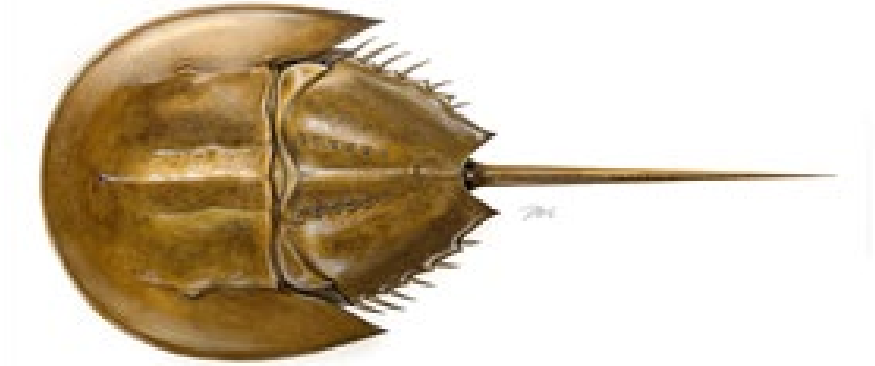
2023 Harvest Specifications for the Delaware Bay



2023 Recommendations are Unique

- Currently operating under Addendum VII
- Draft Addendum VIII being considered today
- DBETC and ARM Subcommittee considered both:
  - Recommendations based on Addendum VII (2012 ARM Framework)
  - Recommendations based on draft Addendum VIII (2021 ARM Framework)

2012 ARM Framework ("old" ARM)

2012 Adaptive Resource Management (ARM)

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

- Red knot and HSC population thresholds
- Red knot and HSC abundance estimates
- 5 harvest packages
- Harvest recommendations

Harvest Packages

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

Thresholds in ARM Utility Functions

Population thresholds

Female HSC:

80% carrying capacity

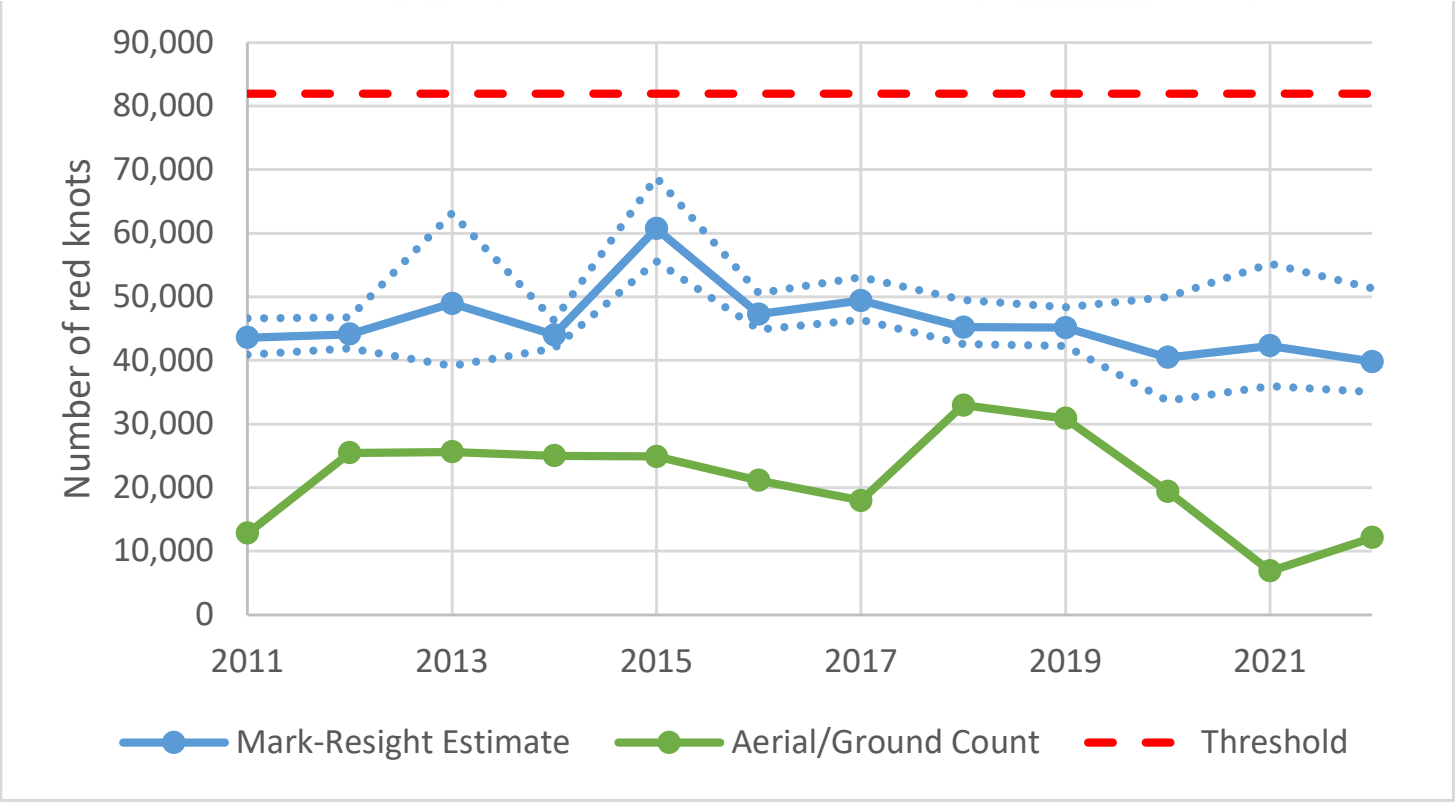
(or 11.2 million F crabs)

Red knot:

81,900 birds

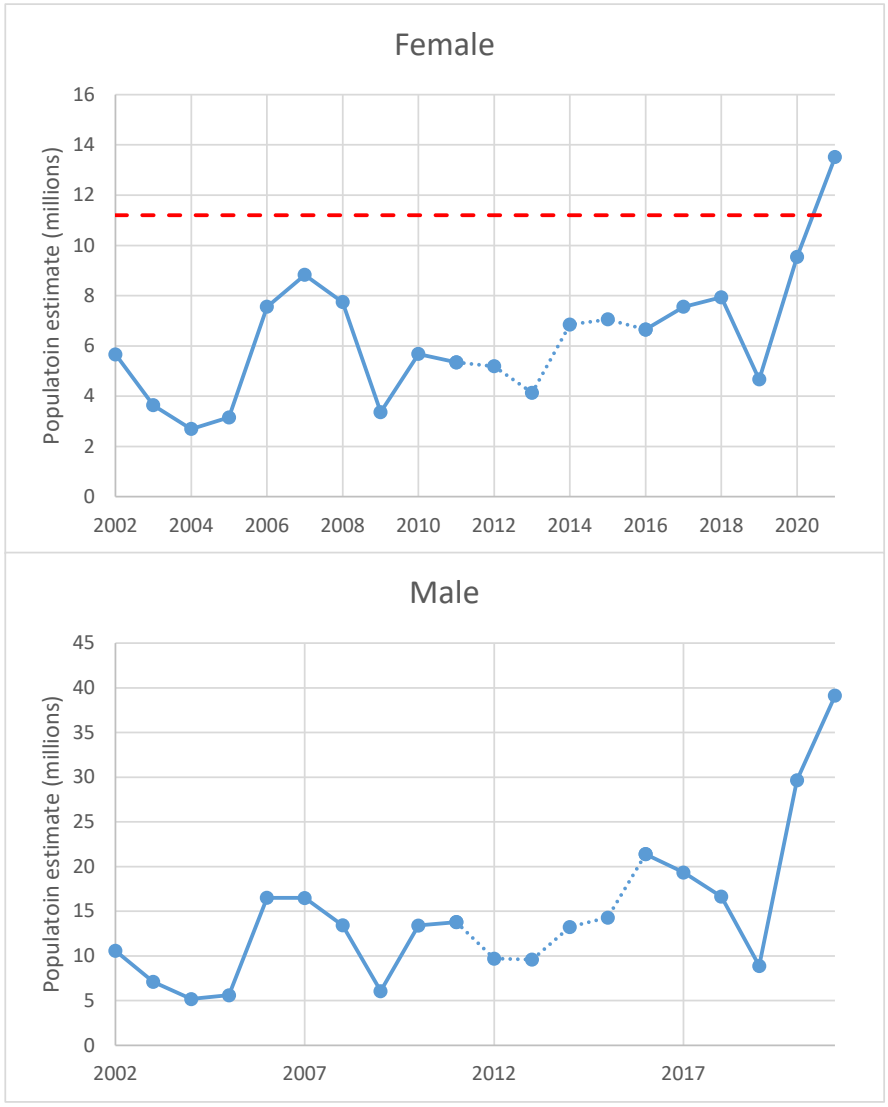
- There is the possibility for female HSC harvest if either of these thresholds are met.

Red Knot Abundance



- 2022 estimate is slightly lower than 2021 estimate
- 2022 estimated stopover duration was 9.4 days, less than the previous two years (12.1 days in 2021; 10.7 days in 2020)
- 2022 estimate of 39,800 is below the threshold of 81,900 birds

Horseshoe Crab Abundance



- **Composite index values for 2012 - 2015**

- HSC abundance estimates are based on VT trawl survey
- VT trawl survey not funded every year, so **composite index** was developed
  - Uses DE 30' trawl, NJ DB trawl, and NJ ocean trawl surveys
- 2021 had 13.5 million females, 39.1 million males
- 2021 estimate of 13.5 million females exceeds the 11.2 threshold

2023 Harvest Recommendation

HSC and red knot abundance estimates:

Horseshoe crab abundance (millions)			Red knot abundance (×1,000)	
Year	Male	Female	Year	Male and female
2021 (Fall)	39.1	13.5	2022 (Spring)	39.8

Harvest package recommendation:

Recommended harvest package	Male harvest	Female harvest
5	420,000	210,000

- Harvest package 5 is recommended because female HSC have exceeded the 11.2 million threshold. This is the first time something other than harvest package 3 is recommended by the ARM.

2023 Harvest Allocation

	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**

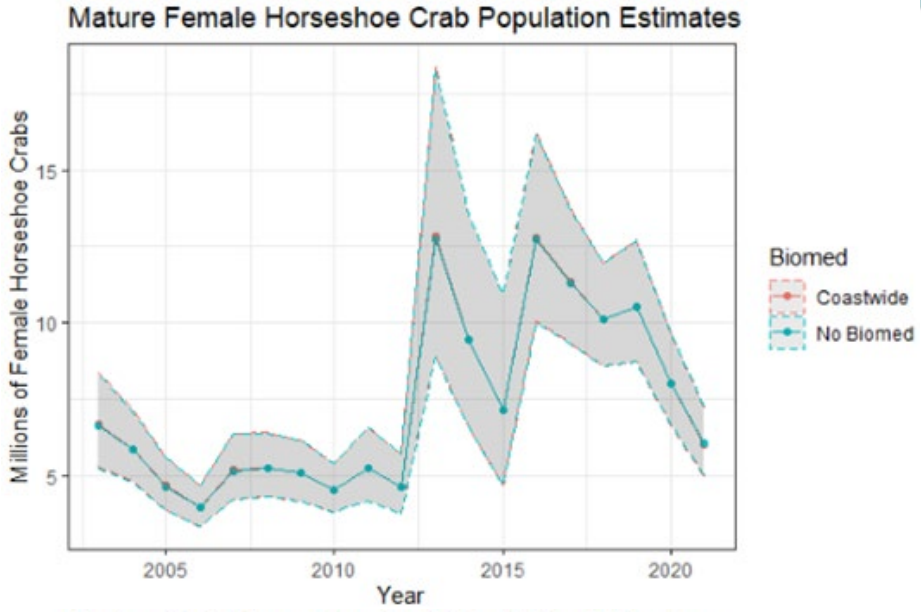
2021 ARM Framework Revision ("new" ARM)

2021 Adaptive Resource Management (ARM)

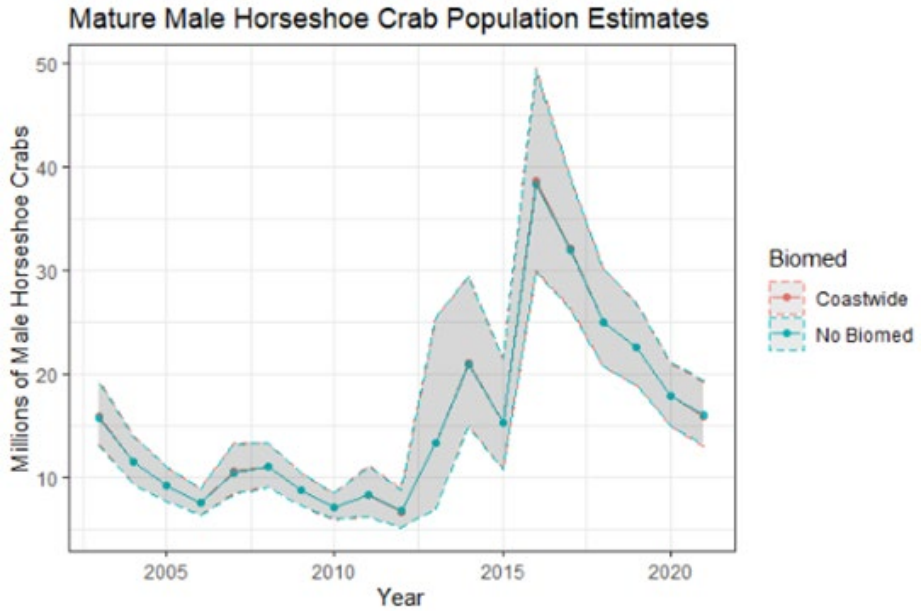
Manage harvest of horseshoe crabs in the Delaware Bay to maximize harvest but also to maintain ecosystem integrity and provide adequate stopover habitat for migrating shorebirds, and ensure that the abundance of horseshoe crabs is not limiting the red knot stopover population or slowing recovery.

- Red knot abundance based on the same mark-resight estimate (2021)
- HSC abundance based on the CMSA (2021)
- Continuous harvest levels
- Rounding of harvest levels to protect confidential data

Horseshoe Crab Abundance

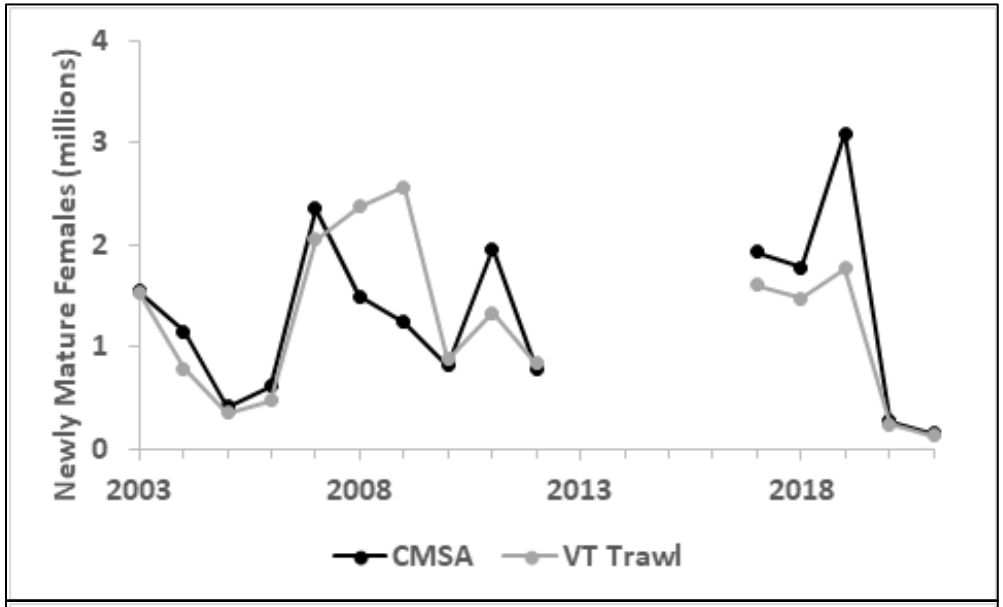


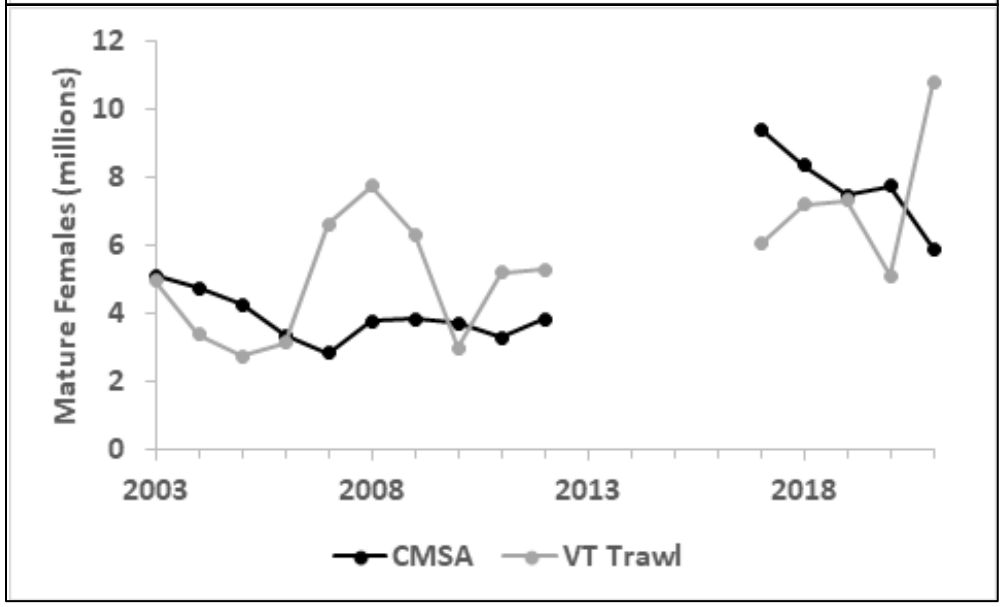
Total females: 6.0 – 6.1 million



Total males: 15.9 – 16.0 million

Horseshoe Crab Abundance





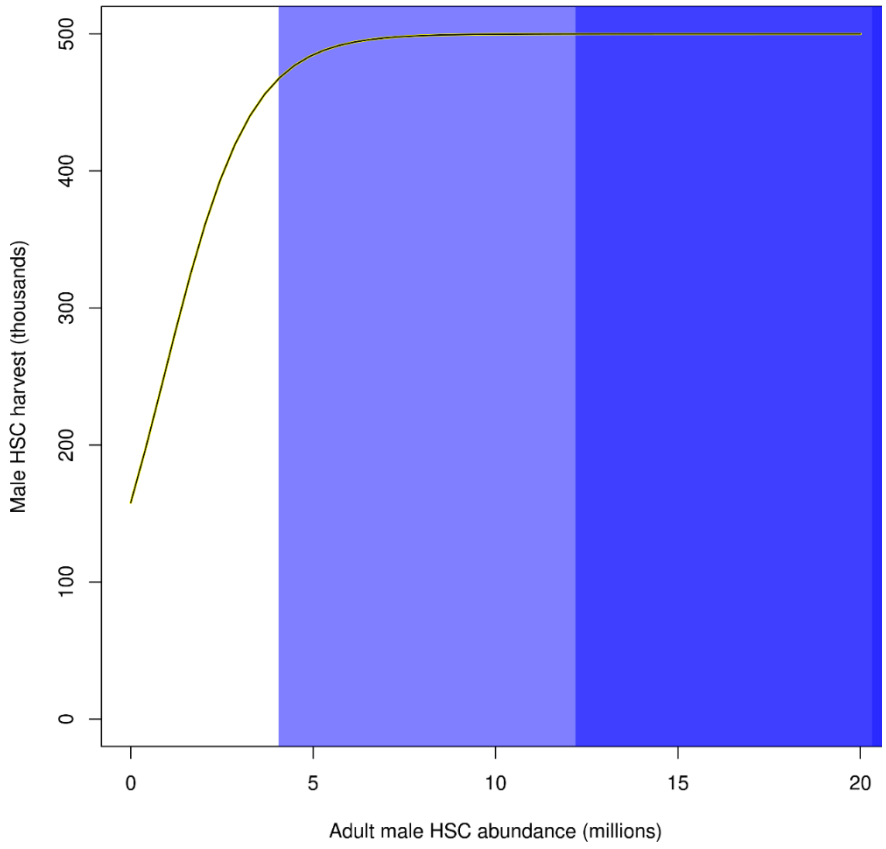
NOTE: CMSA estimates are lower in 2021 than the VA Tech Estimate.

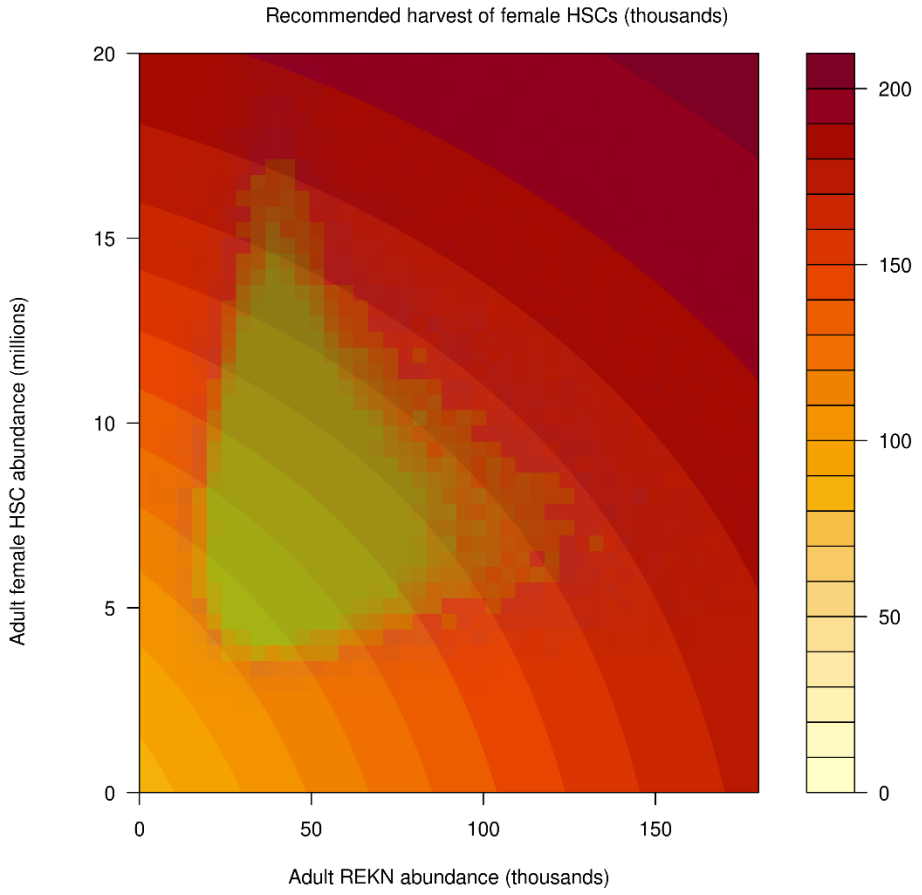
- Low number of newly mature (primiparous) recruits in 2019 and 2020.

2021 ARM Data Inputs

Parameter	Estimate
2021 Red Knot Abundance	42,271
2021 CMSA Female Horseshoe Crabs	6.0 – 6.1 million
2021 CMSA Male Horseshoe Crabs	15.9 – 16.0 million

Harvest Policy Functions





2023 Harvest Recommendation

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

Recommendation

- Consensus among the DBETC and ARM Subcommittee members that the harvest recommendation from the new ARM was preferred over the old ARM


Questions?

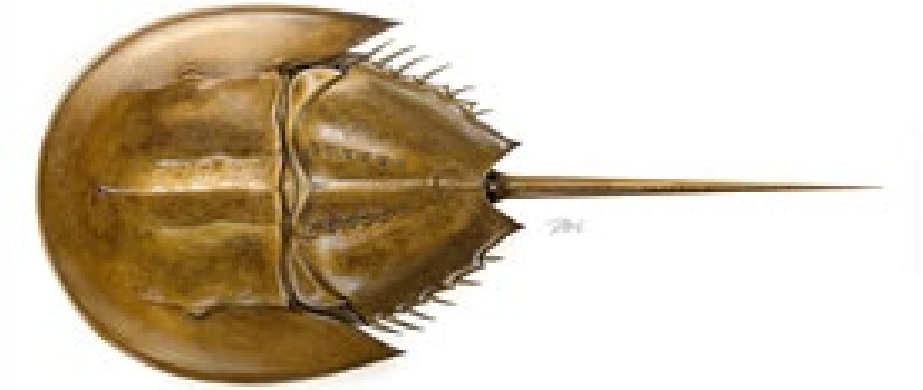
2023 Quota Allocation

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

Draft Addendum VIII on Implementing Recommended Changes from the 2021 ARM Revision and Peer Review Report

and Summary of Public Comment



Horseshoe Crab Management Board

November 10, 2022

Outline

1. Background
2. Action Development Timeline
3. Proposed Management Options
4. Summary of Public Comment
5. Advisory Panel Report
6. Consider Final Action

Background

- Addendum VII (2012) established current ARM Framework for recommending optimal bait harvest for Delaware Bay based on HSC and red knot abundance
- Board accepted 2021 ARM Revision and Peer Review in January 2022
  - Addresses peer review critiques
  - Includes new data sources
  - New modeling software
- Board initiated Addendum VIII to consider use of ARM Revision in setting annual specifications for horseshoe crabs of Delaware Bay-origin

Proposed Action Timeline

Date	Action
January 2022	Board initiated Draft Addendum VIII
Feb-July 2021	PDT met to develop addendum
August 2022	Board approved Draft Addendum VIII for Public Comment
September 2022	Public hearings and comment period
November 2022	**Board meeting to consider final approval of Draft Addendum VIII**

PROPOSED MANAGEMENT OPTIONS

Draft Management Options

- **Option A: No Action**
  - True status quo is not possible given obsolete software
  - Management would revert back to provisions implemented under Addendum VI
- **Option B: Implement ARM Revision for setting bait harvest specifications for Delaware Bay-origin horseshoe crabs**
  - Revised ARM Framework would be used to set the annual harvest specifications for horseshoe crabs of Delaware Bay origin
  - Adopt changes recommended in 2021 ARM revision and peer review

Option A

- No Action: management would revert back to Addendum VI with static harvest quotas

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

Option A

- Addendum VI provisions:
  - prohibits directed harvest and landing of all horseshoe crabs in NJ and DE from January 1-June 7 & female crabs in New Jersey and Delaware from June 8-December 31
  - prohibits the landing of horseshoe crabs in Maryland and Virginia (from federal waters) from January 1-June 7
  - no more than 40% of Virginia's annual quota may be harvested east of the COLREGS line
  - horseshoe crabs harvested east of COLREGS line and landed in Virginia must be comprised of a minimum male to female ratio of 2:1

Option A

Jurisdiction	Addendum VI ASMFC Quota
NJ*	100,000 males
DE	100,000 males
MD	170,653
VA**	152,495 (60,998 East of COLREGS)
TOTAL	**523,148**

- NJ and DE: No female harvest
  - NJ still has full moratorium
- MD: Female harvest allowed, no harvest from January 1 through June 7, no spatial restrictions
- VA: Female harvest allowed, no harvest from January 1 through June 7, and spatial restrictions

Option B

- 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

- Option B includes:
  1. Harvest recommendations
  2. Adaptive management cycle
  3. Revised Delaware Bay-origin % (lambda)
  4. State Allocations
  5. Fallback options

1. Harvest Recommendations

- Status quo maximum harvest of M and F crabs = 500,000 and 210,000
- Sex-specific harvest recommendations on continuous scale
- Sub-options for rounding down optimal harvest recommendation to protect confidential data
  - **Sub-Option B1:** Round down to nearest 25,000 horseshoe crabs
  - **Sub-Option B2:** Round down to nearest 50,000 horseshoe crabs

ARM Revision Harvest Recommendations

Year	CMSA Estimates		Red knots	Optimal HSC Harvest (revised ARM)	
	Female HSC	Male HSC		Female	Male
2019	10,546,128	22,571,690	45,133	150,098	500,000
2020	8,011,985	17,803,437	40,444	136,899	500,000
2021	6,021,880	15,894,926	42,271	127,387	499,998

Example Harvest Recommendations

Year	Optimal HSC Harvest (revised ARM)	
	Female	Male
2020	136,899	500,000

Sub-Option B1: Round down to nearest 25,000 crabs

Year	Optimal HSC Harvest (revised ARM)	
	Female	Male
2020	125,000	500,000

Sub-Option B2: Round down to nearest 50,000 crabs

Year	Optimal HSC Harvest (revised ARM)	
	Female	Male
2020	100,000	500,000

ORIGINAL ARM: Harvest Packages

ORIGINAL ARM (Addendum VII)

2.2.1 ARM Framework

- Selection of 5 possible optimal harvest packages depending on abundance of horseshoe crabs and red knots
- Maximum harvest of M and F crabs = 500,000 and 210,000

Package	Males	Females
1	0	0
2	250,000	0
3	**500,000**	**0**
4	280,000	140,000
5	420,000	210,000

2. Management Process

1. **Annual management process**: status quo, i.e., ARM Framework produces harvest recommendations for the upcoming fishing year.
2. **Interim update process**: Every 3 years, update process where 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.

3. Delaware Bay Origin Crabs

- Updated lambda values for New Jersey, Delaware, Maryland, and Virginia from the ARM Revision
  - Recent genetic evidence used to estimate the proportion of states' landings, discards, and biomedical harvest that were DE Bay origin

State	Lambda
DE	1.0
NJ	1.0
MD	**0.45**
VA	**0.20**

Lambda = Proportion of state harvest that is of Delaware Bay Origin

3. Delaware Bay Origin Crabs

CURRENT

(Addendum VII)

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

PROPOSED

(Addendum VIII)

State	Lambda
DE	1.0
NJ	1.0
MD	**0.45**
VA	**0.20**

4. State Allocations

- **Weighting**
  - Maintain status quo weighting with updated lambdas
- **Harvest Cap: MD and VA**
  - Max limit on total harvest to protect non-DB-origin crabs
- **2:1 male:female offset**
  - When ARM output for female harvest is zero, total male harvest allocation of MD and VA is increased at a 2:1 ratio

STATE	Allocation Weight
NJ	35%
DE	35%
MD	27%
VA	4%

MD Cap	VA Cap
170,653	60,998

4. State Allocations

CURRENT

State	Allocation weight w_i
	Genetics λ
NJ	32.4%
DE	32.4%
MD	28.2%
VA	7.0%

PROPOSED

STATE	Allocation Weight
NJ	35%
DE	35%
MD	27%
VA	4%

Example Harvest Allocations

Year	Optimal HSC Harvest (revised ARM)	
	Male	Female
2019	500,000	144,803 **(100,000)**

	Revised DE Bay Allocations		
STATE	**Male**	**Female**	**Total**
NJ (35%)	173,014	34,603	**207,617**
DE (35%)	173,014	34,603	**207,617**
MD (27%)	132,864	26,573	**159,437**
VA (4%)	21,107	4,221	**25,328**

Example State Allocations

Example recommended harvest of 500,000 males and 100,000 females of DE Bay origin

State	DE Bay Origin Quota			Total Quota (Add. 6 cap)		
	Male	Female	Total	Male	Female	Total
DE	173,014	34,603	**207,617**	173,014	34,603	**207,617**
NJ	173,014	34,603	**207,617**	173,014	34,603	**207,617**
MD	132,864	26,573	**159,437**	139,625	31,028	**170,653**
VA*	21,107	4,221	**25,328**	40,667	20,331	**60,998**
Total	**500,000**	**100,000**	**600,000**	**539,071**	**107,814**	**646,885**

5. Fallback Option

- Models are dependent on annual data
- If data is not available, two alternative ways to set next year's harvest
  - 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
- Updated to include new data sets required to run the revised ARM model

SUMMARY OF PUBLIC COMMENTS

Public Comment Period

- Public comment period from August – September 30, 2022
- Four state public hearings (3 virtual, 1 in person)
- 69 hearing attendees
- 34,613 total written comments

Public Comments

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	18
New Jersey	5
Delaware	8
Maryland	4
Virginia	1
Total Comments Received	**34,631**

Classification of Comments

Option A

- "strongly oppose the use of the 2021 ARM…for setting horseshoe crab harvest regulations"
- ASMFC should "reject" or "abandon" Addendum VIII
- "Oppose" the proposal to increase the harvest of horseshoe crabs, or Addendum VIII

Option B

- Stated support for ARM Revision, but with no female harvest

No Option Selected

- "…retain the established management framework"
- Complete harvest moratorium

Public Comments

	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

Option A

- Opposition to female harvest
  - Few comments acknowledged Option A would allow female harvest in MD
- Disagreement with not using the original population thresholds in ARM for female harvest
- Concern for red knot populations and recovery
- Concern about horseshoe crab populations
- Concern that female harvest will have cascading ecosystem impacts

Option A

- Criticism of the ARM Revision
  - Modeled relationship between HSC and red knot is "weak"
  - HSC population model does not properly account for uncertainty
  - Data used in the ARM Revision
    - Lack of egg-density data in the ARM
    - Equal weighting of three HSC surveys used in model
  - Insufficient stakeholder input
  - Models have not been available for public review

Option B

- 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
  - data collection to support inclusion of egg density into the management model
  - effects of climate change on spawning and breeding habitat for the crabs and birds

General Considerations

- Neither option - moratorium on female harvest
- Moratorium on all HSC harvest
- Concerns with sub-lethal impacts and mortality associated with biomedical industry
- Eel and whelk fisheries using HSC as bait are not in good condition and should be limited
- Desire for more holistic ecosystem-based management for Delaware Bay resources

ADVISORY PANEL REPORT

AP Input on Draft Addendum VIII

- AP met virtually on October 13, 2022
- 7 advisors attended
- ASMFC staff provided a summary of Addendum VII and options.
- A summary of public comment was reviewed.
- General comments and discussion:
  - Management should adapt to use best available science
  - Horseshoe crab populations have improved under ARM management
  - The AP acknowledges the public comment in opposition to addendum VII
    - The process is much more complex than it is often described, and this oversimplification is not an accurate description of the model
  - Spirit of public comment reflects desire to protect female horseshoe crabs for the benefit of the crabs, the ecosystem and the red knot. The original ARM and now revised ARM is consistent with that desire

AP Input on Draft Addendum VIII

- Reverting back to addendum VI would decrease bait quotas for some states and allow female harvest in others.
- Reverting back to addendum VI sets quotas based on historical landings, independent of other data, and exclusive of the most recent data
- Reducing bait harvest in the DE bay area could mean additional pressure in the North East. ("Balloon effect")
- States have the ability implement stricter controls
- Amenable to a modest harvest supported by data. Not averse to the board conservatively limiting female harvest

Conclusion:

- **The AP members present, unanimously supported Addendum VIII option "B" as the best, science-based management option.**

Additional AP Comments

- Coastal development is a major factor affecting beach habitat for red knots and HSC
- Virginia Tech trawl survey should run tows earlier in the year (late May – July) to capture large numbers of juveniles at those times
- 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.

CONSIDER FINAL ACTION

Board Action

- Selection of management program
  - Option A
  - Option B
    - Sub-option B1
    - Sub-option B2
- Consider final action on Draft Addendum VIII


Questions ?

2023 Harvest Recommendation

Using sub-option B1: round down to the nearest 25,000	
Male harvest	**Female harvest**
475,000	125,000

Using sub-option B2: round down to the nearest 50,000	
Male harvest	**Female harvest**
450,000	100,000

2023 Quota Allocation

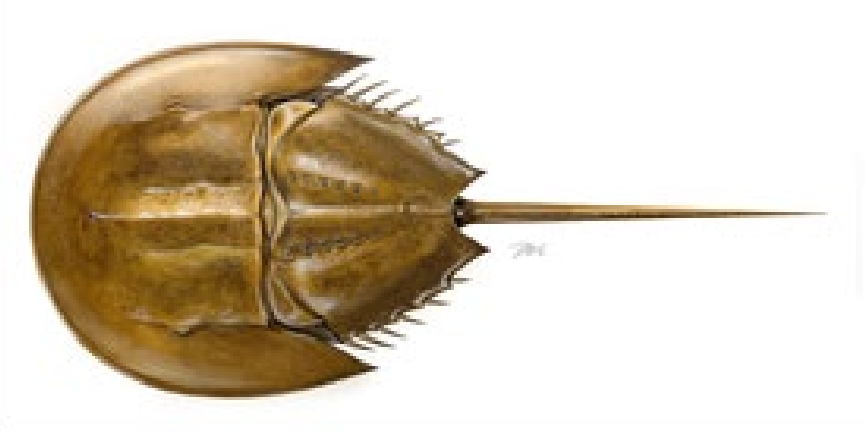
Using sub-option B1 to round down to the nearest 25,000				
State	Delaware Bay Origin Quota		Total Quota	
	Male	Female	Male	Female
Delaware	164,364	43,254	164,364	43,254
New Jersey	164,364	43,254	164,364	43,254
Maryland	126,220	33,215	135,100	35,553
Virginia	20,052	5,277	40,667	20,331
TOTAL	475,000	125,000	504,495	142,390

2023 Quota Allocation

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

Work Group Nominations

Task to Review Biomedical Best Management Practices



Horseshoe Crab Management Board

November 10, 2022

Work Group Task

- Board agreed to form work group in August 2022

- Review best management practices for handling biomedical catch and suggest options for updating and implementing BMPs

Best Management Practices

- BMP document produced by WG in 2011 with recommendations for each step from capture to return
  - Collection, Transport to Facility, Holding/Bleeding, Post-bleeding Holding, Return to Sea
- BMPs are recommended in FMP but not required by ASMFC
  - FMP requires states to issue a special permit, or other specific authorization, for harvests for biomedical purposes, and return of horseshoe crabs taken for biomedical purposes to the same state or federal waters from which they were collected

Nominations

Katie Rodrigue, RI DEM

Derek Perry, MA DMF

Samantha MacQuesten, NJ DEP

Brett Hoffmeister, Associates of Cape Cod

Nora Blair, Charles River Labs

Benjie Swan, Limuli Labs

Dr. Daniel Sasson, SC DNR

Board Action

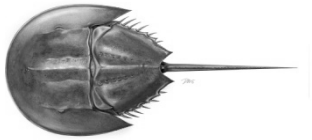
- Consider/approve nominations to the biomedical BMP Work Group

Questions?

Horseshoe Crab FMP Review for the 2021 Fishing Year

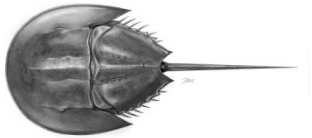
Horseshoe Crab Management Board

November 2022



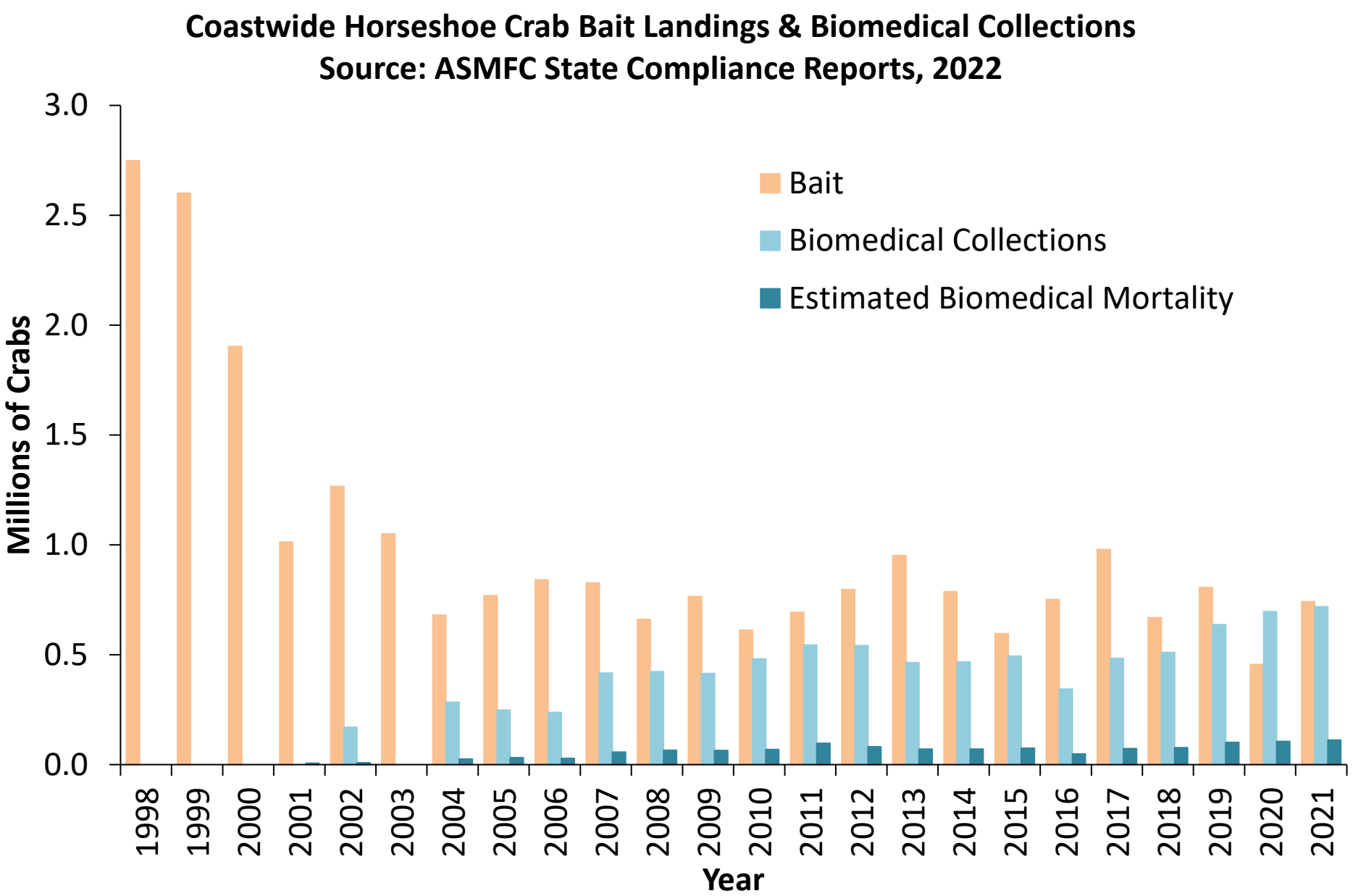
Management History

- **FMP Approved (1998)**
- **Addendum I (2000) –** State bait harvest quotas and *de minimis*
- **Addendum II (2001) –** Quota transfers
- **Addendum III (2004) –** DE Bay state bait quotas and seasonal closures
- **Addendum IV (2006) –** DE Bay state bait quotas and seasons
- **Addendum V (2008) –** Extension of Add IV
- **Addendum VI (2010) –** Extension of Add V
- **Addendum VII (2012) –** DE Bay ARM Framework



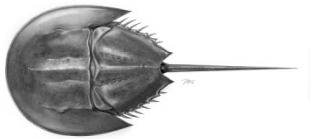
Descriptions in Section I of FMP Review

Annual Total Harvest



2021 Bait Fishery

- Total coastwide harvest was 741,684 crabs
  - *Includes CT landings*
  - 63% increase from 2020 landings of 455,831 crabs
  - Low 2020 landings due to COVID-19
- Majority from MD (24%), DE (23%), MA (21%), VA (15%)



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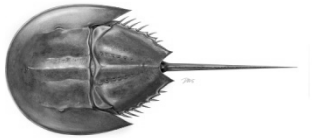
Biomedical Use

- Biomedical-only crabs collected in 2021: 718,809
  - 3% increase from 2020
- Biomedical-only mortality estimate: 112,104
  - Biomed Mortality = # Observed Dead Before Bleeding + 15% x # Biomed-Only Bled
  - 13% of total directed removals; biomedical mortality + bait harvest (836,296 crabs)



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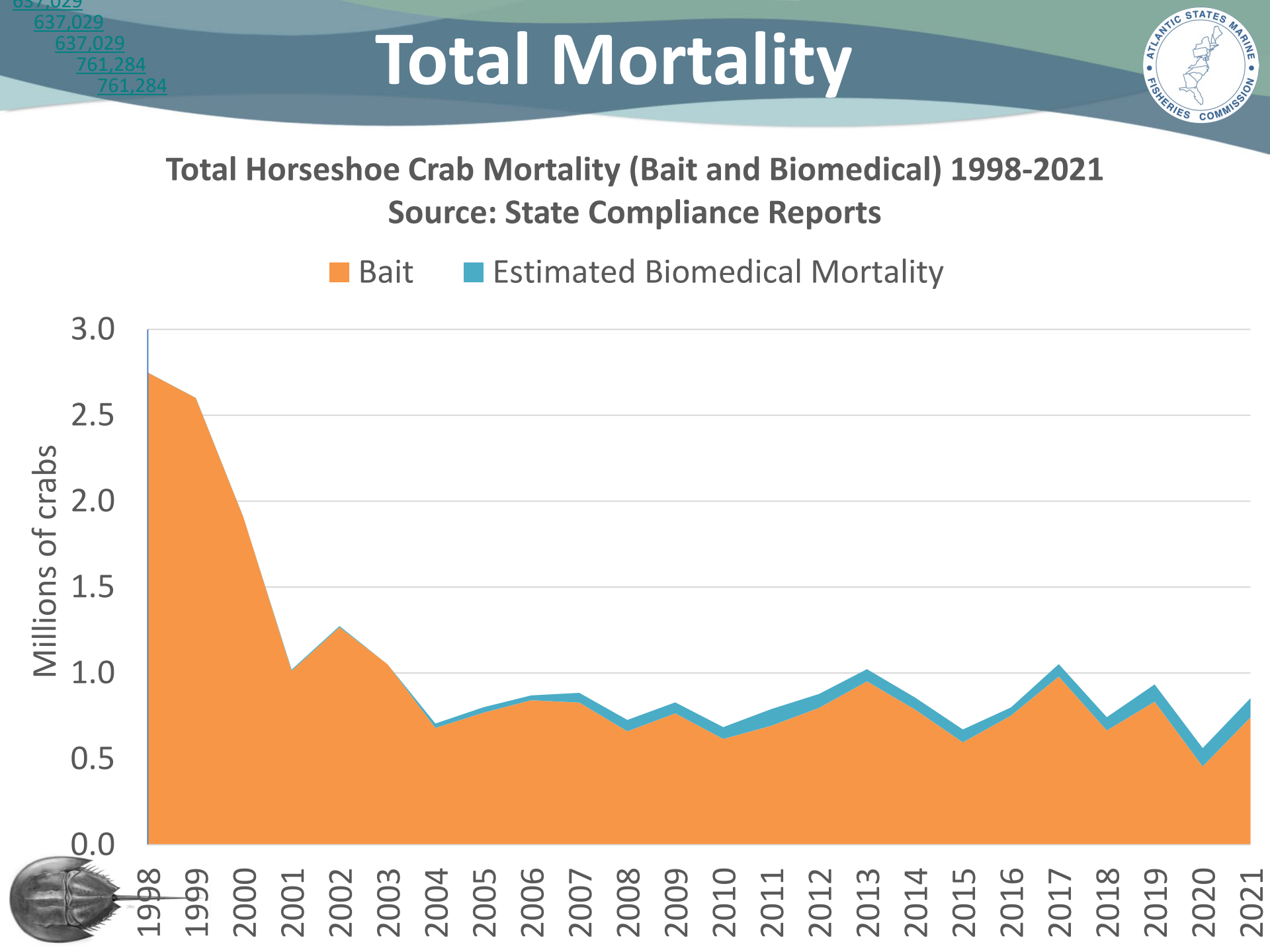
Total Mortality



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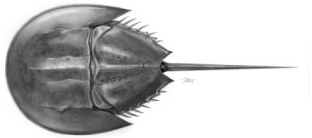
COVID-19 Impacts

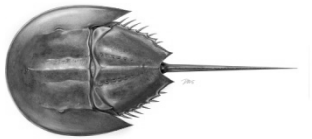
- COVID-19 pandemic impacted required sampling

- Surveys not conducted in 2021
  - LIS Trawl Survey
  - NJ Benthic Survey



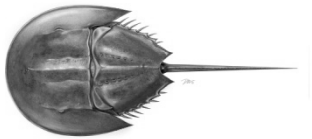
De Minimis

- Combined average bait landings (by numbers) for last two years < 1% of coastwide bait landings for the same two-year period
- SC, GA, and FL all requested and qualify for *de minimis* status for 2021



PRT Recommendations

- Continue seeking long-term funding for VT trawl survey
  - Funded through 2022
- Consider annual characterization of discard removals

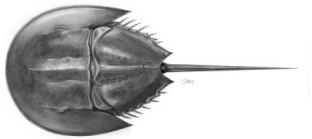


PRT Recommendations

- All states and jurisdictions appear to be in compliance with FMP provisions
  - CT did not meet compliance report deadline

- *Board action:*

  Consider approval of the FMP Review and state compliance reports for the 2021 fishing year, and *de minimis* status for SC, GA, and FL.



Questions?