



Supplement to Species Listing Proposal: Listing Endangered, Threatened, and Special Concern Species in Massachusetts

Scientific Name: *Limulus polyphemus* Current Listed Status: None
Common Name: American Horseshoe Crab

Proposed Action:

Add the species, with the status of: Special Concern Species

This is a supplement to the proposal submitted on February 24, 2023

Proponents:

Sharl Heller, President, Southeastern Massachusetts Pine Barrens Alliance

Address: The Center at the Center Hill Preserve, 158 Center Hill Road, Plymouth, MA 02360

Telephone: Cell: 617-449-8816; Center Office: 774-773-9982 Email: sheller@comcast.net

Signature Sharl Heller Date Submitted: June 5, 2023

Barbara Brennessel, Ph.D., Professor Emerita of Biology, Wheaton College

- *Diamonds in the Marsh: A Natural History of the Diamondback Terrapin*
- *Good Tidings: The History and Ecology of Shellfish Aquaculture in the Northeast*
- *The Alewives' Tale: The Life History and Ecology of River Herring in the Northeast*
- *The Adventures of Allie the Alewife*
- *Tidal Water: A history of Wellfleet's Herring River*

Tim Simmons, Conservation Ecologist

Restoration ecologist with the Massachusetts Division of Fisheries and Wildlife Natural Heritage and Endangered Species Program (NHESP), retired

Deborah Cramer, Author

Great Waters: An Atlantic Passage (W.W. Norton)

Smithsonian Ocean: Our Water Our World (Harper Collins/Smithsonian Books)

The Narrow Edge: A Tiny Bird, an Ancient Crab, and an Epic Journey (Yale University Press)

National Academy of Sciences Best Book

Society of Environmental Journalists Rachel Carson Book Award

Volando a Orillas del Mar: El viaje épico de un ave playera que une continentes (Vázquez

Mazzini, Buenos Aires)

绝境 (Commercial Press, Beijing)

Forthcoming (Yeren Press, Taiwan)

JUSTIFICATION

On February 24, 2023, we submitted a proposal to list the American horseshoe crab as a species of special concern. Since then, important changes in the horseshoe crab regulatory landscape and new information increase the urgency and need for this designation. These include:

- 2023 consent order issued by the U.S. District Court in Charleston, South Carolina, restricting the horseshoe crab take.
- 2023 restrictions added to permits in the horseshoe crab fishery in South Carolina.
- 2023 draft compatibility determination issued by the Fish and Wildlife Service for the Cape Romain National Wildlife Refuge finding that horseshoe crab take within the Refuge during spawning season is incompatible with its mission to protect migrating shorebirds.
- 2023 failure of the MA Division of Marine Fisheries (DMF) and the MA Marine Advisory Commission to promulgate regulations sufficiently strong to rebuild, or even stabilize, severely diminished horseshoe crab populations.
- Failure of the DMF to honor its mission to protect horseshoe crabs for shorebirds and other dependent wildlife.
- New information regarding historic and current stopovers of threatened red knots in Massachusetts, the historic abundance of horseshoe crabs in Massachusetts, and the reliance of shorebirds on horseshoe crab eggs.

South Carolina Consent Order Closed Almost Every Prime Horseshoe Crab Spawning Beach (~30 Beaches)

The consent order issued in April 2023 by the U.S. Federal District Court in Charleston, South Carolina, reducing the take of horseshoe crabs in South Carolina, dramatically increases pressure on horseshoe crabs in Massachusetts.

Under this order, Charles River Labs, which now has a permit to take horseshoe crabs in MA, may no longer be able to meet its demand in South Carolina. Charles River Laboratories, the Southern Environmental Law Center on behalf of Defenders of Wildlife and the South Carolina Coastal Conservation League, and two companies representing fishermen taking biomedical horseshoe crabs signed the order – the result of a lawsuit directed against the state of South Carolina and Charles River Laboratories.

Plaintiffs Defenders of Wildlife and the South Carolina Coastal Conservation League claimed that fishermen taking biomedical crabs for Charles River Labs depleted South Carolina beaches of spawning horseshoe crabs, thereby depriving red knots— listed as threatened under the Endangered Species Act— of horseshoe crab eggs they need to fuel their long-distance flights to their Arctic breeding grounds.

Relevant to Massachusetts, this consent orders closes 30 beaches—almost all of South Carolina’s prime horseshoe crab spawning beaches—to the take of horseshoe crabs for biomedical use.

The biomedical take of horseshoe crabs in South Carolina is about 150,000 horseshoe crabs a year according to Charles River Labs (Kinnard. “Clean Needles Depend on the Blue Blood of Horseshoe Crabs,” AP News, August 20, 2021 <https://apnews.com/article/business-health-coronavirus-pandemic-only-on->

[ap-crabs-78ef3f0a346a6b712caf08b367fbd6b6](#)). Reduction of Charles River Labs's take in South Carolina does not bode well for horseshoe crabs in Massachusetts.

South Carolina has provided as much as 25% of the horseshoe crabs bled and returned to sea in the biomedical industry. Last year Charles River Labs opened new bleeding facilities in Virginia and Massachusetts. Massachusetts is not well-positioned to absorb this increased demand of horseshoe crabs for the following reasons:

- This significant loss of horseshoe crabs in South Carolina occurred in a state without a bait take. In addition to its biomedical take, MA has one of the highest bait takes along the eastern seaboard. (ASMFC Review of the Interstate Horseshoe Crab Fishery Management Plan for the 2021 Fishing Year, published 2022.)
- The disappearance of horseshoe crabs from spawning beaches in South Carolina occurred in a state where both the ASMFC and the state thought horseshoe crab stocks were in good condition. Massachusetts stocks, according to the ASMFC are only in a neutral condition, not having recovered from their depleted state in 1998. (ASMFC 2019 Horseshoe Crab Stock Assessment.)
- South Carolina hosts only one biomedical company. MA now hosts two of the nation's largest companies.
- The annual 200,000 horseshoe crab quota set in Massachusetts is 33 percent higher than the 150,000 horseshoe crabs taken every year by Charles River in South Carolina – a number that depleted its beaches of spawning horseshoe crabs.
- The South Carolina consent decree **prohibits any take** of horseshoe crabs from the named 30 beaches during the spawning season— from March 15 thru June 15. MA allows the take of horseshoe crabs during the entire spawning season.

New Restrictions to Horseshoe Crab Permitting in South Carolina

New restrictions on the South Carolina horseshoe crab permits this year, altering horseshoe crab fishing practices in South Carolina, may also increase pressure on the horseshoe crab biomedical take in Massachusetts.

Until this year, South Carolina fishermen could stockpile horseshoe crabs in holding ponds for weeks at a time, allowing storage of horseshoe crabs when the number caught exceeded the daily capacity at the bleeding lab. New conditions on the horseshoe crab permits: 1) prohibit keeping female horseshoe crabs in holding ponds during the spawning season; 2) limit the number of horseshoe crabs in individual ponds; and 3) limit the time they may be kept in holding ponds, thereby reducing the availability of horseshoe crabs for bleeding, and creating the need to make up the difference in another state.

Draft Compatibility Determination for the Cape Romain National Wildlife Refuge Finds Horseshoe Crab Take Incompatible with the Mission of the Refuge

Fishermen selling horseshoe crabs to Charles River Labs took as many as 25,000 crabs in one spawning season from the Cape Romain National Wildlife Refuge without obtaining the required special use permit from the Refuge. Following a lawsuit by the Southern Environmental Law Center representing Defenders of Wildlife, the Cape Romain National Wildlife Refuge confirmed, in 2021, that anyone

seeking to take horseshoe crabs from within the Refuge would require a special permit, thus temporarily stopping the take there. In its recently issued draft Compatibility Determination, the FWS found that taking horseshoe crabs from within the Refuge is not compatible with the mission of the Refuge and with the mission of the national wildlife refuge system, including the mission to protect migrating shorebirds whose most energy-rich source of food are horseshoe crab eggs.

(<https://www.fws.gov/DraftCD-CapeRomainNWR> Draft Compatibility Determination for the Harvest of Horseshoe Crabs, Cape Romain National Wildlife Refuge).

Charles River Labs has declared that “purchasing horseshoe crabs from permitted harvesters in South Carolina is critical to CRL’s ability to supply its customers with LAL [Limulus ameobocyte lysate] products.” (Defenders of Wildlife, *Plaintiff*, v. U.S. Fish & Wildlife Service, *Defendant*, and Charles River Laboratories International, Inc., *Intervenor-Defendant*. United States District Court for the District of South Carolina. Civ. No. 2:20-cv-3657-BHH Declaration of Gregory J. Marshall)

To meet demand, the company has sought additional sources of horseshoe crabs and began taking them in Massachusetts in the summer of 2022.

Failure of the MA Division of Marine Fisheries and the MA Marine Advisory Commission to Protect, Rebuild, or even Sustain Diminished Populations of Horseshoe Crabs

Shortly after we submitted a proposal to designate the horseshoe crab as a species of special concern, the MA Division of Marine Fisheries (DMF) published draft regulations to further govern the horseshoe crab fishery. The Division held a hearing in April 2023, inviting public comment, and then modified its proposed regulations in response to the concerns of fishermen and whelk dealers. On May 15 the MA Marine Advisory Commission further diluted these regulations by rejecting components which would have limited the horseshoe crab fishery.

The MA DMF has an obligation to conserve horseshoe crabs for migratory shorebirds and other dependent fish and wildlife, according to MA 322 CMR section 6.34: Horseshoe Crab Management:

(1) Purpose. The purpose of 322 CMR 6.34 is to comply with the Interstate Management Plan for horseshoe crabs to manage 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 research; migratory shorebirds; and, other dependent fish and wildlife. The plan requires the Commonwealth to monitor and control harvest levels by all sectors and conserve crabs through a commercial quota for crabs harvested as bait.”

The original regulations DMF proposed, and to a greater extent, the regulations passed by the MA Marine Advisory Committee, serve to protect and enhance the horseshoe crab bait and biomedical fisheries. Neither the original regulations DMF proposed, nor the ones the Commission passed, will sustain, let alone rebuild, the already severely diminished numbers of horseshoe crabs in Massachusetts. Neither will they manage, protect, and rebuild migrating shorebirds, fish and other wildlife dependent on horseshoe crabs and their eggs. Rather, the new regulations allow for an increased take of horseshoe crabs, further jeopardizing migrating shorebirds and other wildlife

Flawed Assumptions

In proposing new regulations, the DMF asserted it has been “appropriately managing the harvest of horseshoe crabs to achieve an exploitable biomass that can sustain a fishery,” that the MA horseshoe

crab stock is showing “improving abundance” in both the trawl and spawning surveys, and that the proposed recommendations therefore were based on taking a “more precautionary” approach. (Daniel J. McKiernan, “Recommendation on Commercial Horseshoe Crab Management,” Memo to the Marine Fisheries Advisory Commission, May 10, 2023.)

The assumptions justifying these regulations are flawed. We are including with this supplement the Southeastern Massachusetts Pine Barrens Alliance’s (SEMPBA) detailed analysis of the regulations, based on its review of current scientific literature, available data, and documented photographs. We are summarizing it below, with additional research.

Massachusetts trawl and spawning data does not indicate that the horseshoe crab numbers are showing signs of meaningful or significant improvement. ASMFC peer reviews of the horseshoe crab stock assessments have stated the best and only way to measure trends in the horseshoe crab population is The Virginia Tech dedicated horseshoe crab trawl survey, which measures trends in adult male and female horseshoe crabs, juvenile male and females, and newly mature females. Absent this essential information, MA is left with its spawning surveys.

Despite DMF assertions to the contrary, the spawning surveys do not show meaningful or statistically significant signs of increased spawning.

On the DMF spawning trend graphs, submitted in our original proposal to you, the confidence intervals in most cases are overlapping, and the x-axes are constructed to amplify the significance of what are, in effect, very minor changes. For example, between 2008 and 2022, the DMF spawning survey for Duxbury Beach shows an increase in spawning activity from less than ¼ of a horseshoe crab to less than ½ a horseshoe crab for every 25 square meters of beach. DMF classifies this as improved spawning, despite the overlapping confidence intervals. When thousands of horseshoe crabs once spawned on Duxbury beaches (Ronald Rood. “The Crab that Isn’t.” *Audubon*, May-June 1967, pp38-42), this barely discernible difference in 14 years of management signifies a gross failure of management.

Experience in other states confirms the inadequacy of trawl data as a measure of trends in horseshoe crab numbers. The ASMFC used the South Carolina trawl data -- which like that in Massachusetts, didn’t track trends by levels of maturity and sex -- to characterize horseshoe crab stocks as being in good condition. Because it takes horseshoe crabs 10 to 12 years to reach maturity, this inadequate data masked the collapse of horseshoe crabs spawning on the beaches, leading to lawsuits and the ultimate closure of those beaches to the take of horseshoe crabs. The same thing is likely occurring in Massachusetts, and the new regulations will do little if anything to meaningfully increase spawning here.

Inadequate Spawning Closure

The regulations originally proposed for 2024, were to replace the existing 5-day springtime lunar closures, taking place around each new and full moon during the period of April 16 thru June 30, with a January 1 thru May 31 prohibition on horseshoe crab harvest by all persons. The DMF shortened that to an April 1 - May 31 closure, which the Commission declined to pass.

The original proposal, recognizing that horseshoe crabs are particularly vulnerable to fishing pressure when they are spawning, was theoretically a step in the right direction. However, the proposal to open the horseshoe crab harvest at the end of May is flawed because of DMF's continued assertion that 80 percent of horseshoe crabs finish spawning by May 31.

This assumption is based on harvest data. We would like to point out that horseshoe crab spawning appears nearly completed by the end of May not because horseshoe crabs have actually finished

spawning, but because fishermen have removed most spawning horseshoe crabs by then. In its 2009 compliance report to the ASMFC, the MA Division of Marine Fisheries, discussing the results of its spawning surveys, said “It should be noted that many of the crabs counted in the surveys were subsequently harvested by fishermen and removed from the population.” (Robert Glenn, MA. Division of Marine Fisheries. “Massachusetts 2009 Compliance Report to the Atlantic States Marine Fisheries Commission – Horseshoe Crab.”)

Horseshoe crabs in Massachusetts spawn later than in South Carolina and Delaware Bay. The April 2023 U.S. District Court consent order in South Carolina, closed the state’s prime horseshoe crab spawning beaches for the length of the spawning season – March 15 to June 15, and in Delaware Bay, horseshoe crab spawning goes from late April through June, with peak spawning in May.

(<https://dnrec.alpha.delaware.gov/fish-wildlife/education-outreach/dupont-nature-center/horseshoe-crabs-and-shorebirds/>)

Water is colder in Massachusetts and warms up later. This later season, beginning in May and extending well into July, and historically into August, is longer than the DMF will acknowledge, and would be apparent in the data if fishermen did not remove the bulk of horseshoe crabs from beaches as soon as they appear in May.

This longer spawning season is based on the following research:

- In 1949 and 1950, Carl Shuster, tagging horseshoe crabs spawning in Barnstable Harbor, documents spawning between early May and the end of August with the highest numbers in June and July and the peak in the third week of June. (Carl N. Shuster, Jr. 1950. “Observations on the Natural History of the American Horseshoe Crab, *Limulus polyphemus*,” from the Third Report on the Investigations of Methods of Improving the Shellfish Resources of Massachusetts. Contribution No. 564. Woods Hole Oceanographic Institution.)
- In the early 1950s, horseshoe crab spawning in Plum Island Sound peaked in July and August. (John P. Baptist, R. Smith Osgood, John W. Ropes. “Migrations of the horseshoe crab, *Limulus polyphemus*, in Plum Island Sound, Massachusetts. Washington. D. C. U.S. Fish and wildlife Service, 1957. Special scientific Report Fisheries No. 220.)
- In the 1960s, horseshoe crabs were still spawning at high numbers in late June. (Report of the Shellfish Constable, Duxbury, 1962.)
- As the take of horseshoe crabs rose, the spawning season contracted, plummeting **fivefold**, from 56 to 11 days at the Cape Cod’s Mashpee Dike between 1984 and 1999. (Widener, J.W. and Barlow, R.B. 1999. Decline of a horseshoe crab population on Cape Cod. *The Biological Bulletin* 197(2): 300-302.) The authors attribute this loss directly to the horseshoe crab fishery there.
- Carmichael, Rutecki, and Valiela, studying growth rates of instars in Pleasant Bay, Cape Cod, in 2001, determined a spawning season beginning at the end of March and continuing through three weeks into July. (Carmichael, Rutecki, Valiela. 2003. “Abundance and population structure of the Atlantic horseshoe crab *Limulus polyphemus* in Pleasant Bay, Cape Cod,” *Marine Ecology and Progress Series*, vol. 246: 225-239.)
- Grady and Valiela found that horseshoe crab spawning on Cape Cod occurs from May through July and peaks in late June and early July. (Sarah Grady and Ivan Valiela. *Stage-structured Matrix Modeling and Suggestions for Management of Atlantic Horseshoe Crab, *Limulus polyphemus*, Populations on Cape Cod, Massachusetts*. Estuaries and Coasts. Vol. 29, No. 4. August 2006, p. 686.)

- By 2009, however, James-Pirri finds that spawning at the Cape Cod National Seashore occurs around the new or full moons in May and June, but has mostly ceased by July. (James-Pirri, M. J. “2012. Assessment of spawning horseshoe crabs (*Limulus polyphemus*) at Cape Cod National Seashore, 2008-2009.” Natural Resource Technical Report NPS/CACO/NRTR—2012/573. National Park Service, Fort Collins, Colorado.)

SEMPA’s comments on the regulations provide photographs of historical horseshoe crab spawning in Pleasant Bay in July. Pockets of spawning also continue in July on other Massachusetts beaches. Cramer observed spawning in Plum Island Sound off the Parker River National Wildlife Refuge on July 13, 2022, and SEMPA observed spawning in Duxbury in on July 21, 2022. These observations suggest the possibility of restoring the extended horseshoe crab spawning period if the take were curtailed. A clip of MA horseshoe crab bait fishermen shows how they can easily remove large numbers of spawning horseshoe crabs from a beach, and most likely hurt those that they throw back into the water. (MacDonald. <https://www.ray-macdonald.com/Nature/Horseshoe-Crabs-in-Duxbury/i-Ln9QSGb/A>)

In Massachusetts it is illegal to take a lobster with roe. There is little reason to take horseshoe crabs, whose females take 11 or 12 years to reach maturity, when they are spawning. In MA, horseshoe crabs are taken for bait in the whelk fishery, a fishery that the DMF acknowledges is depleted. Current whelk regulations will not rebuild the whelk to the point where 50% of whelk in the sea are mature females, until 2033. Right now, according to the DMF, very few whelk in the sea are mature females.

Retention of Failed Lunar Closures

The MA Marine Advisory Commission chose to keep the lunar closures, which have not proved to be an effective way to rebuild spawning horseshoe crabs. In this more northern end of the horseshoe crab range, environmental factors, such as water temperature, not the calendar or lunar cycles, prompts horseshoe crab spawning. (Cheng, Chabot and Watson. “Influence of Environmental Factors on Spawning of the American Horseshoe Crab (*Limulus polyphemus*) in the Great Bay Estuary, New Hampshire, USA.” *Estuaries and Coasts*, November 2015.)

Further, the DMF has acknowledged that lunar closures, while increasing the trawl take of horseshoe crabs, did not substantially reduce the take of spawning horseshoe crabs on beaches where fishermen were removing them by hand. “While lunar closures do afford protection during peak spawning periods, hand harvesters have been able to effectively continue to catch horseshoe crabs along the spawning beaches outside of these closed periods. While we have seen reduced participation in the hand harvest fishery since 2010, landings have remained fairly static.” (Daniel J. McKiernan, “Recommendation on Commercial Horseshoe Crab Management,” Memo to the Marine Fisheries Advisory Commission, May 10, 2023.)

The lack of a relationship between lunar closures and spawning as well as the storing of horseshoe crabs in pens or “carts” near the shore may contribute to the continued steady landings despite the lunar closures. “Penning of horseshoe crabs is a common practice in the biomedical fishery. This allows biomedical firms (or their associated dealer) to collect horseshoe crabs over a window of time and then provide these animals to the biomedical firms for bleeding in appropriate quantities and when they are staffed to process the animals. It may also be used post bleeding to timely place horseshoe crabs back in the water immediately prior to live release.” (Daniel J. McKiernan, “Recommendation on Commercial Horseshoe Crab Management,” Memo to the Marine Fisheries Advisory Commission, February 8, 2023.) In other words, fishermen may legally take horseshoe crabs outside the lunar closures and stockpile them in pens for bleeding on the days when the fishery is closed.

Failure to Regulate Horseshoe Crab Penning

The DMF acknowledges that sublethal and lethal effects of penning are not understood, that horseshoe crabs are susceptible to injury and death in the pens, especially if they are densely packed, and that in 2022, there were two occasions of mortality in penned biomedical horseshoe crabs. (Daniel J. McKiernan, “Recommendation on Commercial Horseshoe Crab Management,” Memo to the Marine Fisheries Advisory Commission, February 8, 2023.)

Despite its “concerns” about penning, and despite the experience in South Carolina, described above, where the disappearance of spawning horseshoe crabs precipitated a lawsuit and then the prohibition of keeping spawning females in holding ponds, and restrictions on the number and length of time horseshoe crabs could be kept in ponds, the DMF offered no regulation of the pens—not their numbers, nor the density, nor the length of time horseshoe crabs can be kept in the pens, nor does the DMF require that the pens are kept fully submerged, even at low tide. And, penned horseshoe crabs cannot lay their eggs on beaches.

The Connecticut General Assembly Voted Unanimously to Prohibit the Hand Capture of Horseshoe Crabs (5/30/2023)

Since we submitted this application, Connecticut General Assembly has unanimously passed a bill banning the take of horseshoe crabs by hand from Connecticut beaches. The bill is now on the Governor's desk and is expected to go into effect on Oct. 1 (https://friendsofanimals.org/cts-lawmakers-protect-plunging-horseshoe-crabpopulation/?fbclid=IwAR0ymQZvd24PDhfywfmGiWoHdvVAZ5_wx0vKEjiHmJX02tL2PeMQytikt80)

Twenty years of horseshoe crab research by biologists at Sacred Heart University has shown that a full ban on the take of horseshoe crabs by hand, as opposed to a prohibition on the take of females, is the only way to rebuild a diminished population. (Mattei, Kasinak, Senbel, Bartholomew. “The Power of Citizen Science: 20 Years of Horseshoe Crab Community Research Merging Conservation, Education, and Management.” J. Tanacredi et al. (eds.), *International Horseshoe Crab Conservation and Research Efforts: 2007-2020*, Springer: 2022).

We continue to stand by our recommendations in our original proposal to halt the take of biomedical horseshoe crabs during the spawning season—April through July.

Unsustainable Biomedical and Bait Quotas

The DMF proposed, and the MA Marine Fisheries Advisory Commission passed, a 200,000 biomedical quota, to be split between the two biomedical companies currently bleeding horseshoe crabs in Massachusetts. A biomedical quota has the potential to limit the take of horseshoe crabs to sustain or rebuild the population. In this case the quota is set too high to realize that benefit. The biomedical take of horseshoe crabs in 2021 (excluding rent-a-crab, where horseshoe crabs are bled and then killed to be used as bait) was 176,000. Thus, the quota allows for **additional growth** in the biomedical industry, which the DMF openly acknowledges (Daniel J. McKiernan, “Recommendation on Commercial Horseshoe Crab Management,” Memo to the Marine Fisheries Advisory Commission, May 10, 2023).

The DMF asserts that increased mortality predicted from this increased take will be compensated for by a commensurate decrease in the bait take. This assertion is flawed as well. The DMF assumes the ASMFC predicted 15 percent mortality rate of bled horseshoe crabs. However, two studies carried out on horseshoe crabs bled by the two companies operating in Massachusetts, show a different result. One, carried out by the South Carolina Department of Natural Resources, using horseshoe crabs bled by Charles River Laboratories, shows a 20 percent mortality rate. (Project Narrative, Final Report : R/CF-14, "Tagging of Horseshoe Crab, *Limulus polyphemus*, in Conjunction with Commercial Harvesters and the Biomedical Industry in South Carolina." South Carolina Sea Grant Consortium Project Report. August 27, 2012).

The other, carried out by the Massachusetts Division of Marine Fisheries, using horseshoe crabs bled by Associates of Cape Cod (a fully owned subsidiary of the Japanese company Seikagaku), finds a 30 percent mortality rate. "We undertook a study of mortality of unbled females vs. those handled and bled by Associates of Cape Cod, the local biomedical company. The results documented a mortality rate of 30%, substantially higher than the 5-15% estimate currently used for management of this fishery." (Massachusetts Division of Marine Fisheries. Massachusetts 2009 Compliance Report to the ASMFC-Horseshoe Crab.) Additional studies of higher than 15% mortality are referenced in the SEMPA analysis, attached.

The DMF fully recognizes that these mortality rates "do not account for pre-bleeding mortality or any potential sub-lethal impacts of bleeding on horseshoe crab fitness and spawning activity." (Daniel J. McKiernan, "Recommendation on Commercial Horseshoe Crab Management," Memo to the Marine Fisheries Advisory Commission, May 10, 2023). Furthermore, the DMF, imposes no sanctions on companies or fishermen who exceed the 15% estimated mortality rate.

The higher mortality rates of biomedical horseshoe crabs, the pre-bleeding mortality, and studies of sub-lethal impacts on spawning (referenced in our original proposal) suggest that this biomedical quota, set too high, will not rebuild, let alone sustain, the already severely diminished numbers of spawning horseshoe crabs. The reduction in the horseshoe crab bait take will not compensate for this higher increased mortality, let alone compensate for the anticipated but underestimated 15% increase in biomedical mortality.

Biomedical companies in Massachusetts are bleeding horseshoe crabs to make limulus amoebocyte lysate (LAL), a widely used test for endotoxin contamination in vaccines, other injected medicines, and implanted medical devices. Synthetic alternatives are available. Four of the world's largest pharmaceutical companies are transitioning away from LAL to the recombinants. (Cramer, "When the Horseshoe Crabs Are Gone, We'll Be in Trouble," New York Times, February 23, 2023.) On May 22, 2023, the Pharmaceutical Supply Chain Initiative, representing 75 of the world's largest pharmaceutical companies, released a position paper recommending that its members "minimize" their use of LAL, and that the availability of recombinant Factor C (rFC) and other recombinants, offers its members a route to "dramatically reduce" the use of LAL. (<https://pscinitiative.org/bulletin?bulletin=629>). Massachusetts, with its regulations, appears to be heading in the opposite direction, enabling increases in the production of LAL.

In April 2023, the Horseshoe Crab Recovery Coalition, a partnership of conservation organizations, museums, and pharmaceutical companies seeking to restore horseshoe crabs to abundance, recommended a suite of biomedical horseshoe crab best management practices to the ASMFC, which the agency did not adopt, and whose horseshoe crab subcommittees are dominated by fishermen, regulators, and biomedical companies. These recommendations included a requirement of no more than 7 percent mortality, including pre-bleeding mortality, for biomedical horseshoe crabs. SEMPBA, in

its comments on the MA regulations, recommended that there be a mortality limit with consequences for violating it. We add that recommendation to our original listing proposal.

Inadequate Reduction in the Bait Take

The Massachusetts DMF passed a reduction in the horseshoe crab bait quota to 140,000 horseshoe crabs from the current quota of 165,000 horseshoe crabs, anticipating this decrease would offset increases in biomedical mortality. We disagree. This reduction in the bait quota, the DMF states is “in line with the 10-year mean for reported landings and is similar to bait landings in 2022 (134,753 crabs).” (Daniel J. McKiernan, “Recommendation on Commercial Horseshoe Crab Management,” Memo to the Marine Fisheries Advisory Commission, May 10, 2023). Regardless of where the quota is set, if there is no actual reduction in the bait take, there will be no reduction in horseshoe crab mortality to compensate for the increased biomedical mortality.

The failure of the Massachusetts Division of Marine Fisheries to manage the horseshoe crab fishery for long term health and viability further emphasizes the need to designate the horseshoe crab as a species of special concern in Massachusetts. As noted previously, horseshoe crabs are taken primarily for bait in the whelk fishery, a fishery that the DMF acknowledges is depleted. We continue to oppose using the horseshoe crab bait fishery to prop up a depleted whelk fishery.

Zero Bait Take

In its analysis of MA’s proposed horseshoe crab recommendations, SEMPA recommended a bait quota of zero, as did Professor Barbara Brennessel in her letter to the Division of Marine Fisheries commenting on the regulations and based on her years of experience monitoring horseshoe crabs in Wellfleet Bay. We recommended an end to the bait fishery in our original proposal and continue to stand by that recommendation for all the reasons listed in the SEMPA analysis, and Professor Brennessel’s letter. We would simply add one more study, from Cape Cod, confirming the low survival of horseshoe crab eggs: fewer than ten out of one million make it to the end of their first year (Carmichael, Rutecki and Valiela. 2003. “Abundance and population structure of the Atlantic horseshoe crab, *Limulus polyphemus* in Pleasant Bay Cape Cod,” *Marine Ecology Progress Series* 246: 225-239).

Ending the horseshoe crab bait fishery would also end the biomedical rent-a-crab program, where horseshoe crabs are taken for bait but first “rented” to Associates of Cape Cod for bleeding. While this program, encouraged by the MA Division of Marine Fisheries, appears to be an efficient use of horseshoe crabs, it doesn’t make sense to encourage a bait fishery that is propping up a depleted whelk fishery. In addition, as the pharmaceutical industry continues to grow—from the development of new RNA vaccines and other injectable drugs, and as the human population in India and China continues to age and its medical needs rise, and as Asian sources of horseshoe crab blood are depleted—pressure will continue to increase on the American horseshoe crab population. Pharmaceutical manufacturer Eli Lilly has already transitioned to a recombinant endotoxin test, and Pfizer, Roche, and Sanofi Pasteur are following suit. The United States Pharmacopeia, which sets the standards for drug manufacturing and testing, is writing regulations which will ease the transition away from LAL, which may take from five to ten years. Until then, given the importance of LAL, every bled American horseshoe crab needs to stay alive and be returned to the sea.

Failure of the Massachusetts Division of Marine Fisheries to Implement its Mission to Protect Horseshoe Crabs for Shorebirds and Other Dependent Wildlife

The need to designate the horseshoe crab as a species of special concern becomes even more pressing following the MA Division of Marine Fisheries assertion, ignoring data from Massachusetts, of “the lack of spatio-temporal linkage between horseshoe crab spawning and shorebird migration” in Massachusetts. (Daniel J. McKiernan, “Recommendation on Commercial Horseshoe Crab Management,” Memo to the Marine Fisheries Advisory Commission, May 10, 2023).

This assertion is incorrect. Instead, it is a self-fulfilling prophecy. If Massachusetts beaches are depleted of spawning horseshoe crabs, there will be no eggs and larvae for the birds to eat, and hence no connection. However, abundant evidence (outlined above) suggests that if fishermen did not remove most of the spawning horseshoe crabs in May, spawning would continue at high rates into June and July, and even August, leaving an abundance of eggs for red knots and other shorebirds migrating north, and an abundance of eggs for red knots and other shorebirds migrating south.

On pages 8 and 9 of our previous submission, we described the reliance of red knots, and other shorebirds whose populations are dramatically declining, on horseshoe crab eggs. Given the Division of Marine Fisheries’ position, and its resulting consequence of no regulatory relief for horseshoe crabs, we are submitting here a more detailed accounting of the essential connection between red knots and horseshoe crab eggs, a connection which applies to ruddy turnstones, semipalmated sandpipers, and other species in decline migrating through Massachusetts in both spring and fall.

Historic Importance of Massachusetts in Red Knot Migration both in the Spring and Fall

Massachusetts is one of the earliest documented epicenters of *rufa* red knot migration in the United States. As far back as 1893, sportsman and naturalist George Mackay recognized Massachusetts as a major stopover for migrating adult and juvenile red knot in both spring and fall. This accounting illustrates the historic richness of Massachusetts as a resource for red knots, both in the fall, from July into October, and also in the spring. Between May 12th and the first week in June, knots would stay for a week or so on Cape Cod. Then, hunters collected them by the “thousands,” and barrels of red knots were shipped to Boston. (Mackay, George. “Observations of the Knot *Tringa Canutus*. *Auk* v. X, 1893 pp. 25-35)

Harrington calculated that six barrels of knots seen by one of MacKay’s observers in the spring, on the deck of the Cape Cod packet bound for Boston, may have contained 5000 to 7000 knots. (Harrington, Hill, and Nikula. 2010. “Red Knots in Massachusetts: An Historical Perspective.” *Bird Observer*. vol 38, no. 4:214-217.)

The birds, MacKay wrote, flocked in “exceedingly large numbers, estimates of which were useless... Often, when riding on the top of the stagecoach on the Cape beyond this point [Sandwich], immense numbers of these birds could be seen, as they rose up in clouds, during the period that they sojourned there.” (Mackay, op.cit.) He suggests that in Billingsgate “twenty to twenty-five thousand a year” were seen. (Mackay, op.cit.) The U.S. Fish and Wildlife Service acknowledges MacKay’s observations of Cape Cod as a critical staging area for Red Knot. (“Rufa Red Knot Ecology and Abundance,” Supplement to Endangered and Threatened Wildlife and Plants; Proposed Threatened Status for the Rufa Red Knot (*Calidris canutus rufa*) [Docket No. FWS–R5–ES–2013–0097; RIN 1018–AY17]

“...preferentially when and where they are available.”

The Fish and Wildlife Service also explicitly recognizes that red knots eat high quality, lipid rich horseshoe crab eggs **“preferentially when and where they are available.”** (U.S. Fish and Wildlife Service. 2020. “Species status assessment report for the *rufa* red knot (*Calidris canutus rufa*)”. Version 1.1. Ecological Services New Jersey Field Office, Galloway, New Jersey, p14.)

Body mass of *rufa* red knots leaving the Delaware Bay stopover has been linked to both the availability of horseshoe crab eggs and to the birds’ subsequent survival rates. (U.S. Fish and Wildlife Service. 2021. “Rufa Red Knot (*Calidris canutus rufa*) 5-Year Review: Summary and Evaluation.” U.S. Fish and Wildlife Service, New Jersey Field Office, Galloway, New Jersey p20.)

Federal courts confirmed scientific findings that removing spawning horseshoe crabs hurts red knots and other shorebirds, not only in South Carolina (reference above) but also in Massachusetts. In 2001, the federal district court confirmed the right of the Monomoy National Wildlife Refuge to deny a special permit for the take of horseshoe crabs within the refuge, whose mission is to protect shorebirds.

“...likely the most significant shorebird conservation issue”

Scientists continue to find links between the taking of horseshoe crabs with the decline and disappearance of red knots. The FWS found that horseshoe crab spawning in South Carolina’s Turtle Island Wildlife Management Area – where over 4000 knots were seen in 2019 -- ceased following intensive biomedical take there. (USFWS 2021 “Rufa Red Knot *Calidris canutus rufa* Five-Year Review: Summary and Evaluation”. Galloway, N. J. USFWS.) Smith, et. al., find that “the magnitude of the horseshoe crab harvest in critical shorebird foraging locations in South Carolina is likely the most significant shorebird conservation issue moving forward in the region.” (Smith, F. M.; Watts, B. D.; Lyons, J.; Keyes, T.; Smith, A.; Sanders, F.; and Thibault, Justin Leroy, "Investigating Red Knot Migration Ecology along the Georgia and South Carolina Coasts: Spring 2019 Season Summaries" (2019). CCB Technical Reports. 588.)

All along the east coast of the United States—in Florida, Georgia, and South Carolina—migrating red knots feed on coquina until horseshoe crabs begin spawning, and then with a seeming uncanny awareness of when the horseshoe crabs began spawning, and where, they move to the richer repast.

A Long History of Shorebirds Eating Horseshoe Crab Eggs and Larvae in Massachusetts

In preparing evidence for the lawsuit against the Monomoy National Wildlife Refuge for halting the take of horseshoe crabs there, and for its analysis of the compatibility of its mission with the take of horseshoe crabs there, a refuge biologist compiled a record of shorebirds eating horseshoe crab eggs on Cape Cod, beginning with an account of sportsman and authority on shorebird hunting, Warren Hapgood, writing in *Forest and Stream* in 1881 of red knots arriving on Cape Cod around the 10th of May. The large flocks of red knots, he said, “have a penchant for ‘horsefoot’ eggs, display considerable ingenuity” scratching the sand and “poking out the eggs with their bills,” and often fight with ruddy turnstones over the eggs. (Hapgood, Warren. 1881. “Range and Rotary Movements of Limicolae,” *Forest and Stream*, vol 17 no 12:225-228.)

In 1912, Massachusetts State ornithologist Edward Howe Forbush wrote that knots “are fond of the spawn of the horsefoot crab, which, often in the company of the Turnstone, they dig out of the sand.” (Forbush, Edward Howe. *A History of the Game Birds, Wild-fowl and Shore Birds of Massachusetts and Adjacent States*. Boston: Massachusetts State Board of Agriculture, 1912.)

Mallory and Schneider describe a flock of short-billed dowitchers on a sandy, tidal flat near Plymouth, MA, fighting over horseshoe crab eggs. As the eggs disappeared, the number of dowitchers feeding there declined. (Mallory and Schneider. 1979. "Agonistic Behavior in Short-billed Dowitchers Feeding on a Patchy Resource." *Wilson Bull.* 91 (2):271-278.

A note to Stephanie Koch of the FWS, submitted as part of the lawsuit, states that according to Carl Shuster, the first documentation of shorebirds eating horseshoe crab eggs is in Barnstable. (Note to Stephanie Koch from Susanne Schaller, March 31, 2000.)

In 2001, staff at the Refuge, flushing the stomachs of short-billed dowitchers in July determined that they were eating horseshoe crab eggs. Other records of shorebirds, including red knots, eating horseshoe crab eggs on Cape Cod include films by artist Robert Verity Clem (U.S. Fish and Wildlife Service, Eastern Massachusetts National Wildlife Refuge Complex Compatibility Determination, May 22, 2002), and as recently as May 28, 2008, photographs of red knot, dunlin, semipalmated sandpiper, and sanderling feeding on horseshoe crab eggs on a high tide in Chatham. (Nikula, personal communication)

In its 2015 Comprehensive Conservation Plan, the Refuge confirmed its conclusions that shorebirds migrating north and returning south are eating horseshoe crab eggs, and that eggs are still found in July and August. (Monomoy National Wildlife Refuge. Final comprehensive Conservation Plan and Environmental Impact Statement. October 2015)

When horseshoe crabs were abundant in Massachusetts, shorebirds were as well. Between 1960 and 2004, red knots staged along the beaches of western Cape Cod Bay (Third Cliff (Scituate), Plymouth Beach, and Duxbury Beach) between July and September, in numbers ranging from 3000, 6000 and 7500 birds. (Harrington, Hill, and Nikula, "Changing Use of Migration Staging Areas by Red Knots: An Historical Perspective from Massachusetts." 2010. *Waterbirds* 33 (2): 188-192.) The knots were also coming through in large numbers in June, on their way north. On June 5th, 1953, Allen Morgan, former Vice-President of Mass Audubon, saw 10,000 red knots while camping in a marsh on Monomoy. (Griscom, Ludlow, Notebooks, June 1953, Ludlow Griscom Papers, NH 1, [box 6, folder 4]. Phillips Library, Peabody Essex Museum, Rowley, MA.)

The long horseshoe crab spawning season in Massachusetts, from May through August, and then with the emergence of trilobite larvae from nests within four to six weeks, after which they settle on adjacent mudflats, (James-Pirri, M. J. "2012. Assessment of spawning horseshoe crabs (*Limulus polyphemus*) at Cape Cod National Seashore, 2008-2009." Natural Resource Technical Report NPS/CACO/NRTR—2012/573. National Park Service, Fort Collins, Colorado) uniquely and critically enables Massachusetts to provide horseshoe crab eggs and/or larvae for migrating shorebirds in two seasons.

The extended availability of horseshoe crab eggs and larvae in Massachusetts is especially important, given that Massachusetts is a critical staging site for red knots. Veit and Petersen, in their history of red knot sightings in Massachusetts, found migrating red knots staging at five primary locations: Third Cliff, Scituate; Plymouth Beach; Duxbury Beach; Monomoy; and the Cape Cod National Seashore. (Veit and Petersen. *Birds of Massachusetts*. Lincoln: Massachusetts Audubon Society, 1993.)

An analysis of 70 years of red knot records in Massachusetts finds that over 90% of recorded red knot sightings come from two regions – the three beaches in western Cape Cod Bay and the outer Cape in the area of Chatham and Orleans. (Harrington, Hill, and Nikula. 2010. "Red Knots in Massachusetts: An Historical Perspective." *Bird Observer*. vol 38, no. 4:214-217 and Harrington, Hill, and Nikula, "Changing Use of Migration Staging Areas by Red Knots: An Historical Perspective from Massachusetts." 2010. *Waterbirds* 33 (2): 188-192.)

These sites have been important for knots migrating to and from southern South America. Their numbers have declined the furthest, dropping 75 percent, and they've yet to rebound. The staging site at Western Cape Cod Bay – Third Cliff, Duxbury Beach, and Plymouth Beach – is used by red knots returning from the Arctic en route to Patagonia. (Harrington, Winn, and Brown. "Molt and Body Mass of Red Knots in the Eastern United States." *The Wilson Journal of Ornithology*, Vol. 119, No. 1 (Mar., 2007), pp. 35-42, and Harrington, Hagan, and Leddy. "Site Fidelity and Survival Differences between Two Groups of New World Red Knots (*Calidris canutus*)." *The Auk* Vol. 105, No. 3 (Jul., 1988), pp. 439-445). This staging area was particularly important, as it was the last stop before a long-distance nonstop flight over the ocean to South America. (Harrington, Hill, and Hikula, "Changing Use of Migration Staging Areas," op.cit.)

Historically, western Cape Cod Bay was the more important staging area for Patagonia bound red knots. Three studies suggest that birds coming through Monomoy are wintering in Florida and the Caribbean. (Joanna Burger, Lawrence J. Niles, Ronald R. Porter, Amanda D. Dey, Stephanie Koch, Caleb Gordon, Migration and Over-Wintering of Red Knots (*Calidris canutus rufa*) along the Atlantic Coast of the United States, *The Condor*, Volume 114, Issue 2, 1 May 2012, Pages 302–313, and Harrington, Winn, and Brown. "Molt and Body Mass of Red Knots in the Eastern United States." *The Wilson Journal of Ornithology*, Vol. 119, No. 1 (Mar., 2007), pp. 35-42, and Niles, L.J., Burger, J., Porter, R.R., Dey, A.D., Koch, S., Harrington, B., Iaquinto, K. & Boarman, M. 2012. "Migration pathways, migration speeds and non--breeding areas used by northern hemisphere wintering Red Knots *Calidris canutus* of the subspecies *rufa*. *Wader Study Group Bull.* 119(2). The Harrington, Winn, and Brown study situates Patagonia bound birds on Plymouth Beach and Third Cliff Beach, and Florida/Caribbean bound birds on eastern Cape Cod.

A conference presentation suggests that between 2009 and 2016 about 45 percent, or about 2200 birds coming through Monomoy in the fall are going to Patagonia. (Lyons, Harrington, Koch, et al. 2019 "Stopover Population Dynamics and Migratory Connectivity of Red Knots at Cape Cod, Massachusetts: Bayesian Analysis of Mark-Recapture and Stable Isotope Data." American Fisheries Society and The Wildlife Society 2019 Joint Annual Conference.)

In a study conducted in 2008, 1000 red knots coming through Pleasant Bay, Cape Cod, were bound for Patagonia (Brian A. Harrington, Stephanie Koch, Larry K. Niles and Kevin Kalasz. "Red Knots with Different Winter Destinations: Differential Use of an Autumn Stopover Area." *Waterbirds* 33(3): 357-363, 2010), making the Cape Cod National Seashore another important site for these knots migrating the greatest distance.

Western Cape Cod Bay beaches have served as a relief valve when Monomoy hasn't been accessible. When in 1959, tidal flats on Monomoy had been destroyed by nor'easters and storm surges, ten times as many knots were seen at Scituate as on Cape Cod. (Norman P. Hill, *The Birds of Cape Cod*, Massachusetts." New York: William Morrow, 1965.

These sites are particularly important because Patagonia bound birds are at greater risk. Harrington found that survival of red knots going to Patagonia is half that of birds wintering in Florida (Harrington, Hagan, and Leddy. "Site Fidelity and Survival Differences between Two Groups of New World Red Knots (*Calidris canutus*)." *The Auk* Vol. 105, No. 3 (Jul., 1988), pp. 439-445).

A more recent study found that knots flying along the Atlantic flyway and wintering in southern South America had lower incubation success (25%) than knots wintering in Texas (67%). (Lyons, Harrington, Koch, et al. 2019 "Stopover Population Dynamics and Migratory Connectivity of Red Knots at Cape Cod, Massachusetts: Bayesian Analysis of Mark-Recapture and Stable Isotope Data." American Fisheries Society and The Wildlife Society 2019 Joint Annual Conference.)

With the Patagonia population at a low with no sign of rebound, and its birds at greater risk, protecting and restoring their staging areas in Massachusetts will greatly increase the likelihood of the birds' recovery.

The dearth of horseshoe crabs spawning in Massachusetts is the culmination of systematic extirpation that began decades ago. We described this in detail in our original proposal, as well as its contribution to the abnormal and alarmingly high male/female sex ratios on Massachusetts beaches; the vulnerability of horseshoe crabs to fisheries just outside the boundaries of the Cape Cod National Seashore and the Monomoy National Wildlife Refuge, suggesting that even these protected areas are not fully protected; and the necessity of an abundance of horseshoe crabs—many more than are currently spawning on Massachusetts beaches—to support the many species of wildlife that rely on them.

Growing Awareness Amidst a Lack of Concern

In a recent article in the *Provincetown Independent*, Mark Faherty, Science Coordinator at Mass Audubon's Wellfleet Bay Sanctuary, said, "You don't target spawning females. It's just not how you would manage any wildlife, in any way, ever. It's how you would harvest horseshoe crabs if you were trying to make them go extinct." (Roth-Dishy, "Stricter Rules Sought for Horseshoe Crab Harvest," *Providence Independent*, April 26, 2023). This year, in proposing new regulations to govern the take of horseshoe crabs, the Massachusetts Division of Marine Fisheries had an opportunity to remedy 20 years of its mismanagement of horseshoe crabs. It chose not to.

Public awareness of the plight of horseshoe crabs is growing. During the public comment period for the proposed regulatory changes, the DMF received over 1,300 letters in support of the new regulations and most asked the DMF to go further and end the bait take. The DMF Director and one Commissioner spoke strongly in support of the January to May closure to show some movement towards conservation, yet the state's Marine Fisheries Advisory Commission, a politically appointed board made up largely of commercial fisheries interests, rejected every recommendation. (<https://www.massaudubon.org/get-outdoors/wildlife-sanctuaries/wellfleet-bay/news-events/proposed-rules-to-restrict-horseshoe-crab-harvest-rejected-by-state-advisory-commission>)

The horseshoe crab has lived on this earth for 475 million years. (Van Roy P, Orr PJ, Botting JP, Muir LA, Vinther J, Lefebvre B, el Hariri K, Briggs DE. "Ordovician faunas of Burgess Shale type." *Nature*. 2010 May 13;465(7295):215-8.) They have survived five mass extinctions, including one that wiped out 97 percent of life in the sea. Now they are endangered, by us, especially in Massachusetts, where we have the least restrictive horseshoe crab regulations along the eastern seaboard, the largest bait and biomedical take, and among the fewest horseshoe crabs. Not only did the exquisite sensitivity of the horseshoe crab's blue blood protect the public health by giving us LAL, its way of seeing led us to an understanding of human vision that won the researcher a Nobel Prize.

The horseshoe crab is a "dominant" species in coastal ecosystems. (Mattei, Kasinak, Senbel, Bartholomew. "The Power of Citizen Science: 20 Years of Horseshoe Crab Community Research Merging Conservation, Education, and Management." J. Tanacredi, et al. (eds.), *International Horseshoe Crab Conservation and Research Efforts: 2007-2020*, Springer: 2022).

In abundance, it has, and could again, support a rich web of life along the seashore. We owe much to horseshoe crabs, sentient animals who deserve far better treatment than what we are providing. (MacDonald. *Horseshoe Crab Cooperative Behavior*, <https://www.raymacdonald.com/Nature/Horseshoe-Crabs-in-Duxbury/i-6mP44D7/A>)

In late May 2023, ornithologists saw red knots, short-billed dowitchers, ruddy turnstones – all shorebird species suffering from alarming declines – eating horseshoe crab eggs in the Monomoy National Wildlife Refuge (<https://www.capeandislands.org/local-news/2023-05-31/the-connection-between-horseshoe-crabs-and-red-knots>) testament to possibility that a once rich resource could still be restored.

Designating the horseshoe crab a special concern species is critical and necessary. This designation is our best and perhaps only chance to return MA's sadly diminished horseshoe crabs to robustness and abundance, and with them the many shorebirds also in severe decline. The health and well-being of horseshoe crabs and red knots depend on it.

Thank you for considering this supplement.