Atlantic States Marine Fisheries Commission

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MEMORANDUM

TO: **Horseshoe Crab Management Board**

FROM: **Delaware Bay Ecosystem Technical Committee and Adaptive Resource Management Subcommittee**

DATE: **October 10, 2025**

RE: **Delaware Bay Horseshoe Crab Harvest Recommendation for 2026**

This memo describes the 2026 harvest recommendation for Delaware Bay Region horseshoe crabs using the methods from the Adaptive Resource Management (ARM) Framework (ASMFC 2022a). Since 2013, the horseshoe crab bait fisheries in the Delaware Bay Region (New Jersey, Delaware, Maryland, and Virginia) have been managed under the ARM Framework to set harvest levels with consideration of the needs of migratory shorebirds. The ARM was developed jointly by the Commission, US Fish and Wildlife Service, and US Geological Survey in recognition of the importance of horseshoe crab eggs to migratory shorebirds stopping over in the Delaware Bay Region. In particular, horseshoe crab eggs are an important food source for the *rufa* red knot, which is listed as threatened under the Endangered Species Act.

Under Addendum VIII (ASMFC 2022b), the 2022 ARM Revision is used to annually produce bait harvest recommendations for male and female horseshoe crabs of Delaware Bay-origin based on the abundance of horseshoe crabs and red knots. Per Addendum IX, male-only harvest can be set for one year or for up to three years (ASMFC 2025). The maximum number of male and female horseshoe crabs the ARM Framework can recommend is 500,000 males and 210,000 females.

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. Population estimates

Red knot abundance estimates used to make harvest recommendations under the ARM Revision are based on mark-resight total stopover population estimates (Figure 1; Lyons 2025). The 2025 red knot population estimate was 54,044 (95% CI: 47,926–61,928), an increase from the 2024 estimate. However, to align the red knot population estimates with the horseshoe crab population estimates, the 2024 red knot population estimate of 46,127 (95% CI: 39,286–57,799) was used in making harvest recommendations for the 2026 harvest season.

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. The Virginia Tech (VT) 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 2022a; Jiao et al. 2024; Figure 4 -Figure 5).

Horseshoe crabs are estimated in the Delaware Bay using a two-stage model (the catch multiple survey analysis) which requires estimates of newly mature and mature horseshoe crabs by sex from the VT Trawl Survey. Between 2019 and 2023, the VT Trawl Survey recorded very low numbers or zero newly mature female horseshoe crabs. Newly mature males did not show the same decline. The model cannot run with a zero data point for newly mature horseshoe crabs. Last year it was determined that newly mature females were being misclassified during sampling as *immature*, not mature, likely because the sampling of non-mature females to determine if eggs are present (indicating that they are newly mature versus immature) has been inconsistently applied between tows. Distinguishing the stages in male horseshoe crabs is straight-forward compared to female horseshoe crabs.

Following the methods from last year's ARM update, to re-calculate newly mature females for 2019-2024, the modeling team used a linear regression of newly mature males and females where females were lagged by one year to acknowledge that newly mature males are typically 9 years old and newly mature females are 10 years old. There was a strong positive relationship between these two population estimates (Figure 6), so the linear regression method can predict newly mature female population estimates for the years of 2019-2024 when newly mature female horseshoe crabs were not sampled as rigorously in the survey. No adjustments had to be made for the male horseshoe crab model.

Using the adjusted newly mature female populations methods in the CMSA model (assuming the coastwide biomedical mortality level), there were approximately 30.1 million (95% CI: 22-41.1) mature male and 19.4 million (95% CI: 13.8-27.2) mature female horseshoe crabs in the Delaware Bay Region in 2024 (Figure 7 - Figure 8).

3. Harvest Recommendation

Harvest recommendations for the 2026 fishing year made using the ARM Revision are based on CMSA estimates of horseshoe crab abundance and the red knot mark-resight abundance

estimates. ARM harvest recommendations are based on a continuous scale rather than the discrete harvest packages in the previous ARM Framework. Therefore, a 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 is determined separately. The maximum possible harvests for both females and males are maintained from the previous ARM Framework at 210,000 and 500,000, respectively.

The annual recommendation of allowable Delaware Bay horseshoe crab harvest is based on the 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. As per Addendum VIII, if the optimal recommended harvest is less than the maximum, it is rounded down to the nearest 25,000 crabs to uphold biomedical data confidentiality. Under Addendum IX, the Board can set male harvest for one year or for up to three years (ASMFC 2025).

The harvest recommendation for 2026 based on the ARM Framework is 175,000 female and 500,000 male horseshoe crabs.

4. Quota Allocation

Allocation of allowable harvest to each state was conducted in accordance with the methodology in Addendum VIII (Table 1). Note that the total quotas for Maryland and Virginia are capped under Addendum VIII based on the female harvest recommendation. Additionally, if multi-year specifications were to be implemented in accordance with Addendum IX, an option is provided for state allocations with no female harvest included and a 2-to-1 offset for Maryland and Virginia (Table 2).

Table 1. Delaware Bay-origin and total horseshoe crab quota for 2026 by state. Virginia total quota only refers to the amount that can be harvested east of the COLREGS line. Total quotas for Maryland and Virginia are capped as established under Addendum VIII.

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

* Total quotas for Maryland and Virginia are capped as established under Addendum VIII.

Table 2. Delaware Bay-origin and total horseshoe crab quota for 2026 by state with no female harvest and the 2-to-1 offset. Virginia total quota only refers to the amount that can be harvested east of the COLREGS line

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

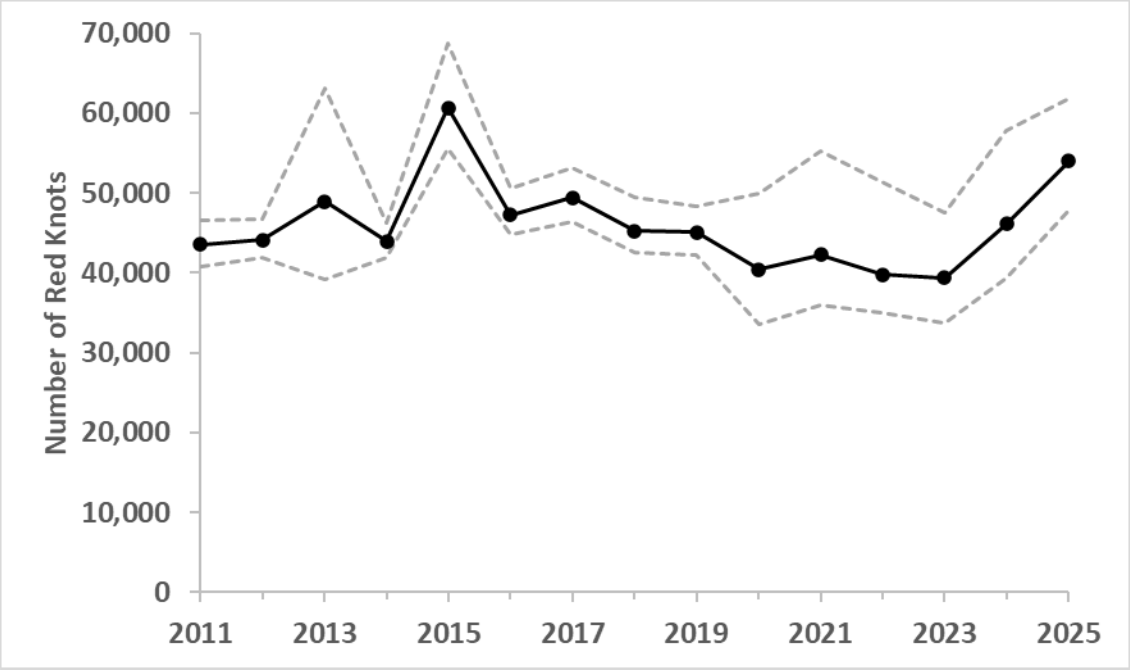

Figure 1. Mark-resight abundance estimates for the red knot stopover population with 95% confidence intervals, 2011-2025.

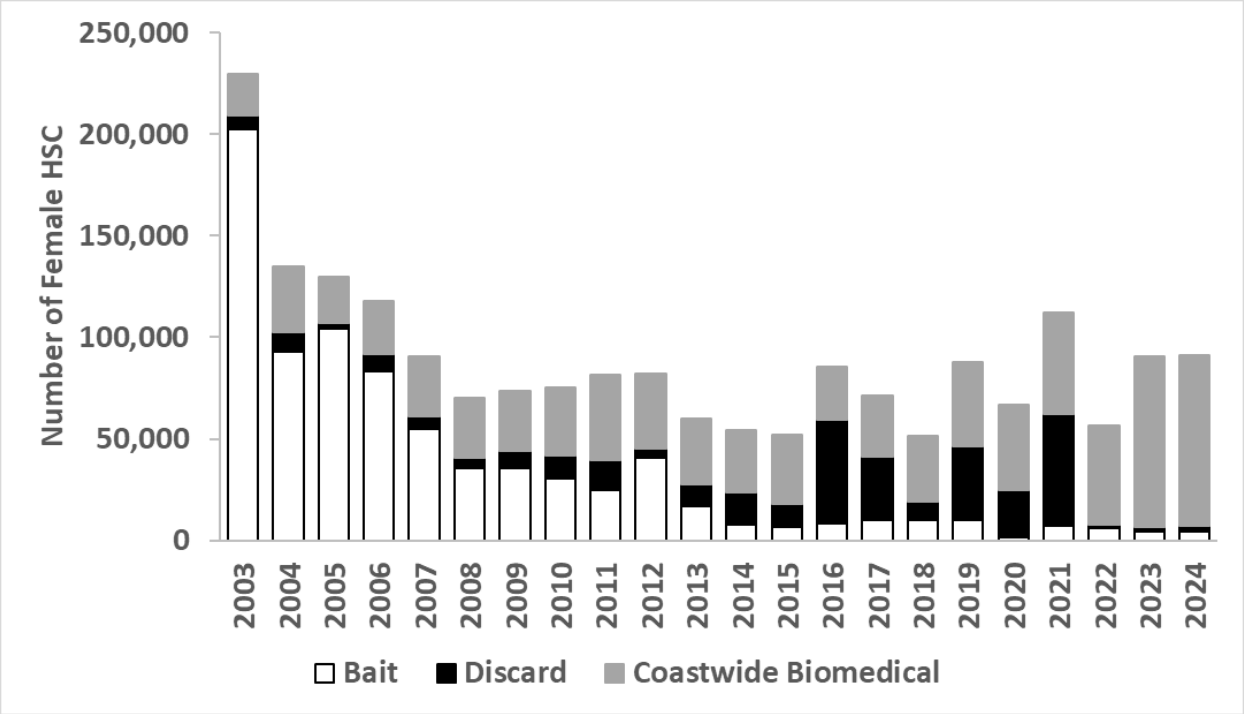

Figure 2. Total female horseshoe crab harvest by source in the Delaware Bay, 2003-2024.

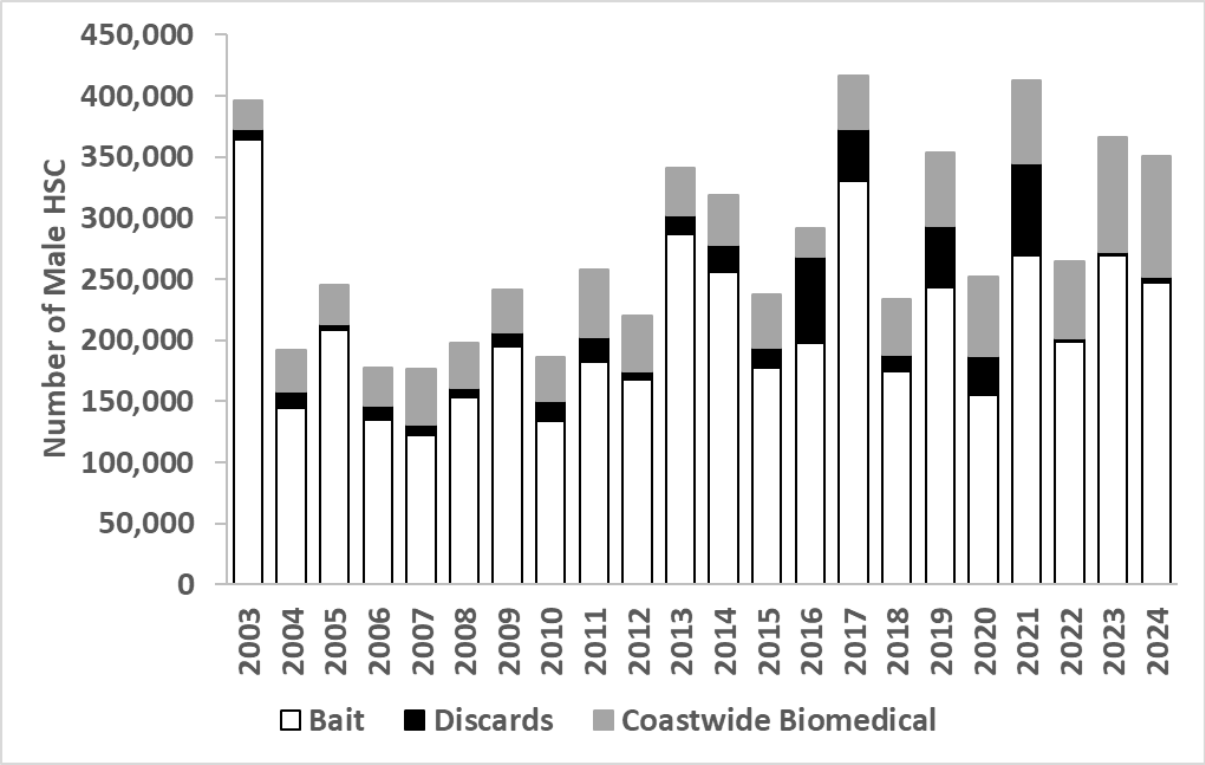

Figure 3. Total male horseshoe crab harvest by source in the Delaware Bay, 2003-2024.

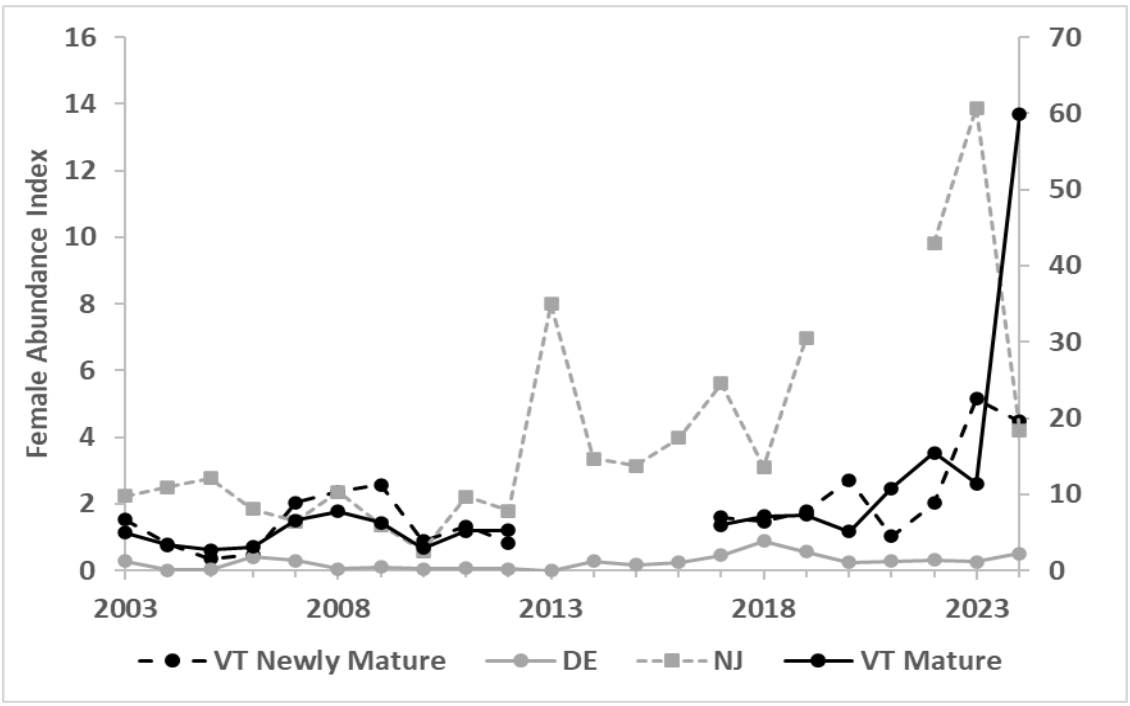

Figure 4. Female horseshoe crab abundance indices used in the CMSA. The Virginia Tech (VT) indices are in millions of newly mature and mature crabs while the Delaware Adult (DE Adult) and New Jersey Ocean Trawl (NJ OT) are in catch-per-tow. The axes for the VT Mature is on the right to account for changes in scale.

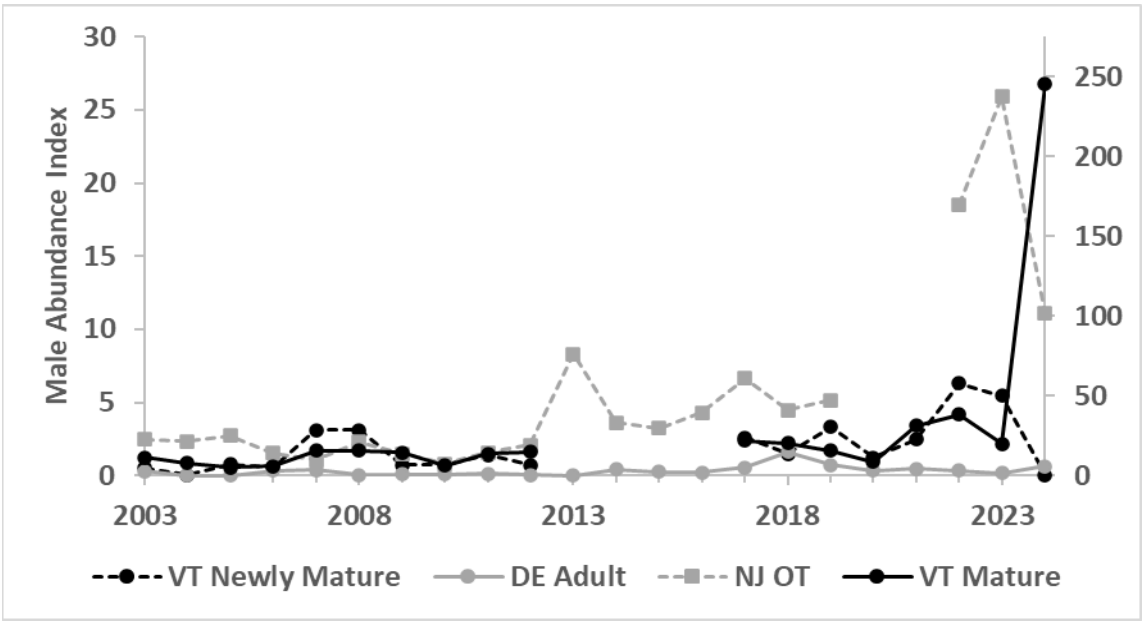

Figure 5. Male horseshoe crab abundance indices used in the CMSA. The Virginia Tech (VT) indices are in millions of newly mature and mature crabs while the Delaware Adult (DE Adult) and New Jersey Ocean Trawl (NJ OT) are in catch-per-tow. The axis for the VT mature index is on the right to account for changes in scale.

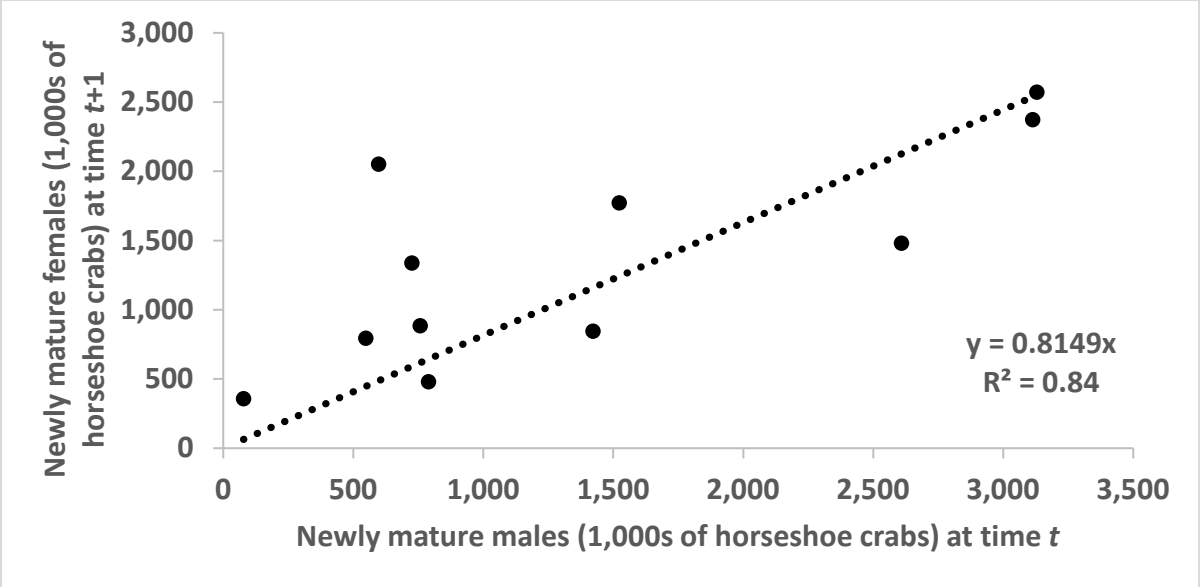

Figure 6. Linear regression between the population estimates of newly mature male to female horseshoe crabs, 2002-2018. The intercept has been fixed at 0.

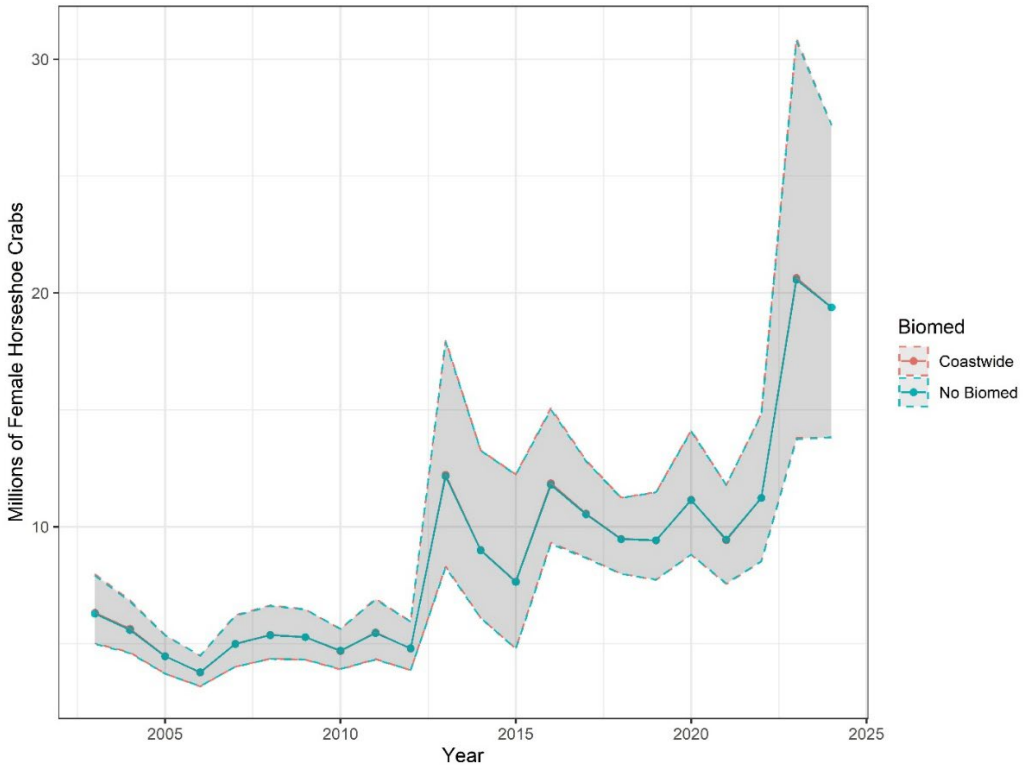

Figure 7. Population estimates from the CMSA for mature female horseshoe crabs with 95% confidence intervals. Delaware Bay biomedical data is confidential so population estimates using coastwide and zero biomedical data provide upper and lower bounds, although there is very little difference between the two and the time series overlap on the figures.

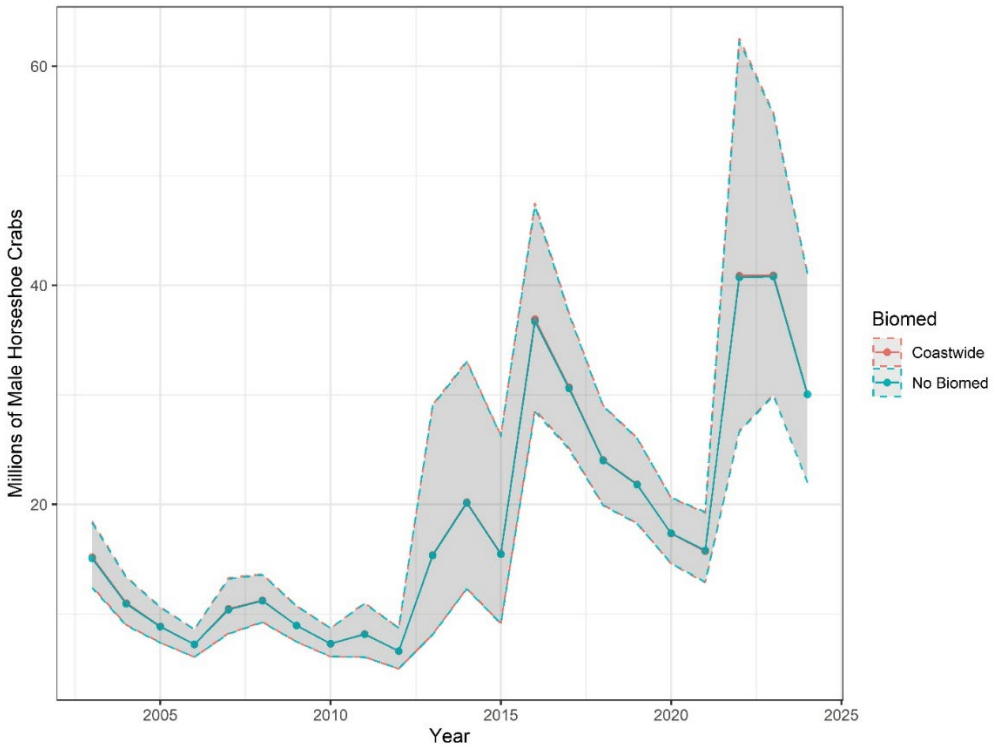

Figure 8. Population estimates from the CMSA for male horseshoe crabs with 95% confidence intervals. Delaware Bay biomedical data is confidential so population estimates using coastwide and zero biomedical data provide upper and lower bounds, although there is very little difference between the two and the time series overlap on the figures.

5. References

ASMFC. 2022a. 2021 Revision to the Adaptive Resource Management Framework and Peer Review Report. Arlington, VA.

ASMFC. 2022b. Addendum VIII to the Interstate Fishery Management Plan for Horseshoe Crabs. Arlington, VA.

ASMFC. 2025. Addendum IX to the Fishery Management Plan for Horseshoe Crab. Arlington, VA.

Jiao, Y., F. Ferretti, and E. Hallerman. 2024. Results of the 2023 Horseshoe Crab Trawl Survey: Report to the Atlantic States Marine Fisheries Commission Horseshoe Crab and Delaware Bay Ecology Technical Committees.

Lyons, J. E. 2025. Stopover Population Estimate and Migration Ecology of Red Knots *C. c. rufa* at Delaware Bay, USA, 2025. Memorandum to the Delaware Bay ARM Working Group, Laurel, Maryland.