Collins
Ocean Grove, NJ

Michael Collins
Sent from my iPhone

From:	MICHEL DUSSACK
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Thursday, August 25, 2022 8:02:13 PM

Opose

Sent from my iPhone

From:	Beanyo Cat
To:	Comments
Subject:	[External] Horseshoe Crab harvesting
Date:	Friday, September 30, 2022 4:42:23 PM

It is shortsighted and destructive to expand the harvesting of horseshoe crabs. If anything, we should be doing more to limit the harvest. The crabs are crucial for migrating birds. Where is our sense of stewardship and responsibility? If fisherman want to harvest them - they must be protected now so numbers can increase. Additionally, expanding the collection to include females is clearly not a vision for the future.
I urge the ASMFC to think longer term and more responsibly regarding the protection of this remarkable species.
Thank you.
Michele Brisson

From: Nancy Mancison
To: Comments
Subject: [External] Horseshoe crab
Date: Sunday, September 11, 2022 11:35:59 AM

I join NJ Audubon society in opposing the Atlantic States Marine Fisheries proposal to increase the harvesting of horseshoe crabs including the increase of females in over a decade.

Thank you for your consideration
Nancy Mancison

Sent from my iPhone

From:	Dan Kuntz & Nancy Burns
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Tuesday, September 13, 2022 10:42:50 PM

I oppose the ASMFC proposal that would allow the harvest of female horseshoe crabs in the Delaware Bay region. Continuing population declines of shorebirds that rely on horseshoe crab eggs during spring migration--particularly the federally threatened red knot--provide strong evidence that the existing moratorium needs to continue. Please protect the crabs, which play a vital role in this fragile ecosystem.

Nancy Burns
150 Locust Ave.
Hamilton, NJ 08610

From: nsleator@gmail.com
To: Comments
Subject: [External] Horseshoe Crab Draft Addendum VIII
Date: Tuesday, September 13, 2022 3:20:35 PM

Dear ASMFC,

I am opposed to revising your standards for harvesting female horse shoe crabs for bait.

Protecting this species is critical to our ecosystem, and they are already at risk.

Nancy Sleator

Sent from my iPhone

From:	Molly Wiltshire
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII- public comment in opposition
Date:	Tuesday, August 23, 2022 11:52:07 AM

Public Comment- Opposition to ASMFC proposed change to harvest controls for horseshoe crabs

We are ignorant in our desire to allow INDUSTRIES to do what's best for them while steamrolling OUR environment, OUR habitat, and OUR ecosystems. Enough! I am sick of industry playing games to force through changes that harm us all.

The conservation targets for horseshoe crabs have not been met. By continuing to overharvest these precious species, industry is causing knock-on effects to shorebird populations that rely on the crabs as a crucial food source.

This proposal of the Atlantic States Marine Fisheries Commission (ASMFC) proposal that would endanger Delaware Bay horseshoe crabs and the migratory shorebirds (Red Knots! Hello! Super important!) that depend on them.

Please do not change the horseshoe crab harvest controls to give ASMFC more control to devastate our environment and our species. I don't want this change. I want our beautiful shore ecosystem to improve, not worsen.

I live close to the Cape May bay shore and see these changes in real time. Strong opposition to this proposed addendum.

Regards,

Molly L Wiltshire
139 Ridgewood Ave
Villas, NJ

"What befalls the earth, befalls
all the sons of the earth."

From:	Monica Cardoza
To:	Comments
Subject:	[External] Horseshoe crab harvest
Date:	Sunday, September 4, 2022 3:47:26 PM

Hello,

Bait is replaceable. Horseshoe crabs and shorebirds are not replaceable.

I respectfully request that protections for these creatures not be weakened.

It’s not just about fishermen and women, who certainly can find other types of bait. It’s about the folk who come to the shore for birding, and they spend money to enjoy that hobby, staying in lodging and eating in restaurants. You want to increase tourism? Focus on all groups, not just one.

Thank you for your time.

Monica Cardoza

From:	Norman Torkelson
To:	Comments
Subject:	[External] Horseshoe Crab Harvesting
Date:	Tuesday, September 13, 2022 3:09:54 PM

You’ve got to be kidding!

Leave the horseshoe crabs alone to their own natural devices.

Mother Nature did not evolve these marvelous creatures over millions of years, only to be harvested for fish bait

Their eggs are an important food source for the migrating birds that stop here in our beautiful Delaware River Valley

STOP THE FOLLY for $$$

Ban the harvesting

Sincerely

Norman Torkelson
18 B Risler Street
Stockton, NJ 08559

Sent from my iPhone

From:	Pat Catanzariti
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Wednesday, September 28, 2022 1:54:25 PM

To whom it may concern,

I'm writing to beg, plead on behalf of the female horseshoe crabs to not harvest them for fishing or the biomedical industry!

For eleven years I had the amazing privilege to live on Slaughter Beach and see first hand the beauty of these gentle creatures. These are the oldest living creatures on the planet. The value that these crabs bring to the world is still being explored and yet man continues to exploit them! When will we learn! The symbiotic relationship with the Red Knot bird population is critical, not to mention their extreme value their blue blood provides to protect us from humans in every saline bag. And more is still being researched about their extraordinary blood.

If all that is being proposed is to NOT capture/kill the female crabs so that their population can grow and be sustainable, then this is a small ask!! PLEASE!

And quite frankly, I'm not quite understanding why the fishing industry needs these gentle creatures for BAIT! Really? Is there nothing else that this industry can use as a substitute? Do they really need to kill these creatures that provide both an environmental and biomedical need for the planet?

Please, please stop this massacre!

Thank you,
Pat Catanzariti

From: Pam Horovitz
To: Comments
Subject: [External] Horseshoe Crab Harvest
Date: Sunday, September 11, 2022 7:04:57 PM

Dear members of the ASMFC.

I just found out that local fishermen want to change the law so that they can increase their haul of horseshoe crabs to USE FOR BAIT. That's not a good enough reason to threaten both the crabs and the shore birds like the Red Knot that depend on horseshoe crab eggs during migration.

I want to support our fishermen, but I also want to support the birds and marine life that make our shore diverse. Therefore I urge the members of the Atlantic States Marine Fisheries Commission to maintain critical protections for horseshoe crabs.

Thank you for considering my comments.

Pam Horovitz
517 Fislerville Rd
Mullica Hill, NJ 08062
Cell 856 745 5395

From: Pam Young
To: Comments
Subject: [External] Please do not allow this!
Date: Friday, September 2, 2022 7:17:01 AM

Female horseshoe crabs should not be used for bait! Please do not allow this!

Pam Young

Sent from my iPhone

From:	Peggy marshaleck
To:	Comments
Subject:	[External]
Date:	Sunday, September 11, 2022 11:30:30 AM

Good morning!
Please be considerate of the migrating red knots & the need for the horseshoe crabs future.
Yes, we've seen more crabs this year but not enough to change the law. This food source is critical and we truly hope you'll consider this before any decision.
Thank you for your time!
Joe & Peggy M
Narberth, PA

Sent from my iPhone

From:	Patti Drago
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Wednesday, September 28, 2022 12:18:30 PM

We support the recommendation by the DE Center for Inland Bays that only male horseshoe crabs be harvested.

Respectfully submitted,

Patti Drago & Rich Weissmann
17695 Venables Drive, Lewes, DE 19958i

From:	Paul West
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Tuesday, September 13, 2022 10:32:58 AM

I am writing to express my opposition to the Atlantic States Marine Fisheries Commission's proposal to increase the harvest of horseshoe crabs, including a harvest of females for the first time in over a decade.

This action will have a significant impact on the federally threatened Red Knot and other shorebirds that depend on horseshoe crab eggs as a food source during spring migration stopovers in Delaware Bay.

Any reduction in food sources will place additional stress on migrating shorebirds, which has the potential of resulting in further population declines of these species.

From:	Patricia Bernard
To:	Comments
Subject:	[External] Please NO!
Date:	Sunday, September 11, 2022 10:43:25 PM

Please Please Please NO NO NO on the proposal on the changes to the horseshoe crab protections. I will do anything I can to prevent enacting this newest proposal.
Horible horrible Horrible------> Atlantic States Marine Fisheries Commissions

From:	Peter Boice
To:	Comments
Subject:	[External] Proposed change to horseshoe crabs harvest limit
Date:	Thursday, September 15, 2022 3:25:32 PM

I strongly opposing the Atlantic States Marine Fisheries Commission’s proposal to increase the harvest of horseshoe crabs, including a harvest of females for the first time in over a decade. This action will have a significant impact on the federally threatened Red Knot and other shorebirds that depend on horseshoe crab eggs during spring migration stopovers in Delaware Bay, putting them at risk of further population declines.

Based on field work, including egg density studies conducted by the Delaware Bay Shorebird Project and other organizations, it is clear that horseshoe crab populations have not recovered from their population crash in the 1990s. Egg density data is the most reliable indicator of the horseshoe crab population, and importantly, it is the most reliable index of value for red knots and other shorebirds. Yet the Commission has never included these surveys in its modeling. The Commission also does not include field survey data for Red Knots, and these show that Red Knot populations are at historic lows.

To increase the harvest rate now would be extremely foolhardy!

Yours

Peter Boice

From: plizardman@aol.com
To: Comments
Subject: [External] Horseshoe Crab Draft Addendum VIII
Date: Wednesday, August 24, 2022 9:02:58 AM

Greetings,

I encourage you to discard this addendum. The preservation of the littoral ecosystem needs a healthy population of horseshoe crabs, and already we face dwindling numbers of them. The harvesting of breeding ready females is added insult to the already damaging effects of global warming, rising water temperature and nitrogen fueled oxygen depletion of our estuaries. It is clearly time to minimize disruption of horseshoe crab stocks until they rise back up to sustainable levels.

Thank you,
Philip W. Romano

3316 149th Place,
Flushing NY 11354
(917) 561 9426

From:	Ramona Gault
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Sunday, September 4, 2022 2:53:01 PM

Dear Ms. Starks,

The Atlantic marine fisheries commission has proposed a change in the rules governing the protection of horseshoe crabs. They want to allow the “ harvesting” of female horseshoe crabs. Scientists say the horseshoe crab population is already dangerously low. And the shorebird population that feeds upon their eggs is also dangerously depleted.

Synthetic substances are available now and widely used outside the US to replace horseshoe crab blood for medical uses. It is not necessary to harvest horseshoe crab blood. Also, using horseshoe crabs as bait is a short-sighted, unnecessary practice that threatens the ecological integrity of shorelines, including the survival of red knots. I oppose the fisheries’ change of policy and urge them to vote no to horseshoe crab addendum VII.

Thank you.

Ramona Gault

From:	Zinnia Cardamomum
To:	Comments
Subject:	[External] In support of red knot protection
Date:	Friday, September 2, 2022 8:50:05 PM

Greetings!
We are a mother and father who support safeguarding both horsheshoe crabs and the red knots who depend upon them. We don’t want to take any risks with the possible extinction of red knots.

In the 1980s, about 90,000 red knots were counted each spring along their Delaware Bayshore stopover. Horseshoe crab harvesting exploded in the 1990s, going from an annual harvest of 100,000 in 1991 to 2.5 million by 1998. Horseshoe crab populations crashed and, in turn, red knot numbers plummeted to about 13,000 birds in the mid-2000s.

After New Jersey’s moratorium went into effect, the situation seemed to slowly improve, with more than 30,000 red knots counted in 2018 and 2019. But the population dropped sharply again, with only 6,800 red knots counted in 2021 and 12,000 this year.

The reasons behind the recent low numbers aren’t fully understood, but to Dillingham they unequivocally point to a need to do everything possible to protect the birds.

“We know that red knot numbers are so depleted that they’re listed as threatened,” he said. “We don’t want to take any risks we can avoid. One way we can protect them is to not allow harvests of horseshoe crabs, because they provide the eggs the birds need.”

Female crabs need to be so abundant that they cover the beach and accidentally dig up other nests while depositing their own eggs. The eggs that are disturbed by successive waves of nesting female crabs float along the beach, becoming the food supply that powers the birds’ migration. It makes no biological sense to harvest female crabs until excessive crab eggs and birds return to their 1980s density.

Thank you for your time and consideration and thank you for protecting the beautiful wildlife we share the world with. Rebecca

From:	Caitlin Starks
To:	Comments
Subject:	FW: [External] Comments on ASMFC draft addendum-Crab Fishery Plan
Date:	Friday, September 30, 2022 9:10:06 AM

From: pibe1205 <pibe1205@aol.com>
Sent: Thursday, September 29, 2022 9:09 PM
To: Caitlin Starks <cstarks@asmfc.org>
Subject: [External] Comments on ASMFC draft addendum-Crab Fishery Plan

Dear Ms Starks-
Please reconsider implementation of plan ref killing more Horseshoe Crabs.
If Her Deepness Dr Sylvia Earle recommends protection of this species, Horshoe Crabs, why can we follow her exceptional scientific and humanistic view on this issue.

Sincerely,

Pilar B Stack
Sent from the all new AOL app for iOS

From: Rebecca
To: Comments
Subject: [External] Horseshoe Crab Draft Addendum VIII
Date: Friday, September 2, 2022 8:43:41 PM

Hi there!!

I am a young person who cares about protecting wildlife. I think that we don’t want to take any risks with the possible extinction of red knots.

In the 1980s, about 90,000 red knots were counted each spring along their Delaware Bayshore stopover. Horseshoe crab harvesting exploded in the 1990s, going from an annual harvest of 100,000 in 1991 to 2.5 million by 1998. Horseshoe crab populations crashed and, in turn, red knot numbers plummeted to about 13,000 birds in the mid-2000s.

After New Jersey’s moratorium went into effect, the situation seemed to slowly improve, with more than 30,000 red knots counted in 2018 and 2019. But the population dropped sharply again, with only 6,800 red knots counted in 2021 and 12,000 this year.

The reasons behind the recent low numbers aren’t fully understood, but to Dillingham they unequivocally point to a need to do everything possible to protect the birds.

“We know that red knot numbers are so depleted that they’re listed as threatened,” he said. “We don’t want to take any risks we can avoid. One way we can protect them is to not allow harvests of horseshoe crabs, because they provide the eggs the birds need.”

Female crabs need to be so abundant that they cover the beach and accidentally dig up other nests while depositing their own eggs. The eggs that are disturbed by successive waves of nesting female crabs float along the beach, becoming the food supply that powers the birds’ migration. It makes no biological sense to harvest female crabs until excessive crab eggs and birds return to their 1980s density.

Thanks for your time and consideration.

Take care,

Rebecca

From: Rhonda Anderson
To: Comments
Subject: [External] Horseshoe Crab Draft Addendum VIII
Date: Tuesday, September 6, 2022 7:08:56 PM

Hello,

I am against the raising of quotas on the killing of horseshoe crabs, either for their use as bait or their use in the pharmaceutical industry. In these times of declining numbers and increased environmental stress, it seems unbelievable that this is even being considered.

Thank you,
Rhonda Anderson

From:	Rich Venuti
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Tuesday, August 23, 2022 9:06:10 PM

- The ASMFC must provide the modelling and analysis which justifies the expansion of the harvest of female horseshoe crabs for the public to review.
- The ASMFC should ensure that the original safeguards in their harvest policies prohibiting female horseshoe crabs from being harvested until Red Knot numbers recover are included in any new policies.

Please keep the current limits in place, especially the zero harvest of female crabs. Thank you!

From:	Richard Harvey Swaine
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Thursday, September 29, 2022 3:49:06 PM

To Caitlin Stacks & the ASMFC:

I have read the Draft Addendum VIII to the Horseshoe Crab Fishery Mgmt Plan. I came away from this document feeling some alarm, feeling convinced that a decision to permit the harvesting of female horseshoe crabs has already essentially been made and that there's little the public at large can do to stop it.

Be that as it may, I would like to go on record and protest such a step; the harvesting of these crabs should be halted until, at the very least, populations return to historic levels. The crabs themselves and the birds that depend on their eggs are an essential part of our natural heritage and should be protected.

With the underlying data supporting the new draft addendum kept secret, how can the public not assume the worst? How can the public comment on a proposal when you are not releasing the data supporting the types of increases being proposed? With both Red Knots and horseshoe crabs at historically low numbers it would be lunacy to proceed.

As you well know, Red Knot populations are at historic lows. In the 1990s, more than 90,000 could be found along Delaware Bay. This year, only 12,000 were counted, and in 2021, the number was estimated at an all-time low of 6,800. Evidence is now emerging that Red Knots are bypassing the Delaware Bay stopover altogether in search of life-sustaining food sources elsewhere. This makes their migratory journey all the more perilous.

The killing of female horseshoe crabs all but assures that their population levels will never rebound. This is an awesome responsibility for any group of human beings to take. To knowingly risk the elimination of these creatures, the crabs and the birds dependent upon them, is a choice nobody should be willing to make.

Thank you.

Richard Harvey Swaine
55 Cleveland Avenue
Highland PArk, NJ 08904

(732) 322-6744

From:	Richard Price
To:	Comments
Cc:	Erin Nicklow; Ian Price; Tom Price; Holly Preputnick
Subject:	[External] Opposition to The Atlantic States Marine Fisheries Commission"s Proposal to Allow the Increased Taking of Horseshoe Crabs
Date:	Sunday, September 18, 2022 9:12:56 AM

Dear Administrators:

As a frequent angler and birder who fishes and birds in the Delaware Bay vicinity, I would like to express my opposition to the proposal to allow the increased taking of Horseshoe Crabs. I believe based on scientific data that your proposal will further endanger the vital existence of several bird species like the Red Knot, which depend on the eggs of this invertebrate for sustenance during their long and exhausting migrations.

These birds have survived for millennia based on an adequate supply of nourishment provided by the Horseshoe crabs. Their existence depends on a delicate balance and your current proposal would upset that balance. Please do the right thing and protect the interest of these invertebrates and the creatures that depend on them. Do not put commercial gains ahead of conservation of species at a time of great need for the environment.

Thank you for your attention to this matter.

Sincerely,

Richard D. Price, Ed. D.
7293 Olde Mill Road
Harrisburg, PA 17112

From: R. Peter Mogielnicki
To: Comments
Subject: [External] Horseshoe crab
Date: Tuesday, August 16, 2022 3:22:27 PM

Dear Commission members,

I write in favor of continuing the ban on harvesting female horseshoe crabs.

As I am sure you know, horseshoe crab eggs are a critical source of calories, fat and nutrition for migrating shorebirds. I participated in a breeding horseshoe crab survey in Rhode Island this spring and early summer and virtually the only places I observed shorebird activity along the shores of our coastal lagoons were places where there was evidence of recent horseshoe crab mating activity.

Shorebird populations are far from stable. Red knots, in particular, are experiencing a dramatic decline largely due to poor nutrition during their northward migration which is known to be largely dependent on a rich supply of horseshoe crab eggs. During our surveys, we saw many instances of a female crab being pursued by multiple males so it is the female crabs that seem to be in short supply. And as far as I know, female horseshoe crabs are the only ones that lay the eggs!

One final point. As far as I know, there is little data about how young horseshoe crabs fit into the diets of multiple marine fish. Maximizing their numbers by banning the harvest of female crabs is important for all sorts of reasons.

Thank you very much,

Sincerely,

Robert Peter Mogielnicki
26 Dowd Drive, Charlestown, RI 02813
and
3741 NE 35th Avenue, Portland, Oregon, 97212
Cell (860)869-8766

From:	mark_miano@everyactioncustom.com on behalf of Richard Miano
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Friday, September 30, 2022 11:57:42 PM

Dear Atlantic States Marine Fisheries Commission,

As a supporter of birds and the places they need to thrive, I am writing to strongly oppose the Atlantic States Marine Fisheries Commission's (ASMFC) proposed Addendum VIII Interstate Horseshoe Crab Fishery Management Plan, which increases the number of horseshoe crabs harvested for use as bait and reopens the harvest to include female horseshoe crabs.

The decline in horseshoe crab populations is concerning along the Atlantic Coast. It is especially important along the Delaware Bay, given its importance as a horseshoe crab spawning area and important stopover point for migrating red knots. Several indicators show that both horseshoe crab populations and the population of red knots, which depend their eggs as a source of food, are well below recovery thresholds.

I urge the commissioners to vote no on Addendum VIII for the following important reasons:

1. Horseshoe crab populations remain at historic lows, and their ongoing use both for bait threatens their ability to recover to their historic population levels.
2. Red knot populations are at all-time lows from both climate change and increasing scarcity of the food needed to fuel their 9,000-mile migration.
3. There are alternatives to using horseshoe crabs for the bait industry
4. Nature-based tourism and associated economic activity in the coastal Mid-Atlantic region is vital to local economies that depend on healthy ecosystems and the abundance of horseshoe crabs and the red knot

It is concerning that the proposed revision would likely trigger a resumption in the harvest of female horseshoe crabs, which would make recovery of the species virtually impossible. Under the current ASMFC framework, there is no female crab harvest until female abundance reaches 11.2 million crabs or until the Delaware Bay total red knot stopover population reaches 81,900 birds. Neither red knot nor horseshoe crab populations are anywhere close to satisfying either metric, nor yet, under this addendum, female harvest could be allowed.

The joint collapse of red knots and horseshoe crabs is not inevitable. However, the draft addendum propels them closer to that grim reality. I urge you to vote no on Addendum VIII in order to protect the red knot and the places they need to survive, protect healthy ecosystems in the Delaware Bay, and to support local economies dependent on nature-based tourism that is such a critical component of the communities surrounding the Delaware Bay.

Sincerely,
Mr. Richard Miano
4413 Lowell St NW Washington, DC 20016-2748
mark_miano@hotmail.com

From: Rob Wilson
To: Comments
Subject: [External] Horseshoe Crab Draft Addendum VIII
Date: Sunday, September 11, 2022 4:01:01 PM

Did I read this correctly? This addendum is to RAISE?? the limit on horseshoe crab harvest? For bait?? Are you kidding me? There should be no harvest whatsoever until crab and bird populations rebound. There are a multitude of viable alternatives. Please reconsider this reckless and harmful proposal.

Thanks,

Rob Wilson

From:	Robert Graffin
To:	Comments
Subject:	[External] Horseshoe Crab Protection
Date:	Friday, September 16, 2022 8:34:48 AM

Hello,

Please do NOT allow harvesting of horseshoe crabs per the proposed update to regulations. I urge you to REJECT the new proposal and to continue to protect this species.

Sincerely,
Dr. Robert Graffin

From:	Ron V Marino
To:	Comments
Subject:	[External] horseshoe crabs
Date:	Tuesday, August 16, 2022 5:02:20 PM

Please do not allow overfishing of these creatures. They have been in decline since I first met them years ago!
Dr Ronald Marino

Sent from Mail for Windows

From:	Sallie McElrath
To:	Comments
Subject:	[External] Crabs, Red Knots
Date:	Tuesday, September 27, 2022 7:32:51 AM

Dear Atlantic States Marine Fisheries Commission,

Proceeding with the implementation of the 2021 Adaptive Resource Management Framework Revision would be detrimental to red knots and a host of other species that rely on horseshoe crab eggs to fuel their migration.

Horseshoe crabs are on nature's oldest mysteries. They are hard and scary looking but completely harmless. Red Knots are beautiful migrating birds that have co-existed with the crabs for a very long time. Please do not put them more at risk with this new framework. Protect female horseshoe crabs. No bait!

Barring a full moratorium on horseshoe crab harvest, Option A under section 3.0 (Management Options) would preferable to either possibility of Option B.

Regards,
Sallie McElrath
from Hyattsville MD and a frequent visitor to Delaware for birding

From:	Salome Ward
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Friday, September 2, 2022 2:52:22 AM

To Whom It May Concern:

Horseshoe crabs are a vital species for the ecosystem and contribute to the survival of multiple species including the threatened red knot sandpiper. The current ASMFC model takes into account the link between horseshoe crab eggs and the survival of the red knot. The proposed addendum undercuts this connection and removes protection for female horseshoe crabs which is unacceptable. The population of red knot sandpipers and horseshoe crabs has not recovered nearly enough as per current ASMFC guidelines. Any addendums should be to strengthen recovery and preservation of both species, not weaken it.

Horseshoe crabs are modern day prehistoric creatures. It would be a travesty for them to meet their demise due to our careless over-harvesting, which would also seal the fate of the red knot. Please do not adopt the Draft Addendum VIII.

Sincerely,
Salomé Ward
Westfield, NJ

Sent from my iPhone

From:	Royden Saah
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Thursday, September 15, 2022 11:22:43 PM

Dear Dr. Starks and Atlantic States Marine Fisheries' Commission,

PLEASE VOTE NO on Addendum VII –

I am a medical diagnostic microbiologist who has strengthened the entire Guyana Public Health Laboratory Network, managed emergency response teams in the North Carolina State Public Health Laboratory, and lead the Doctors Without Borders effort to build an Ebola resistant hospital for children in Liberia during the 2014-2015 West African Ebola Epidemic and evaluated CDC in improvement efforts around emergency testing response.

Except for brief stints for COVID response(with WHO and private practice), I now work in the field of biotechnology for use in conservation. I am concerned about the continued reliance of a product (horseshoe crab blood) that unnecessarily impacts both crab populations and the ecosystems in which these crabs have evolved. The use of synthetic products, whenever possible, will decrease pressures on ecosystems in general and assist in the recovery of vulnerable shorebird populations, such as the Red Knot. In this case, synthetic products are available as an alternative to crab blood.

Again, I urge you to vote no and allow the market to use sustainable products for medical diagnostics whenever possible.

With Appreciation,
Royden Saah

J. Royden Saah (he/him)
GBIRd Program Coordinator
Genetic Biocontrol of Invasive Rodents Program (GBIRd)
Island Conservation
Skype: roydensaah
Phone: +1 919 520-5954

From:	Russ Falardeau
To:	Comments
Subject:	[External] Horseshoe crab draft addendum VIII
Date:	Sunday, September 18, 2022 9:06:51 PM

From Russ Falardeau, West Wareham MA

Copy from: Horseshoe Crab Recovery Coalition.

The Horseshoe Crab Recovery Coalition strongly opposes the Atlantic States Marine Fisheries Commission's (ASMFC) plan to change its Horseshoe Crab Fishery Management Plan, a move that would raise quotas on the killing of horseshoe crabs for use as bait by potentially reopening the harvest to include female horseshoe crabs. ● We remain concerned that the underlying data supporting the new draft addendum to the plan has still not been released to the public, so that conservation groups and concerned citizens have no way to truly understand the science on which the new proposal is based. ● Under the current framework there is no female crab harvest until female abundance reaches 11.2 million crabs or until the Delaware Bay total red knot stopover population reaches 81,900 birds. The proposed revision would allow the resumption of the female harvest, even though neither the red knot nor female horseshoe crabs of Delaware Bay are close to satisfying either metric. ● How can we comment meaningfully on a proposal when you are not releasing the data supporting the types of increases being proposed? With both red knots and horseshoe crabs at historically low numbers, we cannot take the commission's assertions on faith. ● Based on field work, including egg density studies conducted by the Delaware Bay Shorebird Project and other organizations, we do not believe that horseshoe crab populations are recovering from their population crash in the 1990s. Egg density data is the most reliable indicator of the horseshoe crab population, and importantly, it is the most reliable index of value for red knots and other shorebirds. Yet ASMFC has never included these surveys in its modeling. Making matters worse, ASMFC also does not include field survey data for Red Knots, and these show that Red Knot populations are at historic lows. In the 1990s, more than 90,000 could be found along Delaware Bay. This year, only 12,000 were counted, and in 2021, the number was estimated at an all-time low of 6,800. Evidence is now emerging that Red Knots are bypassing the Delaware Bay stopover altogether in search of life-sustaining food sources elsewhere. This makes their migratory journey all the more perilous. ● Shorebirds like the red knot are plummeting toward catastrophe, with their declines representing the world's number one conservation crisis facing birds today. And the killing of female horseshoe crabs all but assures that their population levels will never rebound. ● The joint collapse of red knots and horseshoe crabs is not inevitable. But this proposal propels them closer to that grim reality.

My Comments:
Please Please do all you can to protect the horseshoe crabs including keeping the prohibition of harvesting female horseshoe crabs in Delaware. This prohibition (not to harvest of female crabs) should be applied to the whole east coast. Through the 50s to 90s horseshoe crabs were abundant. You would see everytime you went to shoreline. The shoreline would be littered with sheds. When I walk on a tidal flat I would always see horseshoe crab tracks. Today see a horseshoe crab is a real treat, we just don't see them. I don't find any sheds either.

Horseshoe crabs are really in trouble. We have no understanding of the role they play in the ecosystem. We used to have crystal water in the bay and abundant eel grass. The eel grass decline began at same time commercial harvesting horseshoe crabs began. Is the eel gras scarcity due to removing horseshoe crabs from the ecosystem?

Why are we even allowing the commercial harvest of horseshoe crabs, just to make a few men rich. Remember rich men die other rich men take the place, but once the horseshoe crab is gone it is gone forever. Remember the Passenger Pigeon.

Thanks for listening

Russ Falardeau

From:	Ruth MacNutt
To:	Comments
Subject:	[External] Horseshoe crab harvest
Date:	Thursday, September 29, 2022 3:51:43 PM

I am against raising the quota
Ruth MacNutt
ruth.macnutt@gmail.com

From: sam zappala
To: Comments
Subject: [External]
Date: Sunday, September 11, 2022 12:07:38 PM

Sent from Mail for Windows

Because of the GREED of humans; species are dying out. As a result of Earth's condition; no lives will exist.

WAKE-UP.

From:	Sandra A. Unger
To:	Comments
Subject:	[External] Horseshoe crabs
Date:	Sunday, September 11, 2022 4:51:29 PM

I vehemently oppose relaxing limits on horseshoe crab harvesting.

From:	Scott S
To:	Comments
Subject:	[External] Moratorium on Taking Female Horseshoe Crabs for Fish Bait.
Date:	Wednesday, September 7, 2022 7:55:53 AM

Please do not Lift the Moratorium on Taking Female Horseshoe Crabs for Fish Bait.

Scott Scheidt
Paoli, PA

Sent from my iPhone

From:	Sandra Folzer
To:	Comments
Subject:	[External] No harvesting of female horseshoe crabs
Date:	Friday, September 2, 2022 9:12:28 AM

Please do NOT allow harvesting of female horseshoe crabs. Horseshoe crabs have been around since prehistoric times and they are important for our environment, such as providing food for birds. Already we abuse them terribly for medical research since many die after their blood has been taken. No more injuries to these important marine specimens.
Please.
Sincerely,

Dr. Sandra Folzer
209 Rex Ave
Philadelphia, PA 19118

From:	Scott Chelemer
To:	Comments
Subject:	[External] Re: Horseshoe Crab harvest
Date:	Monday, September 12, 2022 10:59:39 AM

From: Scott Chelemer
Sent: Monday, September 12, 2022 10:42 AM
To: comments@asmfc.com <comments@asmfc.com>
Subject: Horseshoe Crab harvest

Dear Madam or sir,

I am writing to ask you to re-consider and in fact cancel your plan to increase the harvest allowance of horseshoe crab eggs in and around the Delaware Bay. I, along with hundreds of other birders, visit Cape May and Cumberland County annually to observe the spring shorebird migration, in particular the Red Knot flight. Increasing the harvest of an already depleted population of horseshoe crabs would further cripple the Knot population, and ultimately may cost the bird its NJ existence! This will also have an impact on the Cape May county economy, as we stay in hotels, dine in restaurants, and shop while we are in the area.

I am also sending a copy of this letter to Hon. Rep. Jeff van Drew, who I believe represents the pertinent area around the Delaware Bay.

Yours sincerely,

Scott B. Chelemer, MD
Mount Laurel, NJ

From: Sharon Rothe
To: Comments
Subject: [External] Horseshoe Crab Draft Addendum VIII
Date: Tuesday, August 23, 2022 10:43:07 AM

Horseshoe Crabs are in danger of going extinct because of overfishing. They should be protected. They are part of our circle of life. Please support the Horseshoe Crab Addendum Vlll. Too many of our species are disappearing because of industrial greed.
S. Rothe

Sent from my iPhone

From:	Sondra Wolferman
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Monday, August 22, 2022 11:52:34 AM

Dear Commissioners:

Horseshoe crabs play an essential role in the ecology of coastal communities and as such should be managed with the goal of sustaining healthy horseshoe crab populations and protecting the ecosystems upon which they, and many other marine animals, rely for survival.

Commercial fisheries using horseshoe crabs as bait for catching snails and eels must face the reality that horseshoe crabs are a finite resource whose numbers are dwindling throughout much of their range. Researchers have been working on alternative baits that are currently available to the industry. Furthermore, the market for snails and eels in the United States is relatively small, suggesting that a large portion of the catch is being exported to overseas markets, mainly Europe and Japan, leaving our coastal communities to deal with the ecological damage caused by over-harvesting of horseshoe crabs for commercial interests in the Delaware Bay and elsewhere in the mid-Atlantic region.

Likewise, the harvesting of horseshoe crabs for use in biomedical research is an antiquated practice that is no longer relevant given the alternatives to animal testing currently available to the science community. Researchers who are up to date in their fields are moving away from cruel and inhumane animal experiments toward non-animal methods that include sophisticated tests using human cells and tissues (in vitro methods), advanced computer-modeling techniques, and studies with human volunteers. A high-ranking former official with the U.S. National Institutes of Health has described experimenting on animals to help humans as "a major failure", such experiments being generally inapplicable, and in some cases harmful, to humans.

Horseshoe crabs have survived on this planet for hundreds of millions of years and deserve better than to be exploited for cruel and unnecessary medical procedures or as fish bait to support an industry that services mainly foreign markets at the expense of our local marine environments.

The annual migration of horseshoe crabs along the Atlantic coastline is a miracle of nature enjoyed by thousands of spectators in the mid-Atlantic region every spring. Let us not be the generation that drives this ancient species closer to extinction.

Thank you for the opportunity to comment.

Sondra Wolferman
Albrightsville, PA

From:	yaedescott
To:	Comments
Subject:	[External] Horseshoe Crabs draft addendum viii
Date:	Monday, August 29, 2022 3:44:44 PM

ASMFC,

Please don't change the current policy to protect the prehistoric and important survival of the horseshoe crabs. It was agreed that the prohibition on harvesting female horseshoe crabs would not be lifted until the Delaware Bay region hosts at least 81,900 Red Knots or 11.2 million female horseshoe crabs.

Neither of these scenarios has occurred, yet the ASMFC proposed changes would result in lifting the prohibition on harvesting female horseshoe crabs, further imperiling the food supply for the remaining Red Knots.

This is coming at a time when Red Knot population is far from stable. The average Red Knot count at Tierra del Fuego for 2018-2020 declined more than 75 percent from average counts in the 1980s and 2000. In 2021, only 6,800 Red Knots were counted, which is by far the lowest count since surveys began.

Scott yaede lower Raritan Watershed Association

Sent from my Galaxy

From:	Shannin Zevian
To:	Comments
Subject:	[External] Please Bin Amendment VIII : Horseshoe Crab Management Plan
Date:	Sunday, September 25, 2022 4:24:25 PM

This proposal seems completely absurd. I'm having trouble believing this is even a discussion that needs to be had. The Atlantic States Marine Fisheries Commission should reject any proposed management of horseshoe crabs that would lead to the increase in harvest of horseshoe crabs, especially if those increases includes the harvest of female horseshoe crabs.

Under the existing management framework, the commission has said that it would not allow harvest of female horseshoe crabs unless the crab population was 11.2 million crabs or the threatened rufa red knot stopover population reached 81,900 birds. Neither threshold has been met, and yet the commission is insisting on changing the population modeling that would allow a harvest increase, including the first harvest of female horseshoe crabs in decades. This makes no sense!

With red knot counts of 12,000 birds this year, up from only 6,800 last year, it defies logic that the horseshoe crab harvest should increase. More worrisome is that the public has yet to see the full details of the scientific model that justifies this harvest increase.

I hope the commission will toss Amendment VIII straight into the bin. At the very least; share the full scientific details of the model with the public & include other scientific data sources such as horseshoe crab egg density and red knot aerial surveys into the model before recommending any changes to harvest.

Thank you for your time,
Shannin Zevian, PhD

From: Stephanie Myers
To: Comments
Subject: [External] Do Not Expand Harvest on Horseshoe Crabs
Date: Wednesday, September 14, 2022 10:34:34 AM

The red knot population is not stable. Let's not put another nail in their coffin by making it harder for them to refuel during their migration. The average red knot count at Tierra del Fuego for 2018-2020 declined more than 75 percent from average counts in the 1980s and 2000. In 2021, only 6,800 red knots were counted, which is the lowest count since surveys began. Allowing female horseshoe crabs to be harvested will jeopardize the crab population, the Bay ecosystem, and the shorebird populations that are already stressed. NO expansion is the responsible way to go. Don't give in to corporate mentality.

From:	Susan Giaccone
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Sunday, September 25, 2022 9:04:11 PM

Please keep your current policy protections for female horseshoe crabs in tact.

Using horseshoe crabs for bait is not worth the risk.   Female horseshoe crabs should not be harvested.

Thank you.

From:	susan kassin
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Tuesday, August 23, 2022 5:01:13 PM

To Caitlin Starks or Whom It May Concern:

The fragile and unique ecosystem of the Delaware Bay is at risk due to the over-harvesting of horseshoe crabs.

I strongly oppose the Atlantic States Marine Fisheries Commission's proposal that would endanger Delaware Bay horseshoe crabs and the migratory shorebirds which depend on them.

Lifting the prohibition on harvesting female horseshoe crabs is a dangerous mistake. We lose these vital creatures at our own peril. Horseshoe crab blood is invaluable to medical science. In addition, the horseshoe crabs are the lifeblood for the migrating Red Knots arriving from South America.

These species are in danger of extinction, and we really need to question our priorities. Once these creatures are gone, that finality will be devastating and deadly. And the truth is that it does not have to be this way.

PLEASE DO NOT APPROVE THE HARMFUL PROPOSAL OF LIFTING PROHIBITIONS ON THE KILLING OF FEMALE HORSESHOE CRABS.

Thank you, and Sincerely,

Susan Solomon

Saint Paul, MN

From:	Stewart Rosen
To:	Comments
Subject:	[External] OPPOSED - Horseshoe Crab Draft Addendum VIII
Date:	Tuesday, August 23, 2022 10:38:00 AM

To whom it may concern:

I vehemently oppose your proposed amendment allowing increased harvesting of horseshoe crabs by the bait and biomedical industries which will put a severe strain on the ecological connection between horseshoe crabs and shorebirds like the threatened Red Knot. Although the Red Knot population is perilously low, the ASMFC has proposed allowing the harvest of female horseshoe crabs, whose eggs provide the food that fuels the final leg of the birds' journey to Arctic nesting grounds.

Stewart Rosen
210 5th Street, Unit
Hoboken, NJ 07030
917-923-9995

From:	Comments
To:	"delawareaudubon@gmail.com"
Cc:	Caitlin Starks
Subject:	RE: [External] Re: ASMFC extreme overreach
Date:	Monday, August 29, 2022 10:31:53 AM

Thank you for providing input on Draft Addendum VIII to the Interstate Fishery Management Plan for Horseshoe Crab. Your comments will be shared with the Horseshoe Crab Management Board for consideration at the next Board meeting, which will likely occur this Fall. Upon considering public input, the Board will select final management measures and consider final approval of Addendum VIII.

Caitlin Starks (she/her) | Senior Fishery Management Plan Coordinator
Atlantic States Marine Fisheries Commission
1050 N. Highland Street, Suite 200 A-N
Arlington, VA 22201
Phone: 703.842.0740 | Fax: 703.842.0741
cstarks@asmfc.org | www.asmfc.org

From: Delaware Audubon <delawareaudubon@gmail.com>
Sent: Friday, August 26, 2022 6:51 AM
To: comments@asmfc.org
Subject: [External] Re: ASMFC extreme overreach

The attached photo shows the only Red Knot seen at Mispillion Harbor on May 15, 2022, which under previous conditions was the approximate peak of the Red Knot stopover at that location. The charismatic Red Knot is now bypassing the Delaware Bay because the continuing horseshoe crab harvest has disrupted the Bay's delicate natural balance, resulting in a dearth of horseshoe crab eggs on the beach when they are needed by the Red Knot. The scarcity of horseshoe crab eggs has increased the hazard of the Red Knot's epic migration, putting the rufa subspecies at increased risk of extinction.

Delaware officials need to acknowledge that the "Adaptive Resource Model" of the Atlantic States Marine

Fisheries Commission, on which the state has been basing its horseshoe crab policy, has not been achieving the model's stated design of Red Knot protection. Because the Delaware Bay horseshoe crab harvest has continued uninterrupted, the Red Knot is showing no signs of recovery from the catastrophic period of horseshoe crab overharvest of the 1990s. The same interests that were behind that disaster are now making the cavalier proposal for a further expansion of the harvest.

Based on actual observations rather than controversial computer model estimates, extinction of the rufa subspecies is now an imminent possibility unless responsible and resolute action is taken by Delaware public officials.

It was a mistake that-the State of Delaware did not implement a horseshoe crab harvest moratorium in 2014 when the Red Knot was listed as Threatened under the Endangered Species Act. That oversight needs immediate correction. Delaware must implement a full bait harvest moratorium, consistent with the one in place in New Jersey, until the Red Knot is removed from Endangered Species Act protection. The fishing industry will not face adverse consequences once the take of horseshoe crabs is prohibited, since there are alternatives to using horseshoe crabs as bait for eel and whelk.

The horseshoe crab bait harvest moratorium must be a priority issue for the 2023 Delaware legislative session. Delaware officials will be recognized worldwide as environmental champions if they have the courage to take the necessary action to prevent the iconic Red Knot from sliding to extinction. They must also keep in mind that if inaction results in the demise of the Red Knot, there is no reset button.

New York Times - Red Knots in Steepest Decline in Years, Threatening the Species' Survival

Steve Cottrell
President, Delaware Audubon Society

On Sun, Aug 14, 2022 at 8:32 AM Delaware Audubon <delawareaudubon@gmail.com> wrote:

> It is astounding that the ASMFC is now considering recommending increasing the take of an essential food source of a shorebird listed as Threatened under the Endangered Species Act. The Red Knot was listed as Threatened by the U.S. Fish and Wildlife Service in 2014 and is showing no visible signs of recovery. The same fishing interests that caused the population crash of the Red Knot in the 1990s are now proposing to expand the slaughter of horseshoe crabs to include females, based on numbers generated by its new Adaptive Resource Management model. The model's rosy numbers regarding the Red Knot population are in sharp contrast to numbers from the field which indicate the Red Knot's status remains precarious.
>
> It is perplexing that the model does not take into account the wild card climate variable, which suggests that the proponents of the new model are deliberately

choosing to ignore the implications of climate change. Perhaps the proponents of the new model are unaware that the extinction of the Carolina Parakeet and the Passenger Pigeon occurred very rapidly, and that a single extreme climate event befalling a species that is barely hanging on will push it over the edge.

It is obvious that the ASMFC committed considerable resources to the development of its new model. While the major greenhouse gas emitting nations are in the process of retooling to convert from using fossil fuels to using renewable energy sources, it is peculiar that the ASMFC is not making any evident effort to investigate converting from the primitive practice of butchering a finite natural resource for use as bait to using a less environmentally destructive bait source. Likewise, the horseshoe crab bleeding industry in the United States is resisting efforts to convert from the now-antiquated, barbaric practice of bleeding Limulus for bacterial endotoxin testing to the use of the equivalent synthetic rFC, holding the United States behind Europe, where rFC was endorsed by the European Pharmacopoeia.

As Mr. Roy Miller of Delaware pointed out at the August 3 meeting of the Horseshoe Crab Management Board, states are not obligated to adhere to the recommendations made by the ASMFC in determining their horseshoe crab harvest policies. Indeed, Delaware's legislators have wider concerns beyond the interests of a small number of horseshoe crab fishermen, and are expected to base state policies on sound economic and environmental reasoning. We look forward to working with Delaware's legislators in the hope that a horseshoe crab bait harvest moratorium matching New Jersey's will be enacted and implemented until the Red Knot is removed from Endangered Species Act protections. Hopefully by then, alternatives to using the horseshoe crab for bait and endotoxin testing will become standard practice so that the Delaware Bay's ecological balance can be restored.

Delaware's horseshoe crab policy is in urgent need of reform

Steve Cottrell
President, Delaware Audubon Society

From:	Tari Pantaleo
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VII
Date:	Monday, September 5, 2022 8:50:37 PM

For countless millennia, horseshoe crabs living in the Delaware Bay have played a vital role in the life cycles of migrating shorebirds, like the red knot, a sandpiper that can migrate 9,000-plus miles--from the tip of Tierra Del Fuego in South America to the Arctic tundra in Canada. the red knot depends on the nutrient-rich horseshoe crab eggs along the Delaware Bayshore to double their body weight and gain enough strength to complete their journey to nest and raise young in the north.

In the 1990s, horseshoe crabs were over-harvested as bait, leading to dramatic drops in crab and red knot populations. Red knots are now listed as threatened under the federal Endangered Species Act.

Since 2008, New Jersey has tried to protect red knots by imposing a moratorium on harvesting horseshoe crabs for bait in state-controlled waters. However, they can still be taken for their blood, which contains a chemical used by the biomedical industry.

Although New Jersey bans the harvest of horseshoe crabs for bait within state-controlled waters (three miles or less from the shoreline), there are no limits beyond the three-mile mark. As a result, trawlers from many nearby states capture horseshoe crabs off the New Jersey coast. Even on the Delaware side of Delaware Bay, fishermen can still legally harvest male horseshoe crabs as bait.

This already-difficult situation for horseshoe crabs and red knots could be made more perilous by a rule change proposed by the Atlantic States Marine Fisheries Commission (ASMFC), which is proposing to switch to a new scientific model for assessing horseshoe crab populations, one it claims is more accurate.

The new model would eliminate a longstanding policy decision not allowing the harvesting of any female horseshoe crabs until the populations of both crabs and red knots return to higher levels.

We don’t want to take any risks with plummeting population of red knots. We should not be using horseshoe crabs for bait!

From:	Susie Miller
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Friday, September 30, 2022 5:50:40 PM

It just seems like common sense to not allow the harvest of female horseshoe crabs. With climate change and overdevelopment of our coastal environments directly impacting the decline of shorebird populations, you would think you would do everything to protect the female horseshoe crabs.

Instead I am writing this email to voice my opposition to amending the management plan to allow the harvest of female crabs.

When do we ever learn??

Susie Miller
PO Box 192
Ocean View DE 19970

From:	johnd4photo@aol.com
To:	Comments
Subject:	[External] Horseshoe Crab increase
Date:	Sunday, September 11, 2022 1:13:55 PM

Dear Sir or Madam,

I have learned that you are considering increasing the limit on the harvesting(killing) of horseshoe crabs. I am opposed as birds need the eggs. I live in south Jersey and can see the decrease in migratory birds caused by this.

Thank you for your consideration.

Terry Dailey from Mays Landing, NJ

From:	Terry Cooper
To:	Comments
Subject:	[External] horseshoe crabs
Date:	Sunday, September 11, 2022 11:51:08 PM

Hello,

I am writing in protest of increasing the harvesting of horseshoe crabs in the Delaware Bay.
To increase the harvest of horseshoe crabs at this time, and likely for some time to come, would upset the balance
of nature in that region. Red knots are becoming fewer and fewer. They are an important bird in the Delaware Bay region and are important in maintaining the natural food chain . To harvest more horseshoe
crabs at this time would severely impact the number of red knots. At this time we can maintain some balance
in the natural world and we should continue to do so in every area of life that we can.

Thank you,
Terry Cooper

From:	Timothy Russell
To:	Comments
Subject:	[External] Horse shoe crab harvest limits
Date:	Wednesday, September 28, 2022 11:19:06 PM

Please do not increase harvest limits for Horseshoe crabs. It is my understanding that the population numbers of these crabs are already diminished. It would be a shame if one more local animal disappears due to human activity.
Thank you
Tim Russell

Sent from my iPad

From:	AOL Customer Care
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Wednesday, August 24, 2022 11:38:44 AM

I oppose allowing horse shoecrab harving in Delaware Bay.
Theodora McCann

From:	Theodore Chase
To:	Comments
Subject:	[External] Horseshoe crab draft addendum VIII
Date:	Sunday, September 11, 2022 12:11:44 PM

I join NJ Audubon in opposing the Atlantic States Marine Fisheries Commission's (ASMFC) proposal to increase the harvest of horseshoe crabs, including a harvest of females for the first time in over a decade. It should be obvious that harvesting females will further decrease the horseshoe crab population, and will have a significant impact on the federally threatened Red Knot and other shorebirds that depend on horseshoe crab eggs during spring migration stopovers in Delaware Bay, putting them at risk of further population declines. Please, pay attention to the scientific data submitted by NJ Audubon showing that horseshoe crab populations and eggs are not increasing, and do not proceed with this change.

From:	Tom Ostrand
To:	Comments
Subject:	[External] horseshoe crab Draft Addendum VIII
Date:	Sunday, September 11, 2022 12:20:02 PM

I am strongly against the Atlantic States Marine Fisheries Commission's (ASMFC) proposal to increase the harvest of horseshoe crabs, including a harvest of females for the first time in over a decade. This action will have a significant negative impact on the federally threatened Red Knot and other shorebirds that depend on horseshoe crab eggs during spring migration stopovers in Delaware Bay, putting them at risk of further population declines.
Please do not remove the current prohibition of female horseshoe crab harvesting, and do not increase the limit on overall crab harvesting.

Thank you!

Thomas Ostrand
Metuchen, New Jersey

From:	Tom Mitchell
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Sunday, September 11, 2022 11:20:15 AM

I urge you to continue to protect the female horseshoe crabs from harvesting. Their population has not recovered and neither has the population of red knots, which are the existing requirements necessary to allow for the resumption of harvesting female horseshoe crabs. Please continue to maintain those requirements. Thank you.

From:	Tim Freiday
To:	Comments
Subject:	[External] Horseshoe crab harvest
Date:	Tuesday, September 13, 2022 1:39:59 PM

Hello,

Please do not increase the horseshoe crab harvest in the Delaware bay or open it to the harvesting of female crabs. The population of crabs is still too low to support this. There are less eggs available for the federally threatened red knot, whose populations are also way below historical levels. The phenomenon of migratory shorebirds in the region are a boon for the tourism industry on the Bay, bringing thousands of bird watchers to see the spectacle. We must maintain the population of crabs at a high enough level to support these birds or risk losing this spectacle for good. There are other baits that can be used for harvesting conch. Do not increase the harvest of horseshoe crabs.

Thank you,
Tim Freiday, M.S.

From:	Thomas Morris
To:	Comments
Subject:	[External]
Date:	Monday, September 12, 2022 10:26:57 AM

Please use common sense and do not increase the harvest of horseshoe crabs, especially the harvest of female crabs. Red Knots and other shorebirds need horseshoe crab eggs to complete their spring migration to the Arctic. Red Knot populations have been declining for years.

Thank you.

Tom Morris
197 Maplewood Ave, Milford, CT 06460

Tom Morris

From: hogue
To: Comments
Subject: [External] Horseshoe Crab Draft Addendum VIII
Date: Wednesday, September 28, 2022 4:11:05 PM

I am contacting you to ask you to please consider not allowing the harvesting of female horseshoes crabs. After moving to DE 6 years ago, I learned about the life and history of the horseshoe crab, including reading the book, Horseshoe Crab, Biography of a Survivor by Anthony D. Fredericks. I have participated in the annual horseshoe crab survey and spend countless hours walking the bay beaches "rescuing" or "flipping" the crabs and have called in numerous tags. I've witnessed the harvesting as well. I have so much respect for this creature who comes for an ancient ancestry here on Earth.

It seems to me that this amazing creature deserves better than what it's history and current demands upon it have been. It is a vital food supply for the migrating birds, including the endangered Red Knot. And of course, we process their blue blood for our medical needs. And we know that some die in that process. We use them as bait. Many perish on the beaches and particularly high numbers along Port Mahon Road, Little Creek because of the rocks that were placed there in attempts to control road flooding. Now you want to open up harvesting of the females (the EGG Layers) Of course the females are bigger, and they already struggle to survive when they are on their backs and can't get themselves flipped back over. Who among the harvesters if allowed to do so will not focus of collecting these bigger females over males. It could have a very negative impact of the female population, and the birds who rely on them for their eggs.

Please give the female horseshoe crab respect and every opportunity to thrive and do not open them up to harvesting.

Thank you,
Vickie Hogue

From:	Valerie Yefimova
To:	Comments
Subject:	[External] Please maintain critical protections for horseshoe crabs.
Date:	Monday, September 12, 2022 12:15:41 PM

- As a member of the Horseshoe Crab Recovery Coalition, New Jersey Audubon stands in strong opposition to the Atlantic States Marine Fisheries Commission's (ASMFC) plan to change its Horseshoe Crab Fishery Management Plan, a move that would raise quotas on the killing of horseshoe crabs for use as bait by potentially reopening the harvest to include female horseshoe crabs.
- Under the current framework there is no female crab harvest until female abundance reaches 11.2 million crabs or until the Delaware Bay total red knot stopover population reaches 81,900 birds. The proposed revision would allow the resumption of the female harvest, even though neither the red knot nor female horseshoe crabs of Delaware Bay are close to satisfying either metric.
- Based on field work, including egg density studies conducted by the Delaware Bay Shorebird Project and other organizations, we do not believe that horseshoe crab populations are recovering from their population crash in the 1990s. Egg density data is the most reliable indicator of the horseshoe crab population, and importantly, it is the most reliable index of value for red knots and other shorebirds. Yet ASMFC has never included these surveys in its modeling. ASMFC also does not include field survey data for Red Knots, and these show that Red Knot populations are at historic lows. In the 1990s, more than 90,000 could be found along Delaware Bay. This year, only 12,000 were counted, and in 2021, the number was estimated at an all-time low of 6,800. Evidence is now emerging that Red Knots are bypassing the Delaware Bay stopover altogether in search of life-sustaining food sources elsewhere. This makes their migratory journey all the more perilous.
- The joint collapse of red knots and horseshoe crabs is not inevitable. But this proposal propels them closer to that grim reality.

Thank you for your time and attention,

Valeriya Efimova

From:	Bill Maher
To:	Comments
Subject:	[External] Horseshoe Crab Draft Addendum VIII
Date:	Friday, September 30, 2022 9:41:09 PM

Dear ASMFC Regulators, How are you?
I hope that you will consider my letter arriving after 5pm on September 30, 2022.
I am sure you have heard that Horseshoe Crabs used to cover the Beaches of our Cape May Bayshore during May!
Now 50 years later, in May you can actually count the Horseshoe crabs they are so sparse on our Bayshore beaches.

Horseshoe Crabs have been around for 350 million years, that means that many Estuarine Ecosystems evolved on their watch.
It is very important to this Co-Evolution process, that I always noticed lines of muddy water when working in the bays.
Upon closer inspection, I saw that Horseshoe crabs were ploughing along the bottom feeding and churning up a cloud of things!
This churning up process
obviously provides nutrients, bacteria, diatoms, etc.to the Zooplankton that include the larvae of most of our commercial seafood! On up the Food Chain!
In the late 1970's, I provided local Horseshoe crabs to a Limulus Lysate research firm in North Jersey. It was at the beginning of a new and supposedly sustainable Lysate industry.
Today as a medical professional, I know that Pharmaceutical Science can now replicate any natural compound exactly, if they persist. A molecule might need to be left-handed instead of right-handed, and it costs money to find out! Thus, it might be cheaper to just use live Horseshoe Crabs. BUT! In the case of Horseshoe Crabs, and our Biosphere we have to be motivated to preserve all LIFE above the bottom line of costs, OR WE ARE DOOMED!
I would like your feedback too. I have had the experience of watching Horseshoe Crabs being ground for Conch Bait, on the dock at 956 Ocean Drive, Cape May.
I would like for ASMFC regulators to witness this process first hand before coming to a decision. There are other Conch and Eel baits. Also, a fish lure synthetic bait could possibly be twisted to attract conch, like Ant bait!

It is alarming that our local seafood resources have been decimated in my lifetime.
If the Estuary is to retain "Nursery of the Sea" status it will need the countless Horseshoe Crabs of the past to churn things up again!!
So please leave our big old momma Horseshoe crabs alone to keep our Estuaries churned up and fertile!
Sincerely yours,
William Maher,
BS. Marine Biology, plus graduate level: Ichthyology, Estuarine Ecology.

MA. DDS.
More important a Lifetime in and on the waters!

From:	Virginia Johnson
To:	Comments
Subject:	[External] Horseshoe Crab Quotas
Date:	Sunday, September 11, 2022 11:25:10 AM

Sirs. Please do not approve an increase of horseshoe crab quotas nor-the capturing /killing of female horseshoe crabs
It is imperative to their future that an increase not be allowed in the Bay. Thank you.
Virginia Johnson
Mountain Lakes NJ

Sent from my iPhone

From:	WENDY WALKER
To:	Comments
Cc:	audubonconnect@audubon.org
Subject:	[External] Horseshoe Crabs losing protection
Date:	Wednesday, September 14, 2022 6:42:53 AM

As a worried supporter of our environment & Planet Earth, I am deeply concerned that undermining protection of our female horseshoe crabs & allowing fishermen to again use them for bait is going backward in a way that will have tragic consequences foir their future.

Females are already being used with no oversight by pharmaceutical companies.

Research is too scant to continue to decimate HSC populations.

Please uphold ban & protect our future HSC populations.

Respectfully,

Wendy Walker

3020 Cedarville Rd.
Millville, Nj

Atlantic States Marine Fisheries Commission

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MEMORANDUM

TO: **Horseshoe Crab Management Board**

FROM: **Horseshoe Crab Advisory Panel**

DATE: **October 21, 2022**

SUBJECT: **Advisory Panel Input on Draft Addendum VIII**

Background

The Advisory Panel (AP) met on October 13, 2022 to review Draft Addendum VIII for public comment and the public input that has been submitted during the comment period. The AP members also provided input to the Board on the proposed management options. This memo contains the opinions of individual advisors and does not represent a consensus opinion.

Advisory Panel Attendance: Brett Hoffmeister (Associates of Cape Cod Inc.), Allen Bergeson (Lonza), Nora Blair (Charles River Laboratories), David Meservey (Fisherman/Dealer), Christina Lecker (Fuji-Wako), Benjie Swan (Limuli Labs), George Topping (Fisherman)

Public: Sarah Blick (Associates of Cape Cod Inc.)

AP Comments Draft Addendum VIII

Staff reviewed Draft Addendum VIII and then presented metrics regarding public comment. The majority of the public comment was determined to be against moving forward with Addendum VIII and was largely compromised of eight separate form letters, though there were other individual comments.

The letters contained generalized statements about horseshoe crab and red knot populations such as“has not recovered” and “continued decline.” Some presented data that are not consistent with data presented by the ASMFC regarding red knot and horseshoe crab populations. Egg density and achieving the thresholds set in Addendum VII were also mentioned in more than one letter. Though one could argue the accuracy of the statements and data in the letters, the spirit of the letters was clear, reflecting a desire to protect female horseshoe crabs for the benefit of the crabs, the ecosystem and the red knot.

The attending members of the AP pointed out that this goal is consistent with that of the original ARM and that of the revised ARM. Reverting back to Addendum VI would not prohibit female harvest, in fact it would allow it in Maryland. Additionally, the original harvest packages were based on data that is over 10 years old and does not represent a science based, structured decision-making process that is utilized for species under management of the ASMFC. AP members expressed that the ARM was useful since inception, has provided protection of female crabs, and should continue to evolve as new technology, data and science presents itself.

Therefore, there was unanimous support among the advisors on the call for Option B to implement the 2021 ARM Revision for setting harvest specifications for Delaware Bay-origin crabs. Each of the bullets below summarizes the input of individual advisors.

M22-107

- The Board should adopt the revised ARM because it is science-based management and the best we have, and the science should not be ignored. Reverting back to Addendum VI would be going backward because we have so much more information now. Both options give the states similar amounts of harvest, just spread out a little differently. Sub-option B1 seems more reasonable and there is no need to round the optimal harvest output down by 50,000 crabs. It should be noted that reverting back to Addendum VI would also allow female harvest in Maryland.
- As someone who fishes for horseshoe crabs for biomedical and some for bait, it would be fine to open up a small amount female harvest for bait, but that it does not need to increase by a lot. 10,000-12,000 females for Maryland would not be a problem and would not harm the progress we have made. There have been large increases in the population in recent years; it is not in danger or being overfished but management should be cautions with it. Harvesting fewer females is working for the population and will keep it sustainable.
- Based on the data, supports Option B. Option A for no action would reduce bait harvest unnecessarily from current levels.
- Support for Option B, with no strong preference for either of the sub-options.
- Supports Option B to use the revised ARM to maintain sustainable harvest by using the best science. As a bait dealer in the northeast, this advisor sees demand for bait in the south. If the horseshoe crab harvest in the Delaware Bay region is cut back it will increase demand in the northeast, and he does not want to see that additional pressure on those populations.
- Although Addendum VIII is overwhelmingly unpopular with the public comments, this advisor thinks the ARM model has to be updated and the method for calculating the harvest specifications needs to evolve, therefore Option B is the most sensible. It could be helpful to limit the amount of female crabs harvested for bait because males are more abundant, but ultimately management should follow the science.
- The Board should not throw away the ARM Framework. Acknowledging the overwhelming opposition to the upgrade to the ARM from the public comments, this advisor has faith in the ARM and the science behind it and supports Option B. He is also concerned about the balloon effect on bait demand that the dealer mentioned if Delaware Bay bait harvest is reduced further He was not opposed to the Board limiting females a bit more to be conservative, but at some point modest harvest is allowable based on the science. He also noted that reverting to Addendum VI would take quota off the table compared to current harvest, especially for Delaware and Maryland.

General Comments

Several advisors raised concerns about the weight carried by the form letters submitted as part of the public comments. They were concerned that the signatories did not actually have to understand what they were advocating for, they just had to sign and send the pre-written message. The process is much more complex than it is often described, and this oversimplification is not an accurate description of the model.

It was noted that states still have the ability to limit harvest in their respective waters, and can be more conservative than the Commission's management plan.

Atlantic States Marine Fisheries Commission

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MEMORANDUM

TO: Horseshoe Crab Management Board

FROM: Horseshoe Crab Adaptive Resource Management (ARM) Subcommittee and Delaware Bay Ecosystem Technical Committee

DATE: October 21, 2022

SUBJECT: Horseshoe Crab Harvest Recommendations Based on the ARM Framework

Background

Addendum VII (2012) established the Adaptive Resource Management (ARM) Framework, which incorporates both red knot and horseshoe crab abundance levels to set harvest levels for horseshoe crabs of Delaware Bay-origin. As part of the routine stock assessment schedule and because the original software used for the Framework is now obsolete and no longer supported, the ARM Framework was revised in 2021. The purpose of revising the ARM Framework was to address previous peer review critiques, include newly available data, and adopt advances in modeling software and optimization approaches. The ARM Revision (2021) was peer reviewed and accepted for management use by the Horseshoe Crab Management Board (Board). The Board initiated Draft Addendum VIII to consider formalizing the use of the ARM Revision for setting harvest specifications for horseshoe crabs of Delaware Bay-origin, and a public comment period occurred in August and September 2022. The Board will consider final action on Draft Addendum VIII at the November 2022 Board meeting.

Under the annual process of the ARM Framework, the ARM Subcommittee recommends harvest specifications for the upcoming year based on the ARM Framework results. The Delaware Bay Ecosystem Technical Committee (DBETC) then reviews the ARM results and recent horseshoe crab and red knot monitoring data to provide a recommendation for harvest specifications to the Board. This year, because the Draft Addendum VIII has not been finalized, the ARM considered harvest specifications generated using the original ARM Framework as well as the 2021 ARM Framework Revision. Two enclosed documents provide the details of the ARM Results and the discussions and recommendations of the ARM Subcommittee and DBETC:

1) 2023 Horseshoe Crab Harvest Recommendations Based on Adaptive Resource Management (ARM) Framework and Recent Monitoring Data: Report to the Delaware Bay Ecosystem Technical Committee by the ARM Subcommittee, October 2022
2) ARM Subcommittee and DBETC Meeting Summary from October 12, 2022

The key recommendations from the committees are highlighted below.

Committee Recommendations

The consensus recommendation from the DBETC and ARM Subcommittee members is to use the harvest recommendation from the 2021 ARM Revision. Because Draft Addendum VIII contains two options for rounding the harvest output from the ARM to protect confidential data, two possible harvest limits were generated using the revised ARM:

M22-108

1) 475,000 male and 125,000 female horseshoe crabs; or
2) 450,000 male and 100,000 female horseshoe crabs

Consistent with the proposed allocation methodology in Draft Addendum VIII, the resulting state allocations of the Delaware Bay origin quota and total state quotas would be one of the two options presented in the table below, depending on the rounding option selected by the Board when final action is taken on Draft Addendum VIII. One committee member felt the quota caps for MD and VA that were established in Addendum VII should be removed.

Additionally, both committees recommend that the Board consider implementing the provision from Addendum VI that was omitted from Addendum VII that prohibits harvest and landings of all horseshoe crabs in New Jersey, Delaware, and Maryland from January 1 through June 7, and also prohibits the landing of horseshoe crabs in Virginia from federal waters from January 1 through June 7. This requirement would offer protection to spawning horseshoe crabs and reduce disturbance to migrating shorebirds foraging on the beaches.

Table 1. Delaware Bay-origin and total horseshoe crab quota for 2023 by state and rounding convention options included in Draft Addendum VIII. Virginia total quota only refers to the amount that can be harvested east of the COLREGS line.

Using sub-option B1 to round down to the nearest 25,000				
State	Delaware Bay Origin Quota		Total Quota	
	Male	Female	Male	Female
Delaware	164,364	43,254	164,364	43,254
New Jersey	164,364	43,254	164,364	43,254
Maryland	126,220	33,215	135,100	35,553
Virginia	20,052	5,277	40,667	20,331
TOTAL	475,000	125,000	504,495	142,390

Using sub-option B2 to round down to the nearest 50,000				
State	Delaware Bay Origin Quota		Total Quota	
	Male	Female	Male	Female
Delaware	155,713	34,603	155,713	34,603
New Jersey	155,713	34,603	155,713	34,603
Maryland	119,578	26,573	139,625	31,028
Virginia	18,996	4,221	40,667	20,331
TOTAL	450,000	100,000	491,718	120,564

2023 Horseshoe Crab Harvest Recommendations Based on Adaptive Resource Management (ARM) Framework and Recent Monitoring Data

Report to the Delaware Bay Ecosystem Technical Committee (DBETC) by the ARM Subcommittee

October 2022

This report describes the 2023 harvest recommendation for Delaware Bay horseshoe crabs using two methods: the Adaptive Resource Management (ARM) Framework adopted in 2013 (Section 1) and the Revised ARM Framework from 2021 (Section 2). The DBETC and ARM subcommittee met via conference call on October 12th to review the results and make recommendations to the Board (Section 3).

Established through Addendum VII (2012), the ARM Framework incorporates both shorebird and horseshoe crab abundance levels to set optimized harvest levels for horseshoe crabs of Delaware Bay-origin. The ARM Framework used a program called Adaptive Stochastic Dynamic Programming (ASDP) which produces a large look-up table that included the recommended harvest for all possible states of the horseshoe crabs and red knots populations and the recommended, or optimal, harvest for each combination of population estimates. The look-up table was created in 2012 and refreshed in 2016. In the interim years, the table provided the annual harvest recommendations.

As part of the routine stock assessment schedule and because the ASDP program is now obsolete and unmaintained, the ARM Framework was revised in 2021. The purpose of revising the ARM Framework was to address previous peer review critiques, include newly available data, and adopt advances in modeling software and optimization approaches. The ARM Revision (2021) was peer reviewed and accepted for management use by the Horseshoe Crab Management Board (Board), but Draft Addendum VIII, the management document that formalizes its implementation, has not been approved by the Board. The Board will consider final action on Draft Addendum VIII at the November 2022 Board meeting.

1. Harvest Recommendation Based on 2013 ARM Framework

This section summarizes the 2023 harvest recommendations using the ARM Framework adopted in 2013. Detailed background on the ARM Framework and data sources can be found in previous technical reports (ASMFC 2009; McGowan et al. 2009; ASMFC 2012).

1.1. Objective statement

Manage harvest of horseshoe crabs in the Delaware Bay to maximize harvest but also to maintain ecosystem integrity and provide adequate stopover habitat for migrating shorebirds.

1.2. Population Models

Underlying the original ARM model are population models for both red knots and horseshoe crabs. The ARM model uses an optimization routine which is a procedure for finding the best solution given the current state of the Delaware Bay system. Population dynamics models that link horseshoe crabs and red knots were used to predict the effect of harvest packages. In the ARM Framework, the model determines the best choice among five potential harvest packages (numbers of male and females that can be harvested) given the current abundance of red knots and horseshoe crabs. ASDP was used to create a decision matrix to identify the optimal harvest package given the most recent monitoring data.

1.3. Monitoring data

Red knot abundance estimates are taken from a mark-resight estimate (Figure 1). The spring estimate from 2022 was 39,800 red knots. These data and methods can be evaluated in Lyons 2022.

Sources of data for horseshoe crab abundance were a set of trawl surveys conducted by Virginia Tech university (Wong et al. 2022). For the ARM Framework, newly mature and mature horseshoe crabs from the Delaware Bay swept area population estimates calculated using the delta distribution model are added together (Table 1). Next, the total mature population estimates (newly mature plus mature) are decremented by half a year of natural mortality (M=0.274) to account for time between when the survey operates in the fall and the population lays eggs on the beach in the following spring. Therefore, 13.5 million females and 39.1 million males were used as an input to the Framework.

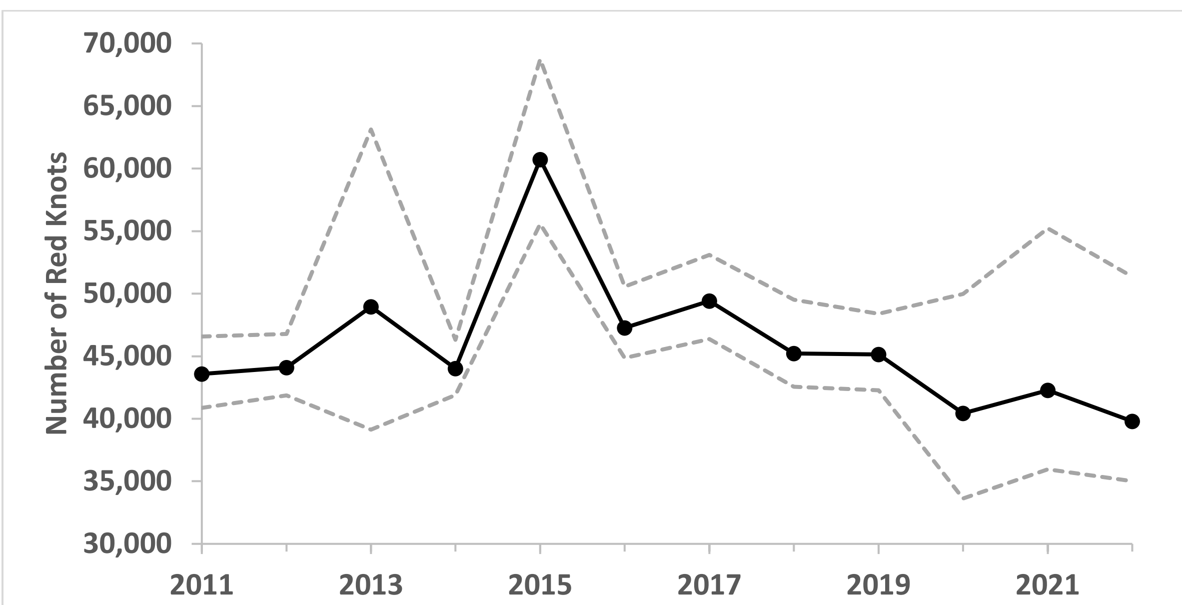

Figure 1. Mark-resight abundance estimates for the red knot stopover population with 95% confidence intervals, 2011-2022.

Table 1. Horseshoe crab population estimates by sex and stage from the Virginia Tech Trawl Survey used in the ARM Framework.

Year	Females (in millions)			Males (in millions)		
	Newly Mature	Mature	Total	Newly Mature	Mature	Total
2002	1.5	5.0	6.5	0.5	11.6	12.1
2003	0.8	3.4	4.2	0.1	8.1	8.1
2004	0.4	2.7	3.1	0.8	5.2	5.9
2005	0.5	3.1	3.6	0.6	5.8	6.4
2006	2.1	6.6	8.7	3.1	15.8	18.9
2007	2.4	7.7	10.1	3.1	15.8	18.9
2008	2.6	6.3	8.9	0.8	14.6	15.4
2009	0.9	3.0	3.9	0.7	6.2	7.0
2010	1.3	5.2	6.5	1.4	14.0	15.4
2011	0.8	5.3	6.1	0.7	15.1	15.8
2012[1]	-	-	-	-	-	-
2013	-	-	-	-	-	-
2014	-	-	-	-	-	-
2015	-	-	-	-	-	-
2016	1.6	6.0	7.6	2.6	21.9	24.5
2017	1.5	7.2	8.7	1.5	20.7	22.2
2018	1.8	7.3	9.1	3.3	15.7	19.1
2019	0.2	5.1	5.4	1.3	8.9	10.2
2020	0.1	10.8	10.9	2.5	31.5	34.0
2021	0.0	15.5	15.5	6.3	38.5	44.9

[1] The Virginia Tech Trawl Survey was not conducted in 2012-2015.

1.4. Harvest packages

The five harvest packages were compared to determine which will best meet the objective statement given the most recent monitoring data (Table 2). Harvest is of adult horseshoe crabs of Delaware Bay-origin.

Table 2. The five possible harvest packages in the ARM Framework (2012).

Harvest package	Male harvest	Female harvest
1	0	0
2	250,000	0
3	500,000	0
4	280,000	140,000
5	420,000	210,000

1.5. Harvest recommendation

The decision matrix was optimized incorporating recommendations on red knot stopover population estimates and associated calibration of a red knot utility threshold (81,900 red knots) as well as the horseshoe crab population estimates and a female horseshoe crab population utility threshold (11.2 million). The accepted procedure used in all past years was followed.

The recommended harvest package for the 2023 fishing year is package 5, or 420,000 male and 210,000 female horseshoe crabs. This is the first time since the ARM Framework was implemented that female horseshoe crab population estimates have exceeded their 11.2 million threshold and that a harvest package other than 3 has been recommended.

1.6. Quota Allocation

Allocation of allowable harvest under ARM package 5 (420,000 males, 210,000 females) was conducted in accordance with management board approved methodology in Addendum VII (Table 3).

Table 3. Delaware Bay-origin and total horseshoe crab quota for 2023 by state. Virginia total quota in the table only refers to the amount that can be harvested east of the COLREGS line. Virginia's overall state quota is 152,495 crabs, but only 40% of that may be harvested east of the COLREGS line.

	Delaware Bay Origin Quota		Total Quota		
State	**Male**	**Female**	**Male**	**Female**	**Sexes Combined**
Delaware	136,195	68,097	136,195	68,097	204,292
New Jersey	136,195	68,097	136,195	68,097	204,292
Maryland	118,533	59,268	113,769	56,884	170,654
Virginia	29,077	14,538	40,665	20,333	60,998
Total	420,000	210,000	398,382	241,854	640,236

2. Harvest Recommendation Based on 2021 ARM Revision

This section summarizes annual harvest recommendations using the ARM Framework Revision developed in 2021. Detailed background on the ARM Framework and data sources can be found in the ARM Revision report (ASMFC 2022).

2.1. Objective Statement

Manage harvest of horseshoe crabs in the Delaware Bay to maximize harvest but also to maintain ecosystem integrity, provide adequate stopover habitat for migrating shorebirds, and ensure that the abundance of horseshoe crabs is not limiting the red knot stopover population or slowing recovery.

2.2. Population estimates

In the ARM Revision, all quantifiable sources of mortality (i.e., bait harvest, coastwide biomedical mortality, and commercial dead discards; Figure 2 - Figure 3) were used in the catch multiple survey analysis (CMSA) to estimate male and female horseshoe crab population estimates for 2003-2021 (Figure 4). Population estimates for horseshoe crabs were made using the coastwide biomedical data or no biomedical data which provide upper and lower bounds for the public. The harvest recommendation will be based on the results using confidential biomedical data from the region. The Virginia Tech Trawl Survey estimates are used in the CMSA along with the New Jersey Ocean Trawl and the Delaware Fish and Wildlife Adult Trawl Surveys (ASMFC 2022; Wong et al. 2022).

The 2021 CMSA population estimates for mature females is lower than those from the Virginia Tech Trawl Survey due to a few reasons. For one, the two estimates use different methods. Total abundance is estimated by extrapolating the mean catch-per-tow to the Delaware Bay sampling area for the Virginia Tech trawl versus a population model with the CMSA. Because the VA Tech Trawl Survey is conducted in the fall, the CMSA lags the Virginia Tech Trawl Survey forward to match the timing of the other two trawl surveys and most recent harvest data (i.e., the 2020 Virginia Tech trawl values are used in the model to estimate abundance in 2021; Figure 5). Thirdly, the CMSA population estimates are influenced by the staged abundance data from the Virginia Tech Trawl Survey, and the abundance of newly mature females was very low in 2019-2021 (Table 1). The CMSA is a simple, stage-based model that essentially sums the newly mature and mature crabs, subtracts harvest and accounts for natural mortality, and predicts the next year's population. Since the newly mature female estimates have been low, the model estimated lower population estimates than those of the Virginia Tech Trawl Survey in 2021.

Red knot abundance estimates used to make harvest recommendations under the ARM Revision are the same as those used in the original ARM Framework and based on mark-resight total stopover population estimates (Figure 1; Lyons 2022).

In summary, in the Delaware Bay region in 2021, there were approximately 15.9-16.0 million mature male and 6.0-6.1 million mature female horseshoe crabs (the range represents the difference between using coastwide and no biomedical data). The 2021 red knot population estimate was 42,271.

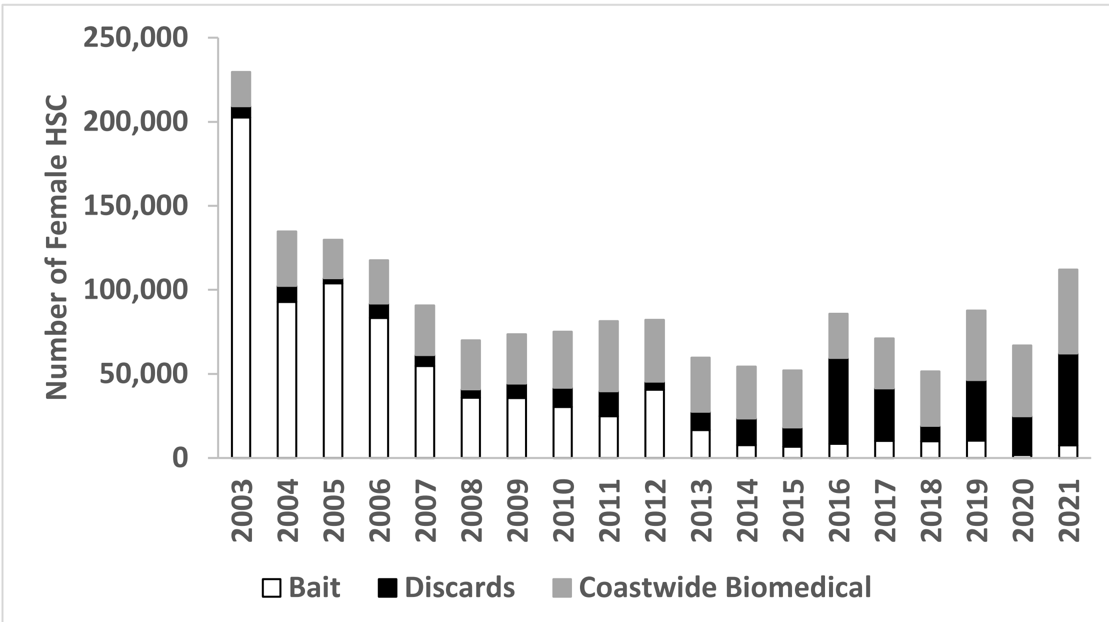

Figure 2. Total female horseshoe crab harvest by source in the Delaware Bay, 2003-2021.

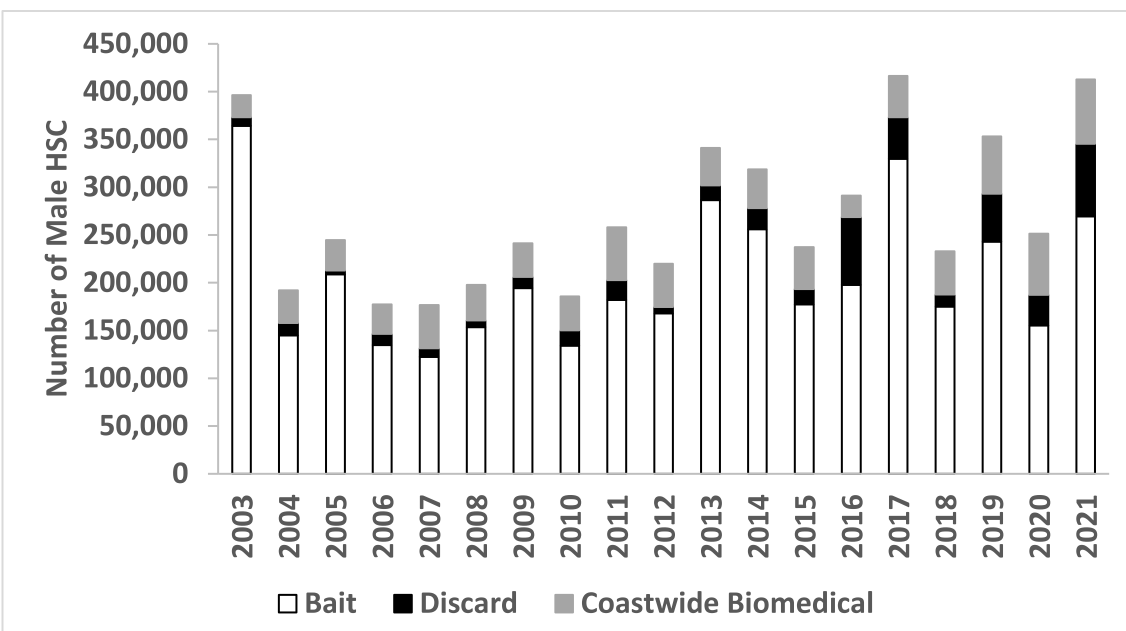

Figure 3. Total male horseshoe crab harvest by source in the Delaware Bay, 2003-2021.

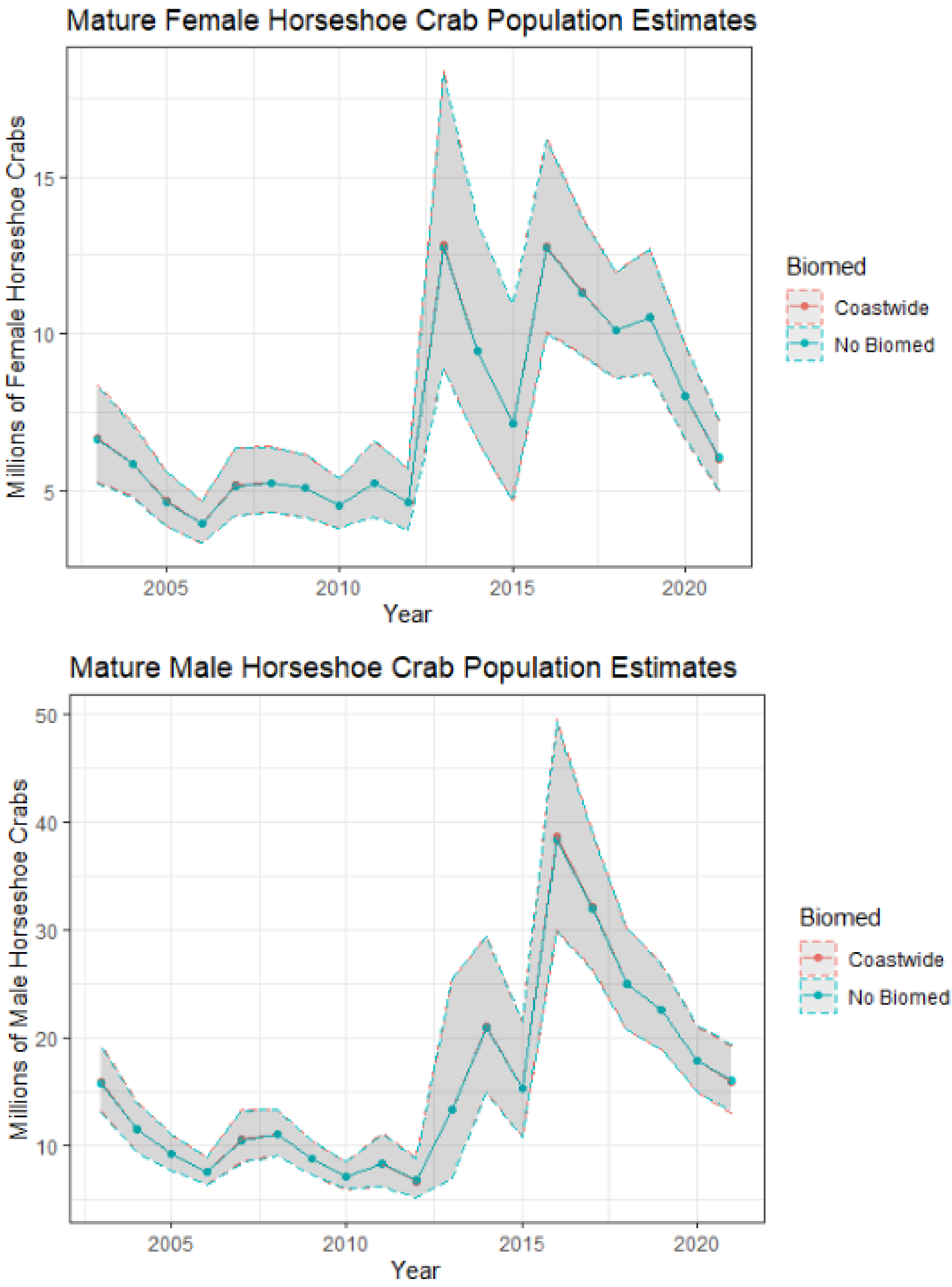

Figure 4. **Population estimates from the CMSA for mature female (top) and male (bottom) horseshoe crabs with 95% confidence intervals. Delaware Bay biomedical data is confidential so population estimates using coastwide and zero biomedical data provide upper and lower bounds, although there is very little difference between the two and the time series overlap on the figures.**

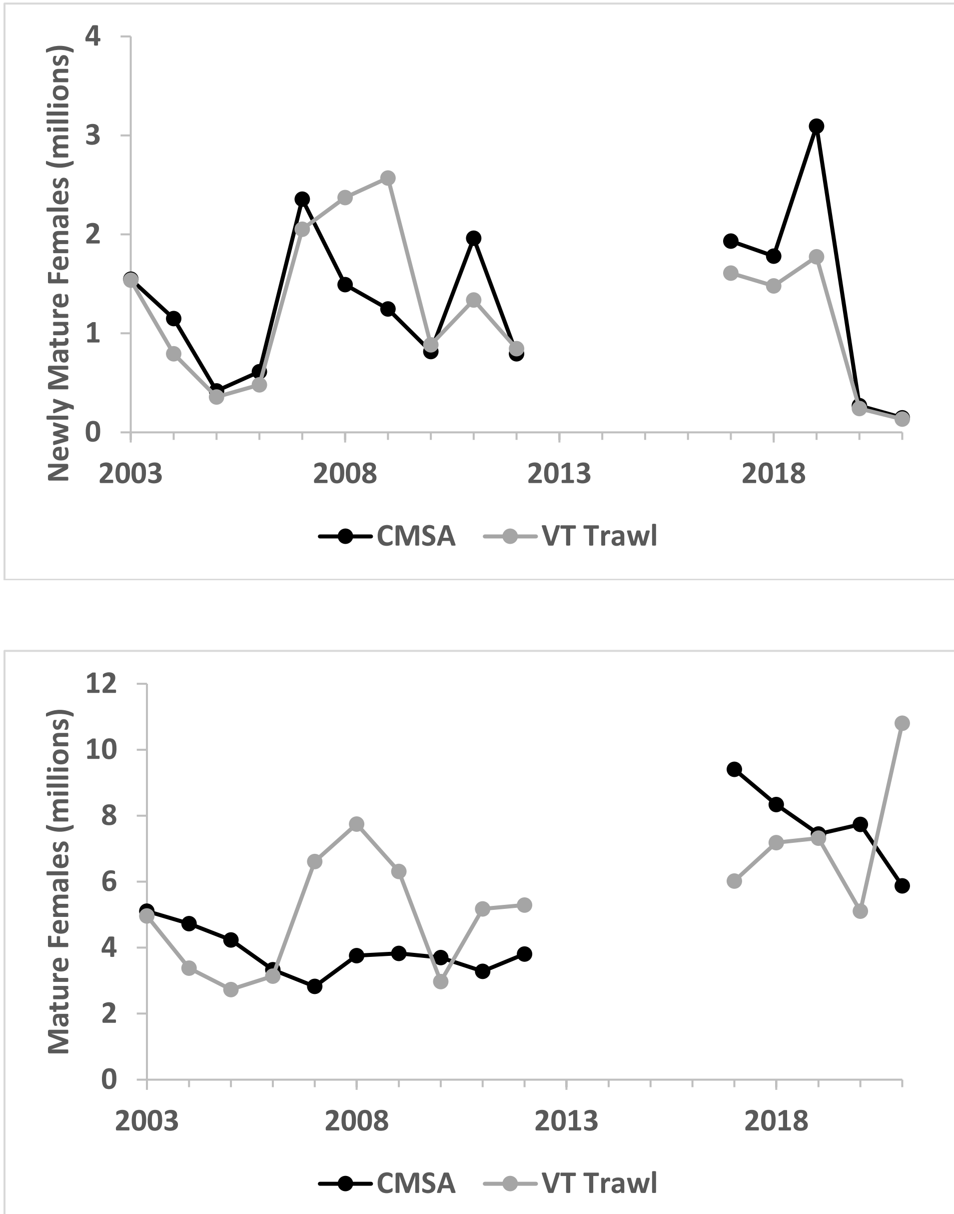

Figure 5. Comparison of newly mature and mature female horseshoe crab estimates between the catch multiple survey analysis (CMSA) using coastwide biomedical data and Virginia Tech Trawl Survey (VT Trawl) 2003-2021. VT Trawl data is lagged forward one year from the values reported in Table 1.

2.3. Harvest Recommendation

Harvest recommendations for the 2023 fishing year made using the ARM Revision are based on CMSA estimates of horseshoe crab abundance and the red knot mark-resight abundance estimate in 2021. This is because the complete data series needed to run the CMSA in 2022 is not yet available since bait and biomedical removals are not finalized for 2022 when the model is run in the fall. The time lag between when CMSA estimates of crab abundance are available (e.g., a terminal year of 2021), the annual harvest decision is made (e.g., at the Board meeting in November 2022), and when harvest recommendations are actually implemented (e.g., the 2023 fishing year) was incorporated into the ARM Revision optimization.

ARM Revision harvest recommendations are based on a continuous scale rather than the discrete harvest packages in the previous Framework. Therefore, a harvest number up to the maximum allowable harvest could be recommended, not just the fixed harvest packages (Table 2). Harvest of females is decoupled from the harvest of males so that each are determined separately. The maximum possible harvest for both females and males are maintained from the previous ARM Framework at 210,000 and 500,000, respectively.

The annual decision of allowable Delaware Bay horseshoe crab harvest is based on current state of the system (abundances of both species in the previous calendar year) and the optimal harvest policy functions from the ARM Revision. Annual estimates of horseshoe crab and red knot abundances are used as input to the harvest policy functions, which then output the optimal horseshoe crab harvest to be implemented.

Two options were given in draft Addendum VIII which were to round down the optimal harvest to the nearest 25,000 or 50,000 crabs to uphold data confidentiality. Two harvest recommendations, one using each rounding option, have been provided here based on an optimal harvest level given horseshoe crab abundance and red knot abundance in 2021 (Table 4). The horseshoe crab abundance in 2021 was determined by using the confidential Delaware Bay biomedical data in the CMSA. If the Board chooses to use the 2021 ARM Revision to set Delaware Bay bait harvest specifications as proposed in Draft Addendum VIII, it may select one of the options provided below.

Table 4. Harvest recommendations from the 2021 ARM Revision depending on the rounding convention options given in Draft Addendum VIII.

Using sub-option B1 to round down to the nearest 25,000	
Male harvest	**Female harvest**
475,000	125,000

Using sub-option B2 to round down to the nearest 50,000	
Male harvest	**Female harvest**
450,000	100,000

2.4. Quota Allocation

Quota of horseshoe crab harvest for Delaware Bay region states. Allocation of allowable harvest was conducted in accordance with the methodology proposed in Draft Addendum VIII (Table 5).

Table 5. Delaware Bay-origin and total horseshoe crab quota for 2023 by state and rounding convention options included in Draft Addendum VIII. Virginia total quota only refers to the amount that can be harvested east of the COLREGS line.

Using sub-option B1 to round down to the nearest 25,000				
State	Delaware Bay Origin Quota		Total Quota	
	Male	Female	Male	Female
Delaware	164,364	43,254	164,364	43,254
New Jersey	164,364	43,254	164,364	43,254
Maryland	126,220	33,215	135,100	35,553
Virginia	20,052	5,277	40,667	20,331
TOTAL	475,000	125,000	504,495	142,390

Using sub-option B2 to round down to the nearest 50,000				
State	Delaware Bay Origin Quota		Total Quota	
	Male	Female	Male	Female
Delaware	155,713	34,603	155,713	34,603
New Jersey	155,713	34,603	155,713	34,603
Maryland	119,578	26,573	139,625	31,028
Virginia	18,996	4,221	40,667	20,331
TOTAL	450,000	100,000	491,718	120,564

3. Committee Recommendation

There was consensus among the DBETC and ARM Subcommittee members that the harvest recommendation produced by application of the ARM Revision (Section 2) was preferred over that from the previous ARM Framework (Section 1). One committee member felt the quota caps for MD and VA that were established in Addendum VII should be removed. Additionally, both committees recommend the Board consider implementing the provision from Addendum VI that was omitted from Addendum VII that prohibits directed harvest and landings of all horseshoe crabs in New Jersey and Delaware from January 1 through June 7. The committees were in agreement that this provision would provide additional protection for horseshoe crabs during beach spawning and red knot stopover.

4. References

ASMFC. 2009. A Framework for Adaptive Management of Horseshoe Crab Harvest in the Delaware Bay Constrained by Red Know Conservation, Stock Assessment Report No. 09- 02 (Supplement B) of the Atlantic States Marine Fisheries Commission. Washington D.C. 51pp.

ASMFC. 2012. Addendum VII to the Fishery Management Plan for Horseshoe Crab. Washington D.C. 10pp.

ASMFC. 2022. Revision to the Framework for Adaptive Management of Horseshoe Crab Harvest in the Delaware Bay Inclusive of Red Knot Conservation and Peer Review Report. Arlington, VA. 302 pp.

Lyons, J.E. 2022. Red Knot Stopover Population Estimate for 2021. Memorandum to the Delaware Bay ARM Working Group. U.S. Geological Survey Patuxent Wildlife Research Center, Laurel, Maryland. 13 pp.

McGowan, C. P., D. R. Smith, J. D. Nichols, J. Martin, J. A. Sweka, J. E. Lyons, L. J. Niles, K. Kalasz, R. Wong, J. Brust, M. Davis. 2009. A framework for the adaptive management of horseshoe crab harvests in the Delaware Bay constrained by Red Knot conservation. Report to the Atlantic States Marine Fisheries Commission Horseshoe Crab Technical Committee.

Wong, C. Y. Jiao, and E. Hallerman. 2022. Results of the 2021 Horseshoe Crab Trawl Survey: Report to the Atlantic States Marine Fisheries Commission Horseshoe Crab and Delaware Bay Ecology Technical Committees. 27 pp.

Several advisors agreed that population trends for horseshoe crabs appear to be favorable since the original ARM was implemented.

One advisor said they would like to see the Virginia Tech trawl survey run nighttime tows earlier in the year (late May – July) because they are seeing large numbers of juveniles at those times. They are everywhere, not just off Maryland, and that should be recorded by the survey.

This advisor also noted that more and more human development is being built on the beaches, and that means less access for birds and crabs on the beaches for foraging and spawning. Red knots do not like people around. The whole east coast is being developed on waterfronts, and that is taking up habitat. For this reason, we cannot only blame the horseshoe crab numbers for the red knots declines in these areas.

Two other advisors agreed with this comment, and added that when the red knot was listed as threatened, horseshoe crab egg availability was only one contributing factor, not the only contributing factor for the red knot status. Other threats, like disturbances to the birds while feeding, were also included.

One advisor who could not attend the meeting provided the following input by email:

> The comments provided are interesting and highlight the potential nuances that could be considered for recommending Option B (e.g., what might be a scientifically reasonable number for settling on the amount of the female harvest; how best to manage regional shifts in demand for bait, etc). It is clear the ARM model has to be updated and the method for calculating the harvest specifications needs to evolve, and therefore unanimous AP support for Option B is not surprising and seems most sensible. But it is not clear how best to achieve that goal.
>
> It is true there are multiple stressors on red knot populations, and the AP comments are spot on about this. There are additional key aspects of red knot decline such as the disturbance to birds and habitat from relentless coastal development. That must be kept in mind when discussing horseshoe crab harvest impacts and supporting management recommendations.
>
> This advisor also strongly recommended there be a discussion about how to communicate and explain the gap between public opinion and that of the AP on Draft Addendum VIII, stating that it seems the biggest problem here is communication.

Atlantic States Marine Fisheries Commission

Horseshoe Crab Adaptive Resource Management Subcommittee & Delaware Bay Ecosystem Technical Committee Conference Call

Call Summary

Wednesday, October 11, 2022
9:00 AM - 11:00 AM

Attendance:
Horseshoe Crab Adaptive Resource Management Subcommittee: John Sweka (Chair), Jim Lyons (Vice Chair), Henrietta Bellman, Linda Barry, Steve Doctor, Wendy Walsh, Margaret Conroy, Bryan Nuse
Delaware Bay Ecosystem Technical Committee: Wendy Walsh (Chair), Henrietta Bellman (Vice Chair), Adam Kenyon, Eric Hallerman, Yan Jiao, Jordy Zimmerman, Steve Doctor, Samantha MacQuesten
Horseshoe Crab Technical Committee Members*: Adam Kenyon, Catherine Fede, Claire Crowley, Jeffrey Dobbs, Jordy Zimmerman, Samantha MacQuesten, Steve Doctor, Chris Wright
ASMFC Staff: Caitlin Starks, Kristen Anstead, Toni Kerns
Additional Attendees: John Clark, Brett Hoffmeister, Bill Hyatt, Shanna Madsen, Jesse Hornstein, Clint Moore, Daniel Sasson, Kristoffer Whitney, Chad Wong, Sheila Eyler, Robert LaFrance

The Adaptive Resource Management (ARM) Subcommittee and the Delaware Bay Ecosystem Technical Committee (DBETC) met via webinar to review the most recent population estimates for horseshoe crabs and red knots, the harvest recommendations from the ARM for the 2023 fishing year, and supporting horseshoe crab and red knot data sets. Below are the agenda items and summary of the committee's discussion and decisions.

1. **Survey Results for 2021 Horseshoe Crab (Eric Hallerman)**

Eric Hallerman presented the Virginia Tech (VT) Trawl Survey results for 2021. Yan Jiao and Chad Wong provided analytical support for the report given to the ARM and DBETC. The lower Delaware Bay survey ended earlier than in most years due to a net being obstructed and destroyed. The average bottom temperature was the highest seen in the time series. Mean stratified catches-per-tow were at their highest point in the time-series for mature males, mature females, and newly mature males. Mean catch-per-tow of immature male and female horseshoe crabs in the coastal Delaware Bay area have remained variable since 2002 and have no apparent trend. Mean catch-per-tow of newly mature male horseshoe crabs in the coastal Delaware Bay area remained highly variable, with newly mature males showing a minor positive trend over the study period. Newly mature females have remained relatively low since 2019 and no newly mature females were observed in 2021. Mean catch-per-tow of mature male and female horseshoe crabs in the coastal Delaware Bay area continue to be highly variable, with their highest points in 2021, showing a positive trend over the time-series. Correlation analyses showed that mean catch-per-tow of all demographic groups may be correlated with ordinal date, and mean catch-per-tow of immature and mature individuals may be correlated with temperature.

The committees discussed the finding of zero newly females being caught in the study areas. Hypotheses posed for the low numbers of newly mature crabs include a spatial distribution difference in recent years that has affected the trawl survey's ability to capture crabs at this state, a recruitment failure a decade ago, or misclassification of stage by the survey crew, which has changed in recent years. The ARM Subcommittee will need to discuss how this estimate will impact the ARM model when the VT Tech trawl data are used next year since the catch survey model relies on estimates of newly mature crabs to predict abundance in the following year.

The 2022 sampling season is currently underway, but has been slowed down due to hurricane activity. Eric noted that, anecdotally, numbers of crabs appear to be down, but they are seeing crabs in places where they are not usually seen. They are also seeing immature crabs getting soft and ready to molt although temperatures have not declined much.

2. **Survey Results for 2022 Red Knots (Jim Lyons)**

Jim Lyons presented the red knot stopover population estimate. The population estimate for red knots is 39,800 birds for 2022 (95% credible interval: 35,013 – 55,355). This estimation is a decrease from 2021, and was below 40,000 birds for the first time since 2011. The confidence intervals around the population estimates for 2020-2022 are wider than in previous years, which can be attributed to decreased survey effort due to COVID-19 restrictions. The 2022 red knot mark-resight data set included a total of 1,546 individual birds that were recorded at least once during mark-resight surveys at Delaware Bay in 2022, a similar number to the previous two years. This year few birds arrived before May 13th; about 20% arrived near May 15th and the proportion arriving peaked at 25% around May 27th. The stopover population increased steadily from the beginning of the season and peaked around May 18–21. The persistence pattern was fairly typical, with a peak early in the sampling season, and then declining toward the end of the season. The resight probability was low at the beginning of sampling but increased to around 50% at the end of the season.

It was noted by the ARM subcommittee that a decline in the accompanying aerial counts for 2022 may have been affected by an air show at the Air Force Base in Delaware on May 24th. Henrietta Bellman reported that Delaware resighting survey effort was comparable to pre-COVID levels.

3. **Review of Supplementary Surveys for Horseshoe Crabs and Red Knots**

   a. **NJ Ocean Trawl Survey (Lindy Barry)**

Lindy Barry reminded the groups that the NJ Ocean Trawl did not run in 2020 or 2021 due to COVID restrictions. Since 2010, there has been an increasing trend through the terminal year of 2019.

In 2022, the survey was reinitiated starting in April. For the months used in the ARM model, preliminary numbers from the April are the highest in time series and the August numbers also seem relatively high. Lindy noted that due to budget issues fewer samples will be taken in the survey. For the 60ft and 90ft depth strata, there will be one less tow per cruise, resulting in a total of 60 instead of 78 samples. There is not a concern that this will significantly impact the quality of the data.

Wendy Walsh asked how the missing years of data from the NJ Ocean Trawl affect the results of the catch multiple survey analysis (CMSA). Kristen said that the CMSA can handle missing years of data because there are three surveys of relative abundance included in the model now.

b. DE Bay 30 ft. Trawl Survey and Spawning Survey (Jordy Zimmerman)

Jordy Zimmerman reviewed the DE Bay 30ft and 16ft Trawl Survey methods and sampling routine for horseshoe crabs. For the 30ft trawl, the 2021 catch per unit effort is above time series mean for April-July and all months. In the 16ft trawl the adult catch in 2021 is below the time series mean. Juvenile and young-of-year crab catch is also decreased in 2021, and have been below the time series mean since 2017. Staging of crabs caught in the surveys has occurred since 2017. The survey routinely catches more multiparous crabs than primiparous crabs, as expected, although most primiparous crabs caught were female and most multiparous crabs were male.

The spawning survey is used by the ARM for providing a sex ratio of males to females on the spawning beaches. Jordy noted that 36 sampling occasions (14%) were missed for 2021, which is a relatively low proportion for the time series. However, of the 36 samples missed, 22 occurred in the second lunar period in May, which is usually a time of high horseshoe crab abundance.

The index of female spawning availability for DE and NJ shows a slight but insignificant positive slope, with the 2021 values near the time series means. The 2021 index of male spawning availability for DE and NJ are above the time series mean, and show a significant increasing trend for both states. The Baywide female index shows no trend, while the Baywide male index shows an increasing trend. Peak spawning in 2021 occurred May 9 – 13 for DE (the first time the peak occurred in the 1st lunar period), and May 24 – 28 (2nd lunar period) for NJ.

c. Shorebird survey

Henrietta Bellman gave a summary of red knot sampling in Delaware. Henrietta said in Delaware it was a more typical year in terms of effort than the previous years which were impacted by COVID-19 restrictions. Team size and catch effort were similar to before COVID impacts. However, she noted that the capture success rate was low, amounting to about half of the 2019 numbers of captures. The number of ratio scans were comparable to 2019, but the number of resights and unique flags were about half of the 2019 values. She also noted that this year they had a difficult time finding red knots outside the Mispillion site.

The committees discussed that ASMFC staff and committee chairs should work with Henrietta and Wendy to strategize on what red knot survey information should be presented to the ARM Subcommittee and DBETC on an annual basis. Staff will follow up to determine what summary information from the shorebird surveys would be most beneficial for the committees to consider when discussing ARM harvest recommendations.

4. Review Results of ARM Model

The sections below summarize the committees' discussion on the ARM results. Details on the methods applied and the results themselves are provided in the memo to the Board from the ARM Subcommittee and DBETC dated October 20, 2022.

a. Results from original ARM Framework

John Sweka reviewed the ARM model structure and annual process for the committees. Conor McGowan used the horseshoe crab population estimates from the Virginia Tech Trawl report and red knot population estimates in the optimization matrix of the original ARM model and determined the resulting harvest recommendation. Using the old ARM Framework, the recommended harvest package for the 2023 fishing year is package 5, or 420,000 male and 210,000 female horseshoe crabs. John noted that this is the first time since the ARM Framework was implemented that female horseshoe crab population estimates have exceeded their 11.2 million population utility threshold and that a harvest package other than package 3 has been recommended. Red knots remain below the population utility threshold established in the original ARM (81,900 birds).

b. Results from 2021 ARM Framework Revision

Kristen Anstead reviewed the annual process, results, and harvest recommendations for 2023 using the revised ARM Framework. The Virginia Tech Trawl Survey estimates are used in the CMSA along with the NJ Ocean Trawl and the DE Fish and Wildlife Adult Trawl (30') Surveys. All quantifiable sources of mortality (i.e., bait harvest, biomedical mortality, and commercial dead discards) were used in the CMSA to estimate male and female horseshoe crab population sizes. Public population estimates for horseshoe crabs were made using the coastwide biomedical data or no biomedical data, which provide upper and lower bounds. The exact harvest recommendation is based on the results using confidential biomedical data from the Delaware Bay region and cannot be publicly shared. The exact recommended male and female harvest levels are rounded down to protect confidential data.

In the Delaware Bay region in 2021, there were approximately 15.9-16.0 million mature male and 6.0-6.1 million mature female horseshoe crabs (the range represents the difference between using coastwide and no biomedical data). The 2021 red knot population estimate was

42,271. Harvest recommendations for the 2023 fishing year made using the ARM Revision are based on CMSA estimates of horseshoe crab abundance and the red knot mark-resight abundance estimate in 2021. The maximum possible harvest for both females and males are maintained from the previous ARM Framework at 210,000 and 500,000, respectively.

Two options were given in draft Addendum VIII which were to round down the optimal harvest to the nearest 25,000 or 50,000 crabs to uphold data confidentiality. Two harvest recommendations, one using each rounding option, have been provided below based on an optimal harvest level given horseshoe crab abundance and red knot abundance in 2021. If the Board chooses to use the 2021 ARM Revision to set Delaware Bay bait harvest specifications as proposed in Draft Addendum VIII, it may select one of the options provided below.

Using sub-option B1 to round down to the nearest 25,000	
Male harvest	**Female harvest**
475,000	125,000

Using sub-option B2 to round down to the nearest 50,000	
Male harvest	**Female harvest**
450,000	100,000

5. Board Recommendation

The ARM Subcommittee and DBETC recommend using the revised ARM to set the Delaware Bay bait harvest specifications for 2023. This would result in one of the two sets of harvest levels presented above, depending on the options selected by the Board when they consider approval of Draft Addendum VIII.

The allocation methodology that would be used to distribute the Delaware Bay-origin quota amongst the states of New Jersey, Delaware, Maryland, and Virginia is specified in Addendum VII, and maintained in Draft Addendum VIII. However, the committees discussed an issue regarding Maryland's total allocation, which includes non-Delaware Bay-origin crabs. Specifically, in order for Maryland to not exceed its Delaware Bay allocation of males and females, the state's total harvest quotas must maintain the same sex ratio as the ARM recommendation. This has not previously been discussed by the ARM Subcommittee and DBETC because until this year the ARM has recommended zero female harvest, restricting Maryland's total quota to male-only harvest. The state allocations recommended by the committees for 2023 are consistent with the proposed methodology in Addendum VIII and ensure the Delaware Bay-origin quota would not be exceeded (see Table 1 of the memo to the Board from the ARM Subcommittee and DBETC dated October 20, 2022.

One committee member felt the quota caps for MD and VA that were established in Addendum VII should be removed. They argued that the caps do not reflect the present abundance of horseshoe crabs, nor do they allow for the proper allocation of total quota among the four states.

The committees also recommended that for the Delaware Bay states, horseshoe crab harvest should not be allowed before June 7. Addendum III established a closed season for bait harvest of horseshoe crabs in and around the Delaware during peak horseshoe crab spawning that prohibited harvest and landings of horseshoe crabs in New Jersey, Delaware and Maryland from May 1 through June 7, inclusive. Addendum IV carried forward this requirement and also prohibited the landing of horseshoe crabs in Virginia from federal waters from January 1 through June 7. June 7 was chosen as the end of the closure as this is the date when most of the migrating shorebirds have left the Delaware bay region. However, Addendum VII did not include the seasonal closure for the Delaware Bay region. Re-establishment of this requirement would offer protection to spawning horseshoe crabs as well as reduce disturbance to migrating shorebirds foraging on the beaches. This requirement would be especially important if female harvest is going to be allowed. Current state regulations do prohibit harvest of Delaware Bay-origin horseshoe crab from January 1 through June 7.

6. Other Business

There was no additional discussion beyond the agenda items. No public comments were provided.

Results of the 2021 Horseshoe Crab Trawl Survey:

Report to the Atlantic States Marine Fisheries Commission Horseshoe Crab and Delaware Bay Ecology Technical Committees

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Abstract

With the continued growth of the mid-Atlantic horseshoe crab (*Limulus polyphemus*) fishery, annual analyses of the population dynamics of key demographic groups are needed for appropriate management. We conducted a trawl survey within the lower Delaware Bay and along the coast of the Delaware Bay area (Virginia to New Jersey), quantified mean catch per 15-minute tow, and compared relative abundance of demographic groups with those of prior years. Analysis of this year's data resulted in the highest mean stratified catch-per-tow values within the Delaware Bay Area over the time series for mature males, mature females, and newly mature males. These values were higher than last year's values for all demographic groups when a normal distribution was assumed for observations in each stratum. Mean stratified catch-per-tow for all demographic groups in the Delaware Bay Area continues to be highly variable, although mature individuals have shown a positive trend over the time series. Newly mature males also appear to show a slightly positive trend since 2002. Prosomal widths of all demographic groups, except immature females, show decreasing trends over the time series in the DBA. Our findings will be used to parameterize the Adaptive Resource Management model used to set annual harvest levels for horseshoe crabs.

Introduction

To effectively manage the mid-Atlantic horseshoe crab (*Limulus polyphemus*) fishery, accurate information on relative abundance levels and trends is needed. The Adaptive Resource Management model (McGowan et al. 2011) adopted by the ASMFC requires annual, fishery-independent indices of newly-mature recruit and adult abundances. The purpose of this project was to conduct a horseshoe crab trawl survey along the Mid-Atlantic coast in order to: (1) determine horseshoe crab relative abundance, (2) describe horseshoe crab population demographics, and (3) track inter-annual changes in horseshoe crab relative abundance and demographics. Here, we report our cumulative results through the fall 2021 trawl survey.

We have provided the Adaptive Resource Management (ARM) Subcommittee relative abundance estimates of horseshoe crabs in the DBA and LDB surveys to inform the ARM model runs.

Herein, we present the population estimates through the 2021 survey. Gear catchability has not been evaluated for these estimates, so they should be considered conservative.

Methods

The 2021 horseshoe crab trawl survey was conducted in two areas (Figure 1). The coastal Delaware Bay area (DBA) survey extended in the Atlantic Ocean from shore out to 22.2 km (12 nautical miles), and from 39º 20' N (Atlantic City, NJ) to 37º 40' N (slightly north of Wachapreague, VA). This area was previously sampled from 2002 to 2011, and again from 2016 to 2021. The lower Delaware Bay (LDB) survey area extended from the Bay mouth to a line between Egg Island Point, New Jersey and Kitts Hummock, Delaware. The LDB was previously sampled from 2010 to 2012 and in 2016- 2021. The surveys were conducted between 10 August to 25 September 2021.

The DBA survey area was stratified by distance from shore (0-3 nm, 3-12 nm) and bottom topography (trough, non-trough) as in previous years. The LDB survey area was stratified by bottom topography only, as in previous years. Sampling was conducted aboard a 16.8-m chartered commercial fishing vessel operated out of Ocean City, MD. We used a two-seam flounder trawl with an 18.3-m headrope and 24.4-m footrope, rigged with a Texas Sweep of 13-mm link chain and a tickler chain. The net body consisted of 15.2-cm (6-in) stretched mesh, and the bag consisted of 14.3-cm (5 5/8-in) stretched mesh. Tows were usually 15-minutes bottom time, but were occasionally shorter to avoid fishing gear (e.g., gill nets, crab and whelk pots) or vessel traffic. Start and end positions of each tow were recorded when the winches were stopped and when retrieval began, respectively. Bottom water temperature was recorded for each tow. We sampled 43 stations in the DBA survey and 2 stations in the LDB. Two of the trawls in the DBA were shorter in duration than average, a five-minute tow within our inshore/trough strata and a six-minute tow within our inshore/not-trough strata. We decided to include data from these trawls in our analysis as they did not involve net malfunctions and hence still should provide valuable data. Additionally, due to the high variance in CPUE and density of HSCs in each stratum (Figure 2), a larger sample size will help better explain this variability.

Horseshoe crabs were culled from the catch, and either all individuals or a subsample were examined for prosomal width (PW, millimeters) and identified for sex and maturity. Maturity classifications were: immature, newly mature (those that are capable of spawning but have not yet spawned), and mature (those that have previously spawned). Newly mature and mature males are morphologically distinct and are believed to be classifiable without error. However, some error is associated with distinguishing newly mature from immature females. All examined females that were not obviously mature (i.e., bearing rub marks) or immature (too small or soft-shelled) were probed with an awl to determine presence or absence of eggs. Females with eggs but without rub marks were considered newly mature. Females with both eggs and rub marks were considered mature. Initial sorting classifications were: presumed adult males (newly mature and mature), presumed adult females, and all immature. Up to 25 adult males, 25 adult females, and 50 immatures were retained for examination. The remainder were counted separately by classification and released. Characteristics of the examined subsamples were then extrapolated to the counted portions of the catch

In each stratum, the mean catch per 15-minute tow and associated variance were calculated using two methods, i.e., either assuming a normal-distribution model or a delta-lognormal distribution model (Pennington, 1983). Stratum mean and variance estimates were combined using formulas for a stratified random sampling design (Cochran, 1977). The approximate 95% confidence intervals were calculated using the effective degrees of freedom (Cochran, 1977). Annual means were considered significantly different if 95% confidence limits did not overlap. Stratified means calculated using the delta-lognormal distribution model are not additive - i.e., means calculated for each demographic group do not sum to the mean calculated using all crabs. Means calculated using the normal-distribution model are additive, within rounding errors.

Annual size-frequency distributions, in intervals of 10-mm prosomal width, were calculated for each sex/maturity category by pooling size-frequency distributions of all stations (adjusted for tow duration if necessary) in a stratum in a year to determine the relative proportions for each size interval. Those proportions then were multiplied by the stratum mean catch-per-tow that year to produce a stratum size-frequency distribution. Stratum size-frequency distributions then were multiplied by the stratum weights and added in the same manner as calculating the stratified mean catch per tow. Areas under the distribution curves represent the stratified mean catch per tow at each size interval.

Within the DBA, excluding the two shorter trawls, the average tow distance for a 15-min tow was 1.5 kilometers at a speed of 4.79 KPH. Respectively, LDB 15-min tows averaged 1.3 kilometers at a speed of 3.61 KPH. No net-spread measurement device was used during sampling. Instead, net-spread was calculated using the net-spread regression relationship, *net spread (S, in meters)/tow speed (C, in KPH)*, developed from previous trawl *surveys (S = 13.84 - 0.858 × C)*. From our combined 43 tows, the average net-spread was 8.7 meters.

For each tow, catch density (catch/km^2) was calculated from the product of tow distance (in km) and estimated net-spread (converted from meters to km) assuming that all fishing was done only by the net, and that there was no herding effect from the ground gear (sweeps):

$$\text{catch/km}^2 = \text{catch/[tow distance (km)} \times \text{net-spread (km)]}.$$

Within each stratum, the mean catch per square-kilometer and associated variance were calculated assuming a normal-distribution model and a lognormal delta-distribution model. Stratum mean densities and variance estimates were combined to produce a stratified mean density ($\bar{X}_{st}$) using formulas for a stratified random sampling design as with the catch-per-tow estimates described above. Population totals were estimated by multiplying stratified mean density ($\bar{X}_{st}$) by survey area (DBA = 5127.1 km^2 ; LDB = 528.4 km^2):

$$\text{Population total} = \bar{X}_{st} \text{ x } (5127.1 \text{ or } 528.4 \text{ km}^2)$$

Results

Delaware Bay Area

For all demographic groups other than newly mature males, mean stratified catch-per-tow values have remained relatively consistent between 2016 and 2018. Since then, there has been a substantial increase in variation over the past three years (Tables 1 and 2; Figure 3). While the mean stratified catches-per-tow for immature individuals decreased compared to last year, mature males and females, as well as newly mature males, have all seen an increase in their mean values. There were no newly mature females caught in any trawls within the Delaware Bay Area.

There is a significant correlation between stratified mean catches of mature males and mature females ($r = 0.94$; $p < 0.001$; $T = 10.868$; $n = 16$) when considering all data since 2002. This is also true for immature males and females ($r = 0.98$; $p < 0.001$; $T = 18.78$; $n = 16$), but not for newly mature individuals. This is similar to results found in last year's report that found a significant correlation between newly mature individuals between 2002 – 2018. However, this correlation was lost with the addition of data from 2019 and 2020. This is likely due to the relatively low number of newly mature males and females trawled in these years. For example, in 2021, newly mature males were caught in only 24% of all trawls performed, for a total of 408 individuals, compared to mature males which were caught in 80% of the forty-five trawls performed this year, for a total of 17,206 individuals.

Lower Delaware Bay

Sampling within the lower Delaware Bay started in 2010 and this year marked the ninth year of trawling this area, with a gap in sampling between 2013-2015. Since 2016, there has been a relative decrease in the mean relative abundances of almost all demographic groups in the LDB except newly mature females which have remained consistently low. The mean stratified catch-per-tow increased significantly from last year for immature females, immature males, and mature females (Tables 3 and 4; Figure 4). This could be due to the overall low number of trawls performed in the LDB, leading to an unrepresentative sample of the population. No newly mature females have been trawled in the LDB since 2018, and this year, no newly mature males were caught. This year presents the lowest mean value for newly mature males in the time series. There was a significant correlation between mean catches of mature males and females ($r = 0.91$; $p < 0.001$; $T = 5.9831$; $n = 9$) along with immature males and females ($r = 0.97$; $p < 0.001$; $T = 11.513$; $n = 9$).

Size distribution

Similar to last year's report, size-frequency distributions remain highly variable (Figure 5). There were no distinct modal groups simultaneously in both sexes other than in 2009 with immature individuals. However, this modal group did not continue into the following years and was not found within the lower Delaware Bay (Figure 6).

We had previously reported that mean prosomal widths of mature and newly mature male and female crabs in the DBA survey displayed slight, but detectable, decreases over time (Table 5, Figure 7) (Hata and Hallerman 2017, 2019, Hallerman and Jiao 2020). Since we were unable to sample any newly mature individuals, we are unable to determine whether this trend has continued. Otherwise, there still appears to be a decrease in mean prosomal width in mature males and females in the DBA and LDB, as well as amongst newly mature males in the DBA.

Sex ratios

Overall, mature males were generally twice as common as mature females throughout the sampling period. Sex ratios (M:F) from mean catch-per-tow within the DBA ranged from 1.6 in 2021 to 3.64 in 2016, with an average of 2.50 over the time series. Male to female sex ratios in newly mature individuals have been highly variable, ranging from 0.11 in 2003 to 5.6 in 2019, with a new overall average of 1.68 over the time series. This may reflect sampling effects, temporal variability in recruitment to the newly mature class relative to survey period, or differences in year-class abundance because females are believed to mature a year later than males.

Compared to the coast, the lower Delaware Bay continues to have a much higher male to female sex ratio in mature individuals. These values for mature individuals have ranged from 2.60 in 2018 to 6.15 in 2016, with a new average of 3.94. This relationship between the coast and bay has been historically similar for newly mature individuals, with a low of 0.45 in 2010 and high of 6.10 in 2012. Excluding 2019 and 2020 — where newly mature males were caught but no newly mature females — this led to an average of 3.09. Since no newly mature crabs of either sex were caught this sampling season, we cannot update this further. The higher sex ratios within Delaware Bay may reflect a tendency for male horseshoe crabs to remain near the spawning beaches.

Population estimates

Annual population estimates of immature crabs in the DBA survey mirror trends observed in the catch-per-tow estimates and have been variable over time, with a large peak in 2009 (Tables 6 and 7). This shows that for immature individuals, the estimated mean population total decreased, while for mature individuals, and newly mature males, there appears to be an increase. The only minor difference between this and the catch-per-tow estimates is that this increase is significant for both newly mature males *and* mature females, rather than just newly mature males. Assuming the normal distribution, the significance found in catch-per-tow estimates is mirrored in population total estimates. Similarly, these mean population total estimates are the highest seen for mature individuals and newly mature males in the time series. Estimated numbers of mature males and females have generally been higher since 2006. There is a significant correlation between population estimates for mature males and females ($r = 0.95$; $p < 0.001$; $T = 11.61$; $n = 16$) and immature males and females ($r = 0.99$; $p < 0.001$; $T = 32.06$; $n = 16$), as observed in mean catches per tow above. There is no significant correlation amongst newly mature individuals in the DBA.

Population estimates within the lower Delaware Bay have reflected those seen in the Delaware Bay Area (Tables 8 and 9). Despite the LDB representing only 9.3% of the entire sampling area, 19.4% of immature males and 15.3% of immature females have been collected in this area over the time series. In 2021, only 5.2% of immature males and 3% immature females were collected within the lower Delaware Bay. Proportions of newly mature crabs within the LDB compared to the DBA are most similar to what one would expect based on the sample area that the LDB represents within the total available sampling area. Newly mature females from the LDB on average represent only 4.8% of the total population during the time series, along with newly mature males representing only 7.3%. No immature males or females were caught inside the LDB in 2021. On average, only 16% of mature males and 11% of mature females occurred within the lower Delaware Bay. In our 2021 sampling, less than 1% of mature males, and mature females, were caught in the LDB. This low representation of mature individuals within the lower Delaware Bay is likely due to grown, mature individuals moving offshore towards the continental shelf, away from nursery grounds.

Effects of sampling period estimates

Sampling in the Delaware Bay Area occurred primarily during August, with the last two of forty-one trawls occurring in the beginning of September. This is much earlier than all sampling years prior to 2019. This resulted in a generally high average water temperature compared to sampling before 2016, though very similar to the past five years (Table 10; Figure 8). The two trawls within the lower Delaware Bay occurred at the end of September, which is later than last year, but closer to all previous year averages. Within the lower Delaware Bay, average water temperature is more directly inversely proportional to the ordinal date than it is within the DBA. This holds true for 2021 where the temperature within the LDB was lower than last year, closer to the lows seen in years prior to 2020.

When comparing water temperature and the time of our sampling period, there appears to be a correlation within the DBA of mean catches-per-tow of immature males and females with both water temperature (p = 0.028, p = 0.032) and ordinal date (p = 0.017, p = 0.022). This is also seen in mature males (p_{temp} = 0.02, p_{date} = 0.002) and females (p_{temp} = 0. 023, p_{date} = 0.002). For newly mature males and females, there seems to be a correlation with only ordinal date (p = 0.049, p = 0.044). In the LDB, there are no significant ($p < 0.05$) correlations of mean catches-per-tow with temperature or date in any demographic groups (Table 11).

Key Findings

1. Mean stratified catches-per-tow were at their highest point in the time series for mature males, mature females, and newly mature males.
2. Mean catch-per-tow of immature male and female horseshoe crabs in the coastal Delaware Bay area have remained variable since 2002 and have no apparent trend.
3. Mean catch-per-tow of newly mature male horseshoe crabs in the coastal Delaware Bay area remained highly variable, with newly mature males showing a minor positive trend over the study period, while newly mature females have remained relatively low since 2019.
4. Mean catch-per-tow of mature male and female horseshoe crabs in the coastal Delaware Bay area continue to be highly variable, with their highest points in 2021, showing a positive trend over the time series.
5. Mean catch-per-tow of all demographic groups may be correlated with ordinal date. Mean catch-per-tow of immature and mature individuals may be correlated with temperature.
6. Mean prosomal width appears to still be decreasing in mature and newly mature males and females in the DBA, along with immature males.

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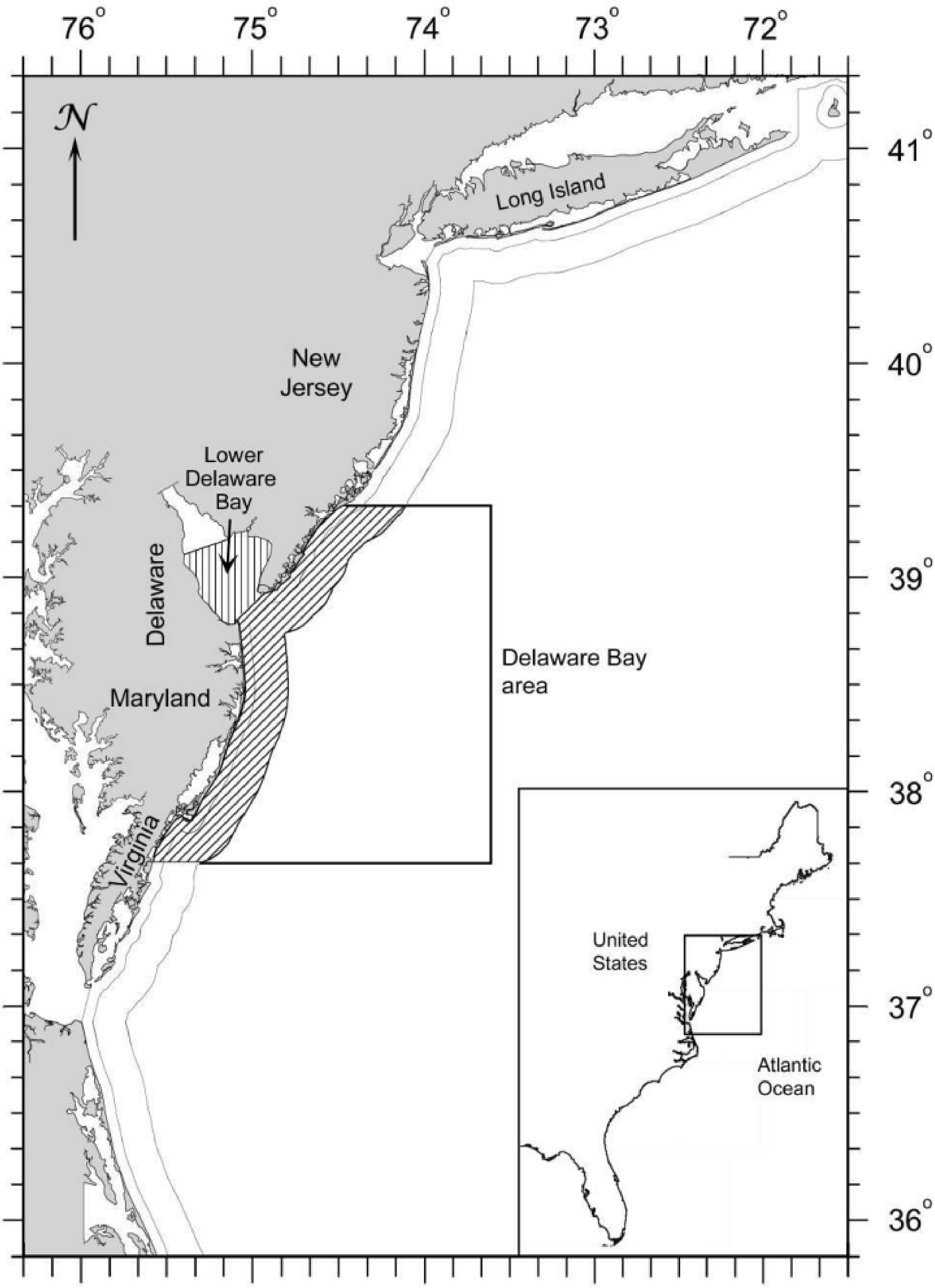

Figure 1. Fall 2020 horseshoe crab trawl survey sampling area. The coastal Delaware Bay area (DBA) and Lower Delaware Bay (LDB) survey areas are indicated. Mean catches between years were compared using stations within the shaded portions of the survey areas.

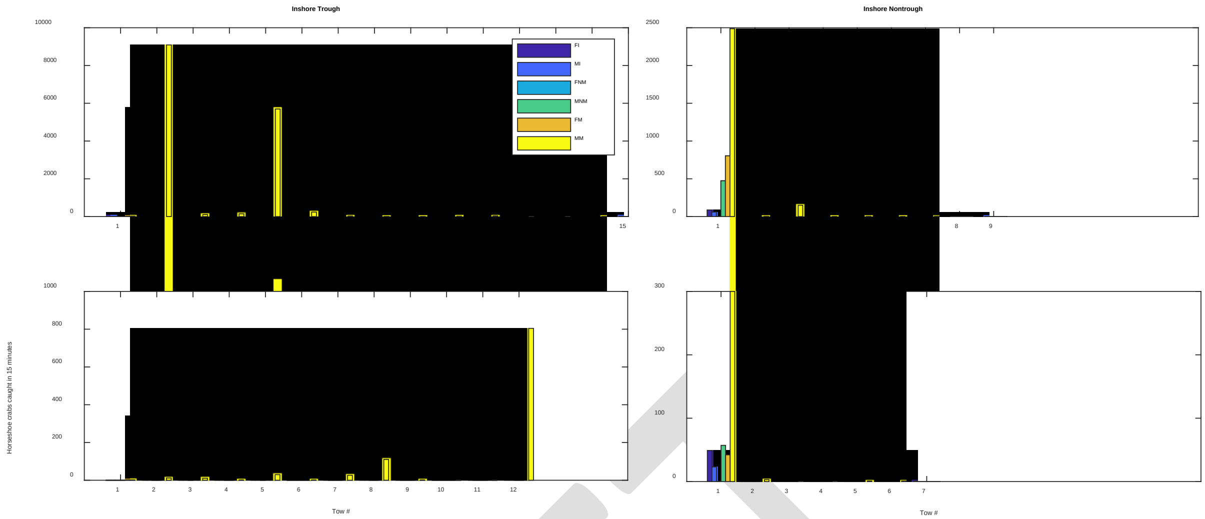

Figure 2. Plots showing high variability of relative abundances of horseshoe crabs of different demographic groups caught within the same strata in fifteen-minute tows in 2020.

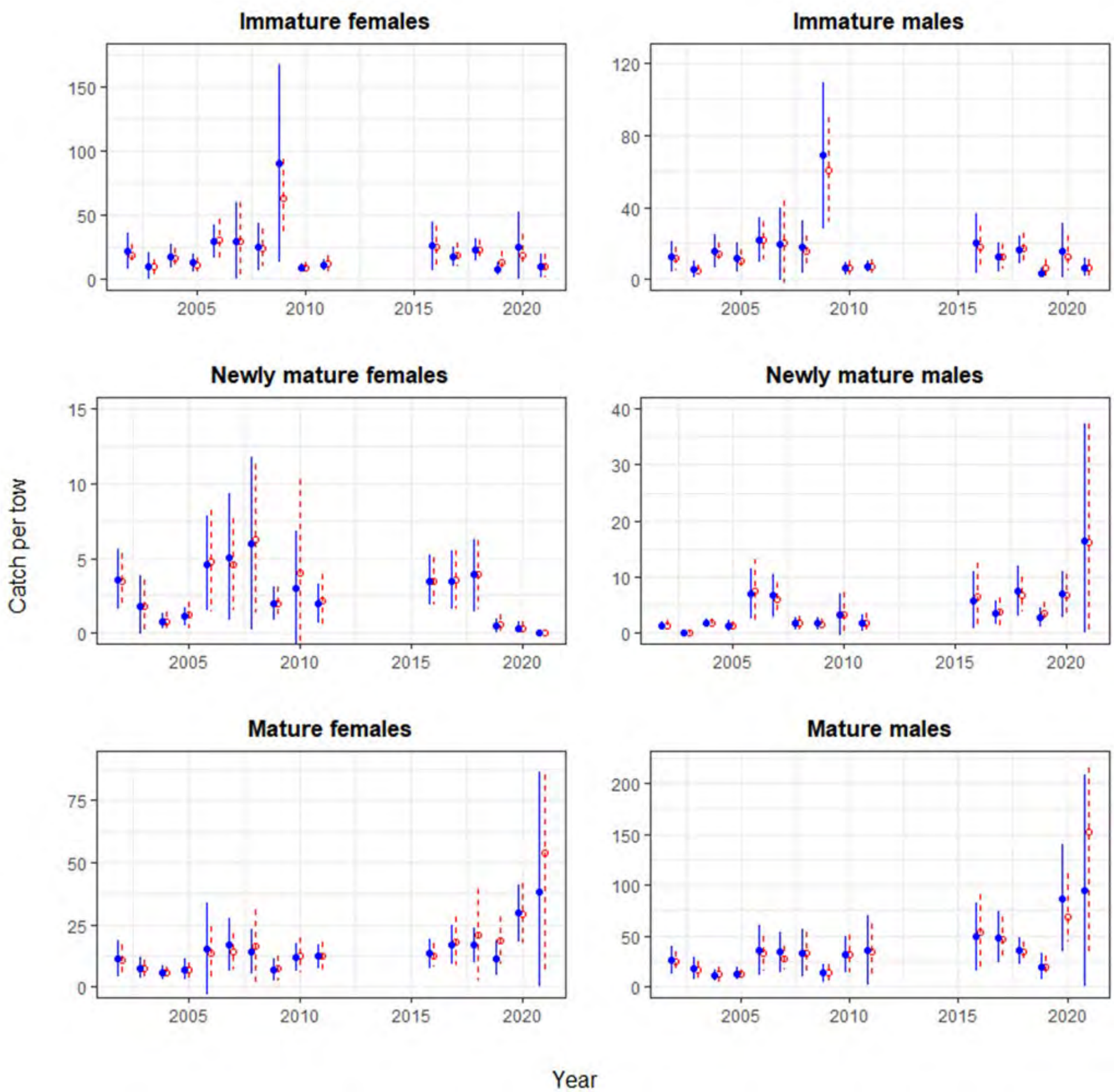

Figure 3. Plots of stratified mean catches per 15-minute tow of horseshoe crabs in the coastal **Delaware Bay area** survey by demographic group. Vertical lines indicate 95% confidence intervals. Solid blue symbols and lines indicate the **delta distribution** model. Open red symbols and dashed lines indicate the **normal distribution** model. Data are from Tables 1 and 2. Note the differences in the *y*-axis scales.

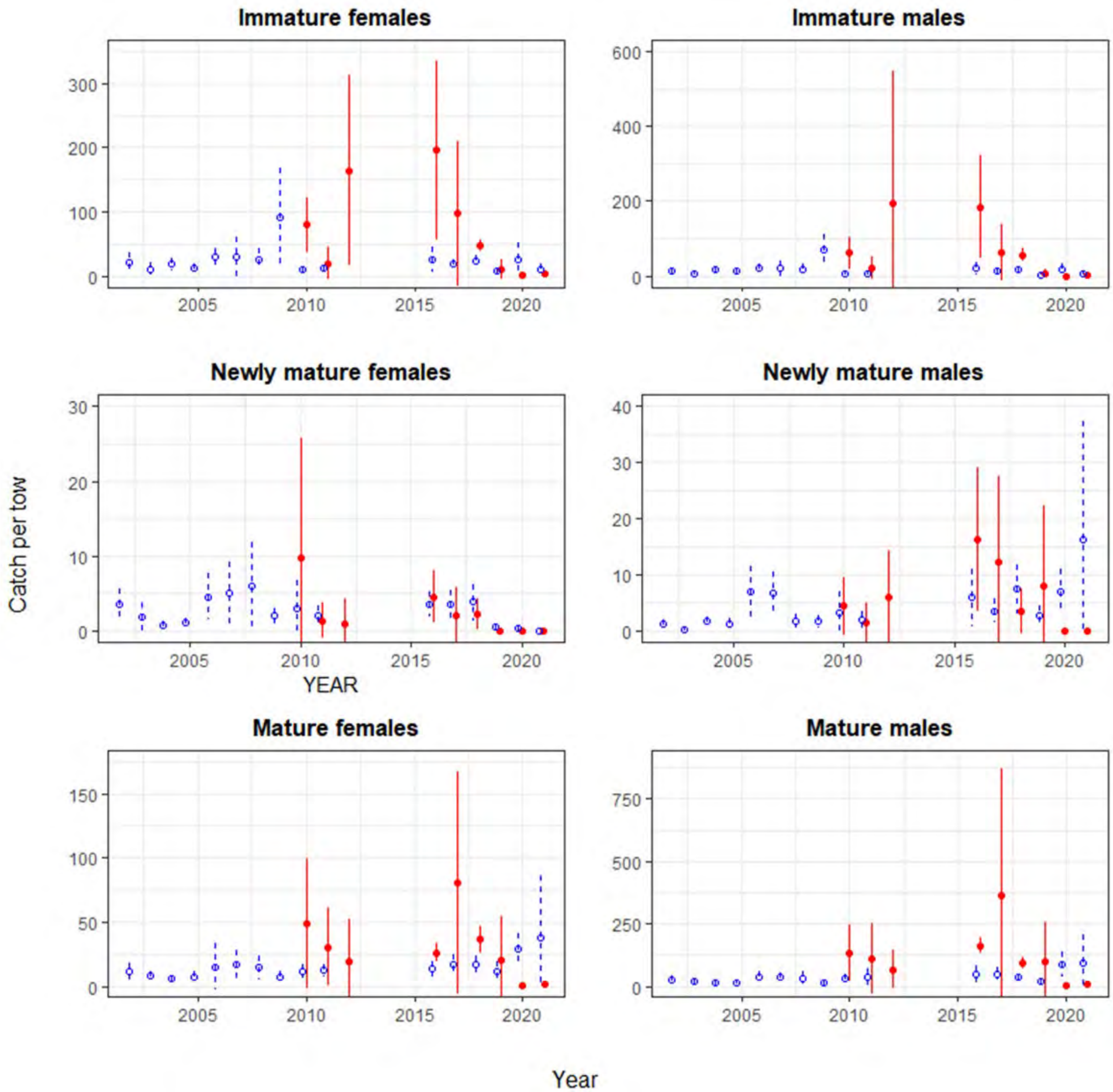

Figure 4. Plots of stratified mean catches per 15-minute tow of horseshoe crabs in the **lower Delaware Bay** survey by demographic group, with coastal **Delaware Bay area** survey means for comparison. Vertical lines indicate 95% confidence limits. Only the **delta distribution** model means are presented for clarity. Solid symbols and lines indicate **the lower Delaware Bay survey**. Open symbols and dashed lines indicate the coastal **Delaware Bay area** survey. Note differences in y-axis scales.

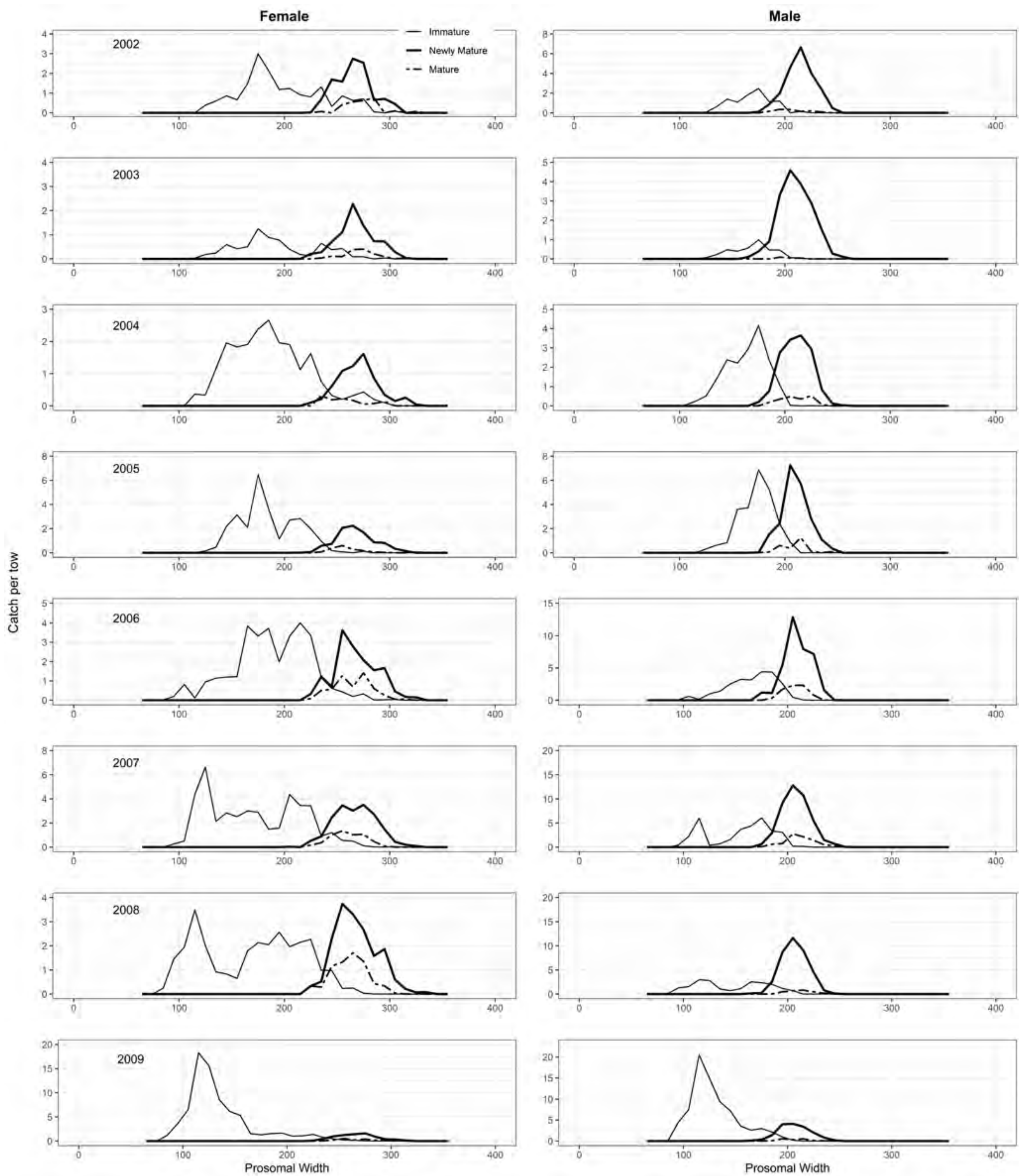

Figure 5. Relative size-frequency distributions of horseshoe crabs by demographic group and year in the coastal **Delaware Bay area** trawl survey. Relative frequencies are scaled to represent stratified mean catches in Table 1.

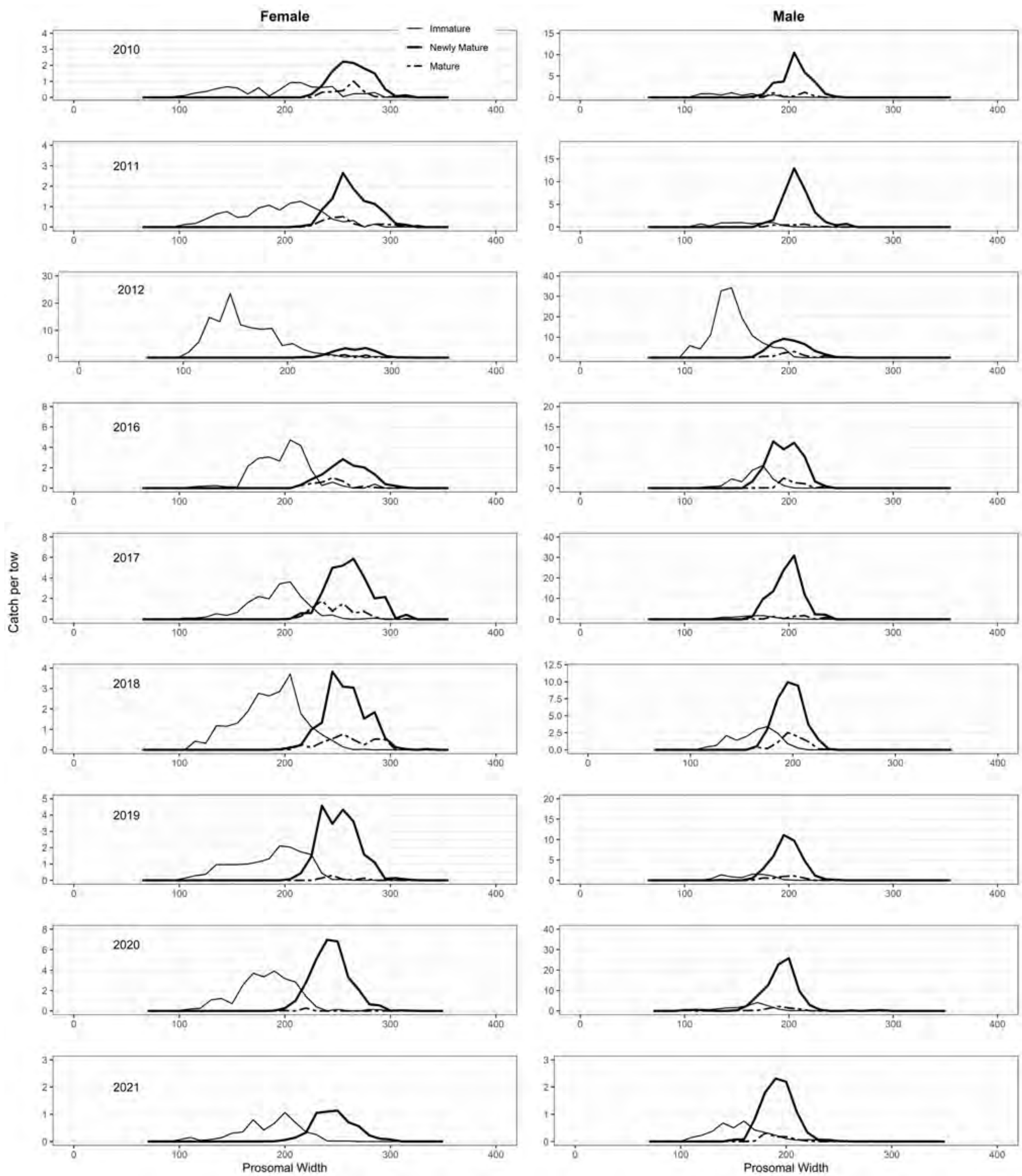

Figure 5. continued.

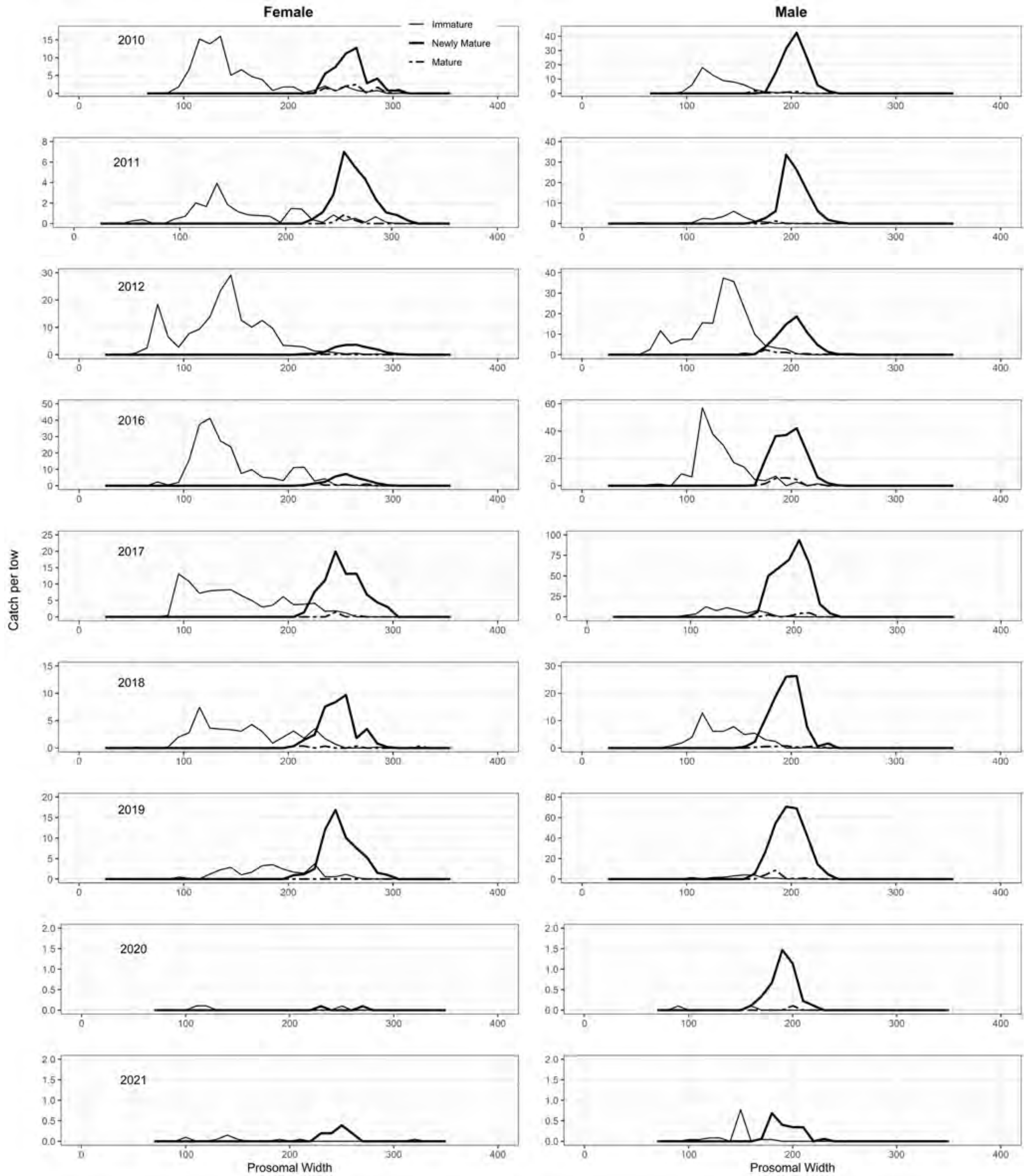

Figure 6. Relative size-frequency distributions of horseshoe crabs by demographic group and year in the **lower Delaware Bay** trawl survey. Relative frequencies are scaled to represent stratified mean catches in Table 3.

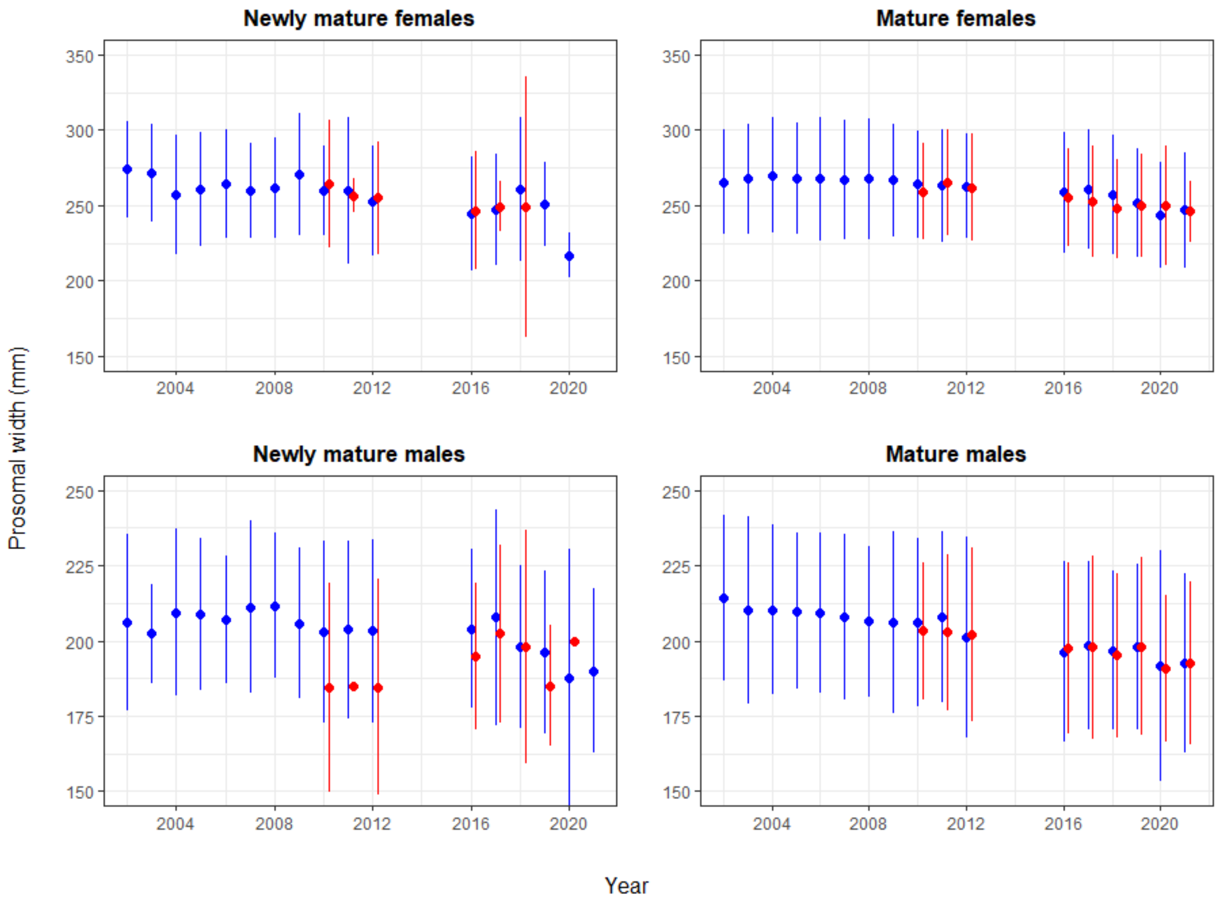

Figure 7. Mean prosomal widths (mm) (± 2 standard deviations) of mature and newly mature female and male horseshoe crabs in the Delaware Bay area (blue symbols and lines) and lower Delaware Bay (red symbols and lines) surveys.

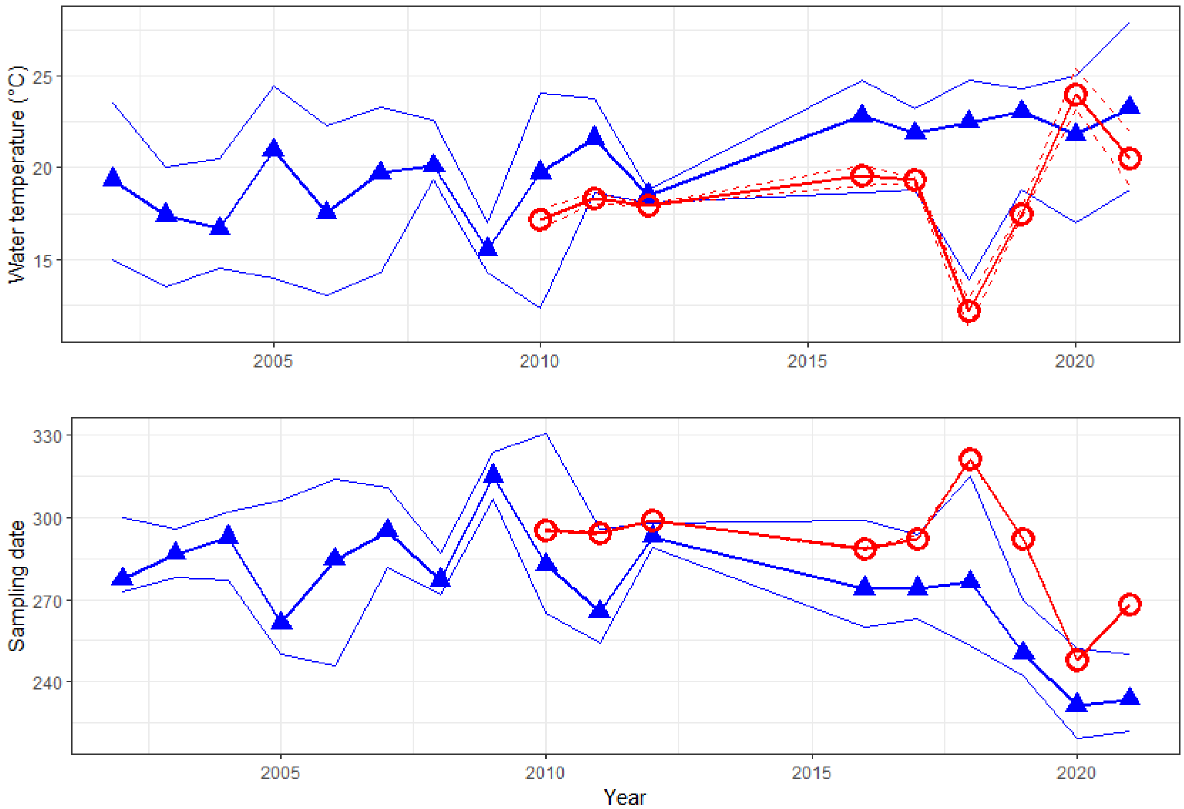

Figure 8. Plots of bottom water temperatures and ordinal sampling dates (days since 1 January) in the coastal Delaware Bay area and lower Delaware Bay trawl surveys. Solid symbols and blue lines indicate coastal Delaware Bay area. Open symbols and red lines indicate lower Delaware Bay. Points indicate mean values. Thinner lines indicate maximum and minimum values. Approximate calendar dates are indicated by gray horizontal lines for reference (ordinal dates are shifted by one day for leap years).

Table 1. Stratified mean catch-per-tow of horseshoe crabs in the coastal **Delaware Bay area** survey, 2002-2021, with the mean, standard deviation (sd), and coefficient of variation (CV), calculated using the **delta distribution** model by demographic group. Also included are the estimated upper and lower 95% confidence limits (UCL, LCL).

YEAR	MEAN	UCL	LCL	CV	SD	YEAR	MEAN	UCL	LCL	CV	SD
Immature Females						**Immature Males**					
2002	21.9	36.1	7.6	0.31	6.8	2002	12.6	21.4	3.9	0.33	4.2
2003	10.5	20.4	0.7	0.43	4.6	2003	5.4	9.9	0.9	0.39	2.1
2004	17.9	27.2	8.6	0.25	4.5	2004	15.7	25	6.4	0.29	4.5
2005	12.7	19.9	5.5	0.28	3.5	2005	11.9	20	3.8	0.33	3.9
2006	29.5	42.8	16.3	0.21	6.3	2006	21.6	33.9	9.2	0.25	5.4
2007	29.6	59.4	-0.2	0.41	12.2	2007	19.5	39.6	-0.6	0.42	8.2
2008	25.3	43.7	6.9	0.33	8.3	2008	18	32.4	3.6	0.35	6.3
2009	90.2	167.4	12.9	0.39	35.5	2009	69	109.7	28.3	0.29	19.8
2010	9	11.9	6.1	0.16	1.4	2010	6.1	9.5	2.8	0.27	1.6
2011	11.4	15.9	6.9	0.19	2.2	2011	6.9	10.1	3.7	0.23	1.6
2016	25.8	45.1	6.5	0.36	9.2	2016	20	36.6	3.5	0.39	7.9
2017	17.9	25.4	10.4	0.19	3.4	2017	12.3	20.5	4.2	0.27	3.3
2018	22.5	31.2	13.9	0.18	4.1	2018	16.5	24.4	8.7	0.22	3.7
2019	8	12.7	3.2	0.3	2.4	2019	3.5	6	1	0.35	1.2
2020	25.3	51.9	0.1	0.6	15.2	2020	16	31.3	0.8	0.56	9.1
2021	**10.4**	**19.8**	**1.1**	**0.52**	**5.5**	**2021**	**6.4**	**11.5**	**1.3**	**0.46**	**3**
Mature Females						**Mature Males**					
2002	11.4	18.5	4.2	0.3	3.4	2002	26.6	39.7	13.4	0.24	6.3
2003	7.7	11.7	3.7	0.25	1.9	2003	18.4	29.6	7.3	0.28	5.2
2004	5.9	8.6	3.3	0.21	1.3	2004	11.4	17.1	5.7	0.24	2.8
2005	7.2	11.4	3	0.27	2	2005	13.2	19.1	7.3	0.21	2.8
2006	15.3	33.8	-3.2	0.44	6.7	2006	36.2	60.9	11.4	0.28	10.1
2007	16.9	27.5	6.2	0.3	5.1	2007	34.3	54.4	14.3	0.28	9.7
2008	14.4	23.3	5.4	0.29	4.2	2008	33.5	57.2	9.8	0.33	11.2
2009	6.7	11.2	2.3	0.32	2.1	2009	14.1	22.8	5.3	0.3	4.2
2010	11.8	17.3	6.3	0.22	2.6	2010	31.5	49.2	13.8	0.27	8.6
2011	12.3	17.1	7.6	0.18	2.2	2011	36	69.8	2.2	0.41	14.7
2016	13.5	19.5	7.6	0.21	2.9	2016	49.2	83.1	15.2	0.29	14.3
2017	16.9	24.8	9	0.23	3.9	2017	48.9	74	23.9	0.25	12.2
2018	16.8	23.7	9.9	0.2	3.3	2018	35.7	48.9	22.5	0.17	6.2
2019	11.6	18.7	4.5	0.3	3.5	2019	20	33.3	6.8	0.33	6.6
2020	29.6	41.2	18.1	0.23	6.9	2020	87	139.4	34.5	0.36	31.1
2021	**38.2**	**86.5**	**0**	**0.72**	**27.42**	**2021**	**95**	**207.8**	**0**	**0.67**	**64.1**
Newly Mature Females						**Newly Mature Males**					
2002	3.6	5.6	1.6	0.26	0.9	2002	1.3	2	0.5	0.28	0.4
2003	1.8	3.8	-0.1	0.49	0.9	2003	0.2	0.5	-0.1	0.84	0.2
2004	0.8	1.3	0.3	0.3	0.2	2004	1.8	2.6	1	0.21	0.4
2005	1.1	1.7	0.5	0.28	0.3	2005	1.3	2.3	0.4	0.33	0.4
2006	4.6	7.8	1.5	0.3	1.4	2006	7.1	11.6	2.6	0.36	2.7
2007	5.1	9.3	0.9	0.39	2	2007	6.7	10.6	2.8	0.28	1.9
2008	6	11.8	0.2	0.44	2.7	2008	1.8	2.9	0.6	0.32	0.6
2009	2	3.1	0.9	0.26	0.5	2009	1.7	2.8	0.5	0.34	0.6
2010	3	6.8	-0.7	0.59	1.8	2010	3.2	7	-0.5	0.55	1.8
2011	2	3.3	0.7	0.31	0.6	2011	1.9	3.4	0.4	0.37	0.7
2016	3.5	5.2	1.9	0.23	0.8	2016	5.9	11	0.7	0.42	2.5
2017	3.5	5.5	1.6	0.27	0.9	2017	3.6	5.8	1.5	0.29	1
2018	3.9	6.3	1.4	0.3	1.2	2018	7.5	11.9	3.1	0.27	2.1
2019	0.5	1	0	0.46	0.2	2019	2.8	4.6	1	0.32	0.9
2020	0.3	0.8	0	0.85	0.3	2020	7	11	2.9	0.35	2.4
2021	**0**	**NA**	**NA**	**NA**	**0**	**2021**	**16.4**	**37.3**	**0**	**0.69**	**11.3**

Table 2. Stratified mean catch-per-tow of horseshoe crabs in the coastal **Delaware Bay area** survey, 2002-2020, with the mean, standard deviation (sd), and coefficient of variation (CV), calculated using the **normal distribution** model by demographic group. Also included are the estimated upper and lower 95% confidence limits (UCL, LCL).

YEAR	MEAN	UCL	LCL	CV	SD	YEAR	MEAN	UCL	LCL	CV	SD
Immature Females						**Immature Males**					
2002	19.1	27.6	10.5	0.22	4.1	2002	11.7	18.3	5	0.27	3.2
2003	9.5	15.9	3	0.32	3.1	2003	4.9	8.1	1.8	0.3	1.5
2004	17	24.5	9.5	0.21	3.6	2004	14	20.3	7.6	0.22	3.1
2005	11.5	17	6.1	0.23	2.6	2005	10.6	16.7	4.4	0.28	2.9
2006	31.1	46.9	15.3	0.24	7.5	2006	21.5	32	11.1	0.23	5
2007	29.8	59.6	0	0.41	12.2	2007	20.5	43.2	-2.3	0.45	9.3
2008	24.6	38.9	10.3	0.27	6.6	2008	15.9	24.2	7.6	0.24	3.8
2009	63.1	93.8	32.4	0.24	14.9	2009	61	89.8	32.1	0.23	14
2010	9.4	13	5.7	0.19	1.8	2010	6.4	10.1	2.6	0.29	1.8
2011	12.2	18.5	6	0.25	3	2011	7.3	11.2	3.3	0.26	1.9
2016	25.1	41.1	9	0.31	7.7	2016	18.1	29.9	6.3	0.31	5.7
2017	19.1	28.7	9.6	0.24	4.6	2017	12.4	19.3	5.5	0.26	3.3
2018	22.5	30.6	14.5	0.17	3.8	2018	17.2	25.9	8.6	0.24	4.1
2019	13.7	21.9	5.5	0.3	4.1	2019	6.6	11.1	2	0.34	2.2
2020	18.8	35.4	8.7	0.32	6	2020	12.7	24	4.7	0.37	4.75
2021	**10.14**	**19.20**	**1.54**	**0.50**	**5.05**	**2021**	**6.39**	**10.99**	**1.83**	**0.42**	**2.66**
Mature Females						**Mature Males**					
2002	11	17	4.9	0.26	2.8	2002	24.6	34.4	14.8	0.19	4.7
2003	7.5	10.9	4.1	0.22	1.6	2003	17	24.7	9.4	0.21	3.6
2004	6	8.3	3.7	0.19	1.1	2004	12.6	20.2	5.1	0.29	3.6
2005	6.8	10	3.5	0.22	1.5	2005	12.3	16.7	7.8	0.17	2.1
2006	13.5	24.2	2.7	0.31	4.2	2006	32.8	49.5	16.1	0.22	7.4
2007	14.2	21.3	7.1	0.24	3.4	2007	28.4	39.9	16.8	0.2	5.6
2008	16.5	31	2	0.41	6.8	2008	32.7	53.7	11.7	0.31	10
2009	7.3	12.3	2.2	0.33	2.4	2009	14.2	22.9	5.5	0.29	4.1
2010	12.7	19.7	5.7	0.26	3.3	2010	32.5	50.9	14.1	0.27	8.8
2011	12.6	18.1	7.2	0.2	2.6	2011	35.4	61.4	9.5	0.32	11.5
2016	12.8	17.4	8.2	0.17	2.2	2016	53.9	90	17.8	0.3	16.2
2017	18.2	28	8.4	0.26	4.8	2017	47.2	69.3	25.1	0.23	10.8
2018	21.1	39.6	2.5	0.41	8.7	2018	34.9	44.9	24.9	0.14	4.8
2019	18.7	28.4	9	0.26	4.8	2019	19.7	31	8.4	0.28	5.6
2020	29.4	41.8	17.3	0.25	7.2	2020	68.8	111.7	44.1	0.21	14.7
2021	**54.03**	**85.27**	**6.79**	**0.50**	**26.82**	**2021**	**152.63**	**215.49**	**30.01**	**0.46**	**69.66**
Newly Mature Females						**Newly Mature Males**					
2002	3.5	5.3	1.7	0.24	0.9	2002	1.3	2.2	0.4	0.31	0.4
2003	1.8	3.6	0.1	0.45	0.8	2003	0.2	0.5	-0.2	0.84	0.2
2004	0.8	1.4	0.3	0.33	0.3	2004	1.8	2.6	1	0.21	0.4
2005	1.2	2.1	0.3	0.35	0.4	2005	1.3	2.1	0.5	0.29	0.4
2006	4.8	8.2	1.4	0.33	1.6	2006	7.5	13.2	1.8	0.36	2.7
2007	4.6	7.7	1.5	0.32	1.5	2007	6.1	9.1	3.2	0.23	1.4
2008	6.3	11.3	1.3	0.37	2.3	2008	1.8	3.1	0.5	0.34	0.6
2009	2	3.1	0.9	0.26	0.5	2009	1.6	2.6	0.6	0.3	0.5
2010	4	10.3	-2.3	0.74	3	2010	3.3	7.2	-0.6	0.56	1.9
2011	2.2	3.9	0.5	0.38	0.8	2011	1.9	3.5	0.4	0.38	0.7
2016	3.5	5.1	1.9	0.22	0.8	2016	6.6	12.6	0.6	0.43	2.9
2017	3.6	5.5	1.6	0.27	1	2017	3.8	6.4	1.3	0.32	1.2
2018	3.9	6.2	1.6	0.28	1.1	2018	6.9	10	3.9	0.21	1.5
2019	0.6	1.2	0	0.48	0.3	2019	3.5	5.5	1.5	0.29	1
2020	0.3	0.8	0	0.84	0.28	2020	6.9	10.6	3.3	0.31	2.1
2021	**0.00**	**NA**	**NA**	**NA**	**0.00**	**2021**	**16.33**	**37.39**	**0.00**	**0.69**	**11.31**

Table 3. Stratified mean catch–per-tow of horseshoe crabs in the **lower Delaware Bay** survey area in 2010-2020, with the mean, standard deviation (sd), and coefficient of variation (CV), calculated using the **delta distribution** model, by demographic group. Also included are the estimated upper and lower 95% confidence limits (UCL, LCL).

	YEAR	MEAN	UCL	LCL	CV	SD		YEAR	MEAN	UCL	LCL	CV	SD
Immature Females							**Immature Males**						
	2010	79.7	122.2	37.3	0.21	16.5		2010	61.2	105.5	16.9	0.3	18.1
	2011	19.7	45.2	-5.9	0.47	9.2		2011	20.2	50.7	-10.4	0.55	11
	2012	164.3	311.8	16.9	0.32	53.1		2012	192.6	548.4	-163.3	0.43	82.7
	2016	196	335.5	56.6	0.29	57		2016	184.2	322.9	45.5	0.32	58.7
	2017	96.7	210	-16.7	0.46	44.1		2017	62.9	137.6	-11.7	0.46	29
	2018	47.2	56.2	38.1	0.08	3.8		2018	55.1	71.8	38.4	0.12	6.8
	2019	9.5	24.3	-5.3	0.6	5.7		2019	5.7	15.8	-4.5	0.7	4
	2020	0.3	0.8	0	0.97	0.3		2020	0.2	0.6	0	0.97	0.2
	2021	**3.1**	**NA**	**NA**	**0.99**	**3.1**		**2021**	**3.3**	**NA**	**NA**	**0.78**	**2.6**
Mature Females							**Mature Males**						
	2010	48.8	98.9	-1.2	0.4	19.5		2010	130.3	242.6	18.1	0.34	43.7
	2011	30.3	60.4	0.2	0.36	10.8		2011	110.2	249	-28.6	0.45	50
	2012	19.1	51.6	-13.4	0.4	7.6		2012	66.8	141.1	-7.4	0.35	23.3
	2016	26.3	33.9	18.7	0.12	3.2		2016	161.7	192.5	131	0.08	13.3
	2017	80.6	167.1	-5.8	0.39	31.1		2017	362.7	868.5	-143.2	0.5	182.2
	2018	36.2	46.6	25.8	0.12	4.3		2018	94.3	117.9	70.7	0.11	10
	2019	20.8	54.7	-13	0.63	13.2		2019	100.4	254	-53.2	0.59	59.7
	2020	0.2	0.5	0	0.97	0.2		2020	4.1	8.8	0	0.67	2.7
	2021	**1.6**	**NA**	**NA**	**0.99**	**1.5**		**2021**	**8.7**	**NA**	**NA**	**0.72**	**6.3**
Newly Mature Females							**Newly Mature Males**						
	2010	9.7	25.8	-6.3	0.64	6.2		2010	4.4	9.5	-0.8	0.46	2
	2011	1.4	3.8	-0.9	0.58	0.8		2011	1.4	4.9	-2.2	0.94	1.3
	2012	1	4.4	-2.3	0.76	0.8		2012	6.1	14.2	-2	0.48	2.9
	2016	4.6	8	1.1	0.31	1.4		2016	16.2	29	3.5	0.3	5
	2017	2.1	5.9	-1.7	0.65	1.4		2017	12.4	27.6	-2.7	0.44	5.4
	2018	2.3	4.4	0.2	0.35	0.8		2018	3.6	7.6	-0.5	0.44	1.6
	2019	0	0	0	NA	0		2019	8	22.3	-6.4	0.7	5.6
	2020	0	0	0	NA	0		2020	0.1	0.3	0	0.97	0.1
	2021	**0**	**NA**	**NA**	**NA**	**0**		**2021**	**0**	**NA**	**NA**	**NA**	**0**

Table 4. Stratified mean catch-per-tow of horseshoe crabs in **the lower Delaware Bay** survey area in 2010-2020, with the mean, standard deviation (sd), and coefficient of variation (CV), calculated using the **normal distribution** model by demographic group. Also included are the estimated upper and lower 95% confidence limits (UCL, LCL).

YEAR	MEAN	UCL	LCL	CV	SD	YEAR	MEAN	UCL	LCL	CV	SD
Immature Females						**Immature Males**					
2010	79.5	116.5	42.6	0.19	15.1	2010	60.4	95.7	25.1	0.25	15.3
2011	21.3	54.2	-11.5	0.55	11.8	2011	21.5	57.2	-14.3	0.6	12.9
2012	165.5	287.6	43.4	0.3	49.9	2012	183.9	360.1	7.8	0.34	63.4
2016	186.5	284.7	88.3	0.22	40.1	2016	167.9	249.7	86	0.21	34.6
2017	90.8	176	5.6	0.37	33.2	2017	58.2	109	7.5	0.36	20.7
2018	47.1	55.6	38.6	0.08	3.6	2018	54.9	69.6	40.2	0.11	6.2
2019	16	30.4	1.5	0.35	5.6	2019	10.7	21.7	-0.4	0.4	4.3
2020	0.3	0.8	0	0.97	0.3	2020	0.2	0.6	0	0.97	0.2
2021	**3.1**	**NA**	**NA**	**0**	**0**	**2021**	**3.3**	**NA**	**NA**	**0**	**0**
Mature Females						**Mature Males**					
2010	49.1	99.8	-1.7	0.4	19.7	2010	128	227.9	28.2	0.3	38.9
2011	28.6	49.9	7.4	0.27	7.7	2011	100.3	187.7	13	0.31	31.5
2012	18.7	46.2	-8.9	0.34	6.4	2012	65.3	111.7	18.8	0.28	18.1
2016	26.2	33.4	19	0.11	3	2016	161.8	192.4	131.1	0.08	13.3
2017	80.5	165	-4	0.38	30.4	2017	303.4	531.7	75.2	0.27	82.2
2018	36.2	47.2	25.1	0.12	4.3	2018	94.7	120.3	69	0.11	10.8
2019	29.3	54.8	3.8	0.34	9.9	2019	49.9	90	9.9	0.31	15.6
2020	0.2	0.5	0	0.97	0.2	2020	4.1	8.8	0	0.67	2.7
2021	**1.6**	**NA**	**NA**	**0**	**0**	**2021**	**8.7**	**NA**	**NA**	**0**	**0**
Newly Mature Females						**Newly Mature Males**					
2010	9.6	24.9	-5.7	0.62	5.9	2010	4.3	9.1	-0.5	0.43	1.9
2011	1.4	3.8	-0.9	0.58	0.8	2011	1.4	4.9	-2.2	0.94	1.3
2012	1	4.4	-2.3	0.76	0.8	2012	6.1	14.1	-1.9	0.47	2.9
2016	4.5	8	1.1	0.3	1.3	2016	16	27.2	4.9	0.27	4.3
2017	2.1	5.9	-1.7	0.65	1.4	2017	12.4	25.7	-1	0.42	5.2
2018	2.3	4.3	0.3	0.34	0.8	2018	3.6	7.6	-0.5	0.44	1.6
2019	0	0	0	NA	0	2019	8.5	22.9	-5.9	0.66	5.6
2020	0	0	0	NA	0	2020	0.1	0.3	0	0.97	0.1
2021	**0**	**NA**	**NA**	**NA**	**0**	**2021**	**0**	**NA**	**NA**	**NA**	**0**

Table 5. Results of correlation analyses of mean prosomal width (mm) and survey year for mature and newly mature males and females from the Delaware Bay area and lower Delaware Bay surveys. Statistics presented are number of years included: *n*; *T-score*; probability, *p*; and correlation coefficient, *r*. A negative correlation coefficient indicates a decreasing regression slope.

Maturity Group	n	T	p	r
Delaware Bay Area 2002 - 2021				**p**
Mature females	17	-7.48	<0.001	-0.888
Newly mature females	17	-4.12	0.001	-0.741
Mature males	17	-14.95	<0.001	-0.968
Newly mature males	17	-4.25	<0.001	-0.739
Lower Delaware Bay 2002 - 2021				
Mature females	9	-6.78	<0.001	-0.932
Newly mature females	9	-3.98	0.016	-0.894
Mature males	9	-6.32	<0.001	-0.922
Newly mature males	9	2.28	0.063	0.681

Table 6. Estimated population (in thousands) of horseshoe crabs in the coastal **Delaware Bay area** survey, 2002-2020, with the mean, standard deviation (sd), and coefficient of variation (CV), calculated using the **delta distribution model** by demographic group. Also included are the estimated upper and lower 95% confidence limits (UCL, LCL).

YEAR	MEAN	UCL	LCL	CV	SD	YEAR	MEAN	UCL	LCL	CV	SD
Immature Females						**Immature Males**					
2002	9470	15665	3275	0.31	2936	2002	5483	9284	1683	0.33	1809
2003	4585	8848	321	0.43	1972	2003	2303	4217	390	0.39	898
2004	7774	11770	3778	0.25	1944	2004	6810	10895	2725	0.29	1975
2005	5630	8856	2404	0.28	1576	2005	5260	8839	1681	0.33	1736
2006	12928	18691	7164	0.21	2715	2006	9327	14554	4100	0.24	2238
2007	13684	27486	-118	0.41	5610	2007	8966	18246	-314	0.42	3766
2008	10933	18650	3216	0.32	3499	2008	7841	13917	1766	0.35	2744
2009	39032	72868	5197	0.39	15222	2009	29864	47269	12460	0.28	8362
2010	3954	5220	2688	0.16	633	2010	2686	4144	1229	0.26	698
2011	4965	6945	2985	0.2	993	2011	3092	4547	1637	0.23	711
2016	11699	20462	2935	0.36	4212	2016	9102	16649	1555	0.39	3550
2017	7505	10708	4302	0.19	1426	2017	5091	8465	1717	0.27	1375
2018	10173	14285	6061	0.19	1933	2018	7507	11173	3842	0.23	1727
2019	3397	5516	1279	0.31	1053	2019	1487	2614	360	0.38	565
2020	9475	19779	0	0.65	6159	2020	5925	11967	0	0.61	3614
2021	**4,174**	**7,947**	**400**	**0.53**	**2218**	**2021**	**2,574**	**4,634**	**513**	**0.47**	**1,199**
Mature Females						**Mature Males**					
2002	4959	8084	1834	0.3	1488	2002	11584	17335	5834	0.24	2780
2003	3379	5160	1599	0.25	845	2003	8069	13029	3110	0.29	2340
2004	2735	4043	1426	0.23	629	2004	5150	7788	2511	0.25	1288
2005	3138	4942	1333	0.27	847	2005	5844	8461	3228	0.22	1286
2006	6611	14330	-1108	0.42	2777	2006	15825	26060	5589	0.27	4273
2007	7746	12704	2789	0.31	2401	2007	15795	25104	6487	0.28	4423
2008	6311	10202	2419	0.29	1830	2008	14647	24995	4299	0.33	4834
2009	2975	4971	979	0.32	952	2009	6240	10197	2283	0.3	1872
2010	5178	7616	2740	0.23	1191	2010	13963	21910	6015	0.28	3910
2011	5290	7282	3297	0.18	952	2011	15060	29000	1120	0.4	6024
2016	6024	8635	3413	0.21	1265	2016	21941	37216	6665	0.29	6363
2017	7185	10525	3844	0.23	1653	2017	20664	31208	10119	0.25	5166
2018	7326	10520	4131	0.21	1538	2018	15749	21880	9619	0.18	2835
2019	5110	8454	1767	0.32	1635	2019	8924	15202	2646	0.35	3108
2020	10803	15359	6247	0.25	2706	2020	31546	51050	12042	0.36	11583
2021	**15,498**	**35,873**	**0**	**0.75**	**11,568**	**2021**	**38,538**	**85,949**	**0**	**0.7**	**26,925**
Newly Mature Females						**Newly Mature Males**					
2002	1537	2400	675	0.26	400	2002	548	869	227	0.28	153
2003	794	1633	-45	0.49	389	2003	78	221	-65	0.84	66
2004	358	575	141	0.29	104	2004	789	1127	451	0.21	166
2005	479	753	206	0.27	129	2005	597	1002	191	0.33	197
2006	2051	3509	594	0.31	636	2006	3113	5113	1113	0.31	965
2007	2373	4339	408	0.4	949	2007	3129	4972	1287	0.28	876
2008	2571	4984	158	0.43	1106	2008	757	1254	261	0.31	235
2009	885	1361	410	0.26	230	2009	725	1240	210	0.34	247
2010	1338	2990	-314	0.59	789	2010	1422	3070	-226	0.55	782
2011	845	1360	331	0.3	254	2011	749	1335	164	0.36	270
2016	1608	2357	860	0.23	370	2016	2608	4884	331	0.42	1095
2017	1480	2274	687	0.26	385	2017	1523	2392	654	0.28	426
2018	1773	2923	622	0.31	550	2018	3341	5367	1316	0.29	969
2019	242	472	12	0.47	114	2019	1271	2154	389	0.34	437
2020	133	330	0	0.87	117	2020	2492	4030	953	0.37	914
2021	**0**	**NA**	**NA**	**NA**	**NA**	**2021**	**6,333**	**14,328**	**0**	**0.68**	**4309**

Table 7. Estimated population (in thousands) of horseshoe crabs in the coastal **Delaware Bay area** survey, 2002-2020, with the mean, standard deviation (sd), and coefficient of variation (CV), calculated using the **normal distribution** model by demographic group. Also included are the estimated upper and lower 95% confidence limits (UCL, LCL).

YEAR	MEAN	UCL	LCL	CV	SD	YEAR	MEAN	UCL	LCL	CV	SD
Immature Females						**Immature Males**					
2002	8222	11875	4568	0.21	1727	2002	5076	7998	2155	0.28	1421
2003	4089	6860	1317	0.32	1308	2003	2114	3462	766	0.3	634
2004	7376	10616	4135	0.21	1549	2004	6033	8786	3281	0.22	1327
2005	5104	7521	2687	0.23	1174	2005	4673	7414	1932	0.28	1308
2006	13714	20988	6439	0.25	3429	2006	9378	13971	4786	0.23	2157
2007	13692	27335	48	0.41	5614	2007	9350	19735	-1035	0.45	4208
2008	10595	16578	4612	0.26	2755	2008	6897	10443	3350	0.23	1586
2009	27375	40519	14232	0.23	6296	2009	26435	38730	14140	0.23	6080
2010	4102	5706	2497	0.19	779	2010	2781	4423	1139	0.29	806
2011	5426	8433	2420	0.27	1465	2011	3301	5219	1382	0.28	924
2016	11292	18441	4144	0.3	3388	2016	8185	13512	2858	0.31	2537
2017	7948	11818	4077	0.23	1828	2017	5082	7829	2335	0.26	1321
2018	10115	13839	6391	0.18	1821	2018	7768	11653	3882	0.24	1864
2019	14855	15027	14682	0.33	4902	2019	66	236	-104	1.27	84
2020	6832	10559	3106	0.32	2213	2020	4610	7540	1679	0.38	1740
2021	**4053**	**7670**	**436**	**0.51**	**2064**	**2021**	**2548**	**4389**	**707**	**0.42**	**1074**
Mature Females						**Mature Males**					
2002	4779	7431	2128	0.26	1243	2002	10711	14972	6450	0.19	2035
2003	3308	4851	1764	0.22	728	2003	7454	10827	4082	0.21	1565
2004	2767	3919	1615	0.2	553	2004	5586	8875	2297	0.28	1564
2005	2957	4323	1592	0.22	651	2005	5408	7322	3494	0.17	919
2006	5867	10517	1218	0.31	1819	2006	14461	21734	7188	0.23	3326
2007	6553	9864	3243	0.25	1638	2007	13100	18506	7694	0.2	2620
2008	7172	13336	1008	0.4	2869	2008	14244	23240	5247	0.3	4273
2009	3230	5523	936	0.33	1066	2009	6319	10255	2383	0.29	1833
2010	5588	8698	2478	0.26	1453	2010	14396	22600	6192	0.27	3887
2011	5388	7629	3147	0.2	1078	2011	14858	25890	3825	0.33	4903
2016	5735	7770	3700	0.17	975	2016	24017	40197	7837	0.3	7205
2017	7785	12033	3537	0.27	2102	2017	19985	29245	10724	0.23	4597
2018	9463	18463	464	0.44	4164	2018	15264	19849	10680	0.15	2290
2019	6420	6506	6334	0.32	2054	2019	11660	11824	11497	0.37	4314
2020	10927	16014	5840	0.28	3021	2020	25200	34983	15416	0.23	5810
2021	**21766**	**40665**	**2867**	**0.49**	**10750**	**2021**	**61879**	**109880**	**13877**	**0.45**	**27576**
Newly Mature Females						**Newly Mature Males**					
2002	1509	2278	741	0.24	362	2002	561	925	196	0.31	174
2003	787	1547	26	0.45	354	2003	78	222	-66	0.84	66
2004	367	613	120	0.32	117	2004	786	1120	452	0.2	157
2005	531	908	154	0.34	181	2005	580	927	233	0.29	168
2006	2122	3705	540	0.33	700	2006	3377	6076	678	0.38	1283
2007	2129	3584	674	0.33	703	2007	2841	4214	1468	0.23	653
2008	2697	4780	613	0.36	971	2008	776	1315	237	0.33	256
2009	883	1366	399	0.26	230	2009	708	1157	259	0.31	219
2010	1770	4532	-992	0.74	1310	2010	1464	3180	-252	0.56	820
2011	882	1495	269	0.34	300	2011	766	1343	190	0.36	276
2016	1583	2304	863	0.22	348	2016	2939	5588	290	0.43	1264
2017	0.00	NA	NA	NA	NA	2017	1590	2623	557	0.32	509
2018	1780	2866	695	0.29	516	2018	3064	4466	1663	0.22	674
2019	77	225	-70	0.94	73	2019	112	267	-43	0.68	77
2020	134	330	0	0.87	117	2020	2430	3676	1184	0.3	740
2021	**0**	**NA**	**NA**	**NA**	**NA**	**2021**	**6308**	**14299**	**0**	**0.68**	**4307**

Table 8. Estimated population (in thousands) of horseshoe crabs in the **lower Delaware Bay** survey area in 2010-2020, with the mean, standard deviation (sd), and coefficient of variation (CV), calculated using the **delta distribution** model by demographic group. Also included are the estimated upper and lower 95% confidence limits (UCL, LCL).

	YEAR	MEAN	UCL	LCL	CV	SD		YEAR	MEAN	UCL	LCL	CV	SD
Immature Females							**Immature Males**						
	2010	3510	5199	1822	0.2	702		2010	2632	4476	788	0.29	763
	2011	870	1931	-191	0.44	383		2011	881	2160	-397	0.52	458
	2012	8021	15084	958	0.32	2567		2012	9381	21965	-3204	0.42	3940
	2016	9046	15558	2534	0.29	2623		2016	8429	14813	2044	0.32	2697
	2017	4536	10029	-956	0.47	2132		2017	2920	6458	-618	0.47	1372
	2018	2211	2803	1619	0.1	221		2018	2597	3516	1678	0.15	390
	2019	525	1278	-229	0.56	294		2019	308	816	-201	0.64	197
	2020	12	33	0	0.97	12		2020	8	22	0	0.97	8
	2021	**130**	**NA**	**NA**	**0.99**	**129**		**2021**	**140**	**NA**	**NA**	**0.78**	**109**
Mature Females							**Mature Males**						
	2010	2117	4260	-25	0.39	826		2010	5657	10247	1067	0.32	1810
	2011	1348	2599	96	0.33	445		2011	4829	10570	-912	0.43	2076
	2012	938	2522	-646	0.39	366		2012	3263	6864	-338	0.35	1142
	2016	1274	1710	837	0.15	191		2016	7735	9709	5761	0.1	774
	2017	3674	7501	-153	0.38	1396		2017	16794	40517	-6929	0.51	8565
	2018	1771	2588	953	0.18	319		2018	4616	6600	2631	0.18	831
	2019	1148	3011	-715	0.63	723		2019	5746	14583	-3092	0.6	3448
	2020	7	19	0	0.97	7		2020	152	332	0	0.68	103
	2021	**65**	**NA**	**NA**	**0.99**	**64**		**2021**	**365**	**NA**	**NA**	**0.72**	**262**
Newly Mature Females							**Newly Mature Males**						
	2010	414	1087	-260	0.63	261		2010	187	409	-35	0.46	86
	2011	65	170	-40	0.58	38		2011	58	208	-93	0.94	55
	2012	50	214	-114	0.76	38		2012	301	710	-109	0.49	147
	2016	206	357	55	0.3	62		2016	727	1268	186	0.29	211
	2017	88	249	-73	0.66	58		2017	542	1100	-16	0.4	217
	2018	115	220	9	0.36	41		2018	148	290	7	0.4	59
	2019	0	0	0	NA	0		2019	361	1022	-299	0.71	257
	2020	0	0	0	NA	0		2020	4	11	0	0.97	4
	2021	**0**	**NA**	**NA**	**NA**	**NA**		**2021**	**0**	**NA**	**NA**	**NA**	**NA**

Table 9. Estimated population (in thousands) of horseshoe crabs in the **lower Delaware Bay** survey area in 2010-2019, with the mean, standard deviation (sd), and coefficient of variation (CV), calculated using the **normal distribution** model by demographic group. Also included are the estimated upper and lower 95% confidence limits (UCL, LCL).

	YEAR	MEAN	UCL	LCL	CV	SD		YEAR	MEAN	UCL	LCL	CV	SD
Immature Females							**Immature Males**						
	2010	3503	5155	1851	0.18	631		2010	2588	4056	1120	0.24	621
	2011	938	2311	-435	0.53	497		2011	935	2437	-567	0.58	542
	2012	8125	14222	2027	0.31	2519		2012	9023	17690	356	0.35	3158
	2016	8618	13190	4046	0.22	1896		2016	7725	11638	3812	0.21	1622
	2017	4325	8829	-178	0.41	1773		2017	2731	5408	53	0.38	1038
	2018	2209	2780	1638	0.1	221		2018	2595	3529	1661	0.15	389
	2019	852	868	836	0.01	9		2019	566	566	566	0	0
	2020	12	33	0	0.97	12		2020	8	22	0	0.97	8
	2021	**130**	**NA**	**NA**	**0**	**0**		**2021**	**140**	**NA**	**NA**	**0**	**0**
Mature Females							**Mature Males**						
	2010	2124	4340	-91	0.41	871		2010	5600	9916	1285	0.3	1680
	2011	1290	2239	340	0.27	348		2011	4479	8332	625	0.31	1388
	2012	915	2242	-412	0.34	311		2012	3188	5456	921	0.28	893
	2016	1264	1647	880	0.13	164		2016	7727	9570	5883	0.1	773
	2017	3654	7307	2	0.36	1315		2017	13805	23702	3908	0.26	3589
	2018	1782	2666	898	0.19	339		2018	4647	6901	2393	0.19	883
	2019	1932	1948	1916	0	0		2019	8356	8356	8356	0	0
	2020	7	19	0	0.97	7		2020	152	332	0	0.68	103
	2021	**65**	**NA**	**NA**	**0**	**0**		**2021**	**365**	**NA**	**NA**	**0**	**0**
Newly Mature Females							**Newly Mature Males**						
	2010	418	1097	-260	0.63	263		2010	185	391	-22	0.43	80
	2011	65	170	-40	0.58	38		2011	58	208	-93	0.94	55
	2012	50	214	-114	0.76	38		2012	302	719	-114	0.5	151
	2016	205	355	55	0.28	57		2016	716	1176	256	0.25	179
	2017	88	249	-73	0.66	58		2017	541	1090	-9	0.4	216
	2018	114	226	3	0.35	40		2018	149	296	1	0.41	61
	2019	0	0	0	NA	0		2019	401	408	394	0	3
	2020	0	0	0	NA	0		2020	4	11	0	0.97	4
	2021	**0**	**NA**	**NA**	**NA**	**NA**		**2021**	**0**	**NA**	**NA**	**NA**	**NA**

Table 10. Mean, minimum (min), and maximum (max) bottom water temperature (C°) and ordinal sampling date (numerical calendar date from 1 January) for survey collections in the Delaware Bay area and Lower Delaware Bay. For reference, 1 September is ordinal date 243 in non-leap years.

	Water Temperature			Ordinal Date		
	mean	**max**	**min**	**mean**	**max**	**min**
Delaware Bay Area						
2002	19.33	15	23.5	277.41	273	300
2003	17.41	13.5	20	286.60	278	296
2004	16.67	14.5	20.5	292.74	277	302
2005	20.94	14	24.5	261.23	250	306
2006	17.53	13	22.3	284.53	246	314
2007	19.69	14.3	23.3	294.96	282	311
2008	20.09	19.3	22.6	277.02	272	287
2009	15.54	14.3	17	315.24	307	324
2010	19.72	12.3	24.1	282.68	265	331
2011	21.60	18.6	23.8	265.44	254	296
2012	18.47	18.1	18.8	292.92	289	298
2016	22.82	18.6	24.8	274.02	260	299
2017	21.89	18.8	23.2	274.05	263	294
2018	22.48	13.9	24.8	276.41	253	315
2019	23.05	18.8	24.3	250.38	242	270
2020	21.79	17	25	231.15	219	252
2021	**23.25**	**18.8**	**28**	**233.44**	**222**	**250**
Lower Delaware Bay						
2010	17.18	16.7	17.7	295.36	295	296
2011	18.32	18	18.6	294.27	294	295
2012	17.96	17.9	18	299.00	299	299
2016	19.56	19	20.1	288.40	288	289
2017	19.35	19.2	19.5	292.30	292	293
2018	12.16	11.3	12.8	321.44	321	322
2019	17.50	17.2	17.8	292.00	292	292
2020	24.00	23.2	25.4	248.00	248	248
2021	**20.50**	**19**	**22**	**268.00**	**268**	**268**

Table 11. Correlations between annual mean catches-per-tow of horseshoe crabs with mean bottom water temperature and ordinal sampling date in the Delaware Bay area survey and the lower Delaware Bay survey, by demographic group. The Delaware Bay area surveys included 15 years, and the lower Delaware Bay surveys included 8 years. Statistics presented include correlation coefficient, *r*; *T-score*; and probability, *p*. Data are from Tables 1, 3, and 10.

	Water Temperature			Ordinal Date		
Delaware Bay Area	***r***	***T***	***p***	***r***	***T***	***p***
Immature females	-0.536	-2.38	0.032	0.567	2.58	0.022
Immature males	-0.547	-2.44	0.028	0.585	2.7	0.017
Mature females	0.562	2.55	0.023	-0.71	-3.78	0.002
Mature males	0.576	2.63	0.02	-0.711	-3.78	0.002
Newly mature females	-0.142	-0.54	0.6	0.51	2.22	0.044
Newly mature males	0.47	1.99	0.066	-0.498	-2.15	0.049
Lower Delaware Bay						
Immature females	-0.116	-0.31	0.767	0.346	0.98	0.362
Immature males	-0.154	-0.41	0.692	0.36	1.02	0.341
Mature females	-0.371	-1.06	0.325	0.537	1.69	0.136
Mature males	-0.153	-0.41	0.694	0.37	1.05	0.327
Newly mature females	-0.273	-0.75	0.477	0.318	0.89	0.405
Newly mature males	-0.086	-0.23	0.826	0.303	0.84	0.428

Red Knot Stopover Population Size and Migration Ecology at Delaware Bay, USA, 2022

A report submitted to the Adaptive Resource Management Subcommittee and Delaware Bay Ecosystem Technical Committee of the Atlantic States Marine Fisheries Commission

7 September 2022

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Abstract. Red Knots (*Calidris canutus rufa*) stop at Delaware Bay during northward migration to feed on eggs of horseshoe crabs (*Limulus polyphemus*). In the late 1990s and early 2000s, the number of Red Knots found at Delaware Bay declined from ~50,000 to ~13,000. Horseshoe crabs have been harvested for use as bait in eel and whelk fisheries since at least 1990, and some avian conservation biologists hypothesized that crab harvest levels in the 1990s prevented sufficient refueling for successful migration to the breeding grounds, nesting, and survival for the remainder of the annual cycle. Since 2013, the harvest of horseshoe crabs in the Delaware Bay region has been managed using an Adaptive Resource Management (ARM) framework. The objective of the ARM framework is to manage sustainable harvest of Delaware Bay horseshoe crabs while maintaining ecosystem integrity and supporting Red Knot recovery with adequate stopover habitat for Red Knots and other migrating shorebirds. For annual harvest recommendations, the ARM framework requires annual estimates of horseshoe crab population size and the Red Knot stopover population. We conducted a mark-recapture-resight investigation to estimate the passage population of Red Knots at Delaware Bay in 2022. We used a Bayesian analysis of a Jolly-Seber model, which accounts for turnover in the population and the probability of detection during surveys. The 2022 Red Knot mark-resight dataset included a total of 1,546 individual birds that were recorded at least one during mark-resight surveys at Delaware Bay in 2022. The passage population size in 2022 was estimated at 39,800 (95% credible interval: 35,013 – 55,355). Although there is broad overlap in the confidence intervals for population estimate from 2020–2022, the population estimate for 2022 was below 40,000 birds for the first time since 2011. The 2022 population size estimate will inform decision making for harvest recommendations in the next management cycle.

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2 Background

Red Knots (*Calidris canutus rufa*) stop at Delaware Bay during northward migration to feed on eggs of horseshoe crabs (*Limulus polyphemus*). The northward migration of *C. c. rufa* coincides with the spawning of horseshoe crabs, whose eggs are the perfect food for a migrating Red Knots because they are easily digestible and energy-rich (Karpanty et al. 2006, Haramis et al. 2007). Horseshoe crabs are therefore an important food resource for Red Knots as well as other shorebirds at Delaware Bay.

Horseshoe crabs have been harvested since at least 1990 for use as bait in American eel (*Anguilla rostrata*) and whelk (*Busycon*) fisheries (Kreamer and Michels 2009). In the late 1990s and early 2000s the number of Red Knots found at Delaware Bay declined from ~50,000 to ~13,000 (Niles et al. 2008). At the same time the number of horseshoe crabs harvested also declined and avian conservation biologists hypothesized that unregulated harvest of horseshoe crabs from Delaware Bay in the 1990s prevented sufficient refueling during stopover for successful migration to the breeding grounds, nesting, and survival for the remainder of the annual cycle (McGowan et al. 2011).

The harvest of horseshoe crabs in the Delaware Bay region has been managed by the Atlantic States Marine Fisheries Commission (ASMFC) since 2012 using an Adaptive Resource Management (ARM) framework (McGowan et al. 2015b). The ARM framework was designed to constrain the harvest so that number of spawning crabs would not limit the number of Red Knots stopping at Delaware Bay during migration. This management framework to achieve multiple objectives requires an estimate each year of both the crab population and the Red Knot stopover population size to inform harvest recommendations (McGowan et al. 2015a). Therefore, we estimated the stopover population size in 2022 using mark-resight data on individually-marked birds and a Jolly-Seber model for open populations, as we have each year since 2011.

3 Methods

Red knots have been individually marked at Delaware Bay and other locations in the Western Hemisphere with engraved leg flags since 2003. Each leg flag is engraved with a field-readable, unique 3-character alphanumeric code (Clark et al. 2005). Mark-resight data (i.e., sight records of individually-marked birds and counts of marked and unmarked birds) were collected on the Delaware and New Jersey shores of Delaware Bay in 2022 according to the methods for mark-resight investigations of Red Knots at Delaware Bay (Lyons 2016). This protocol has been used at Delaware Bay since 2011.

Surveys to locate leg-flagged birds were conducted on each beach in 2022, every three days in May and June according to the sampling plan (Table 1). During these resighting surveys, agency staff and volunteers surveyed the entire beach and recorded as many alphanumeric combinations as possible.

As in previous years, all flag resightings were validated with physical capture and banding data available in the data repository at http://www.bandedbirds.org/. Resightings without a corresponding record of physical capture and banding (i.e., “misread” errors) were discarded and not included in the analysis. However, banding data from Argentina are not available for validation purposes in bandedbirds.org; therefore, all resightings of orange engraved flags were included in the analysis without validation using banding data. We also omitted resightings of 12 flagged individuals in 2022 whose flag codes were previously accidentally deployed in both New Jersey and South Carolina (Amanda Dey, New Jersey Division of Fish and Wildlife, pers. comm., 31 May 2017) because it is not possible to confirm individual identity in this case. Section 4 “Summary of Mark-resight and Count Data Collected in 2022” describes additional quality control procedures and the potential for other types of errors in the mark-resight dataset.

While searching for birds marked with engraved leg flags, observers also periodically used a scan sampling technique to count marked and unmarked birds in randomly selected portions of Red Knot flocks (Lyons 2016).

To estimate stopover population size, we used the methods of Lyons et al. (2016) to analyze 1) the mark-resight data (flag codes), and 2) data from the scan samples of the marked:unmarked ratio. Lyons et al. (2016) rely on the “superpopulation” approach developed by Crosbie and Manly (1985) and Schwarz and Arnason (1996). The superpopulation is defined as the total number of birds present in the study area on at least one of the sampling occasions over the entire study, i.e., the total number of birds present in the study area at any time between the first and last sampling occasions (Nichols and Kaiser 1999). In this superpopulation approach, passage population size is estimated each year using the Jolly-Seber model for open populations, which accounts for the flow-through nature of migration areas and probability of detection during surveys.

In our analyses for Delaware Bay, the days of the migration season were aggregated into 3-day sampling periods (a total of 10 sample periods possible each season, Table 1). Data were aggregated to 3-day periods because this is the amount of time necessary to complete mark-resight surveys on all beaches in the study (a summary of the mark-resight data from 2022 is provided in Appendix 1).

With the mark-resight superpopulation approach, we first estimated the number of birds that were carrying leg flags, and then adjusted this number to account for unmarked birds using the estimated proportion of the population with flags. The estimated proportion with leg flags is thus an important statistic. We used the scan sample data (i.e., the counts of marked birds and the number checked for marks) and a binomial model to estimate the proportion of the population that is marked. To account for the random nature of arrival of marked birds in the bay and the addition of new marks during the season, we implemented the binomial model as a generalized linear mixed model with a random effect for the sampling period. More detailed methods are provided in Lyons et al. (2016) and Appendix 2.

4 Summary of Mark-resight and Count Data Collected in 2022

Mark-resight encounter data.—The 2022 Red Knot mark-resight dataset included a total of 1,546 individual birds that were recorded at least one during mark-resight surveys at Delaware Bay in 2022; these birds were originally captured and banded with leg flags in five different countries (Table 2). This total is remarkably close to the total detected at Delaware Bay in 2020 and 2021: 1,587 and 1,591 individual birds were recorded in 2020 and 2021, respectively (Table

2). **Approximately the same number of flagged Red Knots were detected at Delaware Bay in 2020, 2021, and 2022 (Table 2).**

There was sufficient data for analysis in 9 of the 10 sampling periods in 2022 (≤10 May to 3 June; Table 1). In 2022, data beyond 3 June were too sparse for analysis and were not included.

While the number of birds detected in 2022 was similar to the number detected in 2020 and 2021, this number of individuals resighted within a season is lower than recent (pre-COVID-19) years given the limited use of volunteers for safety reasons. The number of marked birds detected and available for analysis in 2022 was approximately 50% of the number available for analysis in the 2019 (n = 3,072 birds) and 40% of the number available for analysis in 2018 (n = 3,820).

One assumption of the mark-resight approach is that individual identity of marked birds is recorded without error (see Lyons 2016 for discussion of all model assumptions). As noted above, some field-recording errors are evident when sight records are compared to physical capture records available from bandedbirds.org. Again, any engraved flag reported by observers that did not have a corresponding record of physical capture was omitted. Field observers submitted 5,195 resightings in 2022; 80 were not valid (i.e., no corresponding banding data), for an overall misread read of 1.5%. These invalid resightings were removed before analysis, but a second type of "false positive" is still possible, i.e., false positive detection of flags that were deployed prior to 2022 but were not in fact present at Delaware Bay in 2022. It is not possible to identify this second type of false positive with banding data validation or other quality assurance/quality control methods.

Marked-ratio data.—In 2022, 541 marked ratio scan samples were collected: 330 and 211 samples in Delaware and New Jersey, respectively (Appendix 3). In 2020 and 2021, respectively, 734 and 564 marked-ratio scan samples were collected.

Aerial and ground count data.—Aerial surveys were conducted on 22 and 26 May 2022 (Table 3; data provided by S. Feigin, Wildlife Restoration Partnerships on behalf of New Jersey DEP Fish and Wildlife). Ground and boat surveys were also conducted in Delaware and New Jersey on 22 and 26 May 2022 (Table 3).

5 Summary of 2022 Migration

The pattern of arrivals at Delaware Bay in 2022 shows one large peak of arrivals about 18 May, with approximately 25% of all birds that stopped in the bay in 2022 arriving between 17 and 19 May (Fig. 1a). The numbers of birds arriving in the preceding (15 May) and following (21 May) 3-day periods were also relatively large (approximately 20% of all arrivals in each). In 2022, few birds arrived before 14 May or after 28 May.

Stopover persistence is the probability that a bird present at Delaware Bay during sampling period *i* is present at sampling period *i* +1. In 2022, stopover persistence started off relatively high (Fig 1b). Stopover persistence declined around 18 May and again around 21 May, indicating some early departures and turnover in the population. A second peak in stopover persistence around 24 May indicated few departures in this sampling period. After 24 May, persistence declined sharply, indicating synchronous departures of the remaining birds between 27 and 30 May.

Following Lyons et al. (2016), we used the Jolly-Seber model to estimate stopover duration. Stopover duration declined slightly in 2022 for the third year in a row. In 2022, estimated average stopover duration was 9.4 days (95% credible interval 8.6–10.9 days). The stopover duration estimate (and 95% credible interval) was 12.1 days in 2019 (11.6 – 12.5), 10.7 days in 2020 (9.9 – 11.7), and 10.3 days in 2021 (9.0-12.1). This method of estimating stopover duration provides a coarse measure in our Delaware Bay study, however, because it is derived from the estimated number of sampling periods that birds remained in the study area. Sampling periods in this analysis are 3 consecutive days in which the data are aggregated (Table 1). To estimate stopover duration in days at Delaware Bay with this method, we first estimate the number of sampling periods that each bird remained in the study area and then multiply this by 3 (the number of days in each period). The resolution of the stopover duration estimate is thus limited by the resolution of the sampling periods (i.e., the time step in the mark-recapture model).

Probability of resighting in 2022 was relatively low early in the season, less than 20% in four of the first five sampling periods (10 – 21 May, Fig 1c). Probability of resighting increased steadily after 21 May until the end of the season, when it peaked at approximately 50%.

In 2022, 8.4% of the stopover population carried engraved leg flags (95% CI: 7.4% –9.7%). This is similar to the 2021 estimate (8.2% with leg flags [95% CI: 7.0%–9.1%]) and slightly lower than the 2020 estimate (9.6% with leg flags [95% CI: 8.8%–10.3%]).

6 Stopover Population Estimation

The passage population size in 2022 was estimated at 39,800 (95% credible interval: 35,013 – 51,355). Unlike the aerial survey, this superpopulation estimate accounts for turnover in the population and probability of detection. The 2022 stopover population estimate is slightly lower than the 2021 estimate and is below 40,000 for the first time since 2011 when this mark-resight analysis began (Table 4). However, there was wide overlap of the confidence intervals for the stopover population estimates in recent years (Table 4).

Like 2020–2021 population estimates, the 2022 estimate is slightly lower than the 2018 and 2019 estimates (Table 4) and the confidence interval is wider. The uncertainty in the population estimate and wide confidence intervals are due in part to the low probability of resighting for many of the sampling periods during 2020-2022 compared to earlier years (early 2021 notwithstanding).

The time-specific stopover population estimates in 2022 increased steadily from the beginning of the season and peaked around 18–21 May (approximately 20,700 birds; Fig. 1d). Time-specific estimates declined to approximately 13,500 for 24 – 27 May and then declined steadily until 2 June (Fig. 1d).

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Table 1. Dates for mark-resight survey periods (3-day sampling occasions) at Delaware Bay. Survey period 10 was not used in 2022 because the mark-resight data were sparse in this period.			
Survey period	Dates	Survey period	Dates
1	≤10 May	6	23-25 May
2	11-13 May	7	26-28 May
3	14-16 May	8	29-31 May
4	17-19 May	9	1-3 June
5	20-22 May	10	4-6 June

Table 2. Number of Red Knot (*C. c. rufa*) flags detected in Delaware Bay from 2019–2022 by banding location (flag color).

	No. flagged individuals detected			
Banding location (flag color)	***2019***	***2020***	***2021***	***2022***
U.S. (lime green)	2,368	1,255	1,292	1,281
U.S. (dark green)	351	161	118	118
Argentina (orange)	216	89	81	66
Canada (white)	156	52	78	62
Brazil (dark blue)	35	21	17	14
Chile (red)	10	9	5	5
Total	3,136	1,587	1,591	1,546

Table 3. Number of Red Knots detected during aerial and ground surveys of Delaware Bay in 2022. Data provided by S. Feigin, Wildlife Restoration Partnerships on behalf of the New Jersey DEP Fish and Wildlife, Endangered and Nongame Species Program.

	Delaware	New Jersey	Total
Aerial/Ground Surveys			
22 May 2022	280	11,834	12,114
26 May 2022	1,054*	8,660	9,714
Ground/Boat Surveys			
22 May 2022	132	10,812	10,944
26 May 2022	1,054	8,996	10,050

* Delaware ground survey total from 26 May 2022 (1,054 birds) was used here rather than the aerial count of the Delaware shore on the same day because the aerial count (875 birds) was lower than the corresponding ground count.

Table 4. Red Knot stopover (passage) population estimate using mark-resight methods compared to peak-count index using aerial- or ground-survey methods at Delaware Bay. The mark-resight estimate, N*, of stopover (passage) population accounts for population turnover during migration; peak-count index, a single count on a single day, does not account for turnover. “AG” indicates a combination of aerial and ground counts used to formulate the peak-count index.

Year	Stopover population[a] (mark-resight *N**)	95% CI Stopover population *N**	Peak-count index [aerial (A); ground (G)]
2011	43,570	(40,880 – 46,570)	12,804 (A)[b]
2012	44,100	(41,860 – 46,790)	25,458 (G)[c]
2013	48,955	(39,119 – 63,130)	25,596 (A)[d]
2014	44,010	(41,900 – 46,310)	24,980 (A)[c]
2015	60,727	(55,568 – 68,732)	24,890 (A)[c]
2016	47,254	(44,873 – 50,574)	21,128 (A)[b]
2017	49,405[e]	(46,368 – 53,109)	17,969 (A)[f]
2018	45,221	(42,568 – 49,508)	32,930 (A)[b]
2019	45,133	(42,269 – 48,393)	30,880 (A)[g]
2020	40,444	(33,627 – 49,966)	19,397 (G)[c]
2021	42,271	(35,948 – 55,210)	6,880 (AG)[h]
2022	39,800	(35,013 – 51,355)	12,114 (AG)[g]

[a] passage population estimate for entire season, including population turnover
[b] 23 May
[c] 24 May
[d] 28 May
[e] Data management procedures to reduce bias from recording errors in the field; data from observers with greater than average misread rate were not included in the analysis.
[f] 26 May
[g] 22 May
[h] 27 May

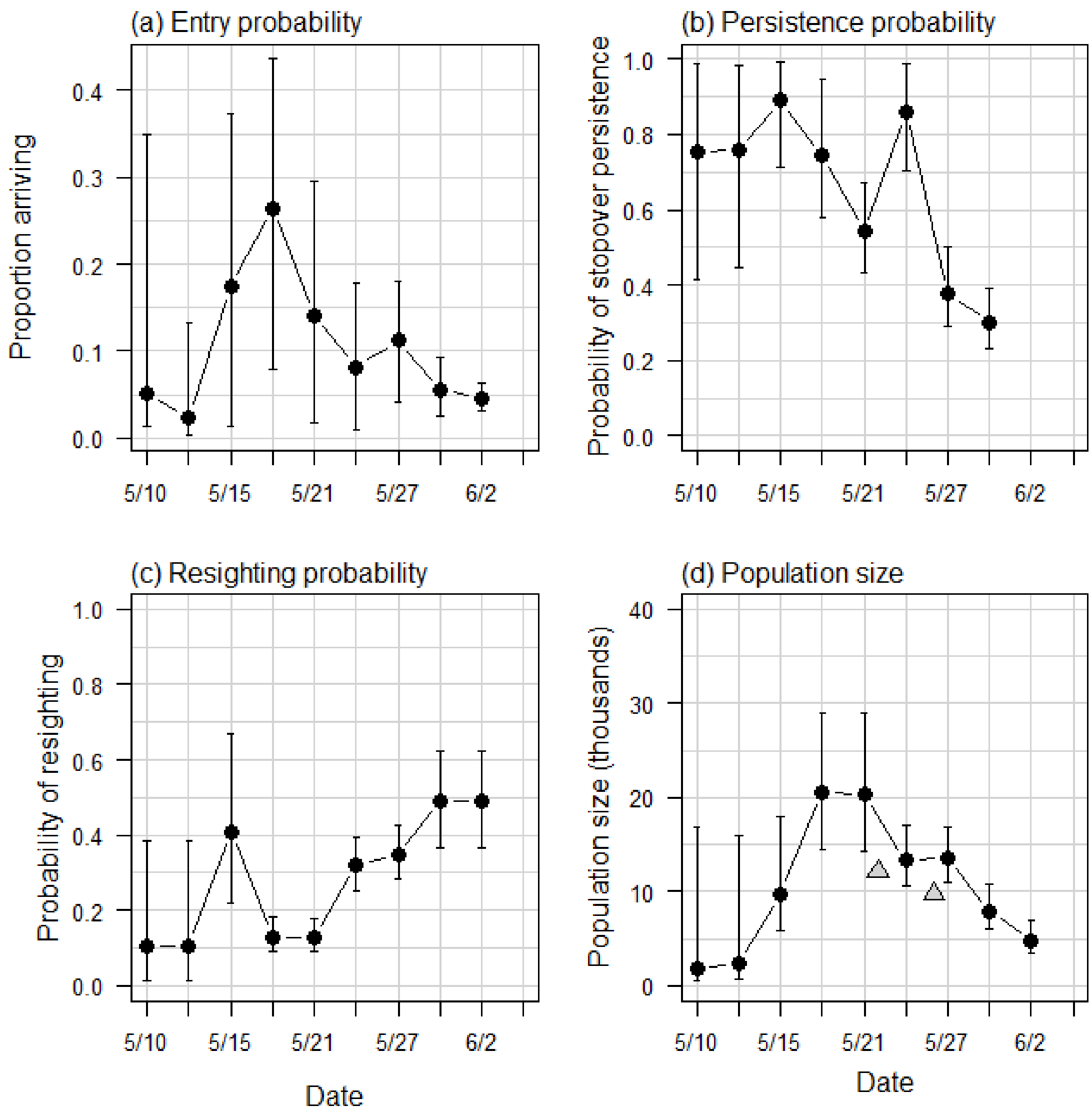


Figure 1. Estimated Jolly-Seber (JS) model parameters from a mark-resight study of Red Knots at Delaware Bay in 2022: (a) proportion of stopover population arriving at Delaware Bay, (b) stopover persistence, (c) probability of resighting, and (d) time-specific stopover population size. Dates on the x-axis represent sampling occasions (3-day survey periods, Table 1). Triangles in (d) are total counts conducted on 22 May 2022 (sum of aerial counts for both DE and NJ) and 26 May 2022 (sum of ground count of DE and aerial count of NJ).

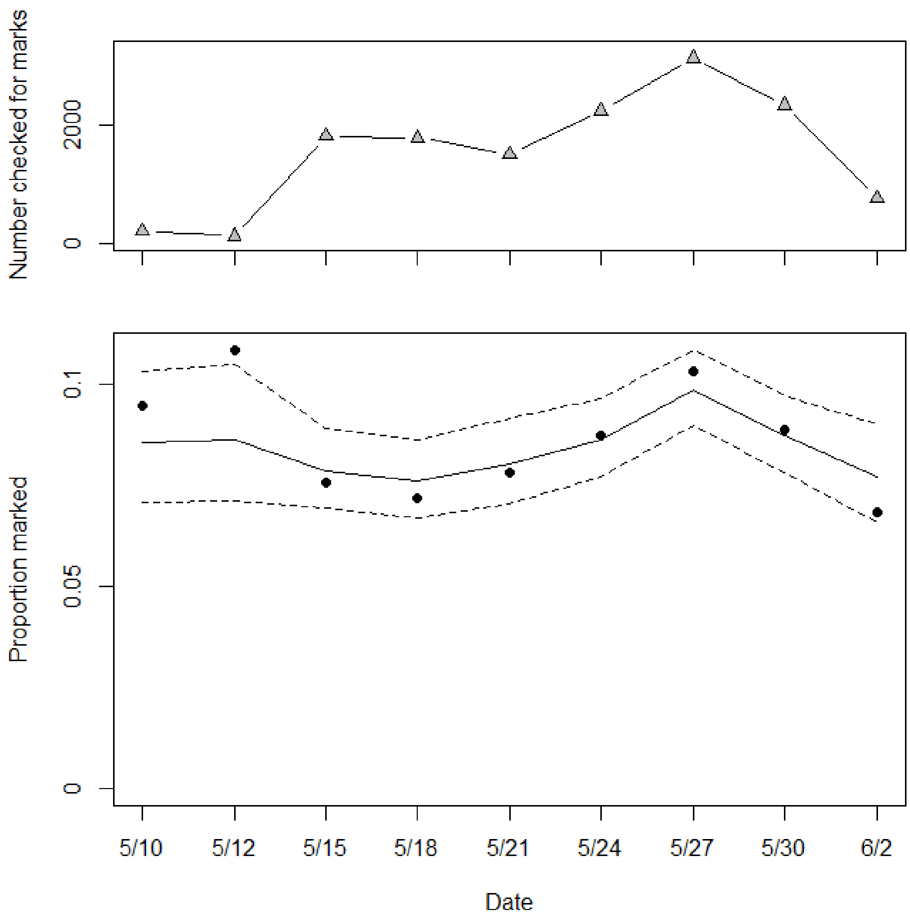


Figure 2. Estimated proportion of the Delaware Bay stopover population carrying leg flags in 2022 (overall average and 95% credible interval: 0.084 [0.073, 0.095]). The marked proportion was estimated from marked-ratio scan samples for each 3-day sampling period. The dates for the sampling periods are shown in Table 1. The upper panel shows the sample size (number scanned, i.e., checked for marks) for each sample period. The bottom panel shows the estimated proportion marked at each sample occasion, which was estimated with the generalized linear mixed model described in Appendix 2. Solid and dashed lines are estimated median proportion marked and 95% credible interval, respectively; filled circles show (number with marks/number scanned).

Appendix 1. Summary of 2022 mark-resight data ("m-array"). NR = never resighted.

			Next resighted at sample								
Sample	Dates	Resighted	2	3	4	5	6	7	8	9	NR
1	≤10 May	17	3	3	0	2	0	0	0	0	9
2	11-13 May	22		8	1	0	1	0	1	0	11
3	14-16 May	309			37	19	25	22	6	1	199
4	17-19 May	199				23	22	10	5	1	138
5	20-22 May	206					39	13	13	3	138
6	23-25 May	366						118	34	1	213
7	26-28 May	465							85	14	366
8	29-31 May	339								51	288
9	1-3 June	174									

Appendix 2. Statistical Methods to Estimate Stopover Population Size Using Mark-Resight Data and Counts of Marked Birds

We converted the observations of marked birds into encounter histories, one for each bird, and analyzed the encounter histories with a Jolly-Seber (JS) model (Jolly 1965, Seber 1965, Crosbie and Manly 1985, Schwarz and Arnason 1996). The JS model includes parameters for recruitment (β), survival (ϕ), and capture (*p*) probabilities; in the context of a mark-resight study at a migration stopover site, these parameters are interpreted as probability of arrival to the study area, stopover persistence, and resighting, respectively. Stopover persistence is defined as the probability that a bird present at time *t* remains at the study area until time *t* + 1. The Crosbie and Manley (1985) and Schwarz and Arnason (1996) formulation of the JS model also includes a parameter for superpopulation size, which in our approach to mark-resight inferences for stopover populations is an estimate of the marked (leg-flagged) population size.

We chose to use 3-day periods rather than days as the sampling interval for the JS model given logistical constraints on complete sampling of the study area; multiple observations of the same individual in a given 3-day period were combined for analysis. A summary (m-array) of the mark-resight data is presented in Appendix 1.

We made inference from a fully-time dependent model; arrival, persistence, and resight probabilities were allowed to vary with sampling period [β_t ϕ_t p_t]. In this model, we set $p_1 = p_2$ and $p_{K-1} = p_K$ (where *K* is the number of samples) because not all parameters are estimable in the fully-time dependent model (Jolly 1965, Seber 1965, Crosbie and Manly 1985, Schwarz and Arnason 1996).

We followed the methods of Royle and Dorazio (2008) and Kéry and Schaub (2012, Chapter 10) to fit the JS model using the restricted occupancy formulation. Royle and Dorazio (2008) use a state-space formulation of the JS model with parameter-expanded data augmentation. For parameter-expanded data augmentation, we augmented the observed encounter histories with all-zero encounter histories (n = 2000) representing potential recruits that were not detected (Royle and Dorazio 2012). We followed Lyons et al. (2016) to combine the JS model with a binomial model for the counts of marked and unmarked birds in an integrated Bayesian analysis. Briefly, the counts of marked birds (m_s) in the scan samples are modeled as a binomial random variable:

$$m_s \sim Bin(C_s, \pi), \qquad (1)$$

where m_s is the number of marked birds in scan sample *s*, C_s is the number of birds checked for marks in scan sample *s*, and π is the proportion of the population that is marked. Total stopover population size $\widehat{N^*}$ is estimated by

$$\widehat{N^*} = {\widehat{M^*}}/{\hat{\pi}} \qquad (2)$$

where $\widehat{M^*}$ is the estimate of marked birds from the J-S model and $\hat{\pi}$ is the proportion of the population that is marked (from Eq. 1). Estimates of marked subpopulation sizes at each resighting occasion t $\left(\widehat{M_t^*}\right)$ are available as derived parameters in the analysis. We calculated an estimate of population size at each mark-resight sampling occasion $\widehat{N_t^*}$ using $\widehat{M_t^*}$ and $\hat{\pi}$ as in equation 2.

To better account for the random nature of the arrival of marked birds and addition of new marks during the season, we used a time-specific model for proportion with marks in place of equation 1 above:

$$m_{s,t} \sim Binomial\left(C_{s,t}, \pi_t\right) \qquad (3)$$

$$for\ s\ in\ 1, \ldots, n_{samples}\ and\ t\ in\ 1, \ldots, n_{occasions}$$

$$logit(\pi_t) = \alpha + \delta_t$$

$$\delta_t \sim Normal\left(0, \sigma^2_{occasions}\right)$$

where m_s is the number of marked birds in scan sample s, C_s is the number of birds checked for marks in scan sample s, δ_t is a random effect time of sample s, and π_t is the time-specific proportion of the population that is marked. Total stopover population size $\widehat{N^*}$ was estimated by summing time-specific arrivals of marked birds to the stopover (B_t) and expanding to include unmarked birds using estimates of proportion marked:

$$\widehat{N^*} = \sum {\widehat{B_t}}/{\pi_t}$$

Time-specific arrivals of marked birds are estimated from the Jolly-Seber model using $\widehat{B_t} = \widehat{\beta_t}\widehat{M^*}$ where $\widehat{M^*}$ is the estimate of the number of marked birds and $\widehat{\beta_t}$ is the fraction of the population arriving at time t.

Appendix 3. Number of marked-ratio scan samples.

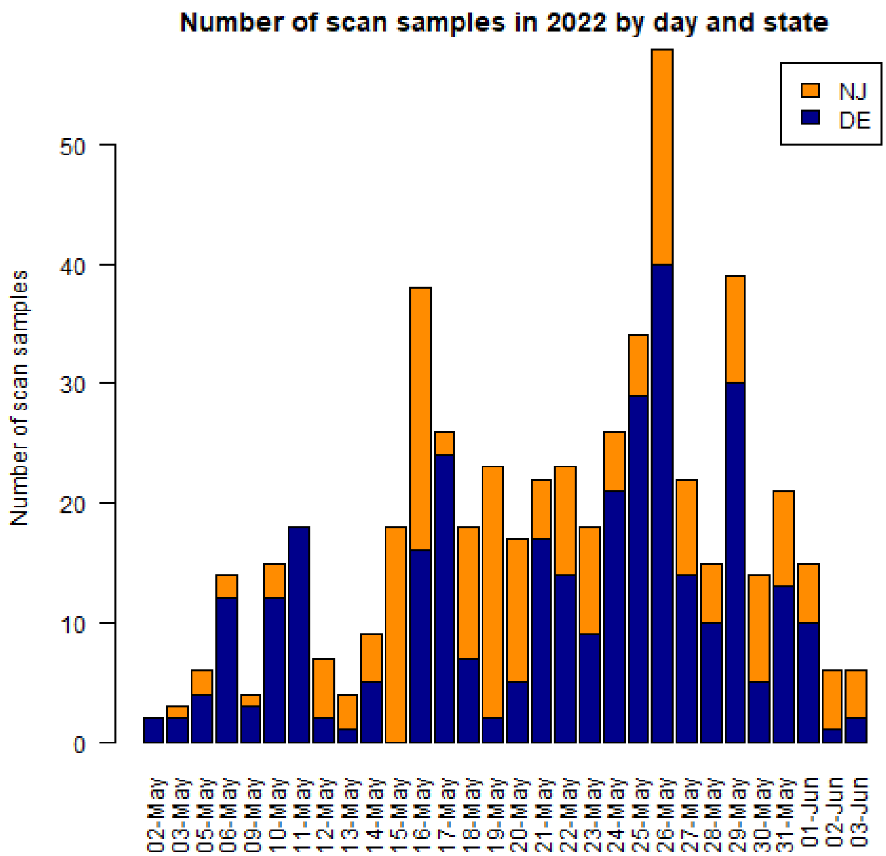
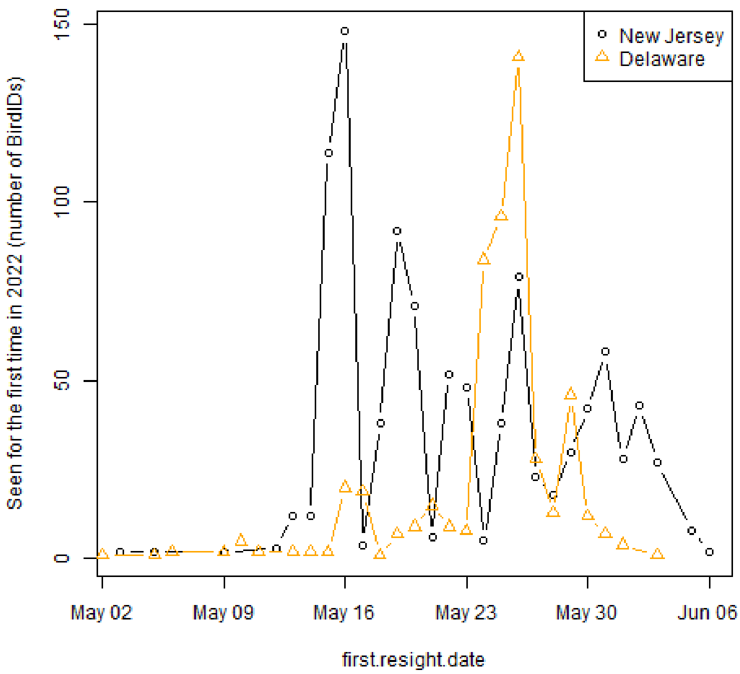


Figure A3.1. Number of marked-ratio scan samples (n = 541) collected in Delaware Bay in 2022 by field crews in Delaware (blue, n = 330 scan samples) and New Jersey (orange, n = 211 scan samples) and date.



New Jersey
Delaware
Seen for the first time in 2022 (number of BirdIDs)
0
50
100
150
May 02
May 09
May 16
May 23
May 30
Jun 06
first.resight.date

DRAFT FOR BOARD REVIEW

ATLANTIC STATES MARINE FISHERIES COMMISSION

REVIEW OF THE INTERSTATE FISHERY MANAGEMENT PLAN

HORSESHOE CRAB
(*Limulus polyphemus*)

2021 Fishing Year

Prepared by the Plan Review Team

October 2022

Sustainable and Cooperative Management of Atlantic Coastal Fisheries

DRAFT FOR BOARD REVIEW

Table of Contents

I. Status of the Fishery Management Plan

Date of FMP Approval:	December 1998
Amendments	None
Addenda	Addendum I (April 2000) Addendum II (May 2001) Addendum III (May 2004) Addendum IV (June 2006) Addendum V (September 2008) Addendum VI (August 2010) Addendum VII (February 2012)
Management Unit:	Entire coastwide distribution of the resource from the estuaries eastward to the inshore boundary of the EEZ
States with Declared Interest:	Massachusetts – Florida, Potomac River Fisheries Commission
Active Boards/Committees:	Horseshoe Crab Management Board, Advisory Panel, Technical Committee, and Plan Review Team; Delaware Bay Ecosystem Technical Committee; Adaptive Resource Management Subcommittee

Goals and Objectives

The Interstate Fishery Management Plan for Horseshoe Crabs (FMP) established the following goals and objectives.

2.0. Goals and Objectives

The goal of this Plan is to conserve and protect the horseshoe crab resource to maintain sustainable levels of spawning stock biomass to ensure its continued role in the ecology of the coastal ecosystem, while providing for continued use over time. Specifically, the goal includes management of horseshoe crab populations for continued use by:

1) *current and future generations of the fishing and non-fishing public (including the biomedical industry, scientific and educational research);*
2) *migrating shorebirds; and,*
3) *other dependent fish and wildlife, including federally listed (threatened) sea turtles.*

To achieve this goal, the following objectives must be met:

(a) prevent overfishing and establish a sustainable population;
(b) achieve compatible and equitable management measures among jurisdictions throughout the fishery management unit;

(c) establish the appropriate target mortality rates that prevent overfishing and maintain adequate spawning stocks to supply the needs of migratory shorebirds;
(d) coordinate and promote cooperative interstate research, monitoring, and law enforcement;
(e) identify and protect, to the extent practicable, critical habitats and environmental factors that limit long-term productivity of horseshoe crabs;
(f) adopt and promote standards of environmental quality necessary for the long-term maintenance and productivity of horseshoe crabs throughout their range; and,
(g) establish standards and procedures for implementing the Plan and criteria for determining compliance with Plan provisions.

Fishery Management Plan Summary
The framework for managing horseshoe crabs along the Atlantic coast was approved in October 1998 with the adoption of the Interstate Fishery Management Plan (FMP) for Horseshoe Crabs. The goal of this plan is to conserve and protect the horseshoe crab resource to maintain sustainable levels of spawning stock biomass to ensure its continued role in the ecology of coastal ecosystems while providing for continued use over time.

In 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 on March 7, 2001, by NMFS in the area recommended by ASMFC. This area is now known as the Carl N. Shuster Jr. Horseshoe Crab Reserve (Figure 1).

In 2001, the Horseshoe Crab Management Board approved Addendum II to the FMP. The purpose of Addendum II was to allow 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 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 reduced 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 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.

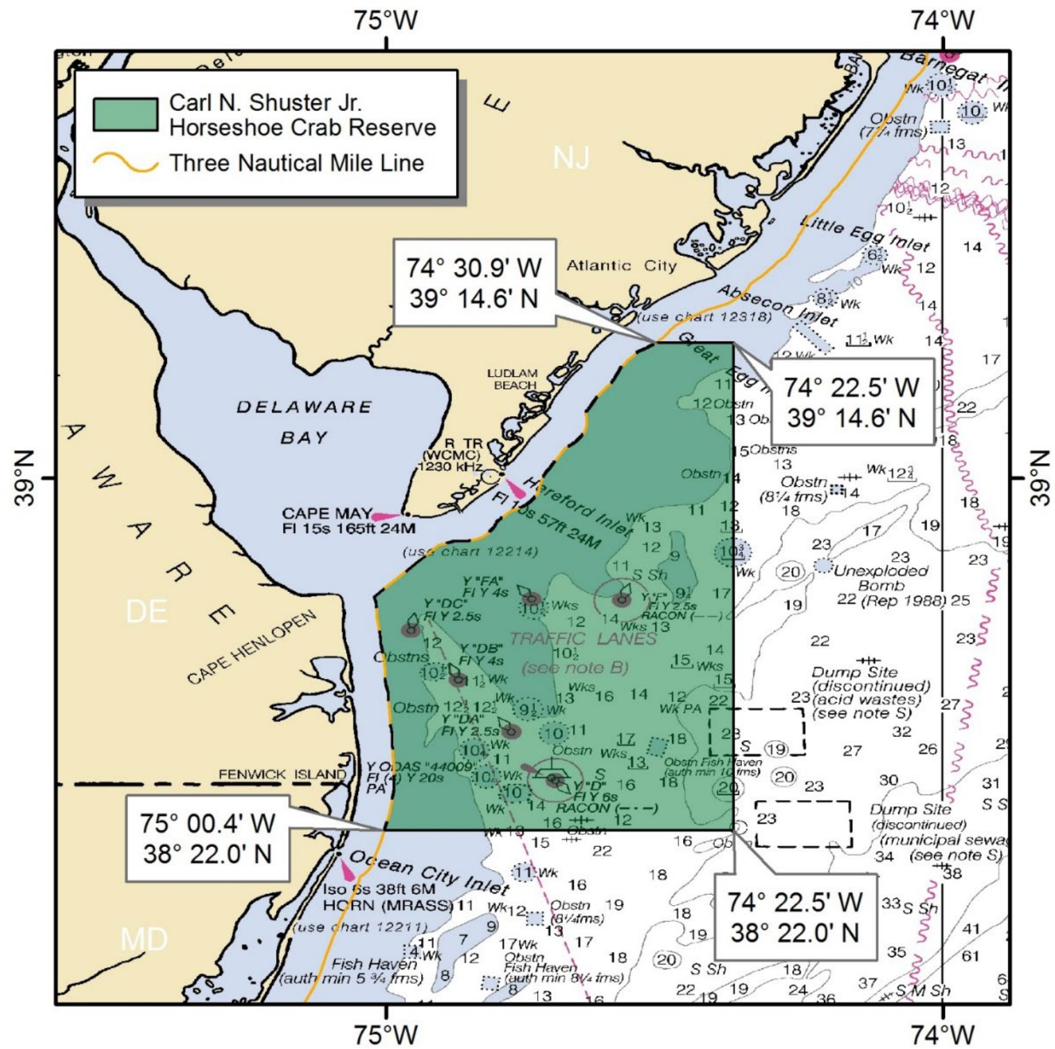


Figure 1. Carl N. Shuster Jr Horseshoe Crab Reserve.

Addendum V, adopted in 2008, extended the provisions of Addendum IV through October 31, 2010.

In early 2010, the Board initiated Draft Addendum VI to consider management options that would follow expiration of Addendum V. The Board voted in August 2010 to extend the Addendum V provisions, via Addendum VI, through April 30, 2013. The Board also chose to include language allowing them to replace Addendum VI with another Addendum during that time, in anticipation of implementing an Adaptive Resource Management (ARM) Framework.

The Board approved Addendum VII in February 2012. This addendum implemented an ARM framework for use during the 2013 fishing season and beyond. The framework considers the abundance levels of horseshoe crabs and shorebirds in determining the optimized bait harvest level for the Delaware Bay states of New Jersey, Delaware, Maryland, and Virginia (east of the COLREGS).

The ARM Framework underwent a revision process in 2021 to incorporate more available data and update the software platform. Several improvements were made to the ARM Framework during this revision. The ARM Revision improves the population models for horseshoe crabs and red knots by incorporating Delaware Bay region-specific data collected over the past few decades. Horseshoe crab population estimates from the Catch Multiple Survey Analysis (CMSA) model used in the 2019 Benchmark Stock Assessment were incorporated into the ARM Revision. Additionally, the ARM Revision includes more sources of horseshoe crab removals than the previous version, adding mortality in the biomedical industry and commercial discards from other fisheries. The maximum number of male and female horseshoe crabs the ARM Revision can recommend remains the same at 210,000 females and 500,000 males. However, harvest recommendations under the ARM Revision are now based on a continuous scale rather than the fixed harvest packages in the previous Framework. Also, the harvest of females is decoupled from the harvest of males so that each are determined separately. While additional data and model improvements are used in the ARM Revision, the conceptual model of horseshoe crab abundance influencing red knot survival and reproduction remains intact with the intent of ensuring the abundance of horseshoe crabs does not become a limiting factor in the population growth of red knots.

After accepting the ARM Revision and Peer Review for management use in January 2022, the Board initiated Draft Addendum VIII to consider allowing its use in setting annual specifications for horseshoe crabs of Delaware Bay-origin.

II. Status of the Stock and Assessment Advice

A benchmark stock assessment was completed and approved for management use in 2019. The assessment report is available at:
http://www.asmfc.org/uploads/file/5cd5d6f1HSCAssessment_PeerReviewReport_May2019.pdf

This assessment was the first to successfully apply a stock assessment model to a component of the horseshoe crab stock. A Catch Multiple Survey Analysis (CMSA) model, a stage-based model that tracks progression of crab abundances from pre-recruits to full recruits to the fishery, was applied to female crabs in the Delaware (DE) Bay region (New Jersey-Virginia). This model estimated regional female crab abundance using relative abundance information from the Virginia Tech Benthic Trawl Survey, New Jersey Ocean Trawl Survey, and Delaware Adult Trawl Survey, and estimates of mortality including natural mortality, commercial bait harvest, commercial discard mortality, and mortality associated with biomedical use. While reference points were not approved to determine stock status, the CMSA population estimates were recommended as the best estimates for female horseshoe crab abundance in the DE Bay region.

The base CMSA model population estimates show an increase in the number of female crabs in the DE Bay region since 2012, when the ARM Framework was established via Addendum VII. This increasing trend is supported by positive trends in regional fishery-independent surveys during this time period. Population estimates from the base model are not publicly available due to the inclusion of confidential biomedical data. However, a sensitivity run assuming no biomedical mortality is publicly viewable, and these estimates are not significantly different from the base model results. Estimates of discard mortality from the Northeast Fisheries Observer Program (NEFOP) were also included in the base CMSA model and indicate that discard mortality could be significant, of similar or greater magnitude than mortality due to bait harvest. Population estimates from the CMSA are currently being considered for incorporation into the ARM Framework, which is applied annually to specify bait harvest quotas for the DE Bay region.

Autoregressive Integrated Moving Average (ARIMA) models, similar to those used in previous assessments, were applied to all regions. ARIMA models were fit to fishery-independent survey indices trends of abundance in each of the regional horseshoe crab populations: Northeast (Massachusetts-Rhode Island), New York (Connecticut-New York), DE Bay, and Southeast (North Carolina-Florida). No definitions for overfishing or overfished status have been adopted by the Management Board. However, the assessment characterized the status of each regional and the coastwide population based on the percentage of surveys within a region (or coastwide) having a >50% probability of the terminal year being below the ARIMA reference point. The ARIMA reference point was the 1998 index for each survey. “Poor” status was defined as >66% of surveys meeting this criterion, “Good” status was defined as <33% of surveys, and “Neutral” status was defined as 34–65% of surveys. Based on these criteria, stock status was neutral for the Northeast region, poor for the New York region, neutral for the Delaware Bay region, and good for the Southeast region. Coastwide, abundance has fluctuated through time with many surveys decreasing after 1998 but increasing in recent years. The coastwide status includes surveys from all regions and indicates a neutral trend, likely due to a combination of positive and negative trends.

III. Status of the Fishery

Bait Fishery

For most states, the bait fishery is open year-round. However, because of seasonal horseshoe crab movements (to the beaches in the spring; deeper waters and offshore in the winter), the fishery operates at different times along the coast. New Jersey has prohibited commercial harvest of horseshoe crabs in state waters since 2006. State waters of Delaware are closed to horseshoe crab harvest and landing from January 1st through June 7th each year, and other state horseshoe crab fisheries are regulated with various season/area closures.

The total reported bait landings in 2021 totaled 724,192 crabs (excluding landings from Connecticut[1]). This is well below the ASMFC coastwide quota of 1,587,274 crabs (Table 1,

[1] At the time of drafting this report, the Commission has not yet received a compliance report from Connecticut. Thus, all coastwide data provided in this report exclude data from Connecticut.

Figure 2) and represents a 58% increase from 2020 landings of 455,831 crabs. Landings increased in New York, Delaware, Maryland, and Virginia. It is likely that 2020 bait landings were depressed due to the COVID-19 pandemic restricting harvest effort, thus the 2021 landings are more similar to 2019 levels.

Reported coastwide landings since 1998 show more male than female horseshoe crabs were harvested annually. Several states presently have sex-specific restrictions in place which limit or ban the harvest of females. The American eel pot fishery prefers egg-laden female horseshoe crabs as bait, while the whelk (conch) pot fishery is less dependent on females. States with greater than 5% of coastal landings are required to report sex for at least a portion of their bait harvest; for 2021 these states include Massachusetts, New York, Delaware, Maryland, and Virginia. Within these states, 68% of reported bait landings were male, 16% were female, and 16% were unclassified in 2021.

The hand, trawl, and dredge fisheries accounted for the majority of reported commercial horseshoe crab bait landings in 2021. Other gears that account for the remainder of the harvest include rakes, hoes, and tongs, fixed nets, and gill nets.

Table 1. Reported commercial horseshoe crab bait landings by jurisdiction. Note: Landings from 2017 and earlier were updated to numbers validated by all jurisdictions for use in the 2019 benchmark stock assessment. “C” indicates confidential landings.

Jurisdiction	ASMFC Quota 2021	State Quota 2021	2021	2020	2019	2018	2017	2016
MA	330,377	165,000	156,013	163,695	172,664	159,002	134,707	110,399
RI	26,053	8,398	1,706	C	C	1,889	3,415	20,676
CT	48,689	48,689	***	15,942	17,588	21,870	19,944	21,945
NY	366,272	150,000	97,860	63,367	167,181	138,223	195,717	176,632
NJ*	162,136	0	0	0	0	0	0	0
DE*	162,136	157,122	172,927	124,803	164,225	126,065	201,132	109,836
MD*	255,980	255,980	181,044	61,165	145,907	66,647	237,146	157,013
PRFC	0	0	0	0	0	0	0	0
VA**	172,828	172,828	112,497	24,031	151,727	140,584	160,331	128,848
NC	24,036	24,036	2,145	3,672	13,463	10,998	25,161	25,197
SC	0	0	0	0	0	0	0	0
GA	29,312	29,312	0	0	0	0	0	0
FL	9,455	9,455	C	0	0	C	1,394	689
TOTAL	1,587,274	1,020,820	724,192	456,675	832,755	665,278	978,947	751,235

*Male-only harvest

**Virginia harvest east of the COLREGS line is limited to 81,331 male-only crabs under the ARM harvest package #3. Virginia harvest east of the COLREGS in 2021 is confidential.

***Connecticut landings were not provided.

Biomedical Use

The horseshoe crab is an important resource for research and manufacture of materials used for human health. There are five companies along the Atlantic Coast that process horseshoe crab blood for use in manufacturing Limulus Amebocyte Lysate (LAL): Associates of Cape Cod, Massachusetts; Lonza (formerly Cambrex Bioscience), Limuli Laboratories, New Jersey; Wako Chemicals, Virginia; and Charles River Endosafe, South Carolina. Addendum III requires states where horseshoe crabs are collected for biomedical purposes to collect and report total collection numbers, crabs rejected, crabs bled (by sex) and to characterize mortality.

The Plan Review Team (PRT) annually calculates total coastwide collections and estimates mortality associated with biomedical use. In 2021, 718,809 crabs were collected coastwide solely for biomedical purposes[2] (Table 2). This represents a 3% increase from 2020. Males accounted for 56.5% of total biomedical collections in 2021 and females comprised 43.5%. Some crabs were rejected prior to bleeding due to mortality, injuries, slow movement, and size (mortality observed while crabs were going through the biomedical process is included under 'Observed Mortality' in Table 2). Approximately 1.7% of crabs collected solely for biomedical purposes were observed and reported as dead from the time of collection up to the point of bleeding.

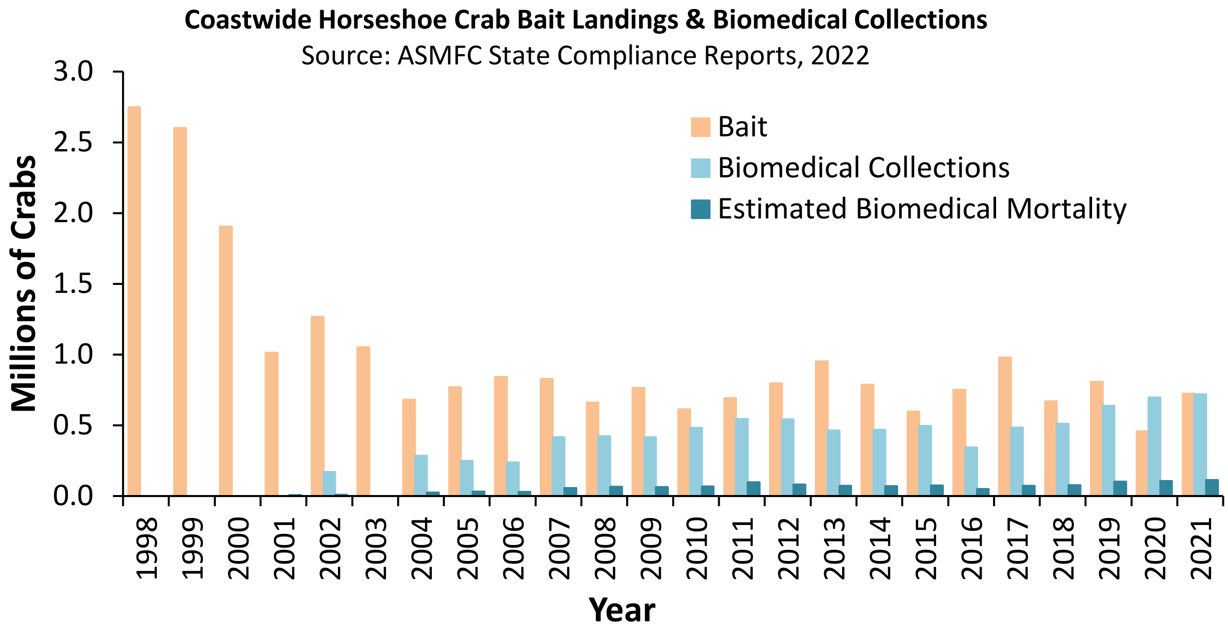
During the 2019 benchmark stock assessment, a meta-analysis of literature estimates was performed to estimate post-bleeding mortality of horseshoe crabs. Although many of these studies did not implement biomedical best practices, these values are the only available estimates of mortality experienced after bleeding. Based on the literature review, post-bleeding mortality is estimated at 15%. Tagging data was used in the assessment to compare survivorship between crabs that were and were not bled. These results indicated some decrease in short-term survivorship, but greater long-term survivorship for bled crabs. These results are likely attributable to the culling process used by biomedical facilities to select healthy crabs for bleeding.

Post-bleeding mortality, calculated as 15% of the number of bled biomedical-only crabs (not from the bait market), for 2021 was estimated as 100,193 crabs. Total mortality (observed mortality plus post-bleeding mortality) of biomedical crabs for 2021 was estimated at 112,104 crabs. The total estimated mortality from biomedical collections represents approximately 13%

[2] This does not include bait crabs that were borrowed for bleeding and then returned to the bait market; these are counted against state bait quotas. The dual use of horseshoe crabs harvested for bait is encouraged as a conservation tool. Facilities that bleed horseshoe crabs to manufacture LAL can utilize crabs from the bait market in what is often referred to as the "rent a crab" program. Permitted bait harvesters and/or dealers can "rent" crabs caught for the bait industry to the bleeding facility; these crabs are returned to the bait vendor after bleeding. These crabs are caught under bait permits, are counted against the bait quota of the state of origin, and must comply with that state's regulations for bait harvest. The dual use of crabs in this program can reduce overall harvest, may decrease overall mortality, can provide the LAL manufacturers with an additional source of raw material, and may offer harvesters and dealers opportunity within this secondary market.

of the 2021 total directed use mortality (836,296 crabs), which includes both total biomedical mortality and removals for bait (excluding bait landings from CT).

Figure 2. Number of horseshoe crabs harvested for bait and collected for biomedical purposes, 1998-2021.



*Biomedical collections are annually reported to the Commission and include all horseshoe crabs brought to bleeding facilities except those that were harvested as bait, “rented” by biomedical facilities and counted against state bait quotas.
*Crabs collected solely for biomedical crabs are returned to the water after bleeding; a 15% mortality rate is assumed for all bled crabs that are released. This number plus observed mortality reported annually by bleeding facilities via state compliance reports equals the 'Estimated Biomedical Mortality.'

Figure 3. Total Horseshoe Crab Mortality from Bait and Estimated Biomedical Mortality, 1998-2021.

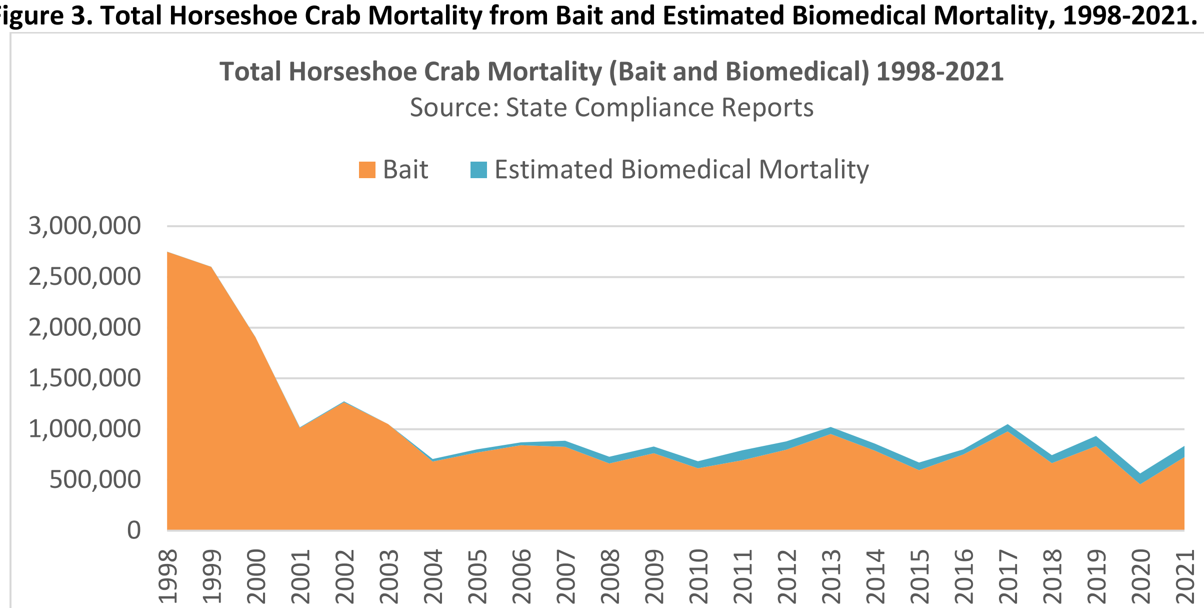


Table 2. Numbers of horseshoe crabs collected, bled, and estimated mortality for the biomedical industry. Numbers shown are for crabs collected solely for biomedical use. Mortality of bled crabs that later enter the bait industry is included in bait harvest.

Year	Crabs Collected	Crabs Bled	Post-Bleeding Mortality	Observed Mortality	Total Mortality
2010	480,914	412,781	61,917	6,829	68,746
2011	545,164	486,850	73,028	24,139	97,166
2012	541,956	497,956	74,693	7,370	82,063
2013	464,657	440,402	66,060	5,447	71,507
2014	467,897	432,340	64,851	5,658	70,509
2015	494,123	464,506	69,676	5,362	75,038
2016*	344,495	318,523	47,778	1,004	48,782
2017	483,245	444,115	66,617	6,056	72,674
2018	510,407	479,142	71,871	5,588	77,459
2019	637,029	589,361	88,404	12,789	101,193
2020	697,025	649,546	97,432	8,907	106,339
2021	718,809	667,951	100,193	11,911	112,104

***Some biomedical collections were reduced in 2016 due to temporary changes in production.**

IV. Status of Research and Monitoring

The Horseshoe Crab FMP set forth an ambitious research and monitoring strategy in 1999 and again in 2004 to inform 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 hundreds of public volunteers.

Addendum III Monitoring Program

Addendum III requires affected states to carry out three monitoring components:

1. All states who do not qualify for *de minimis* status report monthly harvest numbers and subsample a portion of the catch for sex and harvest method. In addition, those states with annual landings above 5% of the coastwide harvest report all landings by sex and harvest method. Although states with annual landings less than 5% of annual coastwide harvest are not required to report landings by sex, the PRT recommends all states require sex-specific reporting for horseshoe crab harvest.
2. States with biomedical collections are required to monitor and report collection numbers and mortality associated with the transportation and bleeding of the crabs.
3. States must identify spawning and nursery habitat along their coasts. All states have completed this requirement, and a few continue active monitoring programs.

Virginia Tech Research Projects

The Virginia Tech Horseshoe Crab Trawl Survey (VT Survey) was not conducted in 2013-2015, due to a lack of funding, but was conducted in 2016-2021, and is in progress for 2022. Funding sources beyond 2022 continue to be explored. The 2021 surveys were conducted between August 10 and September 25.

Analysis of the 2021 data resulted in the highest mean stratified catch-per-tow values within the Delaware Bay Area (DBA) over the time series for mature males, mature females, and newly mature males. These values were higher than the previous year's values for all demographic groups when a normal distribution was assumed for observations in each stratum. Mean stratified catch-per-tow for all demographic groups in the DBA continues to be highly variable, although mature individuals have shown a positive trend over the time series. Newly mature males also appear to show a slightly positive trend since 2002. Prosomal widths of all demographic groups, except immature females, show decreasing trends over the time series in the DBA.

The indices from this survey, along with the New Jersey Ocean Trawl and Delaware Fish and Wildlife Adult Trawl Survey indices, were used to estimate horseshoe crab abundance in the 2021 ARM Framework Revision to produce optimal harvest limits for the upcoming year.

Spawning Surveys
The redesigned Delaware Bay spawning survey was completed for the twenty-third consecutive year in 2021; twelve beaches in Delaware and ten beaches in New Jersey were sampled. Delaware is currently in the process of analyzing survey data.

Tagging Studies
The USFWS continues to maintain a toll-free telephone number and a website for reporting horseshoe crab tag returns and assists interested parties in obtaining tags. Tagging work continues to be conducted by biomedical companies, research organizations, and other parties involved in outreach and spawning surveys. Beginning with the 2013 tagging season, additional efforts were implemented to ensure that current tagging programs are providing data that benefits the management of the coastwide horseshoe crab population. All existing and new tagging efforts are required to submit an annual application to be considered for the USFWS tagging program and all participants must submit an annual report along with their tagging and resighting data to indicate how their tagging program addresses at least one of the following objectives: determine horseshoe crab sub-population structure, estimate horseshoe crab movement and migration rates, and/or estimate survival and mortality of horseshoe crabs. The PRT recommends all tagging programs approved by the states coordinate with the USFWS tagging program, in order to ensure a consistent coastwide program to support management.

Since 1999, over 391,475 crabs have been tagged and released through the USFWS tagging program along the Atlantic coast, and 37,621 unique crabs have been recaptured. Crabs have been tagged and released from every state on the Atlantic Coast from Florida to New Hampshire. In the early years of the program, tagging was centered around Delaware Bay; however, in recent years, tagging has expanded and increased in Long Island Sound and the Southeast. Tagging information from this database has been used in the 2019 Benchmark Stock Assessment to define stock structure, estimate total mortality, and characterize impacts of biomedical use on crab mortality.

New York Region Monitoring
Following the 2019 Benchmark Stock Assessment, which characterized the status of the horseshoe crab population in the New York region as "Poor", the Board directed the PRT to monitor fishery-independent surveys in this area to track progress of state management actions toward improving this regional population. During the assessment, five surveys were included in the ARIMA model to characterize this population. One of these, the Northeast Area Monitoring and Assessment Program (NEAMAP), includes sample areas outside of the New York region, making it too data-intensive to specify the regional index on an annual basis. The most recent information from the state-conducted surveys used in the assessment is summarized below, but can be viewed in greater detail in the Connecticut and New York state compliance reports. The Western Long Island (WLI) Little Neck Bay and Manhasset Bay seine surveys were combined in the assessment to form a single index, but are shown below separately. None of these beach seine surveys were completed in 2020 due to the COVID-19 pandemic but resumed in 2021. Figures 5-8 show the annual index for each survey over the time series until 2021.

Connecticut

- Long Island Sound Trawl (Fall) – 2020 index – **Due to the COVID-19 pandemic the LIS Trawl Survey did not take place. Sampling for LIS Trawl Survey was not authorized until Spring 2021, but results have not been provided.**

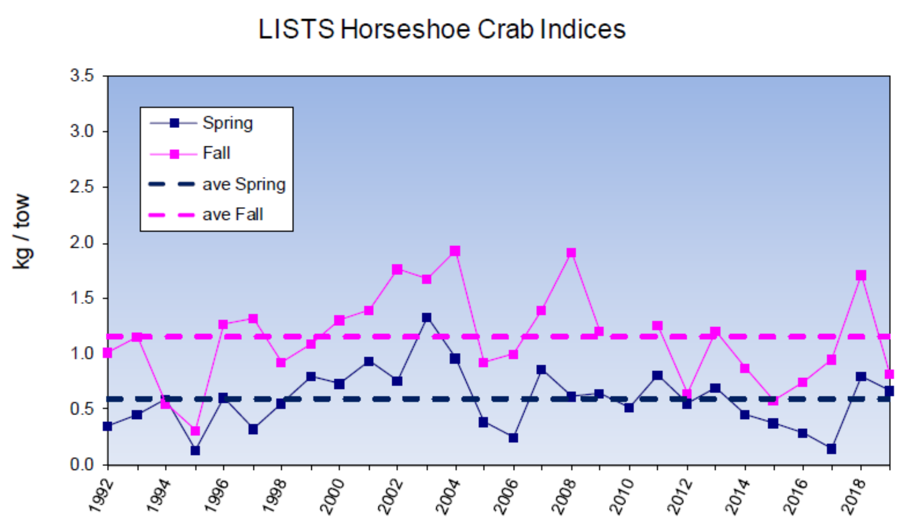


Figure 4. LISTS Horseshoe Crab Indices, 1992-2019.

New York

- Peconic Trawl – 2021 index = 0.13 (delta distribution average catch per unit effort [CPUE]), increase from 2019, below 2010-21 average.
- WLI Jamaica Bay Seine (all horseshoe crabs) – 2021 index = 0.78 (geometric mean), increase from 2019, above 2010-21 average.
- WLI Little Neck Bay Seine (all) – 2021 index = 0.46 (geometric mean), decrease from 2019, below 2010-19 average.

- WLI Manhasset Bay Seine (all) – 2021 index = 0.68 (geometric mean), decrease from 2019, below 2010-19 average.

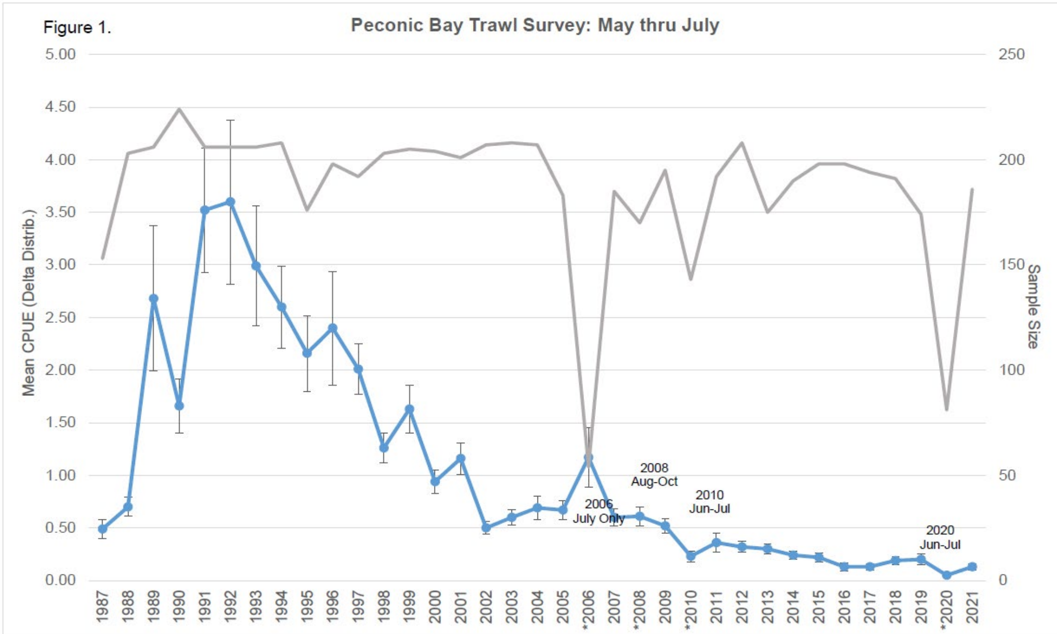


Figure 5. Peconic Bay Trawl Survey: May through July, 1987-2021. (gray line=sample size, blue line=mean CPUE).

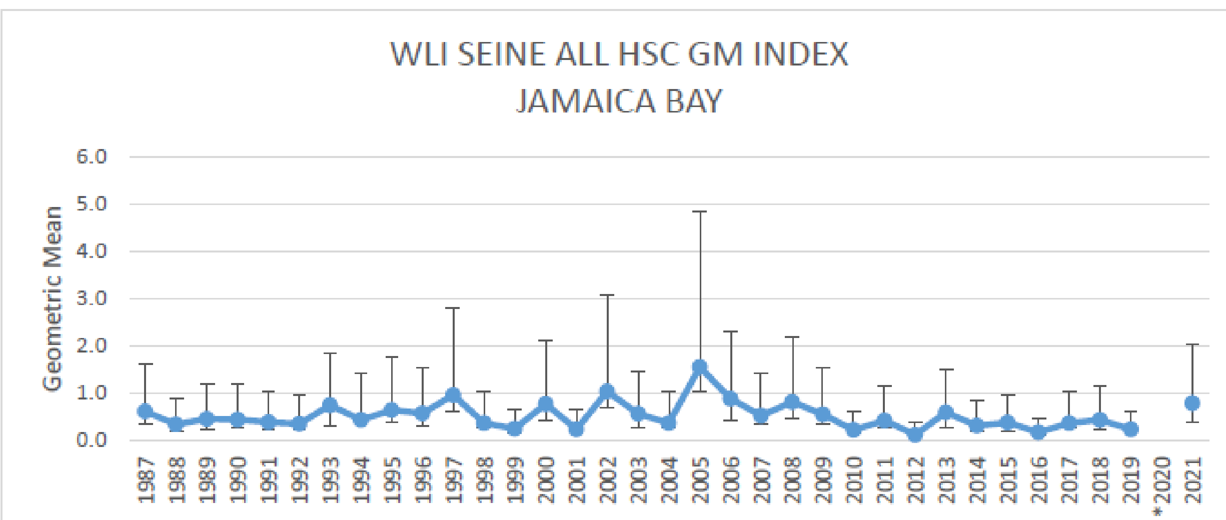


**Figure 6. NYSDEC WLI Jamaica Bay Beach Seine Survey All Horseshoe Crab GM Index, 1987-2021. ***Due to the COVID-19 pandemic, in 2020 sampling did not begin until July.

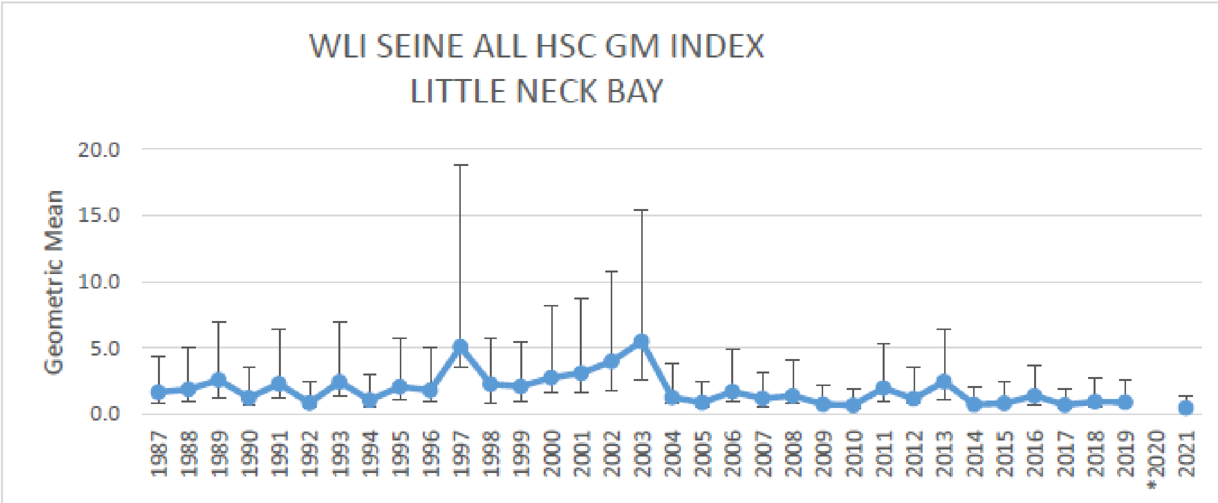


Figure 7. Little Neck Bay Seine Survey All Horseshoe Crab GM Index, 1987-2021. *Due to the COVID-19 pandemic, in 2020 sampling did not begin until July.

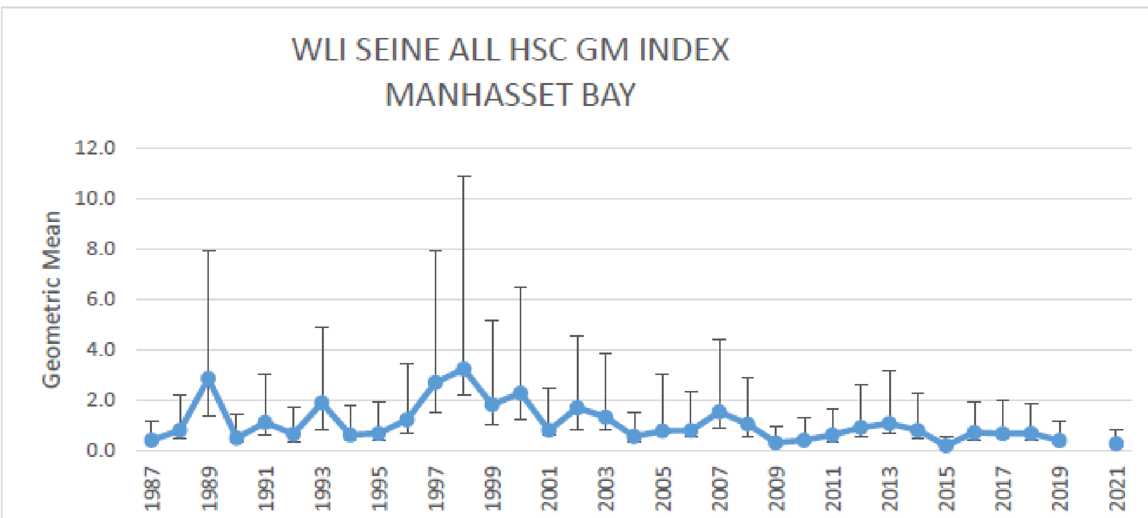


Figure 8. Manhasset Bay Seine Survey All Horseshoe Crab GM Index, 1987-2019. *Due to the COVID-19 pandemic, in 2020 sampling did not begin until July.

V. Status of Management Measures and Issues

ASMFC

Initial state harvest quotas were established through Addendum I. Addendum III outlined the monitoring requirements and recommendations for the states. Addendum IV set harvest closures and quotas, and other restrictions for New Jersey, Delaware, Maryland, and Virginia, which were continued in Addenda V and VI.

In February 2012 the Board approved Addendum VII to implement the ARM Framework; it was implemented in 2013. Addendum VII includes an allocation mechanism to divide the Delaware Bay optimized harvest output from the ARM Framework among the four Delaware Bay states (New Jersey, Delaware, Maryland, and Virginia east of the COLREGS line). Season closures and restrictions present within Addendum VI remain in effect as part of Addendum VII.

State-specific charts outlining compliance and monitoring measures are included in Section VII. Issues noted by the PRT include:

1. In 2021, Delaware's bait harvest exceeded the ASMFC quota of 162,136 male crabs by 10,791 crabs. Delaware's 2021 overage will be deducted from the 2022 quota.
2. Connecticut did not provide an annual compliance report.
3. Massachusetts did not report to ASMFC by the required deadline.

Except for required sampling that was not completed due to the COVID-19 pandemic, <u>the PRT finds that all other jurisdictions appear to be in compliance with the FMP and subsequent Addenda in 2021.</u>

Changes to State Regulations

No changes were made to state regulations for fishing year 2021.

Alternative Baits

Trials testing effectiveness of alternative baits to horseshoe crab for the American eel and whelk fisheries have previously been conducted. Additionally, a survey of bait usage in the eel and whelk fisheries was conducted in 2017. This survey is available at: http://www.asmfc.org/uploads/file/5a04b785HSC_BaitSurveyTCReport_Oct2017.pdf.

Shorebirds

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. As part of a court settlement, the USFWS agreed to initiate proposed listings of over 200 species, including the red knot. In fall 2013, the USFWS released a proposal for listing the red knot as threatened. In January 2015 the USFWS designated the red knot as threatened under the Endangered Species Act.

In 2022 the USFWS conducted an analysis of the changes to horseshoe crab management that would occur under the 2021 ARM Revision to determine the likelihood of impacts to the red knot. The finding from analysis is that there is a < 1% chance of a red knot population decline due to the implementation of potential female harvest under the revised ARM. Therefore, the Service concluded that take, defined under the Endangered Species Act as killing or injuring, of red knots is not likely.

The red knot has been listed as an endangered species in the state of New Jersey since 2012.

VI. PRT Recommendations and Research Needs

De Minimis

States may apply for *de minimis* status if, for the last two years, their combined average horseshoe crab bait landings (by numbers) constitute less than one percent of coastwide horseshoe crab bait landings for the same two-year period. States may petition the Board at any time for *de minimis* status, if their fishery falls below the threshold level. Once *de minimis* status is granted, designated States must submit annual reports to the Board justifying the continuance of *de minimis* status.

States that qualify for *de minimis* status are not required to implement any horseshoe crab harvest restriction measures, but are required to implement components A, B, E and F of the monitoring program (Section 3.5 of the FMP; further modified by Addendum III). Since *de minimis* states are exempt from a harvest cap, there is potential for horseshoe crab landings to shift to *de minimis* states and become substantial, before adequate action can be taken. To control shifts in horseshoe crab landings, *de minimis* states are encouraged to implement one of the following management measures:

1. Close their respective horseshoe crab bait fishery when landings exceed the *de minimis* threshold;
2. Establish a state horseshoe crab landing permit, making it only available to individuals with a history of landing horseshoe crabs in that state; or
3. Establish a maximum daily harvest limit of up to 25 horseshoe crabs per person per day. States which implement this measure can be relieved of mandatory monthly reporting, but must report all horseshoe crabs harvests on an annual basis.

The following states have been removed from the Management Board since its formation: Pennsylvania (2007), Maine (2011), and New Hampshire (2014). South Carolina, Georgia, and Florida are requesting *de minimis* status for the 2022 fishing season based on the 2020-21 season landings and meet the FMP requirements for being granted this status (Table 1). The PRT recommends granting these jurisdictions *de minimis* status.

Biomedical Threshold

The 1998 FMP established a biomedical mortality threshold of 57,500 crabs that, if exceeded, requires the Board to consider management action. This threshold has been exceeded in all but one year since 2008. Results of the 2019 Benchmark Stock Assessment indicate that levels of biomedical mortality prior to 2017 (the terminal year of data used in the assessment) did not have a significant effect on horseshoe crab population estimates or fishing mortality in the Delaware Bay region.

In 2020 the Board tasked the PDT to review the threshold for biomedical use to develop biologically-based options for the threshold and to develop options for action when the threshold is exceeded. It also tasked the PDT to review the best management practices (BMPs) for handling biomedical catch and suggest options for updating and implementing BMPs. The PDT concluded that given the lack of coastwide population estimates for horseshoe crabs, it is not possible to develop a biologically-based threshold for biomedical mortality. Thus, the PDT did not recommend a change to the threshold. Based on this information the Board determined no action is warranted, but agreed to form a work group to review and update the best management practices for biomedical handling to further reduce stress, injury, and mortality to horseshoe crabs collected for biomedical purposes if possible.

Funding for Research and Monitoring Activities

The PRT strongly recommends the funding and continuation of the VT benthic trawl survey. This effort provides a statistically reliable estimate of horseshoe crab relative abundance that is essential to continued ARM implementation and use of the CMSA stock assessment model.

Discard Mortality Estimation

Results of the 2019 Benchmark Stock Assessment indicate that discard mortality may be significant, of similar or greater magnitude than bait harvest. The Review Panel's report indicated that these estimates could be further refined to reduce their uncertainty and more precisely characterize this mortality source. The PRT recommends the Board take steps to increase access to and use of data from the NEFOP, allowing for improved monitoring and estimation of discard mortality.

Improvement of the New York Regional Population

Results of the 2019 Benchmark Stock Assessment indicate a "Poor" status for the New York regional population, due to negative trends in regional abundance indices. New York and Connecticut have indicated that they will take actions within their states to improve this population. The PRT recommends that the Board encourage such actions to continue so that this population's status may improve.

The PRT will continue to annually report regional indices of abundance so that progress of management actions may be tracked through the annual FMP Reviews.

VII. State Compliance and Monitoring Measures

MASSACHUSETTS		
	2021 Compliance	**2022 Management Proposal**
***De minimis* status**	Did not request *de minimis*	Did not request *de minimis*
Bait Harvest Restrictions and Landings		
- ASMFC Quota (Voluntary State Quota)	330,377 (165,000)	330,377 (165,000)
- Other Restrictions	Bait: 300 crab daily limit year round; limited entry; Biomedical: 1,000 crab daily limit; Conch pot and eel fishermen: no possession limit Mobile gear: 75 crab trip limit, exempted from "no-fishing days" starting 10/9/2020; All: May and June 5-day lunar closures; 7" PW minimum size; Pleasant Bay Closed Area	Bait: 300 crab daily limit year round; Biomedical: 1,000 crab daily limit; Conch pot and eel fishermen: no possession limit All: May and June 5-day lunar closures; No mobile gear harvest Fri-Sat during summer flounder season; 7" PW minimum size; Pleasant Bay Closed Area
- Landings	**156,013**	--
Monitoring Component A_1		
- Mandatory monthly reporting	Yes, plus weekly dealer reporting through SAFIS	Yes, plus weekly dealer reporting through SAFIS
- Characterize commercial bait fishery	Yes	Yes
Monitoring Component A_2		
- Biomedical reporting	Yes	Yes
- Required information for biomedical use of crabs	Yes	Yes
Monitoring Component A_3 Identify spawning and nursery habitat	Yes	Not Applicable
Monitoring Component B_1 Coastwide benthic trawl survey	Yes, VT Trawl Survey was conducted in 2021	Yes, VT Trawl Survey will be conducted in 2022; future years and spatial scope unknown at this time
Monitoring Component B_2 Continue existing benthic sampling programs	Yes	Yes
Monitoring Component B_3 Implement spawning survey	Yes	Yes
Monitoring Component B_4 Tagging program	Yes – w/NPS and USFWS; Pleasant Bay, Monomy NWR, Waquoit Bay	Yes – w/NPS and USFWS; Pleasant Bay, Monomy NWR, Waquoit Bay

RHODE ISLAND		
	2021 Compliance	**2022 Management Proposal**
***De minimis* status**	Did not request *de minimis*	Did not request *de minimis*
Bait Harvest Restrictions and Landings		
- ASMFC Quota (Voluntary State Quota)	26,053 (8,398)	26,053 (8,398)
- Other Restrictions	State Restrictions: - Daily possession limit: 60 crabs per permit - Bait Fishery Closure: May 1-May 31 - Biomedical Fishery Closure: 48 hours prior to and 48 hours following new and full moons during May. - Biomedical quota and best management practices	State Restrictions: - Daily possession limit: 60 crabs per permit - Bait Fishery Closure: May 1-May 31 - Biomedical Fishery Closure: 48 hours prior to and 48 hours following new and full moons during May - Biomedical quota and best management practices
- Landings	1,706	--
Monitoring Component A_1		
- Mandatory monthly reporting	Yes, weekly call in and monthly on paper	Yes, weekly call in and monthly on paper
- Characterize commercial bait fishery	Yes	Yes
Monitoring Component A_2		
- Biomedical reporting	Yes	Yes
- Required information for biomedical use of crabs	Yes, details within Massachusetts' biomedical reports	Captured in Massachusetts' biomedical reports
Monitoring Component A_3 Identify spawning and nursery habitat	Yes	Not Applicable
Monitoring Component B_1 Coastwide benthic trawl survey	Yes, VT Trawl Survey was conducted in 2021	Yes, VT Trawl Survey will be conducted in 2022; future years and spatial scope unknown at this time
Monitoring Component B_2 Continue existing benthic sampling programs	Yes	Yes
Monitoring Component B_3 Implement spawning survey	Yes, since 2000	Yes
Monitoring Component B_4 Tagging program	State Wildlife Grant for 2020-2021 tagging program in collaboration with University of Rhode Island.	State Wildlife Grant for 2020-2021 tagging program in collaboration with URI. Status unknown beyond 2021.

CONNECTICUT – 2021 REPORT NOT PROVIDED		
	2021 Compliance	**2022 Management Proposal**
***De minimis* status**	Did not request *de minimis*	Not provided
Bait Harvest Restrictions and Landings		
- ASMFC Quota	48,689	48,689
- Other Restrictions	Limited entry program, possession limits, and seasonal and area closures	Limited entry program, possession limits, and seasonal and area closures
- Landings	Not provided	--
Monitoring Component A_1		
- Mandatory monthly reporting	Not provided	Yes
- Characterize commercial bait fishery	No – exempt under Addendum III because landings are < 5% of coastwide total	No – exempt under Addendum III because landings are < 5% of coastwide total
Monitoring Component A_2		
- Biomedical reporting	Not Applicable	Not Applicable
- Required information for biomedical use of crabs	Not Applicable	Not Applicable
Monitoring Component A_3 Identify spawning and nursery habitat	Not provided	Not Applicable
Monitoring Component B_1 Coastwide benthic trawl survey	Yes, VT Trawl Survey was conducted in 2021	Yes, VT Trawl Survey will be conducted in 2022; future years and spatial scope unknown at this time
Monitoring Component B_2 Continue existing benthic sampling programs	Not provided	Yes
Monitoring Component B_3 Implement spawning survey	Yes, since 1999 (methods differ from DE Bay survey)	Yes
Monitoring Component B_4 Tagging program	Yes, in collaboration with local universities (Sacred Heart University since 2015)	Yes

NEW YORK		
	2021 Compliance	**2022 Management Proposal**
***De minimis* status**	Did not request *de minimis*	Did not request *de minimis*
Bait Harvest Restrictions and Landings		
- ASMFC Quota (Voluntary State Quota)	366,272 (150,000)	366,272 (150,000)
- Other Restrictions	Ability to close areas to harvest; seasonal quotas and daily harvest limits Five-day lunar closures around the full moon in May and the new moon in June. Initial trip limit dropped to 150 crabs in period 2.	Ability to close areas to harvest; seasonal quotas and daily harvest limits - Five-day lunar closures around the full moon in May and the new moon in June. -Initial trip limit dropped to 150 crabs in period 2.
- Landings	97,860	--
Monitoring Component A_1		
- Mandatory monthly reporting	Yes	Yes
- Characterize commercial bait fishery	Yes	Yes
Monitoring Component A_2		
- Biomedical reporting	Yes	Yes
- Required information for biomedical use of crabs	Not Applicable	Not Applicable
Monitoring Component A_3 Identify spawning and nursery habitat	Yes	Not Applicable
Monitoring Component B_1 Coastwide benthic trawl survey	Yes, VT Trawl Survey was conducted in 2021	Yes, VT Trawl Survey will be conducted in 2022; future years and spatial scope unknown at this time
Monitoring Component B_2 Continue existing benthic sampling programs	Yes	Yes
Monitoring Component B_3 Implement spawning survey	Yes	Yes
Monitoring Component B_4 Tagging program	Yes	Yes

DRAFT FOR BOARD REVIEW

NEW JERSEY		
	2021 Compliance	**2022 Management Proposal**
***De minimis* status**	Did not request *de miminis*	Does not request *de miminis*
Bait Harvest Restrictions and Landings		
- ASMFC Quota (Voluntary state quota)	162,136 [male only] (0)	162,136 [male only] (0)
- Other Restrictions	Bait harvest moratorium	Bait harvest moratorium
- Landings	0	--
Monitoring Component A_1		
- Mandatory monthly reporting	Not Applicable	Not Applicable
- Characterize commercial bait fishery	Not Applicable	Not Applicable
Monitoring Component A_2		
- Biomedical reporting	Yes	Yes
- Required information for biomedical use of crabs	Yes	Yes
Monitoring Component A_3 Identify spawning and nursery habitat	Yes	Not Applicable
Monitoring Component B_1 Coastwide benthic trawl survey	Yes, VT Trawl Survey was conducted in 2021	Yes, VT Trawl Survey will be conducted in 2022; future years and spatial scope unknown at this time
Monitoring Component B_2 Continue existing benthic sampling programs	No. Did not complete due to COVID-19.	Yes
Monitoring Component B_3 Implement spawning survey	Yes	Yes
Monitoring Component B_4 Tagging program	Outside, independent groups currently	No
Monitoring Component B_5 Egg abundance survey	Yes, but removed as a mandatory component	Yes
Monitoring Component B_6 Shorebird monitoring program	Yes	Yes

DELAWARE		
	2021 Compliance	**2022 Management Proposal**
***De minimis* status**	Did not request *de minimis*	Did not request *de minimis*
Bait Harvest Restrictions and Landings		
- ASMFC Quota (State Quota)	162,136 [male only] 162,136 [male only]	162,136 [male only] 151,345 [male only]
- Other Restrictions	Closed season (January 1 – June 7); season closed on July 30	Closed season (January 1 – June 7)
- Landings	172,927 (male only)	--
Monitoring Component A_1		
- Mandatory monthly reporting	Yes (daily call-in reports & monthly logbooks)	Yes
- Characterize commercial bait fishery	Yes	Yes
Monitoring Component A_2		
- Biomedical reporting	Not Applicable	Not Applicable
- Required information for biomedical use of crabs	Not Applicable	Not Applicable
Monitoring Component A_3 Identify spawning and nursery habitat	Yes –updates once every 5 years or as needed	Yes – updates once every 5 years or as needed
Monitoring Component B_1 Coastwide benthic trawl survey	Yes, VT Trawl Survey was conducted in 2021	Yes, VT Trawl Survey will be conducted in 2022; future years and spatial scope unknown at this time
Monitoring Component B_2 Continue existing benthic sampling programs	Yes	Yes
Monitoring Component B_3 Implement spawning survey	Yes	Yes
Monitoring Component B_4 Tagging program	No state program but has assisted in the past with various Delaware Bay horseshoe crab tagging initiatives	No
Monitoring Component B_5 Egg abundance survey	Removed as component	Removed as component
Monitoring Component B_6 Shorebird monitoring program	Yes	Yes

Note: The egg abundance survey has been discontinued as a mandatory monitoring element. Delaware will include information on the survey if it continues, but is no longer required to perform the survey.

MARYLAND		
	2021 Compliance	**2022 Management Proposal**
***De minimis* status**	Did not request *de minimis*	Did not request *de minimis*
Bait Harvest Restrictions and Landings		
- ASMFC Quota	255,980 (male only)	255,980 (male only)
- Other Restrictions	Delayed harvest and closed season/area combinations, catch limits	Delayed harvest and closed season/area combinations, catch limits
- Landings	181,040 (male only)	--
Monitoring Component A_1		
- Mandatory monthly reporting	Yes (weekly reports for permit holders; monthly for non-permit holders)	Yes (weekly reports for permit holders; monthly for non-permit holders)
- Characterize commercial bait fishery	Yes	Yes
Monitoring Component A_2		
- Biomedical reporting	Yes	Yes
- Required information for biomedical use of crabs	Yes	Yes
Monitoring Component A_3 Identify spawning and nursery habitat	Yes	Not Applicable
Monitoring Component B_1 Coastwide benthic trawl survey	Yes, VT Trawl Survey was conducted in 2021	Yes, VT Trawl Survey will be conducted in 2022; future years and spatial scope unknown at this time
Monitoring Component B_2 Continue existing benthic sampling programs	Yes	Yes
Monitoring Component B_3 Implement spawning survey	Yes	Yes
Monitoring Component B_4 Tagging program	Yes – through biomedical use	Yes – through biomedical use

POTOMAC RIVER FISHERIES COMMISSION		
	2021 Compliance	**2022 Management Proposal**
***De minimis* status**	Did not request *de minimis*	Did not request *de minimis*
- Ability to close fishery if *de minimis* threshold is reached	No horseshoe crab fishery	No horseshoe crab fishery
- Daily possession limit <25 for *de minimis* state		
- HSC landing permit		
Bait Harvest Restrictions and Landings		
- ASMFC Quota	0	0
- Other Restrictions	None	None
- Landings	0	0
Monitoring Component A_1		
- Mandatory monthly reporting	Yes - weekly	Yes - weekly
- Characterize commercial bait fishery	Not Applicable	Not Applicable
Monitoring Component A_2		
- Biomedical reporting	Not Applicable	Not Applicable
- Required information for biomedical use of crabs	Not Applicable	Not Applicable
Monitoring Component A_3 Identify spawning and nursery habitat	Not Applicable	Not Applicable
Monitoring Component B_1 Coastwide benthic trawl survey	Yes, VT Trawl Survey was conducted in 2021	Yes, VT Trawl Survey will be conducted in 2022; future years and spatial scope unknown at this time
Monitoring Component B_2 Continue existing benthic sampling programs	Not Applicable	Not Applicable
Monitoring Component B_3 Implement spawning survey	Not Applicable	Not Applicable
Monitoring Component B_4 Tagging program	Not Applicable	Not Applicable

VIRGINIA		
	2021 Compliance	**2022 Management Proposal**
***De minimis* status**	Did not request *de minimis*	Did not request *de minimis*
Bait Harvest Restrictions and Landings		
- ASMFC Quota	172,828 (81,331 male-only east of COLREGS line)	172,828 (81,331 male-only east of COLREGS line)
- Other Restrictions	Closed season (January 1 – June 7) for federal waters. Effective January 1, 2013 harvest of horseshoe crabs, from east of the COLREGS line, is limited to trawl gear and dredge gear only.	Closed season (January 1 – June 7) for federal waters. Effective January 1, 2013 harvest of horseshoe crabs, from east of the COLREGS line, is limited to trawl gear and dredge gear only.
- Landings	112,497 (75,239 males)	--
Monitoring Component A_1		
- Mandatory monthly reporting	Yes	Yes
- Characterize commercial bait fishery	Yes	Yes
Monitoring Component A_2		
- Biomedical reporting	No permits issued in 2021	Yes
- Required information for biomedical use of crabs	Yes	Yes
Monitoring Component A_3 Identify spawning and nursery habitat	Yes – completed	Not Applicable
Monitoring Component B_1 Coastwide benthic trawl survey	Yes, VT Trawl Survey was conducted in 2021	Yes, VT Trawl Survey will be conducted in 2022; future years and spatial scope unknown at this time
Monitoring Component B_2 Continue existing benthic sampling programs	Not Applicable	Not Applicable
Monitoring Component B_3 Implement spawning survey	No	No
Monitoring Component B_4 Tagging program	No	No

NORTH CAROLINA		
	2021 Compliance	**2022 Management Proposal**
***De minimis* status**	Did not request *de minimis*	Did not request *de minimis*
Bait Harvest Restrictions and Landings		
- ASMFC Quota	24,036	24,036
- Other Restrictions	Trip limit of 50 crabs; Proclamation authority to adjust trip limits, seasons, etc.	Trip limit of 50 crabs; Proclamation authority to adjust trip limits, seasons, etc.
- Landings	2,145	--
Monitoring Component A_1		
- Mandatory monthly reporting	Yes	Yes
- Characterize commercial bait fishery	Yes	Yes
Monitoring Component A_2		
- Biomedical reporting	Not Applicable	Not Applicable
- Required information for biomedical use of crabs	Not Applicable	Not Applicable
Monitoring Component A_3 Identify spawning and nursery habitat	Little information available; Survey discontinued after 2002 and 2003 due to low levels of crabs recorded	Not Applicable
Monitoring Component B_1 Coastwide benthic trawl survey	Yes, VT Trawl Survey was conducted in 2021	Yes, VT Trawl Survey will be conducted in 2022; future years and spatial scope unknown at this time
Monitoring Component B_2 Continue existing benthic sampling programs	Yes	Yes
Monitoring Component B_3 Implement spawning survey	No	No
Monitoring Component B_4 Tagging program	No	No

SOUTH CAROLINA		
	2021 Compliance	**2022 Management Proposal**
***De minimis* status**	*De minimis* status granted for 2021.	*De minimis* requested for 2022 and meets criteria.
- Ability to close fishery if *de minimis* threshold is reached	No horseshoe crab bait fishery	No horseshoe crab bait fishery
- Daily possession limit <25 for *de minimis* state		
- HSC landing permit		
Bait Harvest Restrictions and Landings		
- ASMFC Quota	0	0
- Other Restrictions	None	None
- Landings	0	--
Monitoring Component A_1		
- Mandatory monthly reporting	Yes (Biomedical)	Yes (Biomedical)
- Characterize commercial bait fishery	Not Applicable	Not Applicable
Monitoring Component A_2		
- Biomedical reporting	Yes	Yes
- Required information for biomedical use of crabs	Yes	Yes
Monitoring Component A_3 Identify spawning and nursery habitat	Completed	No
Monitoring Component B_1 Coastwide benthic trawl survey	Yes, VT Trawl Survey was conducted in 2021	Yes, VT Trawl Survey will be conducted in 2022; future years and spatial scope unknown at this time
Monitoring Component B_2 Continue existing benthic sampling programs	Yes. **Sampling effort reduced due to COVID-19.**	Yes
Monitoring Component B_3 Implement spawning survey	Yes	Yes
Monitoring Component B_4 Tagging program	Yes	Yes

GEORGIA		
	2021 Compliance	**2022 Management Proposal**
***De minimis* status**	*De minimis* status granted in 2021.	*De minimis* requested for 2022 and meets criteria.
- Ability to close fishery if *de minimis* threshold is reached	Yes	Yes
- Daily possession limit <25 for *de minimis* state	25/person; 75/vessel with 3 licensees	25/person; 75/vessel with 3 licensees
- HSC landing permit	Must have commercial shrimp, crab, or whelk license; LOA permit required	Must have commercial shrimp, crab, or whelk license; LOA permit required
Bait Harvest Restrictions and Landings		
- ASMFC Quota	29,312	29,312
(State Quota)	29,312	29,312
- Other Restrictions	None	None
- Landings	0	--
Monitoring Component A_1		
- Mandatory monthly reporting	Yes	Yes
- Characterize commercial bait fishery	No bait landings	Yes
Monitoring Component A_2		
- Biomedical reporting	Not Applicable	Not Applicable
- Required information for biomedical use of crabs	Not Applicable	Not Applicable
Monitoring Component A_3 Identify spawning and nursery habitat	Completed	Not Applicable
Monitoring Component B_1 Coastwide benthic trawl survey	Yes, VT Trawl Survey was conducted in 2021	Yes, VT Trawl Survey will be conducted in 2022; future years and spatial scope unknown at this time
Monitoring Component B_2 Continue existing benthic sampling programs	Yes	Yes
Monitoring Component B_3 Implement spawning survey	No	No
Monitoring Component B_4 Tagging program	No	No

FLORIDA		
	2021 Compliance	**2022 Management Proposal**
***De minimis* status**	*De minimis* status granted in 2021.	*De minimis* requested for 2022 and meets criteria.
- Ability to close fishery if *de minimis* threshold is reached	Yes	Yes
- Daily possession limit <25 for *de minimis* state	25/person w/ valid saltwater products license; 100/person with marine life endorsement	25/person w/ valid saltwater products license; 100/person with marine life endorsement
- HSC landing permit	See above	See above
Bait Harvest Restrictions and Landings		
- ASMFC Quota	9,455	9,455
- Other Restrictions	Daily possession limit	Daily possession limit
- Landings	Confidential	--
Monitoring Component A_1		
- Mandatory monthly reporting	Yes	Yes
- Characterize commercial bait fishery	No	Yes
Monitoring Component A_2		
- Biomedical reporting	Not Applicable	Not Applicable
- Required information for biomedical use of crabs	Not Applicable	Not Applicable
Monitoring Component A_3 Identify spawning and nursery habitat	Yes	Yes
Monitoring Component B_1 Coastwide benthic trawl survey	Yes, VT Trawl Survey was conducted in 2021	Yes, VT Trawl Survey will be conducted in 2022; future years and spatial scope unknown at this time
Monitoring Component B_2 Continue existing benthic sampling programs	Yes	Yes
Monitoring Component B_3 Implement spawning survey	Yes	Yes
Monitoring Component B_4 Tagging program	No	No