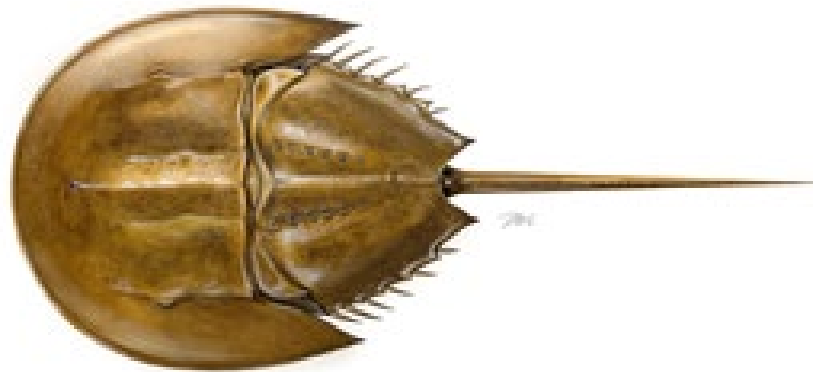


Results of the Stakeholder Survey on Delaware Bay Horseshoe Crab Management



Horseshoe Crab Management Board
October 2023

Outline



1. Background
2. Methods
3. Results
4. Next Steps

Background



- ARM Revision approved for management use in January 2022
 - Peer reviewed by independent panel
- Board approved Addendum VIII in November 2022
 - Adopted use of ARM Revision for setting Delaware Bay bait fishery specifications
 - Numerous comments opposing female harvest
- Board set 2023 specifications at 475,000 males, and 0 females, with 2 to 1 offset for MD and VA

Background



- May 2023: Board formed a workgroup (WG) to develop a stakeholder survey
 - Delaware Bay region harvesters and dealers, biomedical industry, environmental groups
- Purpose: provide guidance in evaluating the current goals and objectives for the Delaware Bay horseshoe crab fishery
- WG met four times from June-September

Overarching Questions



- Is there demand for harvest of female horseshoe crabs?
- Under what conditions would stakeholders be comfortable allowing female harvest?
- What management goals for the Delaware Bay region are important to stakeholders?
- Should the Board consider changes to the management program for setting Delaware Bay bait harvest specifications?

Methods



- WG developed survey questionnaire
 - Reviewed by social science researcher
- WG identified stakeholders from Delaware Bay states
- Survey disseminated through SurveyMonkey to 107 individuals

Group	Harvesters	Dealers	Other Fishermen	Environmental NGO	Biomedical	Towns	Other
#	26	4	39	25	4	3	6
State	NJ	DE	MD	VA			
#	53	15	18	17			



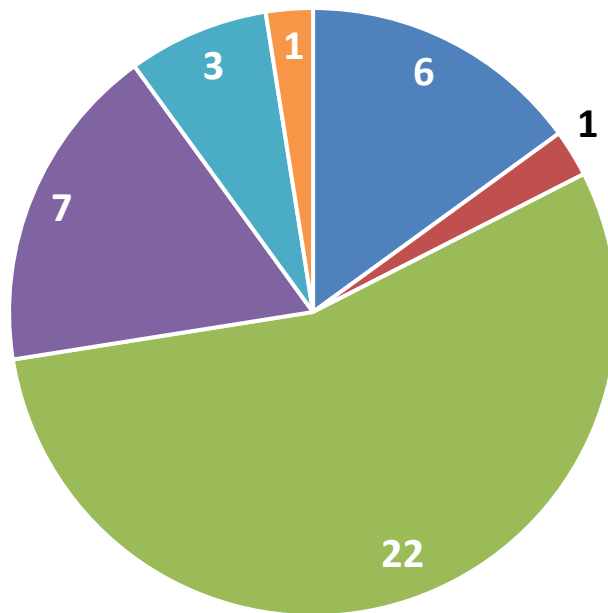
RESULTS

Responses



- 40 responses received (38% response rate)

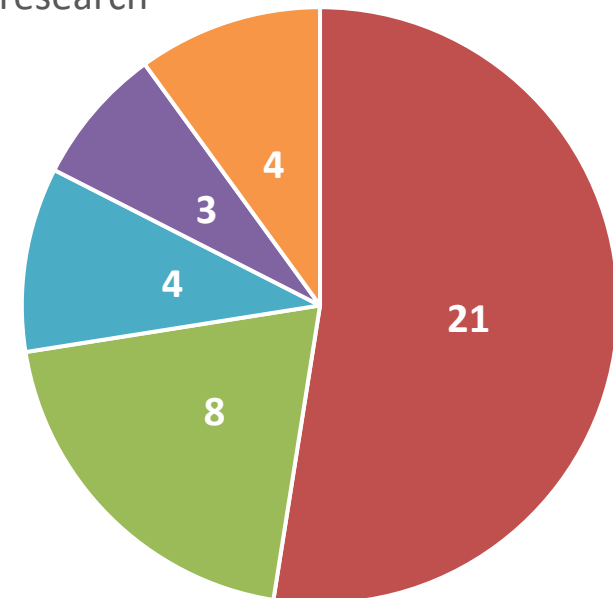
In what state or U.S. territory do you live?



- Virginia
- New York
- New Jersey
- Delaware
- Maryland
- Pennsylvania

Primary Field of Work

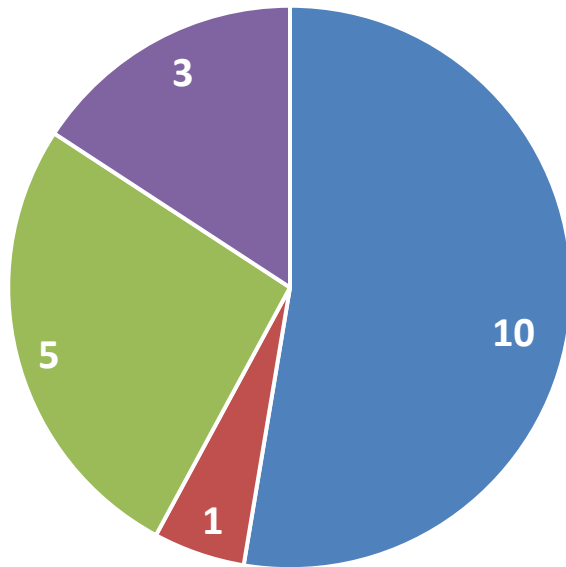
- Commercial fisheries (harvesters and dealers)
- Environmental conservation
- Biomedical industry
- Unemployed or retired
- Academia or research



Commercial Harvest



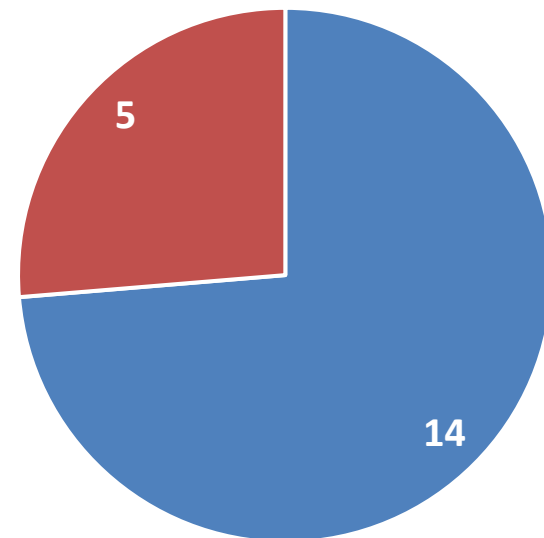
What are the horseshoe crabs that you harvest or sell used for?



- Bait
- I do not know
- Both bait and biomedical
- I do not harvest horseshoe crabs

Have you ever harvested or sold female horseshoe crabs for bait in the past?

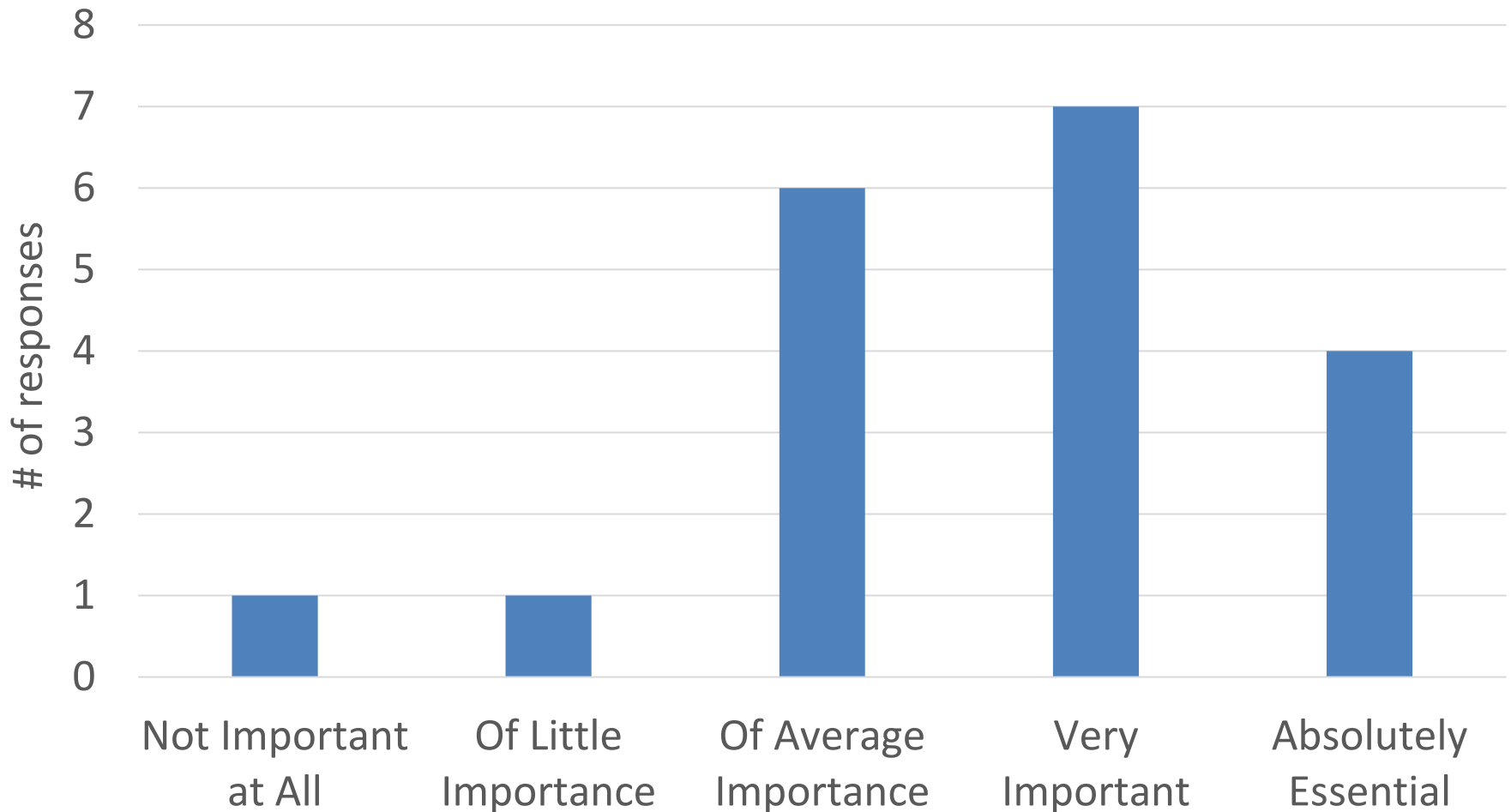
■ Yes ■ No



Importance of Female Harvest



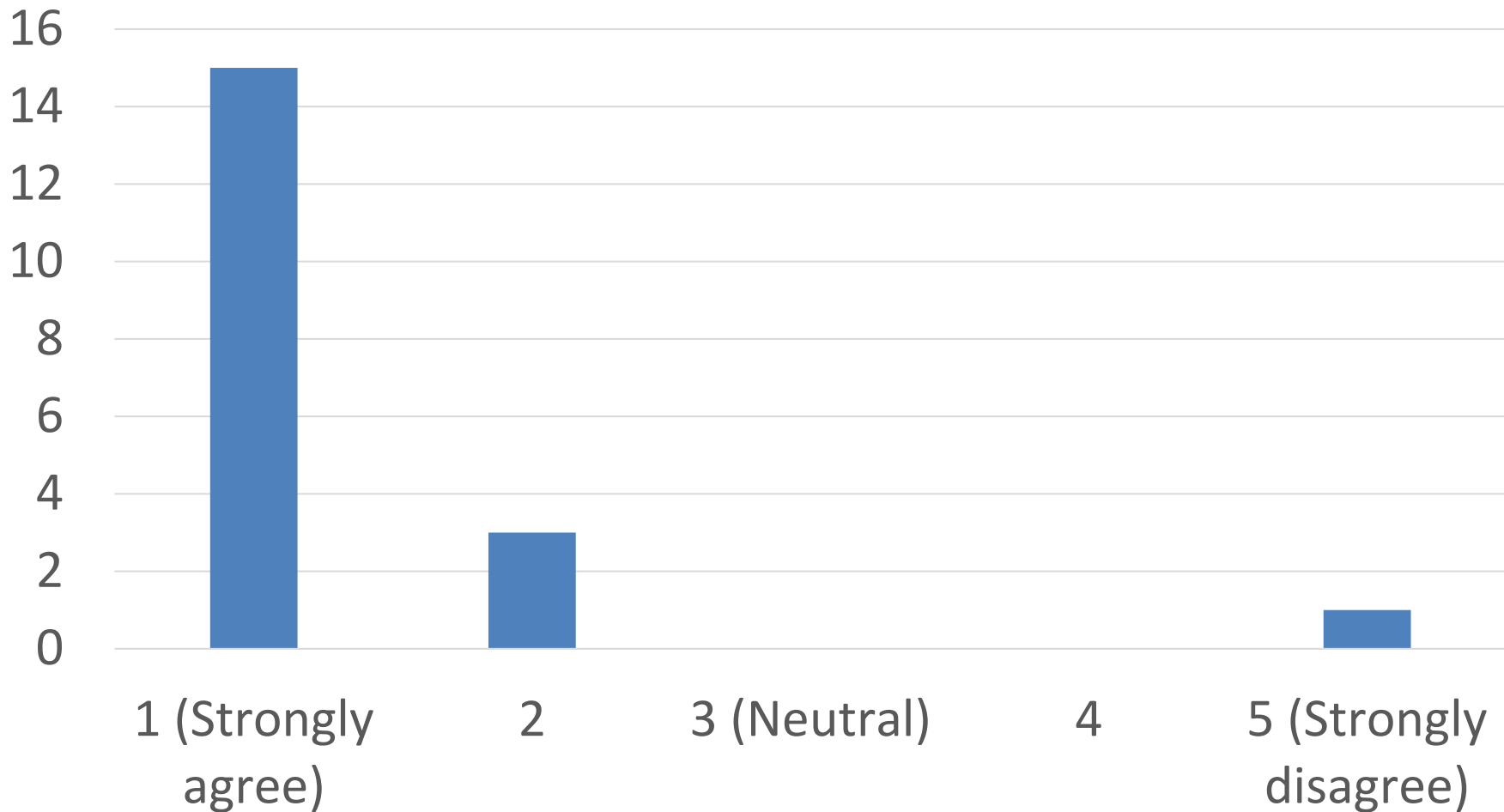
How important is it to you to be able to harvest/sell female horseshoe crabs for bait in the future? (n=19)



Value of Female HSC



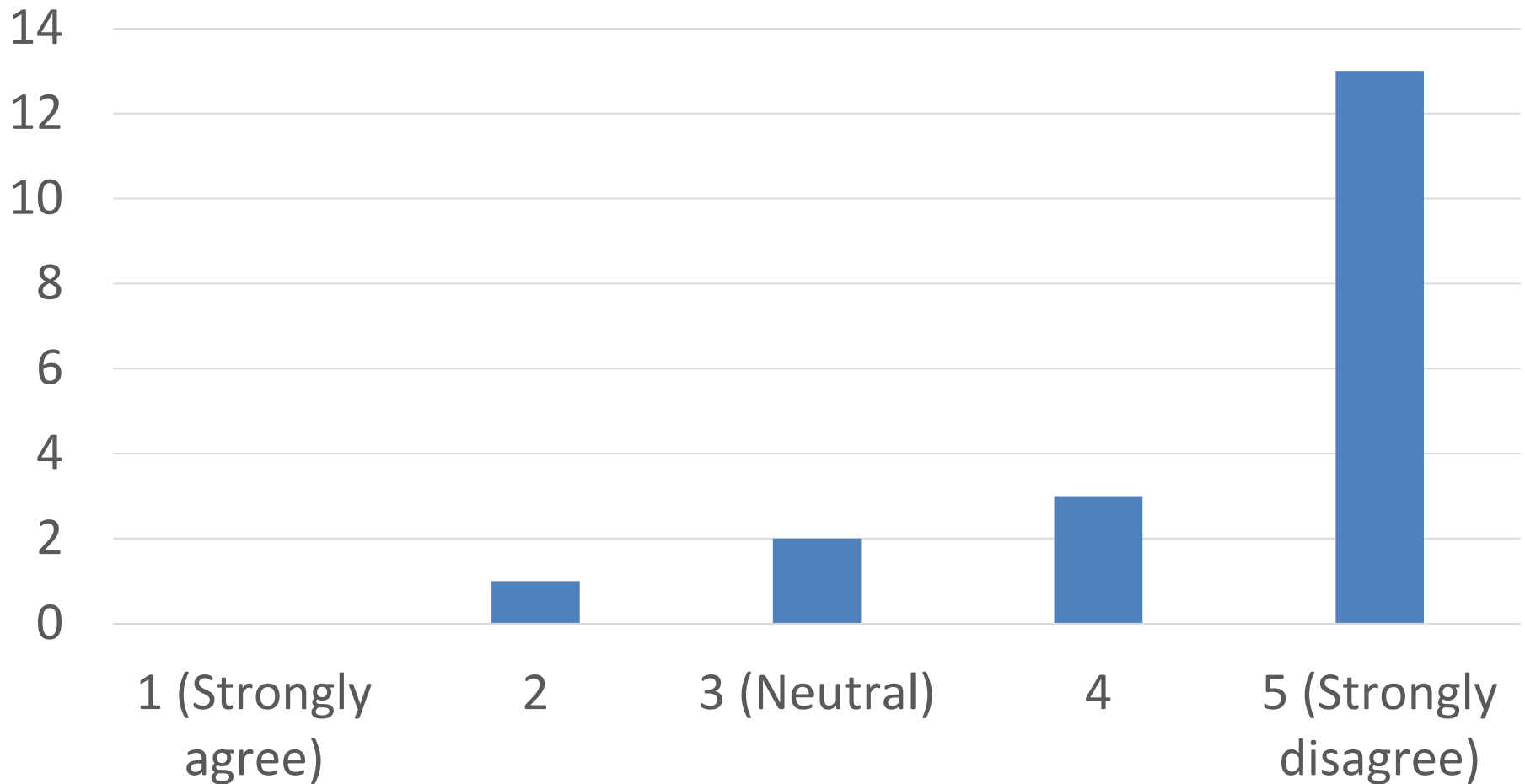
Female horseshoe crabs are worth more money than male horseshoe crabs. (n=19)



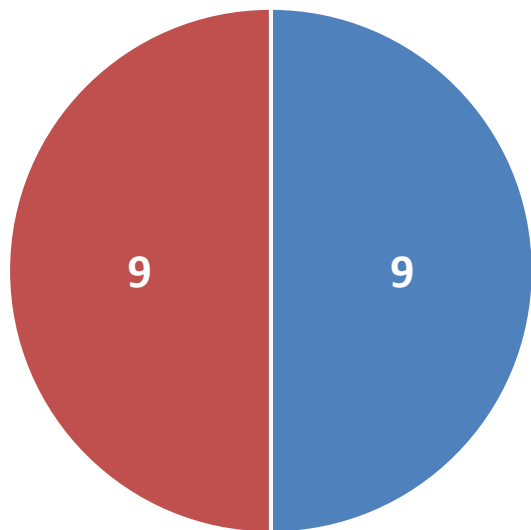
Demand for Female HSC



There is no market demand for female horseshoe crabs. (n=19)



Of the following two options,
which do you prefer?



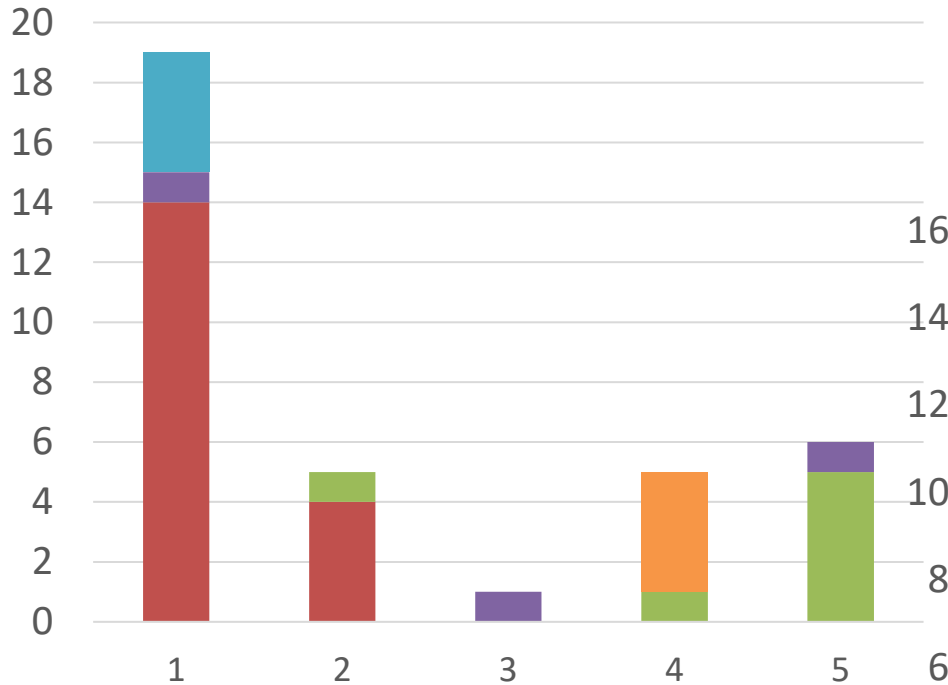
- A larger overall quota of all male horseshoe crabs
- A smaller overall quota including some female horseshoe crabs

State	A larger overall quota of all male horseshoe crabs	A smaller overall quota including some female horseshoe crabs
Delaware	2	1
Maryland		1
New Jersey	7	3
Virginia		4

Delaware Bay Perceptions



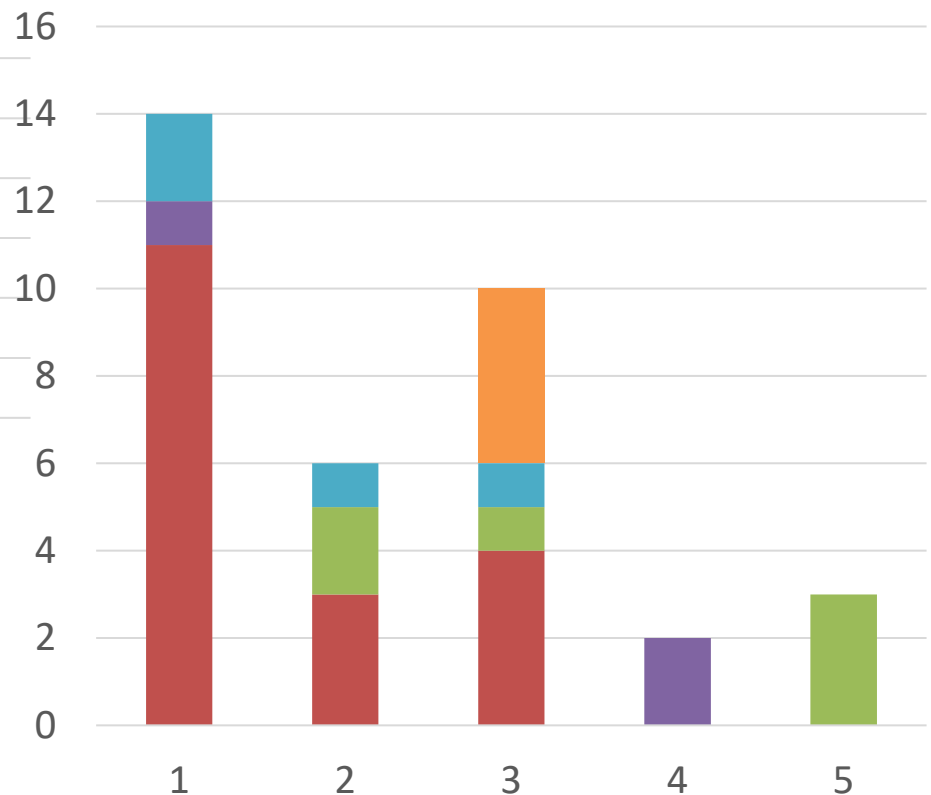
The Delaware Bay population of horseshoe crabs is healthy.



- Academia or research
- Biomedical industry
- Unemployed or retired
- Environmental conservation
- Commercial fisheries (harvesters and dealers)

1= Strongly Agree
3=Neutral
5= Strongly Disagree

The number of horseshoe crabs in the Delaware Bay population is increasing.



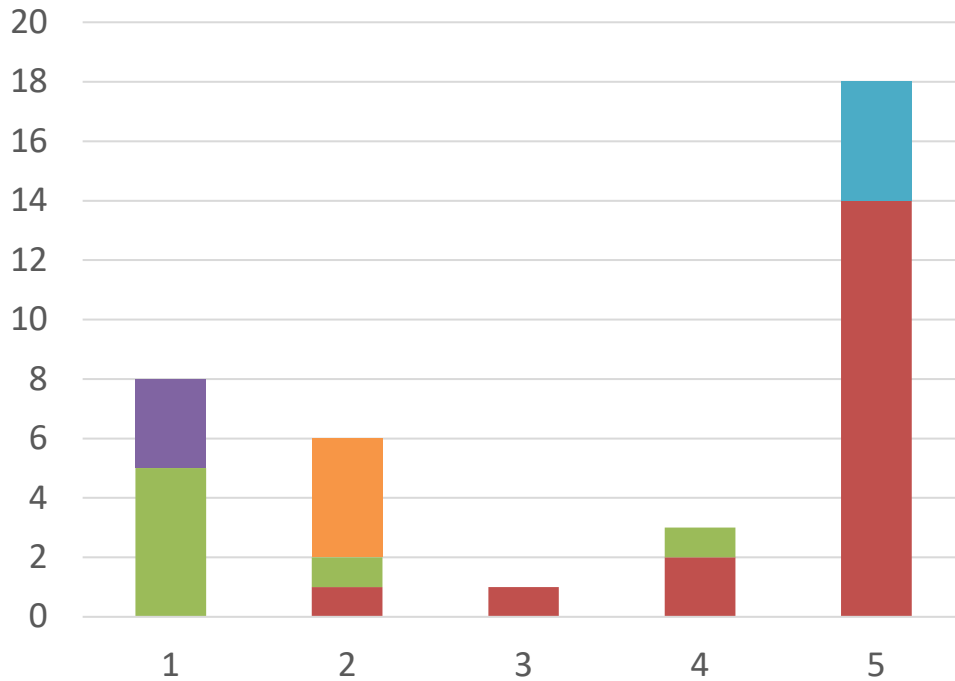
Delaware Bay Perceptions



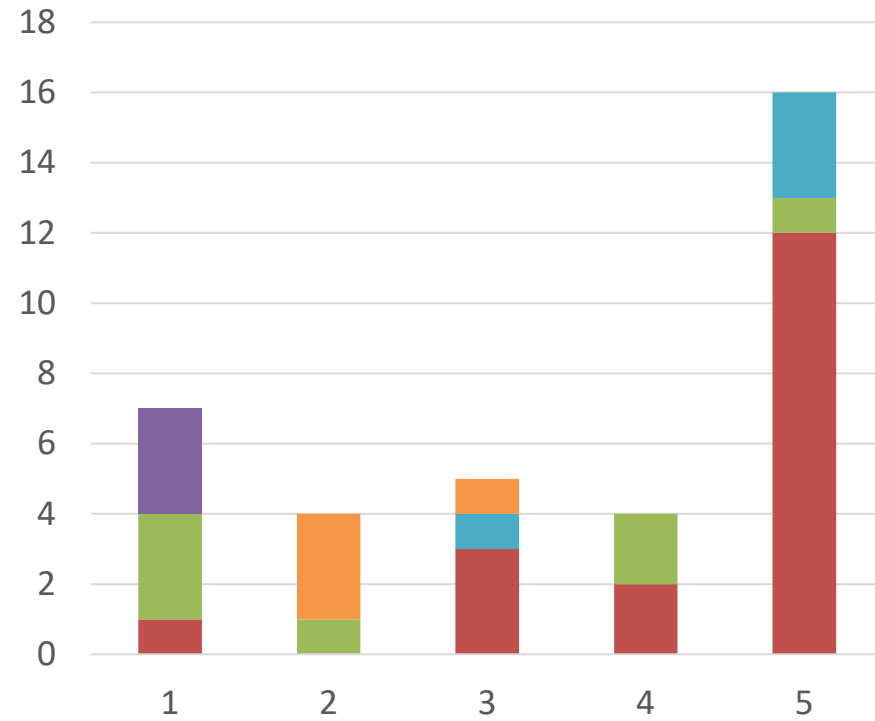
The horseshoe crab bait fishery is negatively impacting the Delaware Bay population of horseshoe crabs.

1= Strongly Agree
3=Neutral
5= Strongly Disagree

The horseshoe crab bait fishery is negatively impacting red knots in the Delaware Bay.



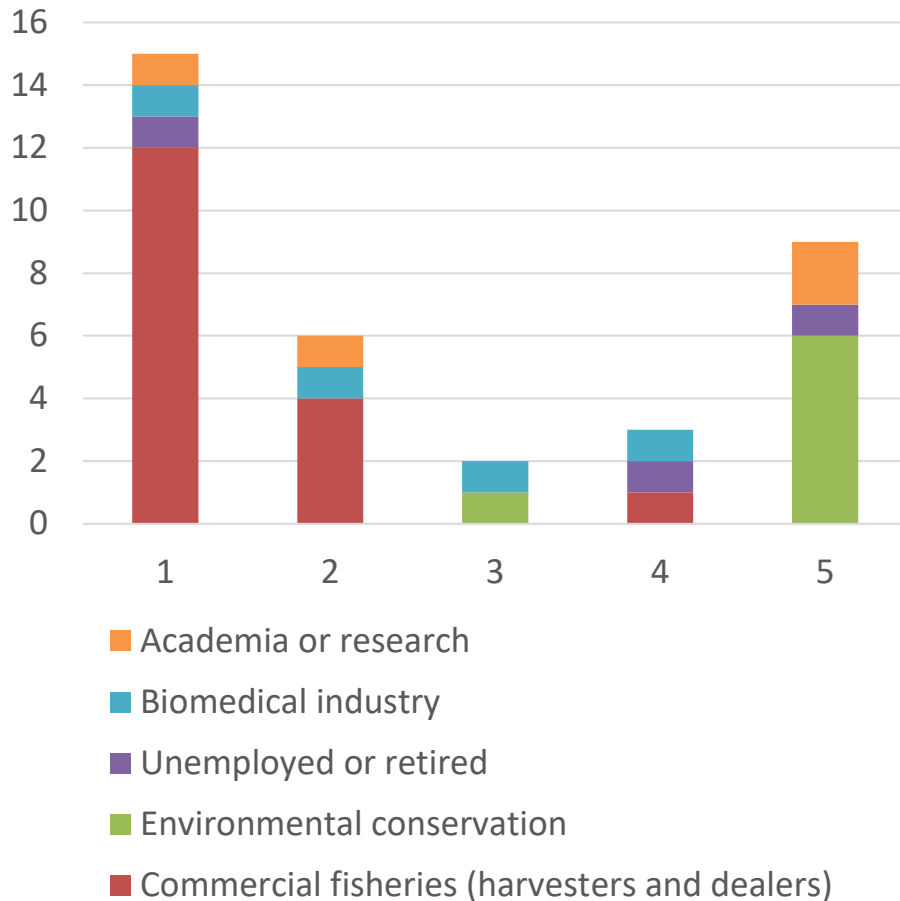
- Academia or research
- Biomedical industry
- Unemployed or retired
- Environmental conservation
- Commercial fisheries (harvesters and dealers)



Delaware Bay Perceptions

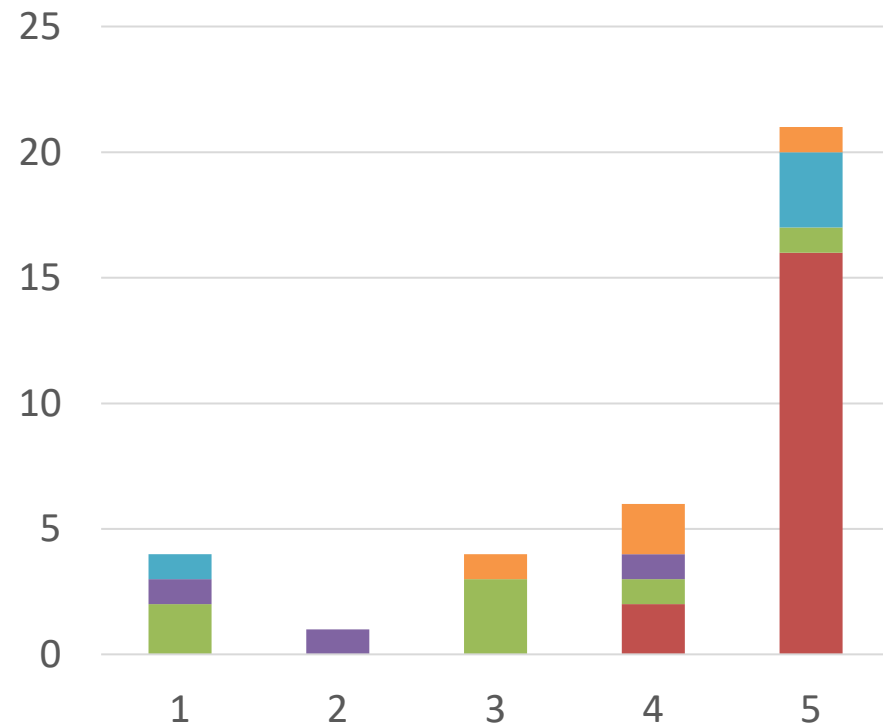


Fishermen should be allowed to harvest female horseshoe crabs from the Delaware Bay population if it is at a healthy level.



1= Strongly Agree
3=Neutral
5= Strongly Disagree

Fishermen should not be allowed to harvest male horseshoe crabs from the Delaware Bay population if it is at a healthy level.



Delaware Bay Perceptions



Statement	Commercial fisheries (harvesters and dealers) (n=18)	Environmental conservation (n=7)	Unemployed or retired (n=3)	Biomedical industry (n=4)	Academia or research (n=4)
A	1.22	4.43	3.00	1.00	4.00
B	4.61	1.57	1.00	5.00	2.00
C	1.65	3.40	3.00	2.00	3.00
D	4.29	2.83	1.00	4.33	2.25
E	1.44	5.00	3.33	3.00	3.25
F	4.88	2.83	2.33	3.67	4.00

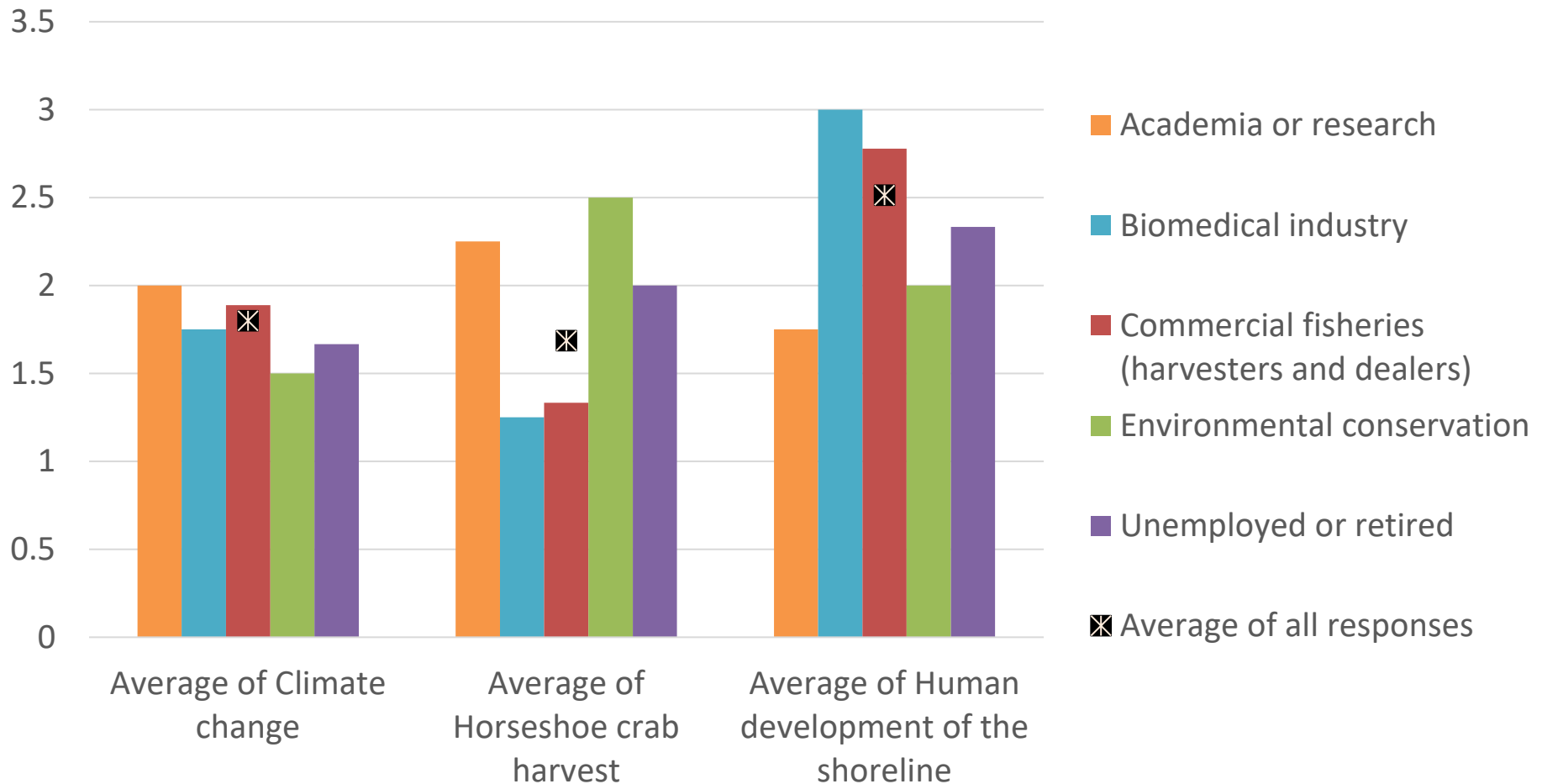
- A. The Delaware Bay population of horseshoe crabs is healthy.
- B. The horseshoe crab bait fishery is negatively impacting the Delaware Bay population of horseshoe crabs.
- C. The number of horseshoe crabs in the Delaware Bay population is increasing.
- D. The horseshoe crab bait fishery is negatively impacting red knots in the Delaware Bay.
- E. Fishermen should be allowed to harvest female horseshoe crabs from the Delaware Bay population if it is at a healthy level.
- F. Fishermen should not be allowed to harvest male horseshoe crabs from the Delaware Bay population if it is at a healthy level.

Impacts on HSC



Please rank the following issues by the level of impact you think they currently have on the Delaware Bay population of horseshoe crabs.

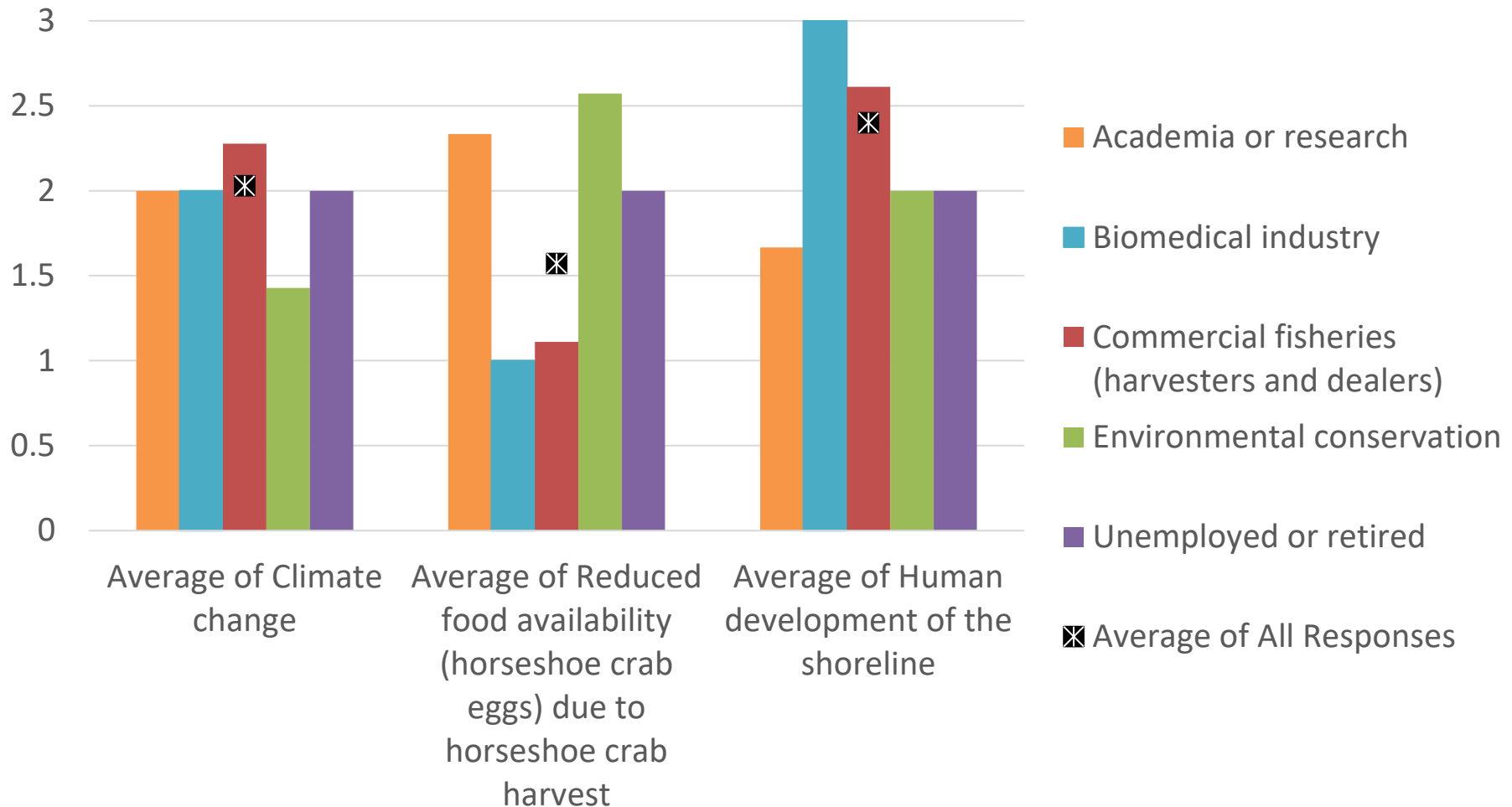
(3 = greatest impact, 1 = least impact) (n=35)



Impacts on Red Knots



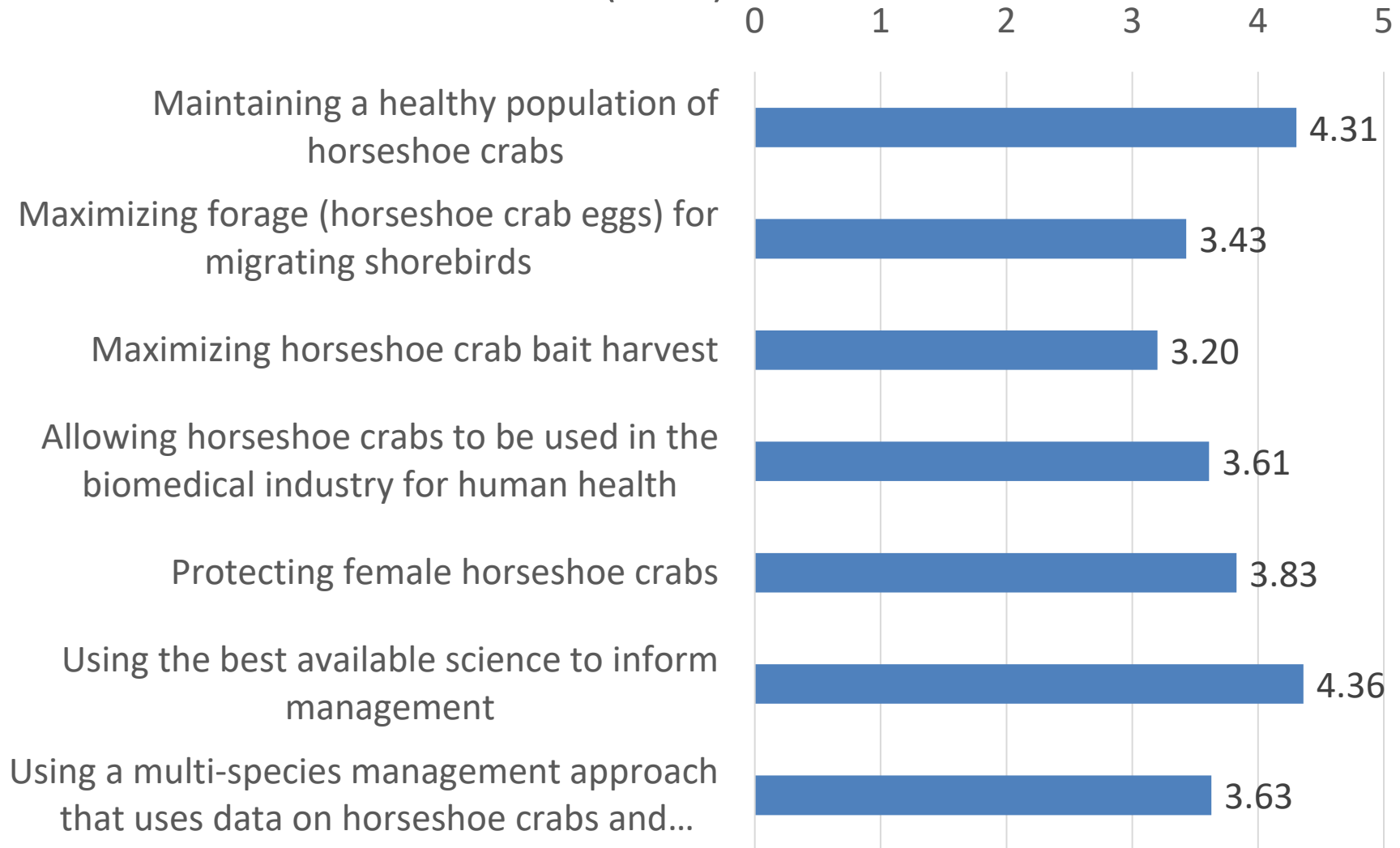
Please rank the following issues by the level of impact you think they currently have on the red knots that stopover in the Delaware Bay during their migration. (3 = greatest impact, 1 = least impact) (n=35)



Management Objectives



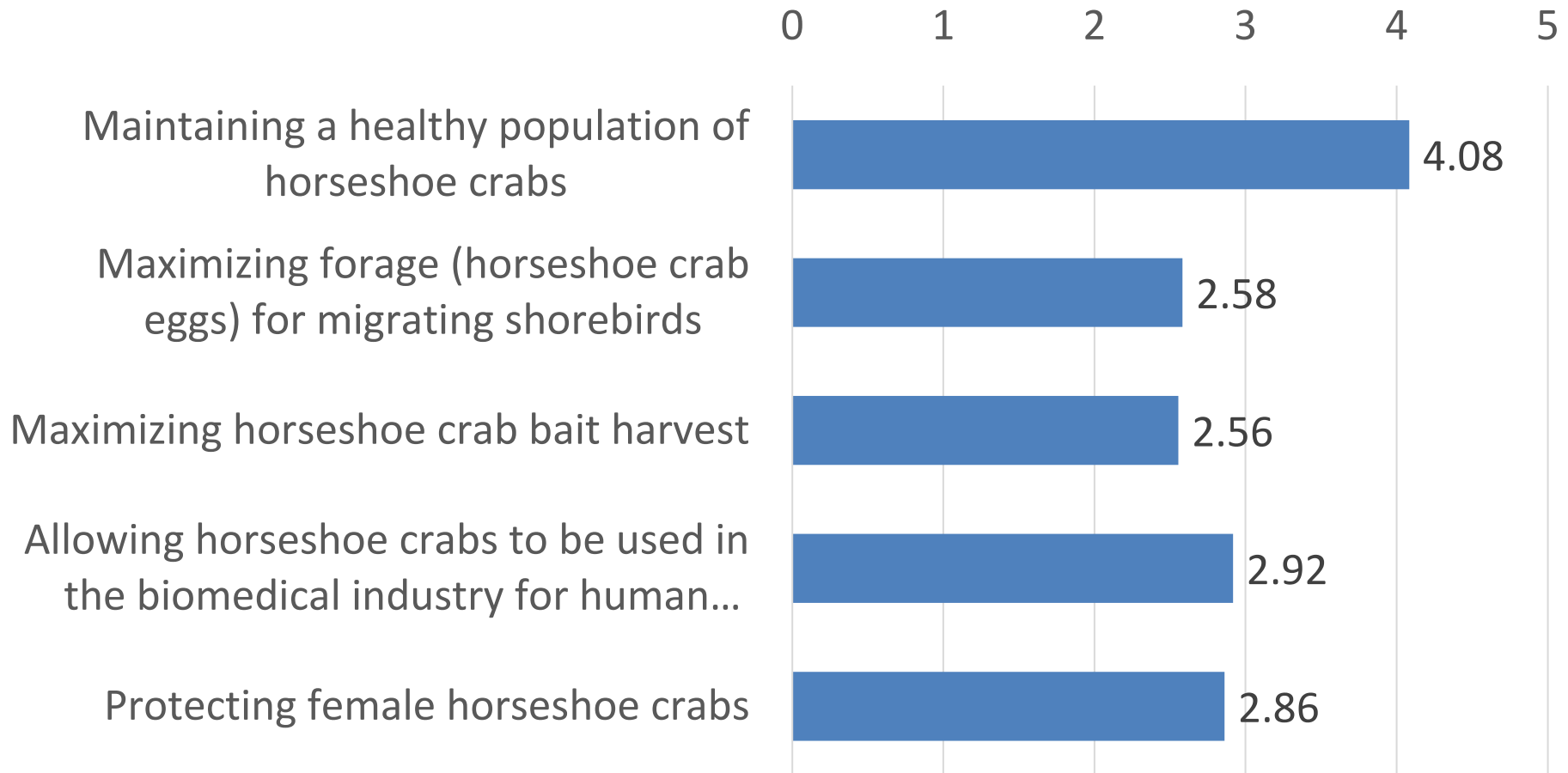
Average importance of management objectives across all groups
(n=34)



Management Objectives



Average Rank of Management Objectives (n=36)



Management Objectives

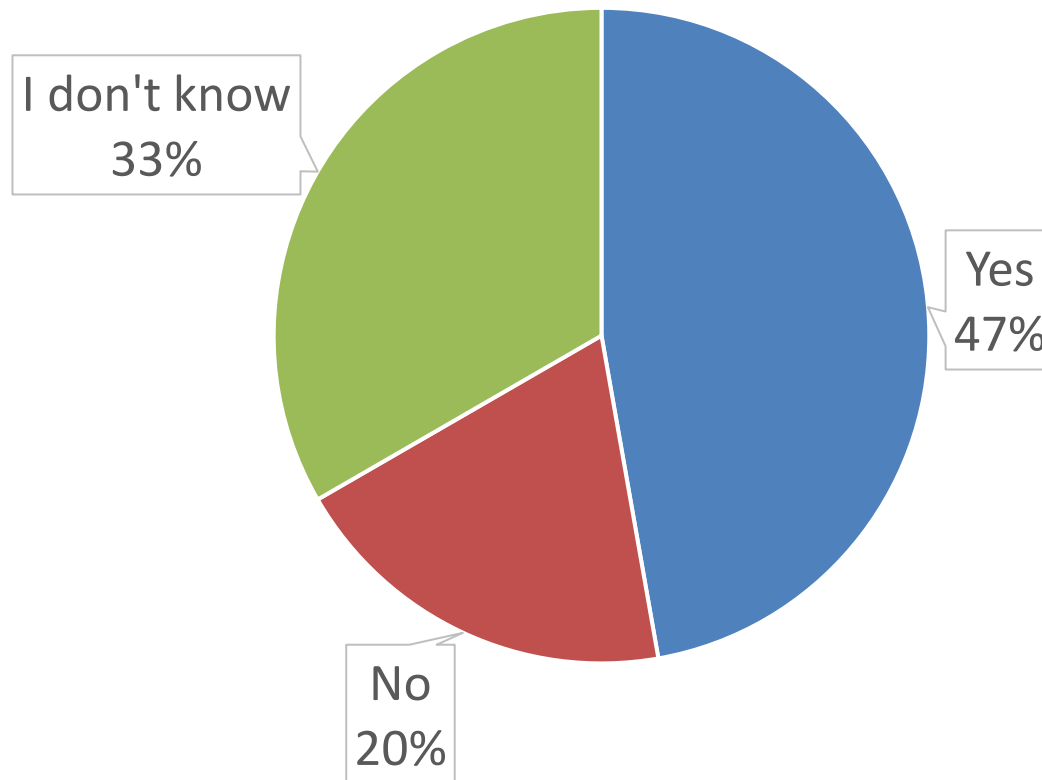


Management Objectives	Academia or research (n=4)	Biomedical industry (n=3)	Commercial fisheries (harvesters and dealers) (n=18)	Environmental conservation (n=6)	Unemployed or retired (n=3)
Maintaining a healthy population of horseshoe crabs	4.75	4.25	4.17	4.00	2.67
Maximizing forage (horseshoe crab eggs) for migrating shorebirds	4.00	1.75	1.61	4.14	4.00
Maximizing horseshoe crab bait harvest	1.00	1.25	3.56	1.29	3.33
Allowing horseshoe crabs to be used in the biomedical industry for human health	2.00	4.25	3.39	2.00	1.67
Protecting female horseshoe crabs	3.25	3.50	2.28	3.57	3.33

ARM Revision



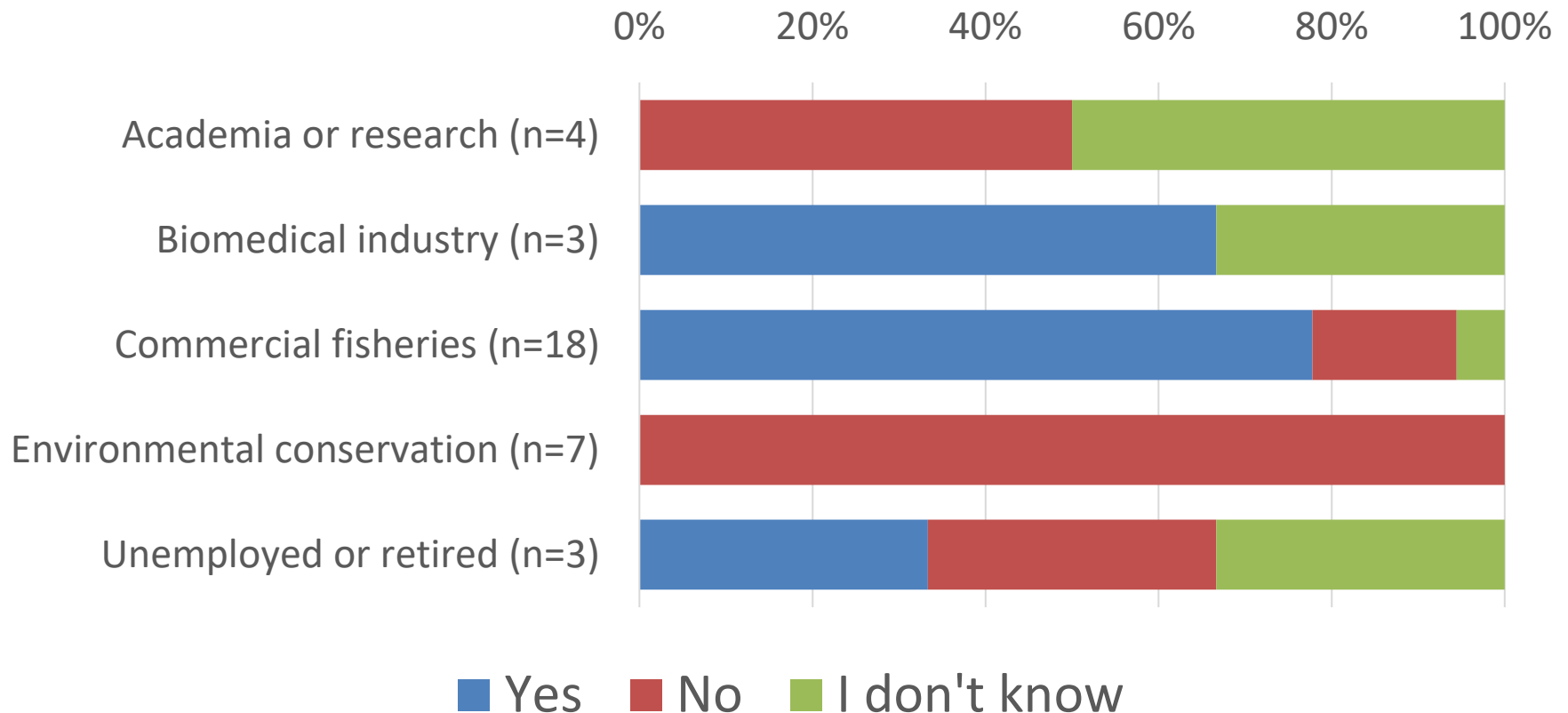
Do you think the Adaptive Resource Management (ARM) model (as revised in 2021) used to recommend harvest levels for male and female horseshoe crabs in the Delaware Bay should be modified?
(n=36)



Allowing Female Harvest



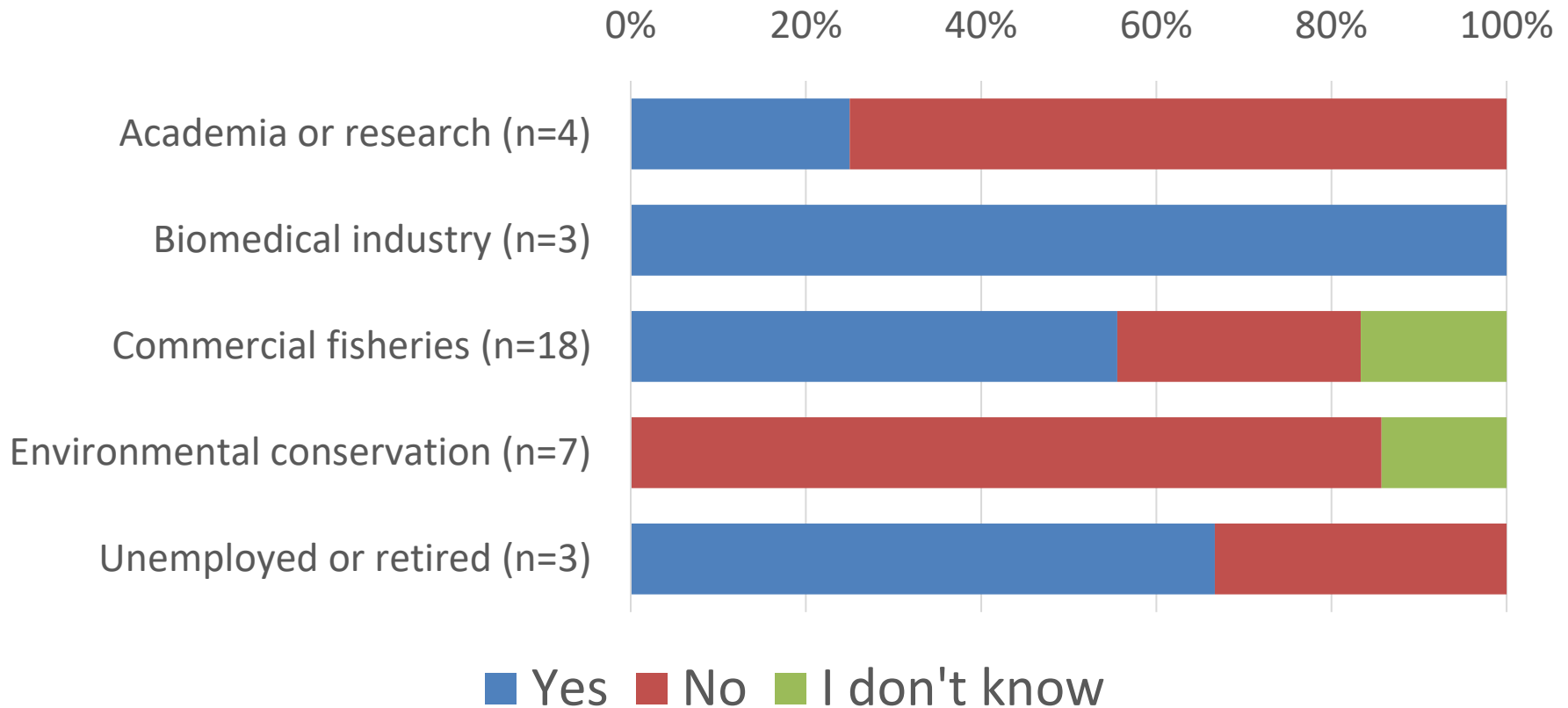
At this point in time, do you think a limited amount of female horseshoe crab bait harvest should be allowed? (n=35)



Female Biomedical Use



Female horseshoe crabs from the Delaware Bay population are currently collected for use in the biomedical industry. Should this continue?





What do you think is most important for managers to consider when making decisions about the management of the Delaware Bay horseshoe crab population?

- Health of the horseshoe crab population (n=9)
- Basing management decisions in robust science (n=5)
- Allowing sufficient bait harvest (n=4)
- Impacts on fishermen and coastal communities (n=3)
- The greater ecosystem, allowing for biomedical use, switching to synthetics, spawning beaches, improving data

Summary



- There is demand for female horseshoe crabs and they are considered more valuable than males
- Majority of commercial industry respondents think female harvest should be allowed now, but majority of other respondents do not
- Maintaining a healthy horseshoe crab population is important across stakeholder groups
- Many respondents think ARM Framework should be modified, though for differing reasons
- Stakeholders highly value the use of the best available science to inform management

Next Steps



- The Board may wish to consider actions in response to the survey results:
 - Tasking the Work Group with developing recommendations
 - Pursuing a more in-depth stakeholder process
 - Initiating management action

Questions?



Results from 2023 ARM Framework



DBETC & ARM Recommendation

Adaptive Resource Management



- ARM Framework revised and accepted by the Board for management use in 2022
- Under Addendum VIII (2022), ARM Framework is used annually to produce bait harvest recommendations for the Delaware Bay
- Maximum harvest that can be recommended:
 - 210,000 females
 - 500,000 males
- 125,000 females and 475,000 males recommended for 2023 and the Board elected to implement 0 female harvest

ARM Objective Statement



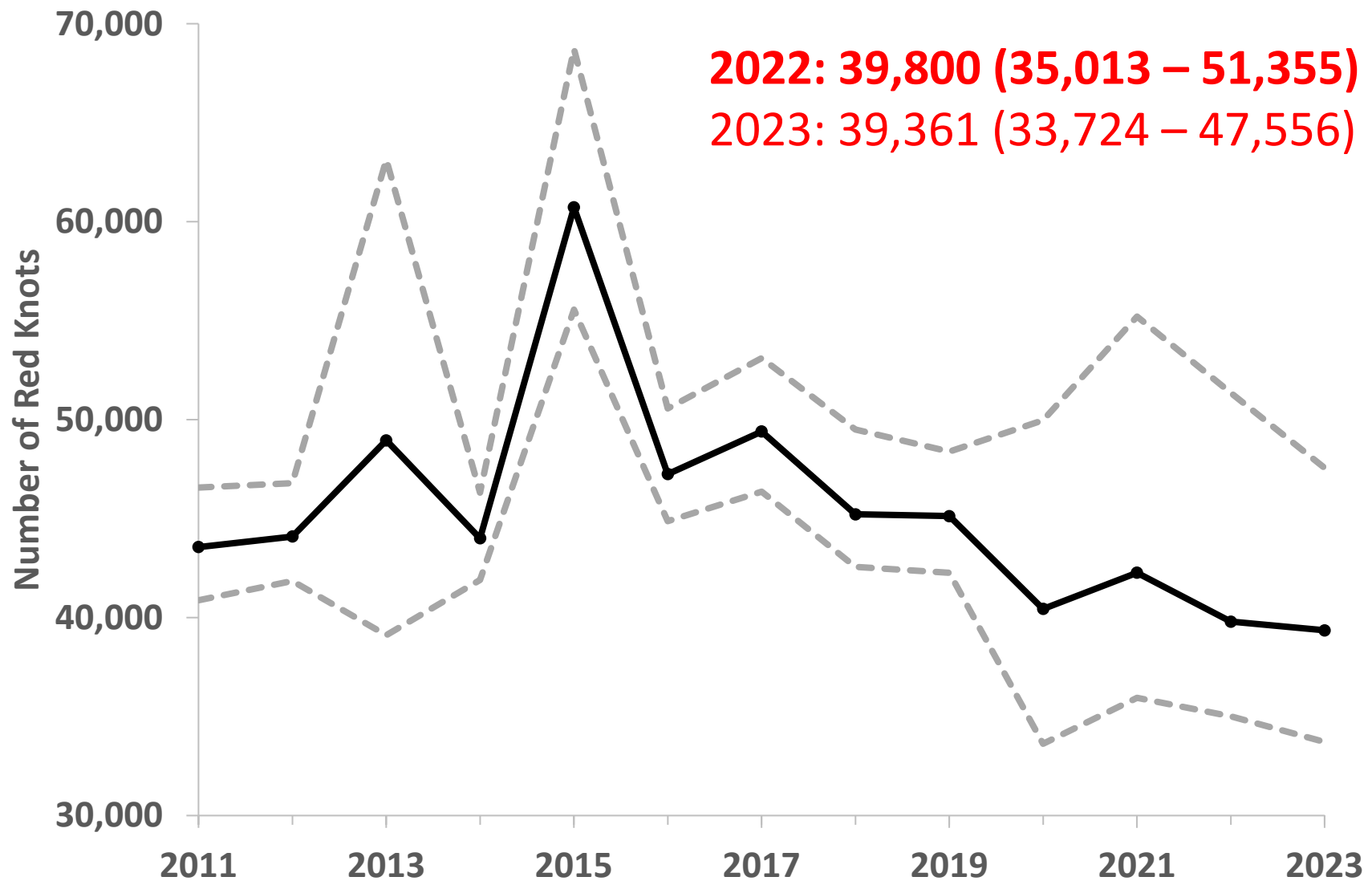
Manage harvest of horseshoe crabs in the Delaware Bay to maximize harvest but also to maintain ecosystem integrity, provide adequate stopover habitat for migrating shorebirds, and ensure that the abundance of horseshoe crabs is not limiting the red knot stopover population or slowing recovery.

Data Used in ARM Annually

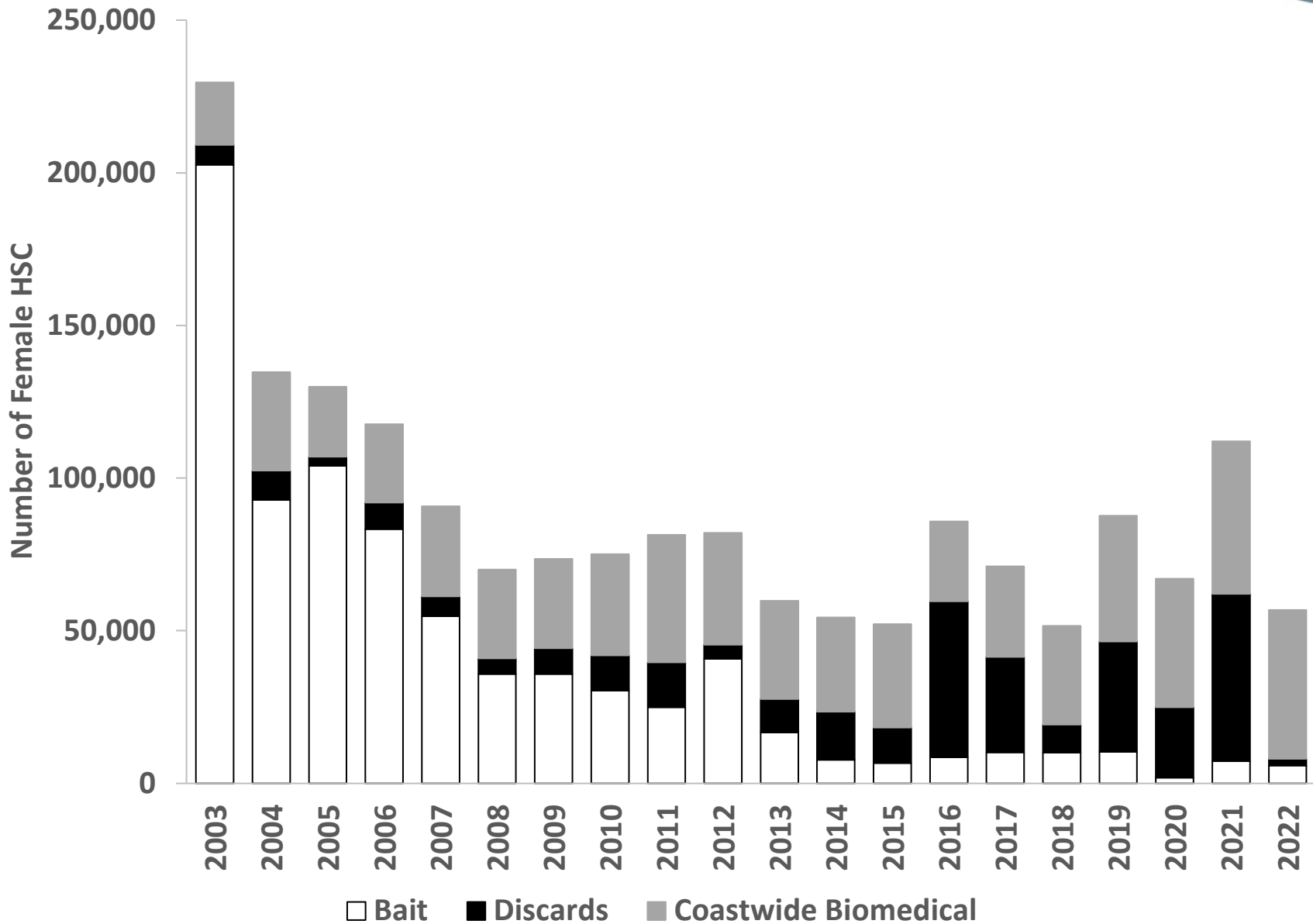


- Red knot population estimates from mark-resight analysis (Lyons 2023)
- Horseshoe crab population estimates from catch survey model
 - Virginia Tech Trawl Survey (Wong et al. 2023)
 - Delaware Adult Trawl and New Jersey Ocean Trawl Surveys
 - Bait landings, discard estimates, and biomedical mortality

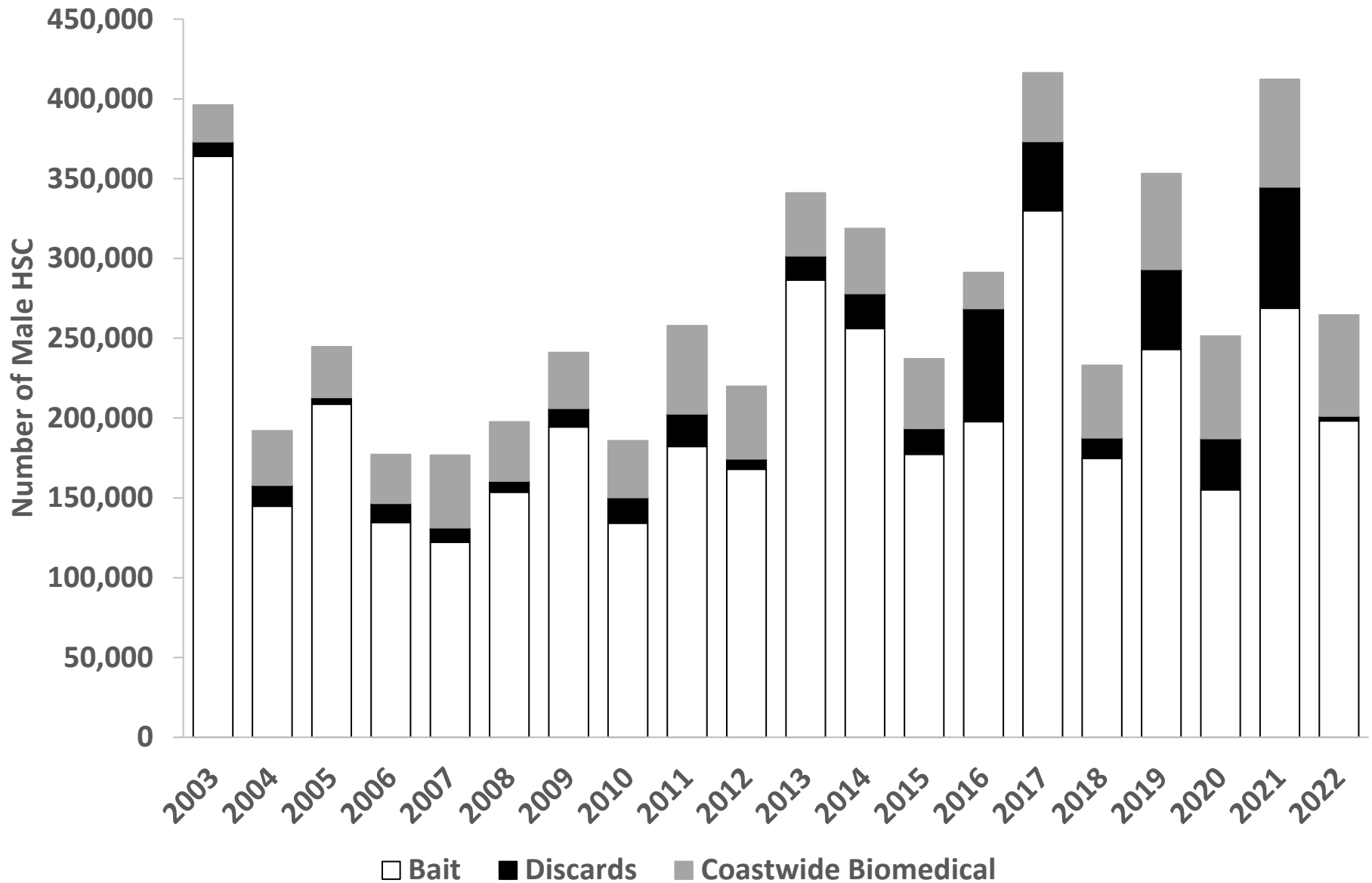
Red Knot Population Estimates



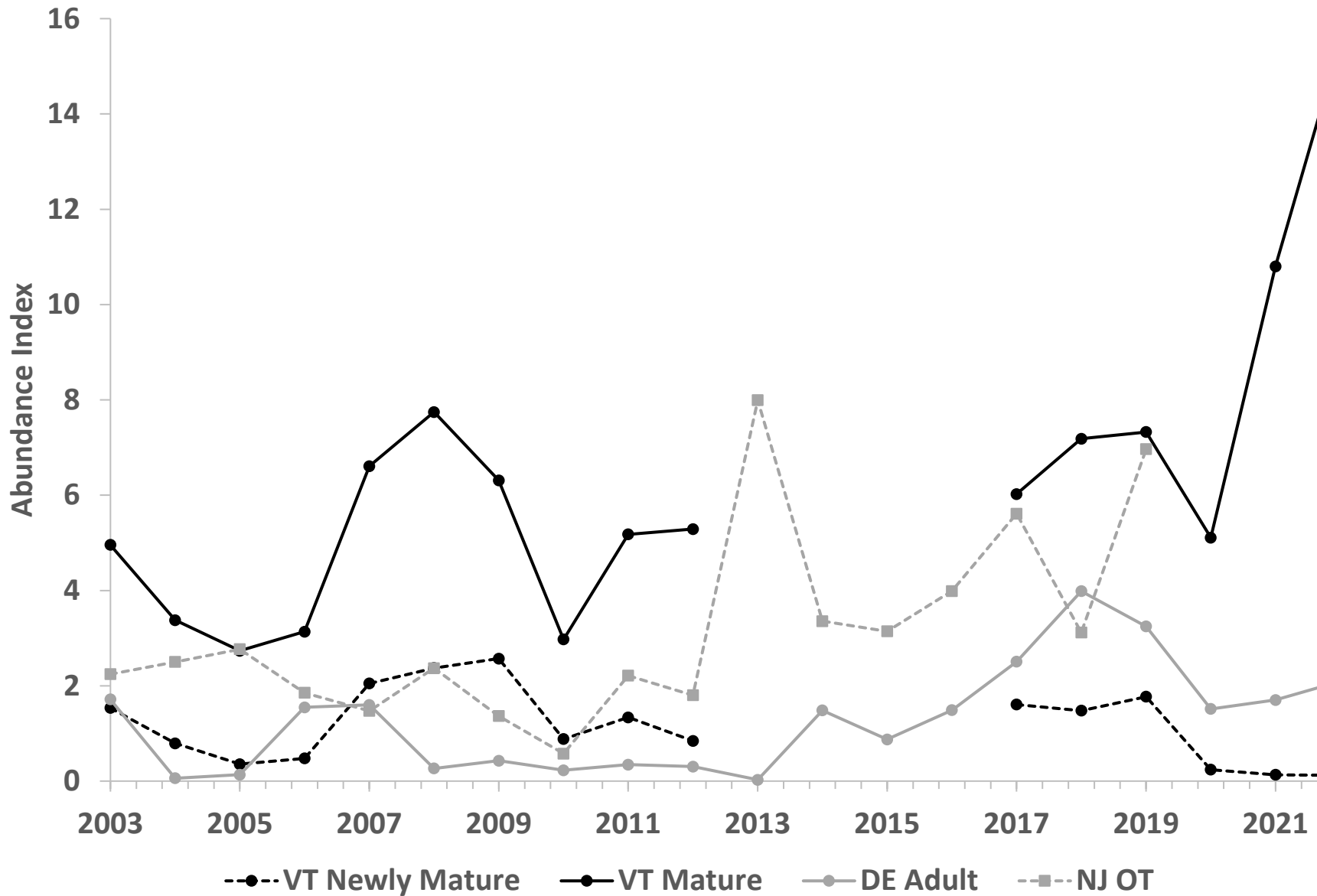
Female Harvest



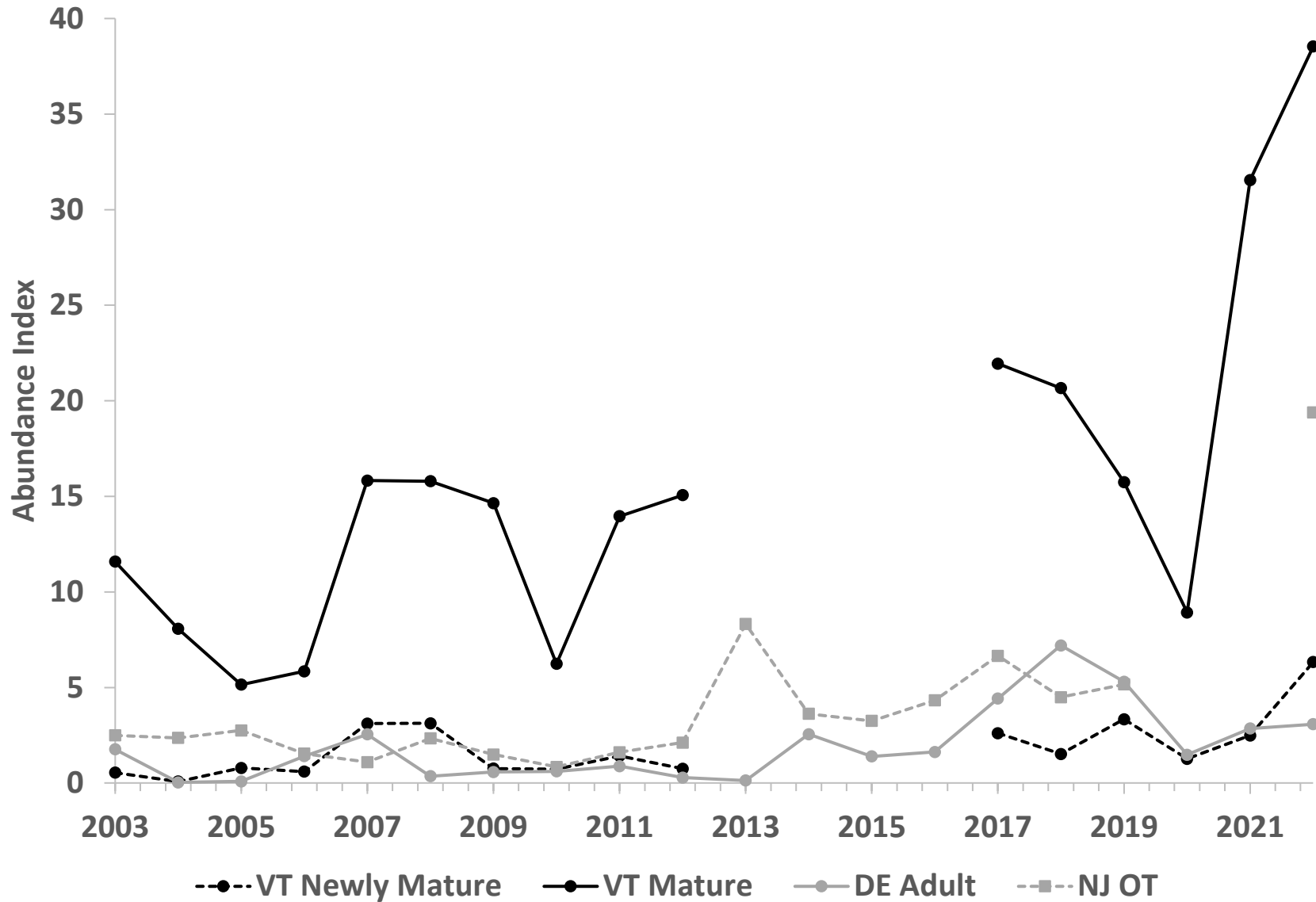
Male Harvest



Female Indices



Male Indices



Newly Mature Problem



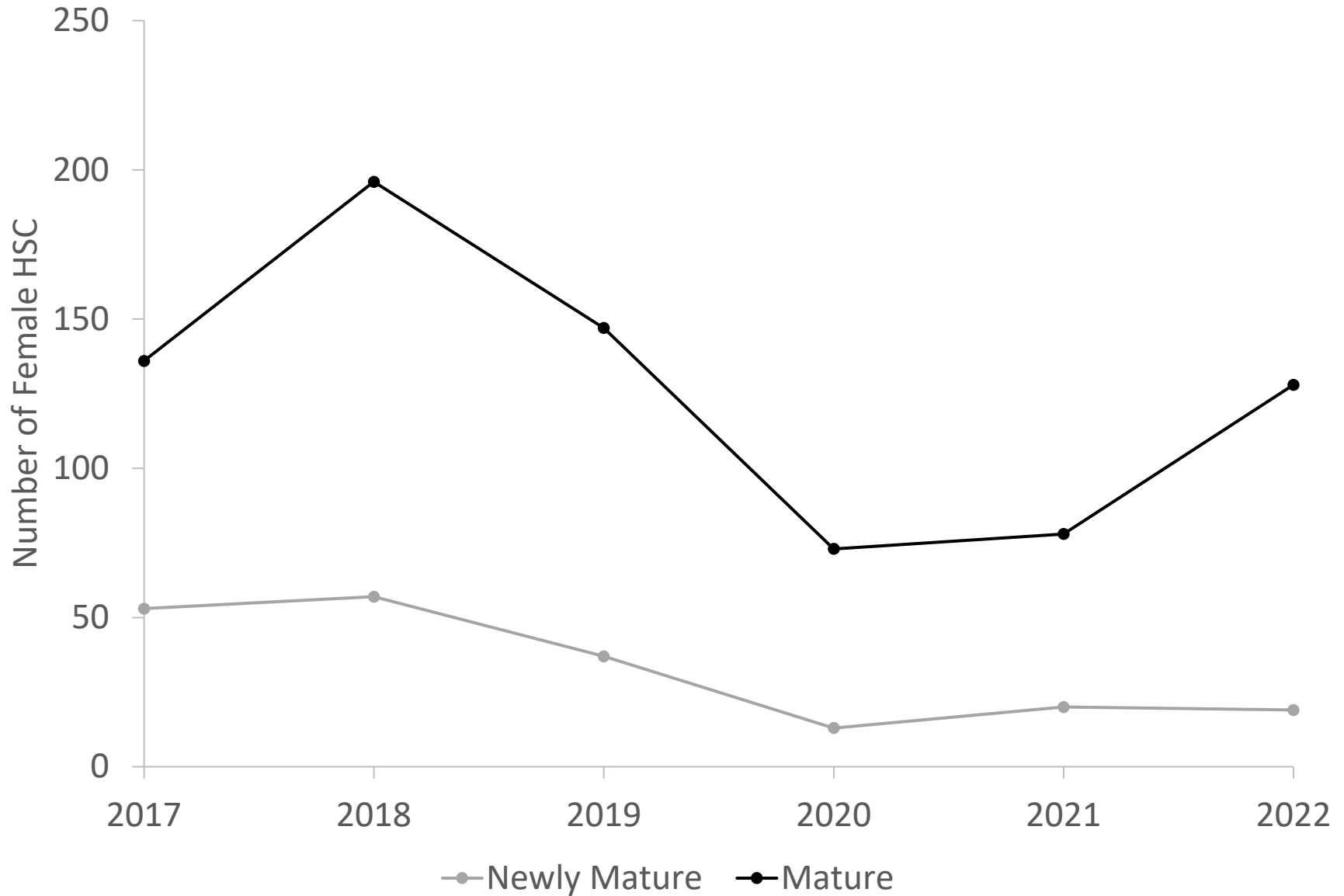
- Zero female newly mature HSC in 2022 VT Trawl Survey
 - CMSA simple stage-based model that sums NM and mature, subtracts harvest and natural mortality, predicts population next year
 - Will not run with 0 newly mature
- Newly mature females low 2020-2022
 1. Catchability
 2. Recruitment failure
 3. Identification issue

Gap Filling Method

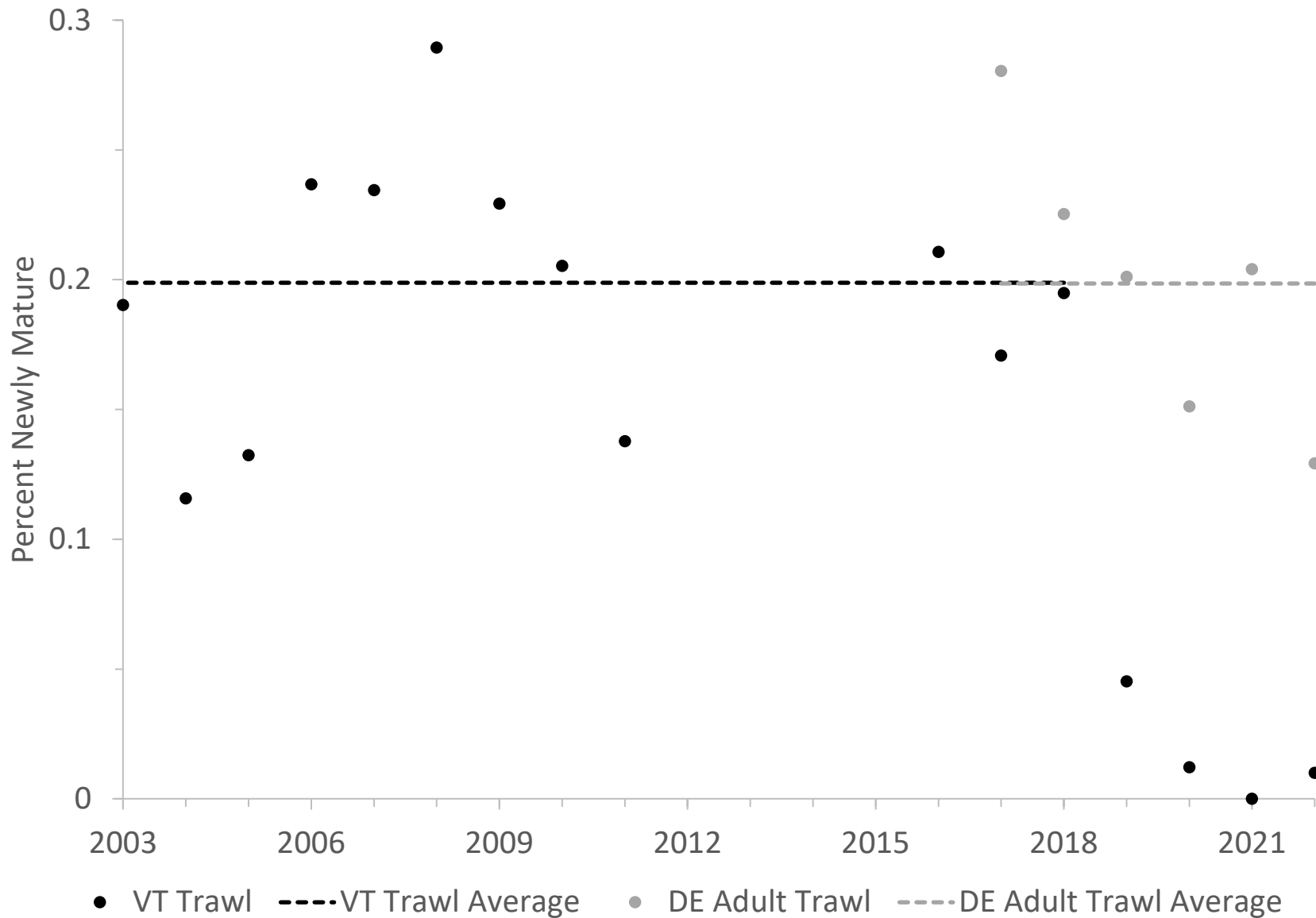


- From 2003-2019, newly mature was 19.88% of total mature (newly mature + mature) in Virginia Tech Trawl
- Corroborating evidence from DE Adult Trawl:
 - From 2017-2022, NM is 19.86% of total
- ARM and DBETC adjusted 2020-2022 so that newly mature females are ~20% of the total (maintains total)
 - Supported by HSC biology

DE Adult Trawl Stages



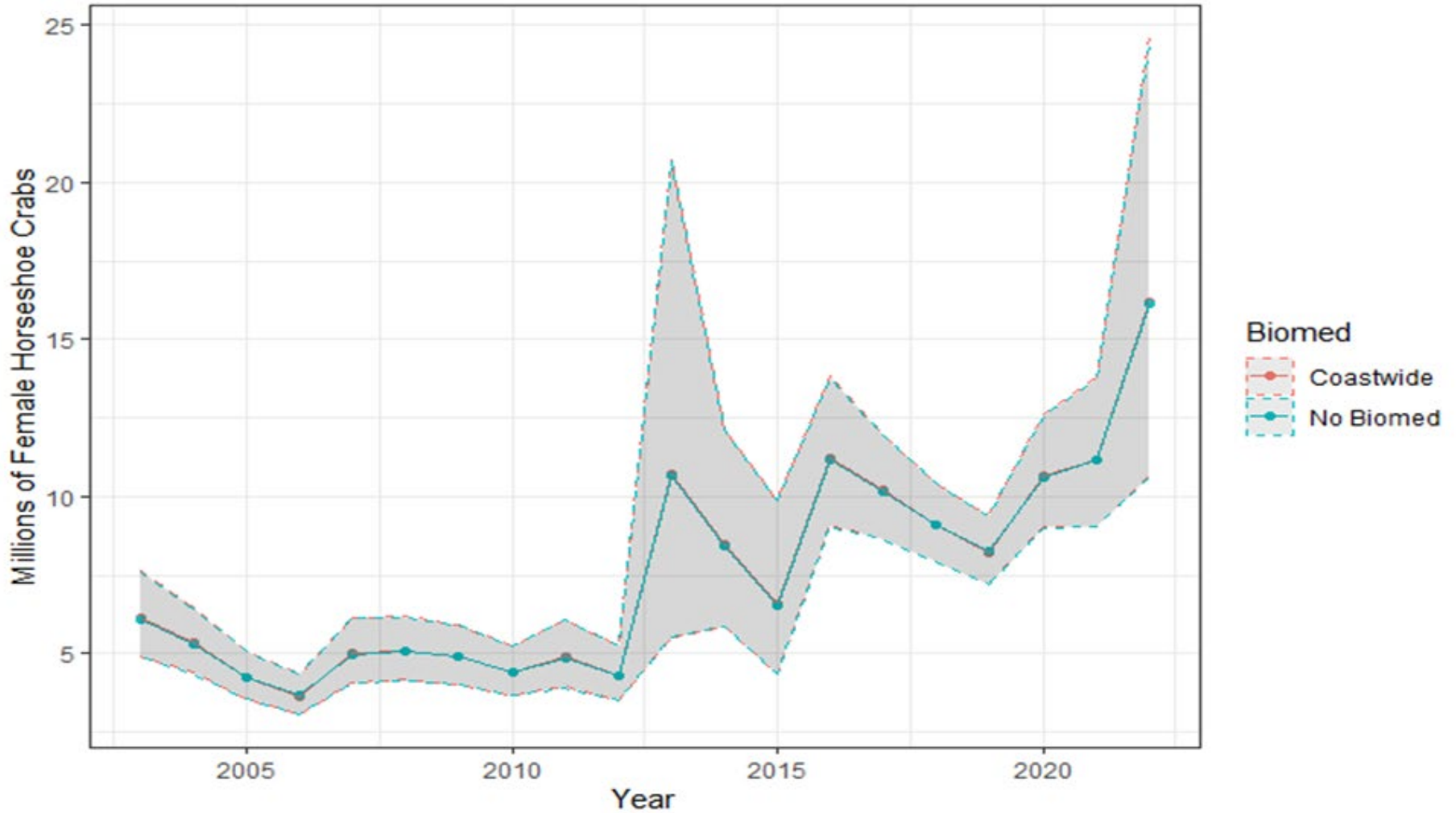
% Newly Mature or $NM/(NM+M)$



Mature Females



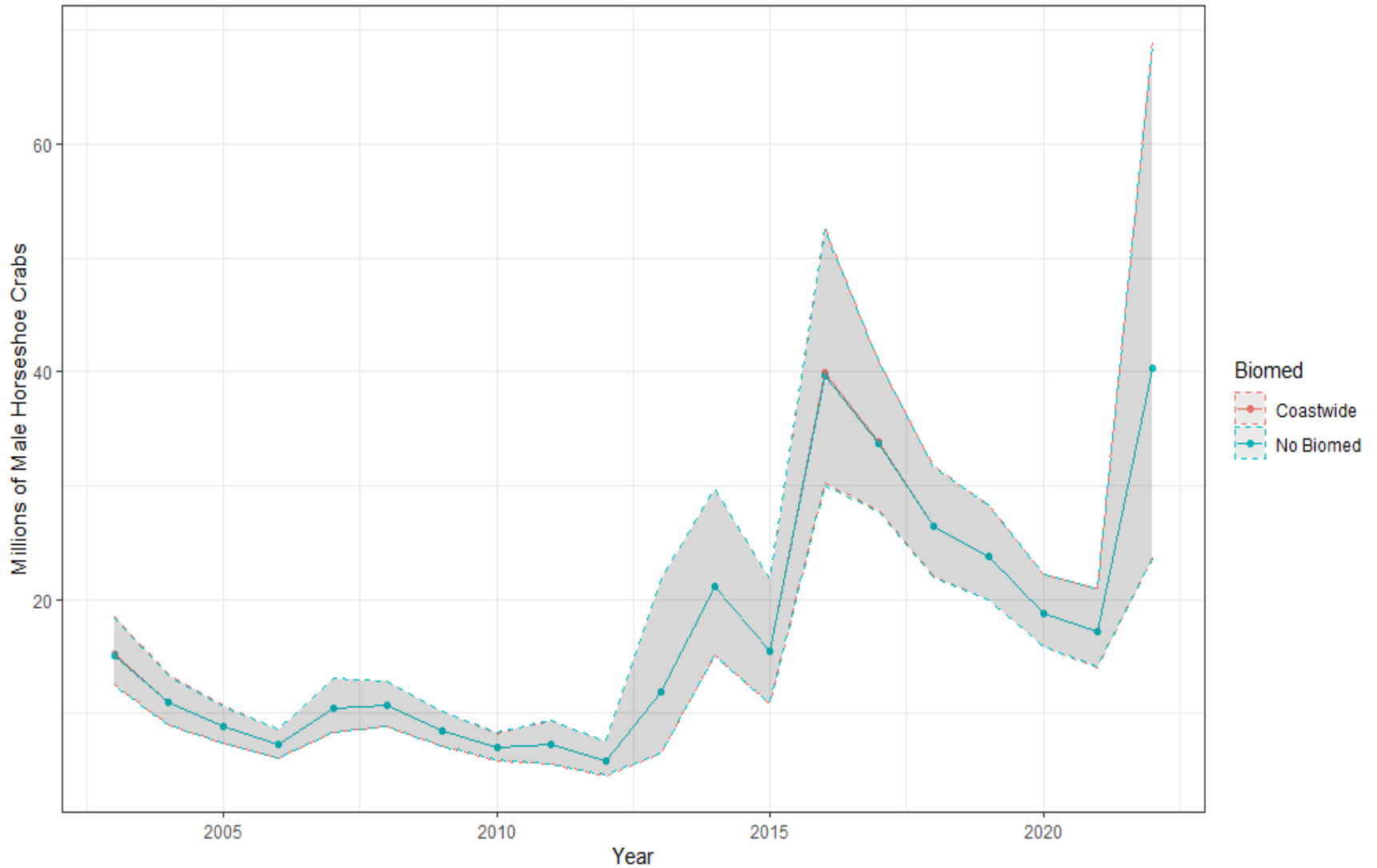
Mature Female Horseshoe Crab Population Estimates



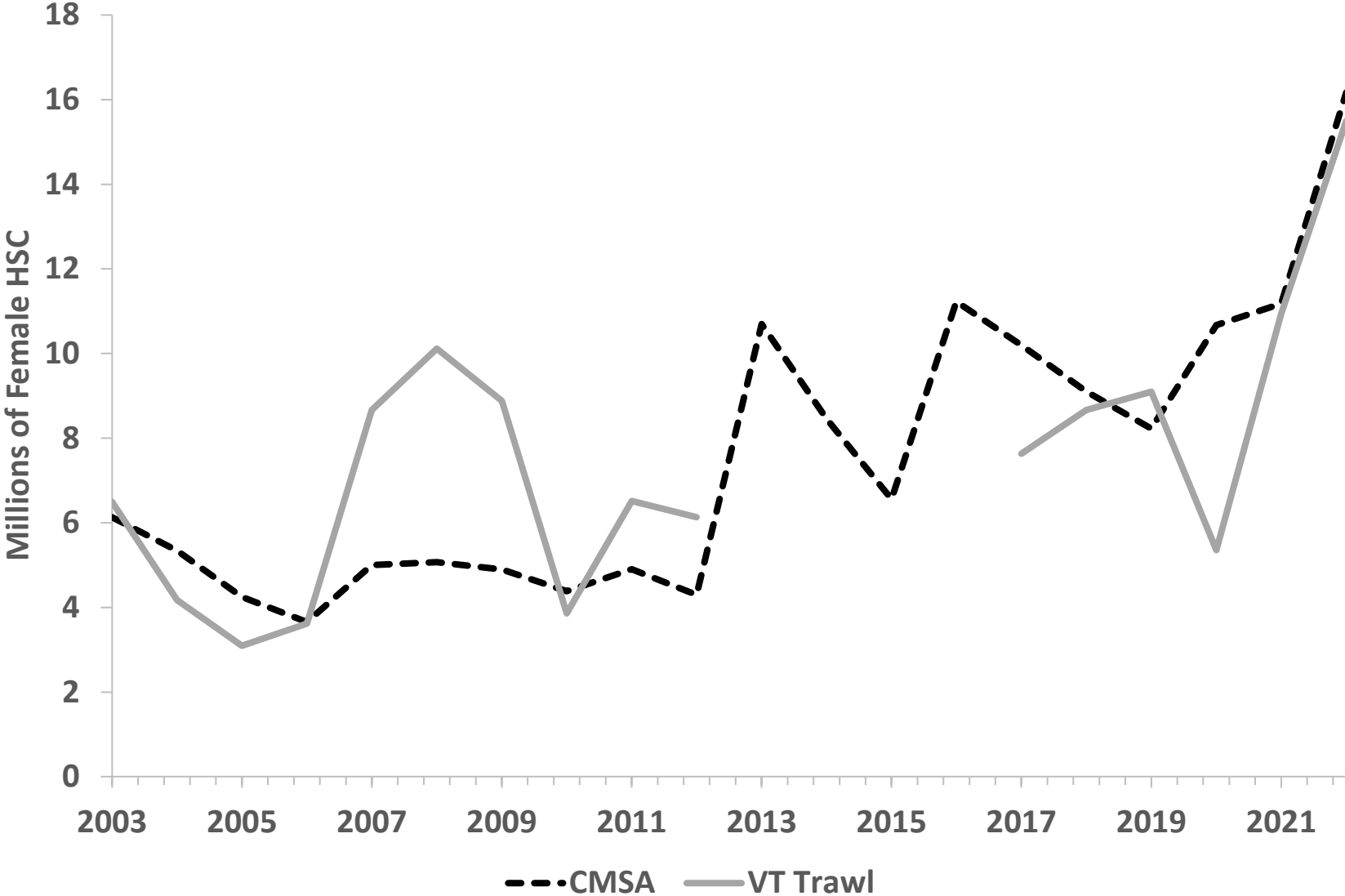
Mature Males



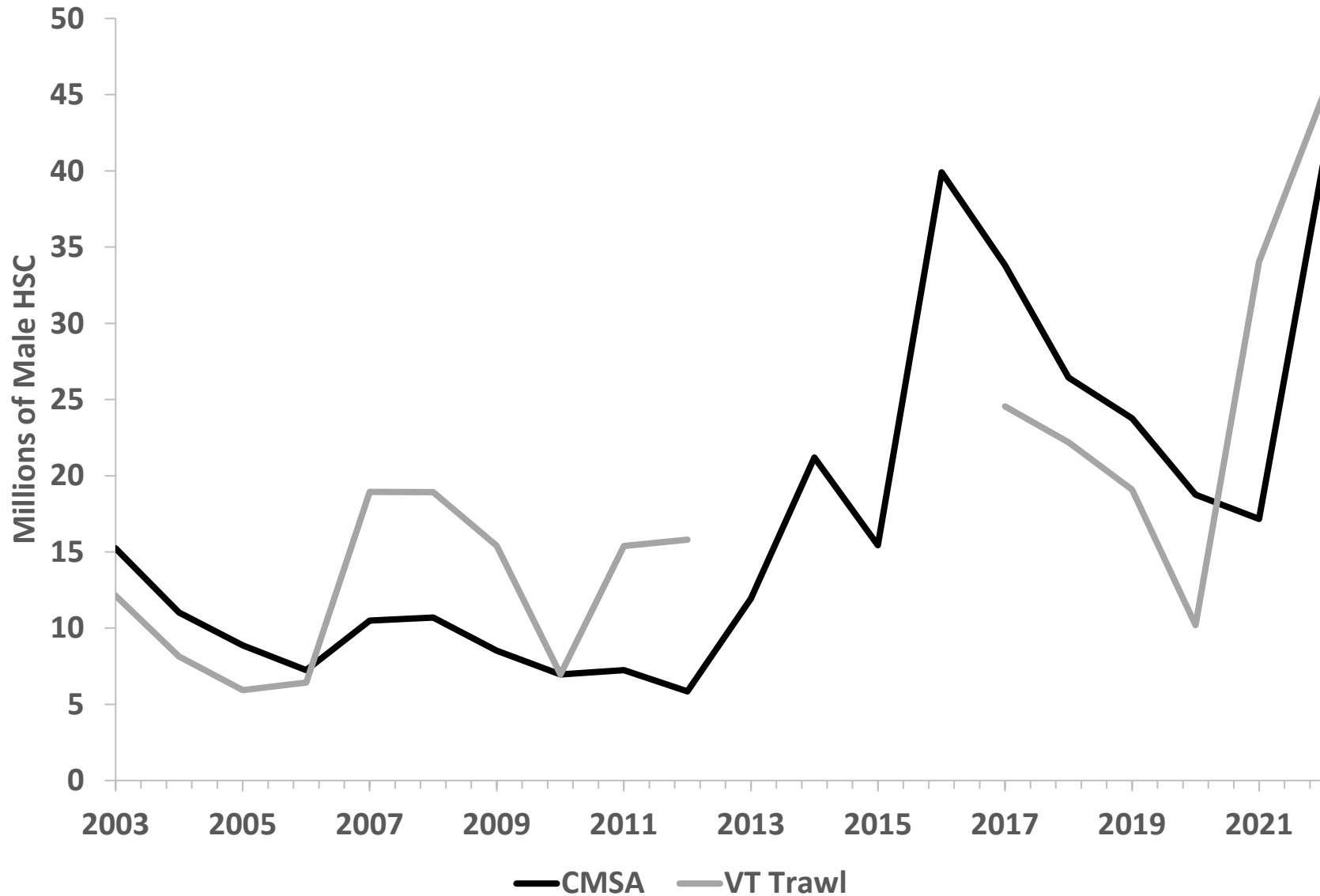
Mature Male Horseshoe Crab Population Estimates



Comparisons



Comparisons



2024 Harvest Recommendation



- Harvest recommendation is based on current state of the system and optimal harvest policy function from the 2021 ARM Revision
- As per Addendum VIII, recommended harvest is rounded down to nearest 25,000 crabs to protect confidential data
- For 2024, ARM recommended harvest:
 - 500,000 male
 - 175,000 female

2024 Quota Allocation



State	Delaware Bay-Origin Quota		Total Quota	
	Male	Female	Male	Female
Delaware	173,014	60,555	173,014	60,555
New Jersey	173,014	60,555	173,014	60,555
Maryland	132,865	46,503	126,410	44,243
Virginia	21,107	7,387	40,667	20,331
TOTAL	500,000	175,000	513,106	185,684

Questions ?????



Board Action



- Set 2024 Delaware Bay bait harvest specifications

2024 Quota Allocation



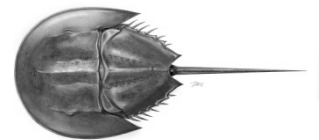
***Assuming 0 female harvest and 2:1 male offset**

State	Delaware Bay-Origin Quota		Total Quota	
	Male	Female	Male	Female
Delaware	173,014	0	173,014	0
New Jersey	173,014	0	173,014	0
Maryland	132,865	0	255,980	0
Virginia	21,107	0	81,331	0
TOTAL	500,000	0	683,339	0



Horseshoe Crab FMP Review for the 2022 Fishing Year

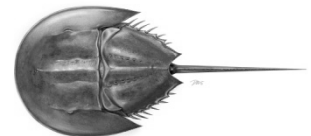
Horseshoe Crab Management Board
October 2023



Management History



- **FMP Approved (1998)**
- **Addendum I (2000)** – State bait harvest quotas & *de minimis*
- **Addendum II (2001)** – Quota transfers
- **Addendum III (2004)** – DE Bay state bait quotas & seasonal closures
- **Addendum IV (2006)** – DE Bay state bait quotas & seasons
- **Addendum V (2008)** – Extension of Add IV
- **Addendum VI (2010)** – Extension of Add V
- **Addendum VII (2012)** – DE Bay ARM Framework
- **Addendum VIII (2022)** – Adopted ARM Revision



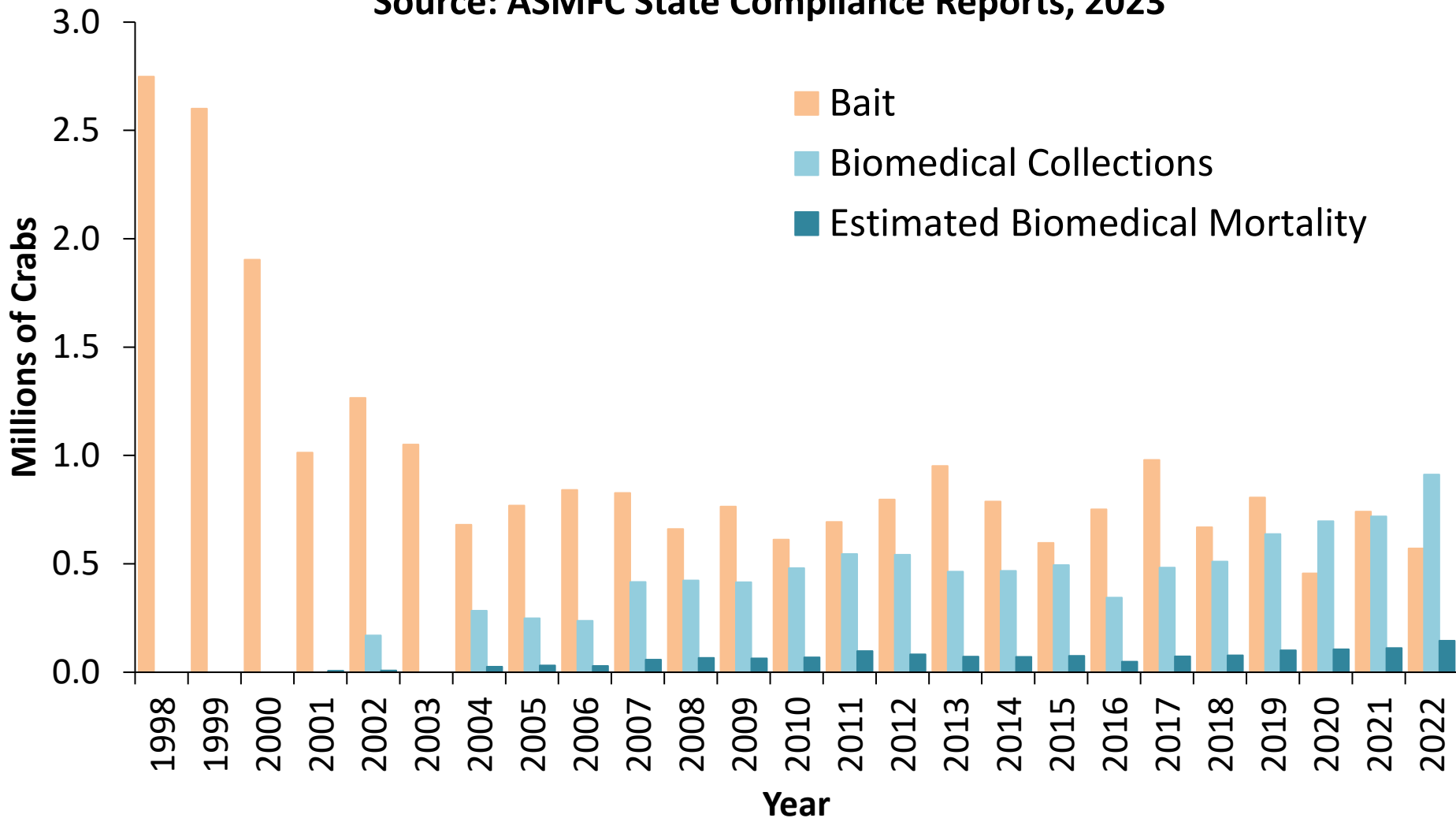
Descriptions in Section I of FMP Review

Annual Total Harvest



Coastwide Horseshoe Crab Bait Landings & Biomedical Collections

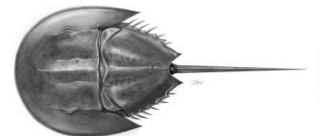
Source: ASMFC State Compliance Reports, 2023



2022 Bait Fishery



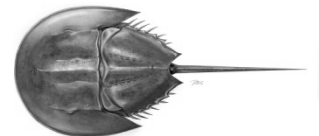
- Total coastwide harvest was 570,988 crabs
 - *RI and FL landings are confidential*
 - 23% decrease from 2021 landings of 741,684 crabs
- Majority from DE (26%), MA (24%), NY (19%), VA (16%), MD (15%)
- 36% of coastwide quota of 1.59 million crabs



Biomedical Use



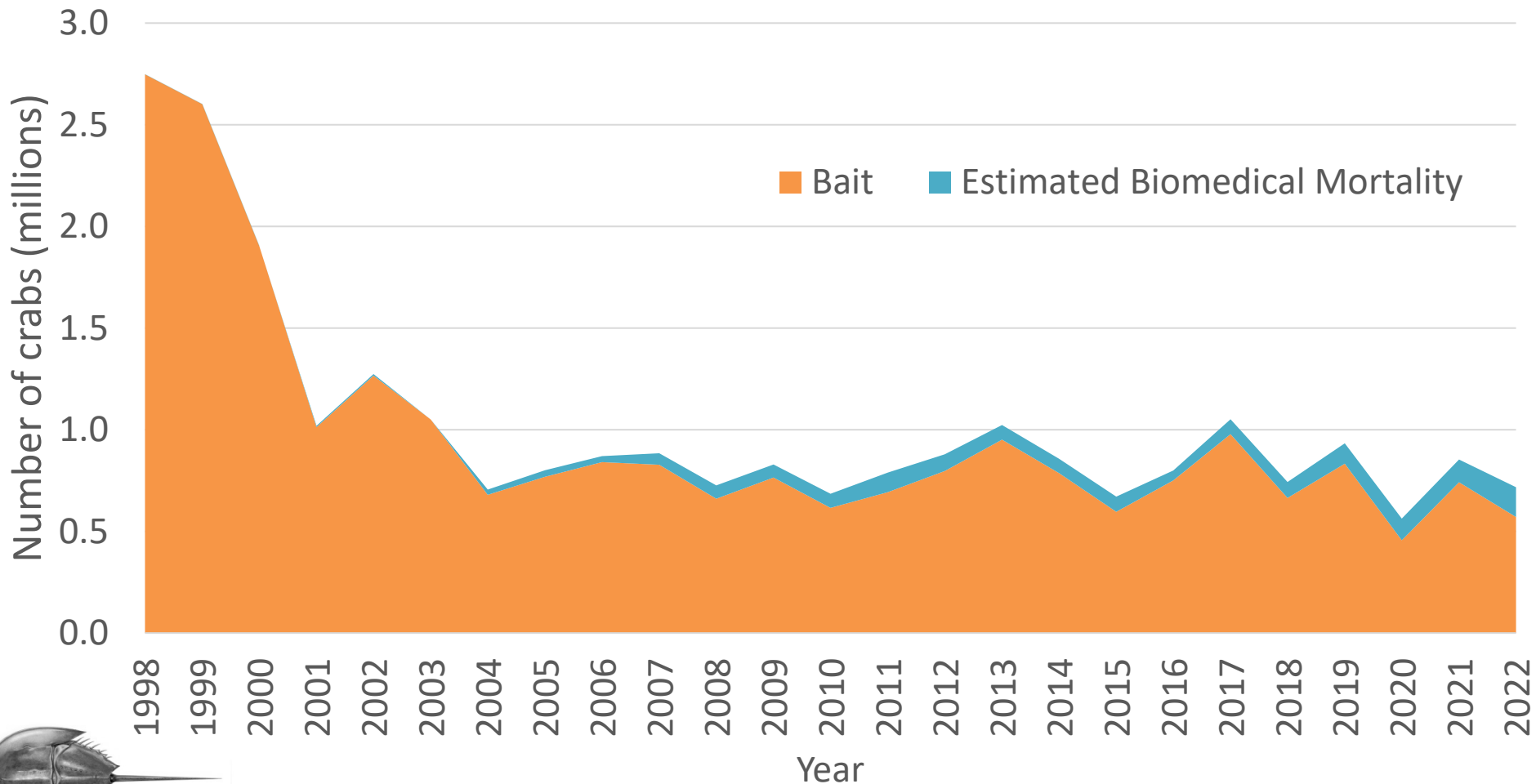
- Biomedical-only crabs collected in 2022: 911,826 crabs
 - 26.8% increase from 2021 (718,809 crabs)
- Biomedical-only mortality estimate: 145,920 crabs
 - Biomed Mortality = # Observed Dead Before Bleeding + 15% x # Biomed-Only Bled
 - 20% of total directed removals; biomedical mortality + bait harvest (716,908 crabs)
- Total removals decreased from 2021



Total Mortality



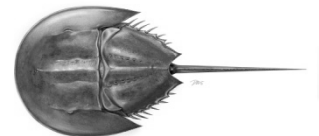
Total Horseshoe Crab Mortality (Bait and Biomedical) 1998-2022
Source: State Compliance Reports



De Minimis



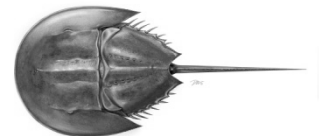
- Combined average bait landings (by numbers) for last two years $< 1\%$ of coastwide bait landings for the same two-year period
- SC, GA, and FL all requested and qualify for *de minimis* status for 2021



PRT Recommendations



- Continue seeking long-term funding for VT trawl survey
 - Funded through 2024
- Consider annual characterization of discard removals

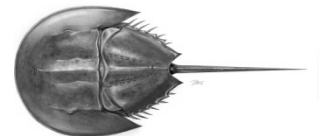


PRT Recommendations



- All states and jurisdictions appear to be in compliance with FMP provisions
 - MA and CT did not meet compliance report deadline
- ***Board action:***

Consider approval of the FMP Review and state compliance reports for the 2022 fishing year, and *de minimis* status for SC, GA, and FL.



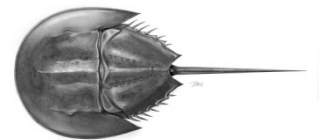
Questions?





Status of Synthetic Alternatives to *Limulus* Amebocyte Lysate

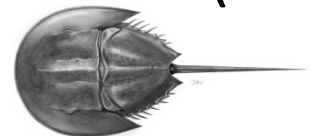
Horseshoe Crab Management Board
October 2023



Background



- LAL has been used to detect pathogens in patients, medical devices, and injectable drugs for over 40 years
- It is currently the standard endotoxin test in the US
- There has been public interest in transitioning to synthetic tests in the US
- Synthetic alternatives to LAL exist and are used in the US and other countries, but require validation
 - Recombinant Factor C (rFC) and Cascade Reagents (rCR)

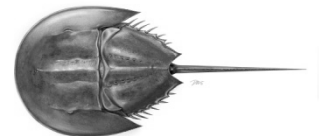


US Pharmacopeia



What is the USP?

- an independent, scientific nonprofit organization
- sets standards for health care products in the U.S. and collects and disseminates product use information to providers and consumers
- USP standards are legally recognized in the U.S. and elsewhere
 - used in more than 140 countries

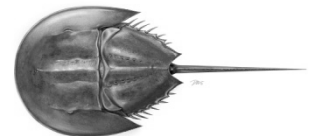


7,029
637,029
637,029
761,284
761,284

Updates on Synthetic Tests



- Currently, rFC and rCR are alternative methods and require validation and demonstration of comparability with LAL
- USP has proposed a chapter that would provide standards for the use of rFC or rCR
- Using rFC/rCR on NEW biopharmaceuticals would not require demonstration of comparability
 - Where LAL is currently used for testing, switching to rFC/rCR would require it

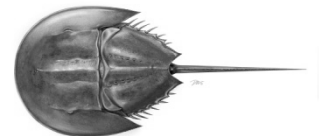


7,029
637,029
637,029
761,284
761,284

Summary



- The proposed USP chapter would open a pathway for more use of rFC and rCR
- FDA may require additional data
- LAL can still be used by any manufacturer that chooses to do so
- The Chapter comment period will be open from Nov. 1, 2023, through Jan. 31, 2024



Questions?

