



Commissioner Ed Potosnak

(Via email: Commissioner@dep.nj.gov)

Chief Advisor Kimberly Cahall

(Via email: Kimberly.Cahall@dep.nj.gov)

Director Melissa P. Abatemarco, Office of Legal Affairs

(Via email: Melissa.Abatemarco@dep.nj.gov)

New Jersey Department of Environmental Protection

Attention: Petition for Declaratory Ruling

Mail code 401-07

401 East State Street, 7th Floor

PO Box 402

Trenton, New Jersey 08625-0402

SUBMITTED VIA U.S. MAIL AND EMAIL

(RulePetitions@dep.nj.gov)

July 28, 2026

Re: Petition for Declaratory Ruling on Limuli Laboratories' Horseshoe Crab Bleeding Practices.

Dear Commissioner Potosnak, Chief Advisor Cahall, and Director Abatemarco:

Pursuant to N.J.S.A. § 52:14B-8, and on behalf of the Center for Biological Diversity and its over 37,000 members and supporters in New Jersey, New Jersey Audubon Society, New Jersey Conservation Foundation, Citizens United to Protect the Maurice River and Its Tributaries, League of Women Voters of New Jersey, Save Coastal Wildlife, American Bird Conservancy, Humane World for Animals, National Wildlife Federation, Delaware Riverkeeper Network, NY/NJ Baykeeper, Upstream Alliance, Delaware Audubon Society, Delaware Ornithological Society, Maryland Bird Conservation Partnership, Friends of the Bay, Professor Tim Cernak, Coastal Expeditions and the Coastal Expeditions Foundation, 100 Miles, and Maritime Aquarium at Norwalk (collectively, the twenty "Petitioners"), I write to respectfully request that the New Jersey Department of Environmental Protection ("DEP") render a declaratory ruling on the lawfulness of Limuli Laboratories' harvesting, bleeding, killing, and injuring of horseshoe crabs.

New Jersey's Legislature has sought to protect its ecologically valuable and ecotourism-drawing migratory shorebirds, including the imperiled and federally protected red knot, by banning industry destruction of the shorebirds' key food source—horseshoe crabs. *See* N.J.S.A. §§ 23:2B-20, -21 ("Moratorium on taking of horseshoe crabs") (hereinafter, "Moratorium"). Yet one company, Limuli Laboratories in Cape May Courthouse, is flouting the Legislature's strict prohibition on harvesting crabs and their blood in ways that harm and kill the horseshoe crabs. As a result, the species that should be thriving in Delaware Bay are continuing to suffer catastrophic population declines.

Through a declaratory ruling on Limuli Laboratories, DEP can fulfill the promise of the Moratorium and avoid damage to horseshoe crabs and the migratory shorebirds that rely on them. Petitioners seek a declaratory ruling “with respect to the applicability to any person . . . or state of facts of any statute . . . enforced or administered by” DEP—here, the applicability of the statutory Moratorium to Limuli Laboratories and its horseshoe crab harvesting and blood-draining practices. By applying the straightforward text of the statutory Moratorium to Limuli Laboratories’ activities, Petitioners request that DEP issue a declaratory ruling that finds Limuli Laboratories in persistent violation of the law.

1. The Law: New Jersey’s Statutory Moratorium on Taking Horseshoe Crabs.

In 2008, responding to blaring scientific alarms that the red knot and other shorebird populations declined by “highly significant” numbers despite millions of dollars “spent on the protection and restoration of shorebird populations and their habitats,” the Legislature determined that “a moratorium on the harvest, landing and possession of horseshoe crabs is critical to ensure that more horseshoe crab eggs will be available as a food source.” N.J.S.A. § 23:2B-20. Describing the enacted legislation, Senator Bob Gordon (D – Bergen) said, “We are giving the food chain a chance to recover from our interference and giving the red knot and other shorebirds a chance to rebound from annihilation.” See Jim Six, “Corzine bans harvesting horseshoe crabs indefinitely,” South Jersey Times, Mar. 25, 2008, *available at* https://www.nj.com/south/2008/03/corzine_to_sign_ban_on_harvest.html (last visited July 27, 2026).

To meet these lofty protection standards, the Legislature enacted a strict moratorium on horseshoe crab harvesting with exceptions only in narrow circumstances. The Moratorium’s language, in relevant part, reads:

- a. Except as provided pursuant to subsection b. or c. of this section, ***there shall be a moratorium on the taking in the State of horseshoe crabs or the eggs of horseshoe crabs, on the landing in the State of such crabs or the eggs of horseshoe crabs taken from outside of the State, and on the possession of horseshoe crabs or the eggs of horseshoe crabs regardless of their origin***, until such time as: (1) the recovery targets for the population of the red knot shorebird, identified pursuant to the United States Fish and Wildlife Service 2007 status assessment, entitled “Status of the Red Knot (*Calidris canutus rufa*) in the Western Hemisphere,” are met; and (2) a shorebird management plan, which, based upon scientific study and evidence, demonstrates to the satisfaction of the Department of Environmental Protection that a more than adequate food supply from horseshoe crab eggs for shorebirds and population viability for both shorebirds and horseshoe crabs exist. [. . .]
- b. **Notwithstanding the provisions of this section to the contrary, the Department of Environmental Protection may issue a permit for:**
 - 1) the taking, landing and possession of horseshoe crabs or the eggs of horseshoe crabs for scientific or educational purposes only, provided that the department determines that the collection of the horseshoe crabs or the eggs of horseshoe

crabs for these purposes will not cause harm to the red knot, other shorebirds, or horseshoe crab populations; or

- 2) the collection of blood from horseshoe crabs for biomedical purposes, ***provided that the horseshoe crabs are released otherwise unharmed to the same waters from which they were collected.***

- c. The moratorium established in subsection a. of this section shall not apply to the possession and use of horseshoe crabs harvested outside of the State, provided that the person found in possession of, or using, the horseshoe crabs has documentation which shows that the horseshoe crabs were not harvested in New Jersey. [. . .]

N.J.S.A. § 23:2B-21 (highlights and emphases added). In short, the Moratorium prohibits all “taking” or “landing” of horseshoe crabs in New Jersey, with an exception for harvesting for biomedical bleeding purposes “provided that the horseshoe crabs are released otherwise unharmed to the same waters from which they were collected.” *Id.*; see also NJDEP, “Wildlife Populations: Horseshoe Crab.” Environmental Trends Report, NJDEP, Division of Science and Research. Last modified May 2025, available at <https://dep.nj.gov/dsr/environmental-trends/wildlife-populations-horseshoe-crab/> (last visited July 16, 2026) (“New Jersey adopted a moratorium on the harvesting of horseshoe crabs in 2008 (N.J.S.A. 23:2B-21), with an exception for the *nonlethal* collection of blood from horseshoe crabs for biomedical purposes”) (emphasis added).

The Moratorium went into effect March 25, 2008. At that time, DEP had specific horseshoe crab regulations, which provided for a harvest quota of 150,000 horseshoe crabs “or as modified by the Commissioner” after December 31, 2007. See N.J.A.C. § 7:25-18.16. Since the Moratorium, however, DEP has *not* updated its regulations. In other words, DEP has not promulgated any regulations implementing the statutory language of the Moratorium, and its existing horseshoe crab regulations are inconsistent with the statutory Moratorium.

2. The Facts and Circumstances: Limuli Laboratories Harvests, Bleeds, and Kills Horseshoe Crabs.

According to a 2025 report that New Jersey submitted to the Atlantic States Marine Fisheries Commission, “Limuli Laboratories in Cape May Court House, NJ on Delaware Bay, operating under a Division of Fish and Wildlife (Division) Scientific Collecting Permit, utilizes horseshoe crabs for the production of Limulus Amoebocyte Lysate (LAL).”¹ Limuli Laboratories was originally a Cape May County company named Finn-Tech that would “collect and bleed horseshoe crabs”; after the founder James Finn died in 1991, Benjie Swan “took over operation of the lab, which was renamed Limuli Laboratories.” *Lamanna v. Swan*, 2012 N.J. Super. Unpub. LEXIS 1868, *13-14 (N.J. Super. App. Div. Jul. 20, 2012). Ms. Swan continues to run Limuli Laboratories out of Cape May County.

¹ Danielle Dyson, “New Jersey Horseshoe Crab Management and Monitoring Program 2024 and Management and Monitoring Program Planned for 2025,” at 3 (July 2025) (attached as Exhibit (“Ex.”) 1).

Limuli Laboratories receives an annual permit from the Marine Resources Administration within DEP. The permit, which has Scientific Collecting Permit number 1848 and is typically issued in February or March of each year, authorizes both “shore collection” by hand and “at-sea collection” by trawl. *See* 2023, 2024, and 2025 Scientific Collecting Permits (attached as Exs. 2-4).² The permit authorizes hand collection in June and July, and collection by trawl from the end of June to the end of December—it allows a “maximum number of 1200 horseshoe crabs per 24 hours” for each method. *See id.* DEP’s Marine Resources Administration has issued Limuli Laboratories a Scientific Collecting Permit for 2026. *See* Ex. 5.

Each annual permit includes a provision identifying the laws and regulations applicable to Limuli Laboratories and its “Subsidiary Permit Holders.” That paragraph also explains the consequences of violating applicable laws, regulations, and permit terms and conditions. The paragraph states:

Violation by the permittee or any Subsidiary Permit Holders of any term or condition of the permit or any State law or regulation promulgated pursuant to N.J.S.A. Title 23 or 50 or N.J.A.C. 7:25 or 7:25A shall render this permit null and void and may subject the permittee and/or Subsidiary Permit Holder to prosecution in addition to permit revocation. Applications for future permits may also be denied.

See 2023 Scientific Collecting Permit ¶ 7; 2024 Scientific Collecting Permit ¶ 7; 2025 Scientific Collecting Permit ¶ 7; 2026 Scientific Collecting Permit ¶ 7 (all attached as Exs. 2-5). The Moratorium is a state law located within the Marine Fisheries chapter of N.J.S.A. Title 23. *See* N.J.S.A. § 23:2B-21.

Limuli Laboratories is both collecting and landing horseshoe crabs in New Jersey. The company hand collects horseshoe crabs between Dennis Creek and Cohansey River and trawls for horseshoe crabs in State waters from Ocean City to Cape May. *See, e.g.,* 2025 Scientific Collecting Permit at 2 (attached as Ex. 4). Limuli Laboratories’ “Biomedical Collection Reporting Worksheet” to the Atlantic States Marine Fisheries Commission (“ASMFC”) for fishing year 2025 identified New Jersey as the “State of Landing” for all the horseshoe crabs it reported bleeding. *See* Limuli Labs. Jan. 8, 2026 Report at 2 (attached as Ex. 6).

Limuli Laboratories’ operations kill and injure hundreds to thousands of horseshoe crabs. Public records from the Limuli Laboratories’ reports to DEP show the significant death and destruction that the company is leveling on horseshoe crabs, both individually and in aggregate. Below are screenshots from the company reports for the 2023, 2024, and 2025 fishing years (the reports, excluding their trawl reporting forms, are attached as Exs. 6-8):

² Petitioners do not think that DEP should be using a Scientific Collecting Permit to authorize Limuli Laboratories’ horseshoe crab harvesting and blood draining practices. The statutory language of the Moratorium itself distinguishes between taking horseshoe crabs “for scientific or educational purposes only”—i.e., the purpose of a Scientific Collecting Permit, *see* N.J.S.A. § 23:4-52 (authorizing DEP to grant permission to “collect” animals and their eggs “for strictly scientific purposes only”)—and “the collection of blood from horseshoe crabs for biomedical purposes.” *Compare* N.J.S.A. § 23:2B-21(b)(1) *with id.* § 23:2B-21(b)(2). This means the Legislature did not believe that draining horseshoe crab blood to use in industry was “scientific or educational purposes only.”

A total of [REDACTED] horseshoe crabs were collected between June 9th and December 21st of 2023. Of these [REDACTED] were hand collected [REDACTED] and [REDACTED] were trawl collected [REDACTED]. Trawl collection of the horseshoe crabs was conducted in [REDACTED]. During the 87 fishing excursions, 1,398 horseshoe crabs were rejected on board for minor injuries. Specifics for the fishing trips are detailed on the Biomedical Collection Reporting Forms.

A total of [REDACTED] animals were transported to the facility. Of these, [REDACTED] horseshoe crabs [REDACTED] were utilized and the remainder rejected (4,568 or [REDACTED]). The rejections were due to minor injury (3,330 or [REDACTED]), slow movements (988 or [REDACTED]) mortality (237 or [REDACTED]) and small size (13 or [REDACTED]). All the horseshoe crabs were released into the waters of the Delaware Bay.

Excerpt from Jan. 20, 2024 report for 2023 fishing year

A total of [REDACTED] horseshoe crabs were collected between June 17th and December 9th of 2024. Of these [REDACTED] were hand collected [REDACTED] and [REDACTED] were trawl collected in [REDACTED]. Trawl collection of horseshoe crabs was conducted in State waters off [REDACTED]. During the 85 fishing excursions, 1,185 horseshoe crabs were rejected on board for minor injuries. Specifics for the fishing trips are detailed in the Biomedical Collection Reporting Forms.

A total of [REDACTED] animals were transported to the facility. Of these, [REDACTED] horseshoe crabs [REDACTED] were utilized and the remainder rejected (4,126 or [REDACTED]). The rejections were due to minor injury (2,762 or [REDACTED]), slow movements (853 or [REDACTED]) mortality (467 or [REDACTED]) and small size (44 or [REDACTED]). All the horseshoe crabs were released into the waters of Delaware Bay.

Excerpt from Jan. 28, 2025 report for 2024 fishing year

A total of [REDACTED] horseshoe crabs were collected between June 10th and December 7th of 2025. Of these, [REDACTED] were hand collected along [REDACTED] and [REDACTED] were trawl collected [REDACTED]. Trawl collection of horseshoe crabs was conducted in [REDACTED]. During the 78 fishing excursions, 1,610 horseshoe crabs were rejected on board for minor injuries. Specifics for the fishing trips are detailed in the Biomedical Collection Reporting Forms.

A total of [REDACTED] animals were transported to the facility. Of these, [REDACTED] horseshoe crabs [REDACTED] (%) were utilized and the remainder rejected (4,134 [REDACTED] %). The rejections were due to minor injury (2,523 or [REDACTED] %), slow movements (1,366 or [REDACTED] %), mortality (240 or [REDACTED] %) and small size (5). All the horseshoe crabs were released into the waters of Delaware Bay.

Excerpt from Jan. 8, 2026 report for 2025 fishing year

Despite the redactions, these show that over the past three years, Limuli Laboratories reported killing an average of 315 and injuring an average of 4,270 horseshoe crabs per year.

These deaths and injuries are separate and apart from the killing, injuring, and other sub-lethal effects occurring during and after bleeding. The above excerpted reports only discuss mortality and injury for horseshoe crabs “rejected” at the facility, which are distinct from “utilized” (*i.e.*, bled) horseshoe crabs. In other words, the reports identify deaths and injuries for horseshoe crabs who were never bled. For the crabs who are bled, the reports are silent—Limuli Laboratories does not report death and injury data for the horseshoe crabs it “utilizes.”

And indeed, death and injury from the bleeding itself are rampant in the horseshoe crab blood harvesting industry. Study after study has found that collecting horseshoe crabs and draining them of their blood generates post-bleeding death rates of up to 30%,³ not to mention sub-lethal effects like injuries and spawning impairment.⁴ Even the ASMFC—whose mortality rate is on the low end—uses 15% bleeding mortality for horseshoe crabs harvested for blood.⁵ Thus, if Limuli Laboratories harvests and bleeds around 100,000 horseshoe crabs each year under its Scientific Collecting Permit (an expected bleeding total from an industrial operation that makes 78 trawling and hand-harvesting trips per year, with a trip limit of 1200 horseshoe crabs), then Limuli is killing 15,000 to 30,000 horseshoe crabs per year (and injuring and harming many more) *in addition* to the hundreds of horseshoe crabs it annually reports killing.

Limuli Laboratories' owner Benjie Swan also acknowledges that people working for the company regularly pick up horseshoe crabs by their telsons. *See* Recording, ASMFC Horseshoe Crab Biomedical Best Management Practices Work Group Public Meeting at 1:15:51 (“We do pick the crabs up by the tail.”), 1:18:05 (“I’ve picked up thousands and millions of crabs by the tail. . .”).⁶ Lifting horseshoe crabs by their telsons causes soft tissue injuries, which can develop into erosive lesions and can interfere with the crabs’ abilities to right themselves when flipped into dorsal recumbency on beaches.⁷ It is also contrary to guidance from several state agencies, which explain that picking up a horseshoe crab by the telson can “harm” or “injure” the animal.⁸

³ E.g., Leschen, A.S. & S.J. Correia. 2010. Mortality in Female horseshoe crabs (*Limulus Polyphemus*) From Biomedical Bleeding and Handling: Implications for Fisheries Management, 43 Marine & Freshwater Behaviour and Physiology. 135-147.

⁴ E.g., Anderson, R.L. et al. 2013. Sublethal behavioral and physiological effects of the biomedical bleeding process on the American horseshoe crab, *Limulus polyphemus*, 225 Biol. Bulletin. 137-151 (“These previously unrecognized behavioral and physiological deficits suggest that the harvest of LAL may decrease female fitness, and thus may contribute to the current population decline”).

⁵ *See* ASMFC 2024 Horseshoe Crab Stock Assessment Update at 1 (Apr. 30, 2024), *available at* https://asmfc.org/wp-content/uploads/2025/01/HorseshoeCrabStockAssessmentUpdate_April2024.pdf (“The bleeding mortality rate of 15% from the meta-analysis of bleeding studies during the benchmark was applied to the numbers of bled crabs to estimate bleeding mortality. . . . The estimated mortality from the biomedical industry in 2022 was 145,920 horseshoe crabs, the highest in the time series.”).

⁶ The recording is on file with undersigned counsel for Petitioners; we are willing to share it with DEP upon request. A very generalized summary of the meeting is available at https://asmfc.org/wp-content/uploads/2025/02/BMP_WG_MeetingSummary_Jan2023.pdf (last visited June 16, 2026).

⁷ *See* N.G. Dannemiller et al. 2024. Traumatic telson avulsion and attempted external stabilization in Atlantic horseshoe crabs (*Limulus polyphemus*), 43 Zoo Biology 205-209 (attached as Ex. 9) (reporting on three horseshoe crabs with partial telson avulsion, “a severe soft-tissue injury with subsequent animal welfare implications”); *id.* (“To avoid potentially serious telson ligament injury, [horseshoe crabs] should never be picked up by the telson.”).

⁸ E.g., Fla. Fish & Wildlife Comm’n, “Facts About Horseshoe Crabs and FAQ,” *available at* <http://myfwc.com/research/saltwater/crustaceans/horseshoe-crabs/facts/> (last visited June 15, 2026) (“Never pick up a horseshoe crab by its tail, as it can harm the animal.”); S.C. Marine Resources Div., “Horseshoe Crabs,” *at* <https://www.dnr.sc.gov/marine/pub/seascience/horseshoecrab.html> (last visited July 2, 2026) (“Do not pick a horseshoe crab up by its tail – the tail is very sensitive and easily injured.”).

3. Limuli Laboratories Is Persistently Violating the Moratorium.

The state of facts described above show that Limuli Laboratories' horseshoe crab collection, landing, and bleeding practices are violating the statutory Moratorium, and Petitioners therefore request that DEP make a declaratory ruling to that effect. A multiple-step analysis shows that the Moratorium is a DEP-enforced statute that covers Limuli Laboratories, and that Limuli Laboratories' activities persistently violate the Moratorium.

First, the Moratorium prohibits “the taking in the State of horseshoe crabs or the eggs of horseshoe crabs, [. . .] the landing in the State of such crabs [, and . . .] the possession of horseshoe crabs or the eggs of horseshoe crabs regardless of their origin,” until such time as the (1) U.S. Fish and Wildlife recovery targets for the red knot population are met *and* (2) DEP is satisfied with a shorebird management plan providing more than adequate food supply from horseshoe crab eggs. N.J.S.A. § 23:2B-21(a). The red knot population recovery targets have not been met,⁹ which means that the Moratorium prohibitions are operative.

Second, as demonstrated in Section 2 above, Limuli Laboratories hand-collects horseshoe crabs from New Jersey shores in June and July, and collects horseshoe crabs via trawl from State waters from Ocean City to Cape May. The company also brings the crabs it collects to its facility in New Jersey. It thus engages in the “taking” and “landing” of horseshoe crabs “in the State,” and is covered by the requirements of the Moratorium. *See* N.J.S.A. § 23:2B-21(a). Because Limuli Laboratories' activities fall within the prohibitions of subsection (a), the next question is whether its operations satisfy the exceptions of either subsection (b) or (c). *Id.* (“Except as provided pursuant to subsection b. or c. of this section . . .”).

Third, Limuli Laboratories is not exempt from the Moratorium via subsection (c), which makes clear that the Moratorium “shall not apply to the possession and use of horseshoe crabs harvested outside of the State.” *Id.* § 23:2B-21(c). The 2023, 2024, 2025, and 2026 permits all show that Limuli Laboratories harvests horseshoe crabs in New Jersey. *See* Exs. 2-5 (describing where the hand and trawl collecting is occurring).

Fourth, subsection (b) does apply to Limuli Laboratories, but the company's practices do not satisfy all elements of the exemption. The Moratorium statute states that DEP “may issue a permit for the collection of blood from horseshoe crabs for biomedical purposes,” N.J.S.A.

⁹ NJDEP. “Wildlife Populations: Red Knot.” Environmental Trends Report, NJDEP, Division of Science and Research. Last modified June 2025, *available at* <https://dep.nj.gov/dsr/environmental-trends/wildlife-populations-red-knot/> (last visited July 16, 2026) (“This wintering population, comprised of long-distance migrants, has declined most rapidly; 74% in 20 years. Overall, a hemispheric population estimated at 160,000 individuals in the mid-1980’s may number just about 46,000 as of September 2024.”). This decline shows the population is well below the recovery target identified in the Moratorium. *See* NJDEP, “Status of Red Knot (*Calidris canutus rufa*) in the Western Hemisphere,” Prepared for U.S. Fish and Wildlife Service (May 2007), *available at* <https://www.fws.gov/doiddata/dwh-ar-documents/1278/DWH-ARZ001219.pdf> (last visited May 15, 2026) (recovery target of at least 100,000 red knots at Delaware Bay stopover).

§ 23:2B-21(b)(2), and DEP has repeatedly issued an annual permit to Limuli Laboratories for horseshoe crab blood collection, *see* Exs. 2-5 (Scientific Collecting Permits).¹⁰

However, the Moratorium qualifies its blood-harvesting exemption: the DEP permit only exempts a permit recipient like Limuli Laboratories from subsection (a), “***provided that the horseshoe crabs are released otherwise unharmed to the same waters from which they were collected.***” N.J.S.A. § 23:2B-21(b)(2) (emphasis added). The state of facts, as described in Section 2 above, show that Limuli Laboratories is not “releasing” the horseshoe crabs it collects “otherwise unharmed” to the waters where it collected the crabs. Limuli Laboratories does not satisfy this exemption in at least three ways:

- **Limuli Laboratories is “otherwise harming” the horseshoe crabs it kills and injures.** Limuli Laboratories itself reports that it kills, on average, over 300 horseshoe crabs, and injures, on average, over 4,000 horseshoe crabs each year. *See* Section 2, above. These reported numbers do not include the post-bleeding mortalities and injuries, which—according to mortality and injury rates from published research (30% mortality) and the ASMFC (15% mortality)—means Limuli Laboratories is killing and injuring tens of thousands more horseshoe crabs each year. In addition, Limuli Laboratories admits to regularly lifting up horseshoe crabs by the telson, which is widely known to cause injury. Killed and injured horseshoe crabs are not “otherwise unharmed” in any sense of the phrase within the statutory Moratorium.
- **Limuli Laboratories is not “releasing” the horseshoe crabs it is killing.** The horseshoe crabs that Limuli Laboratories kills—including both those crabs it reports killing and those unreported crabs that die during or immediately after bleeding—are not being “released . . . to the same waters from which they were collected.” One cannot “release” an already dead horseshoe crab. *See* “Release” Definition, Merriam-Webster Online, at <https://www.merriam-webster.com/dictionary/release> (“to set free from restraint, confinement, or servitude”) (last visited July 16, 2026). Limuli Laboratories’ failure to release the horseshoe crabs it takes also violates the Moratorium.
- **Limuli Laboratories is not releasing horseshoe crabs “to the same waters from which they were collected.”** Limuli Laboratories’ release of live horseshoe crabs is also contrary to the exception in the Moratorium. The Scientific Collecting Permit authorizes Limuli Laboratories to collect horseshoe crabs by John Ciliberto “in the waters of the Atlantic Ocean between 2 and 3 nautical miles off New Jersey from Atlantic City to Cape May.” *E.g.*, Ex. 4 at 1, Ex. 5 at 1 (2025 and 2026 Scientific Collecting Permits). And indeed, Ciliberto collected horseshoe crabs for Limuli Laboratories by trawling in the Atlantic Ocean at a nearly daily rate between July and December 2025. *See, e.g.*, Ex. 10 (trawl data and representative examples of Ciliberto trawl reports). Yet Limuli Laboratories returned all the horseshoe crabs it bled to either Highs Beach or West Creek

¹⁰ As discussed in footnote 2, Scientific Collecting Permits are not the appropriate type of permit for the horseshoe crab bleeding industry practice and DEP’s use of them is inconsistent with the Moratorium statute. Regardless, Petitioners seek a declaratory ruling that DEP should not be issuing *any type of permit* for Limuli Laboratories, considering that the company’s operations consistently violate the Moratorium.

in Delaware Bay. *See* Ex. 4 at 1 (2025 Scientific Collecting Permit) (“All horseshoe crabs collected under this permit will be returned to Delaware Bay at Highs Beach or West Creek.”). These locations in Delaware Bay are not anywhere close to the “same waters” as 2 to 3 miles off the coast between Atlantic City and Cape May. In fact, during the late fall and winter months, horseshoe crabs travel away from Delaware Bay to Atlantic Ocean waters.¹¹ By collecting horseshoe crabs from the Atlantic Ocean, bleeding them, and then releasing them to the Delaware Bay shoreline, Limuli Laboratories is returning injured or weakened crabs to waters that are not seasonally appropriate, violating the Moratorium and significantly threatening the animals’ survival.

In summary, the unredacted information from Limuli Laboratories’ permits and reports, scientific studies showing post-bleeding mortality rates, and Ms. Swan’s public acknowledgment of picking up horseshoe crabs by their telsons all show that the company has persistently violated the statutory Moratorium and will continue to do so as long. Its violations of the plain text of the Moratorium also conflict with the purpose of the law, which is to avoid depleting horseshoe crab eggs and recover the shorebirds that feed on the eggs. *See* N.J.S.A. § 23:2B-20. By killing horseshoe crabs, injuring the crabs, and bleeding them in a way that creates sublethal behavioral and physiological deficits, Limuli Laboratories is reducing the number of horseshoe crabs who come to spawn and create food for the red knot and other shorebirds.¹²

4. Limuli Laboratories Has Violated Its Past Three Permits and Will Do So Again.

Limuli Laboratories is also violating a central provision of its DEP permit. As described in Section 2 above, each year’s Scientific Collection Permit states that Limuli Laboratories’ violation of “any State law or regulation promulgated pursuant to N.J.S.A. Title 23 . . . shall render this permit null and void,” may subject Limuli Laboratories or its subsidiary permit holders to prosecution “in addition to permit revocation,” and may lead DEP to deny applications for future permits. *E.g.*, 2026 Scientific Collecting Permit ¶ 7 (attached as Ex. 5).

The Moratorium is a statutory provision within Title 23 of New Jersey Statutes Annotated. As detailed in Section 3 above, Limuli Laboratories is consistently violating the Moratorium. Therefore, by operation of the permit, Limuli Laboratories’ violation of the Moratorium shall automatically render any active Scientific Collecting Permit “null and void” and revoke the permit, may subject Limuli Laboratories to prosecution, and should lead DEP to deny any future permit applications.

¹¹ *See* M. Ellwood et al., Subtidal Movements of Horseshoe Crabs in the Delaware Bay (2015) (poster finding that “females may begin to leave the Delaware Bay in October”) (attached as Ex. 11).

¹² Female horseshoe crabs spawn roughly 80,000 eggs within a few days upon arrival at the beach each year. *See* Shuster et al. eds., *The American Horseshoe Crab* at 34-36 (Harvard Univ. Press 2003) (attached as Ex. 12). Assuming that half of Limuli Laboratories’ reported mortalities are females, its reported mortalities for the 2024 fishing year meant that Limuli Laboratories removed 18.6 million horseshoe crab eggs from becoming a potential food source for shorebirds that year ((467 killed crabs / 2) * 80,000). This number does not account for eggs from the thousands of horseshoe crabs Limuli Laboratories reported it injured and as a result did not come ashore to spawn, and it also does not account for eggs from the unreported tens of thousands of horseshoe crabs Limuli Laboratories killed and injured through bleeding.

5. Remedy: DEP Should Declare that Limuli Laboratories and Its Practices Are Persistently Violating the Moratorium.

Petitioners respectfully request that DEP make a declaratory ruling on the applicability of the Moratorium to Limuli Laboratories' deadly and injurious horseshoe crab harvesting and blood-draining practices. Considering the facts presented herein, DEP should rule that Limuli Laboratories is persistently violating the Moratorium.

Thank you very much for your consideration of this highly pressing issue. Please feel free to contact me if you have any questions or would like more information in support of this petition's request.

Respectfully,

/s/ Daniel H. Waltz

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On behalf of the following twenty interested parties:

CENTER FOR BIOLOGICAL DIVERSITY
National

NEW JERSEY AUDUBON SOCIETY
New Jersey

NEW JERSEY CONSERVATION FOUNDATION
New Jersey

CITIZENS UNITED TO PROTECT THE MAURICE RIVER AND ITS TRIBUTARIES
New Jersey

LEAGUE OF WOMEN VOTERS OF NEW JERSEY
New Jersey

SAVE COASTAL WILDLIFE
New Jersey

AMERICAN BIRD CONSERVANCY
National

HUMANE WORLD FOR ANIMALS
National

NATIONAL WILDLIFE FEDERATION
National

DELAWARE RIVERKEEPER NETWORK

New Jersey, Delaware, Pennsylvania, New York

NY/NJ BAYKEEPER

New Jersey, New York

UPSTREAM ALLIANCE

New Jersey, Maryland, New York

DELAWARE AUDUBON SOCIETY

Delaware

DELAWARE ORNITHOLOGICAL SOCIETY

Delaware

MARYLAND BIRD CONSERVATION PARTNERSHIP

Maryland

FRIENDS OF THE BAY

New York

TIM CERNAK, UNIVERSITY OF MICHIGAN

Michigan

COASTAL EXPEDITIONS AND THE COASTAL EXPEDITIONS FOUNDATION

South Carolina

100 MILES

Georgia

MARITIME AQUARIUM AT NORWALK

Connecticut

Exhibit 1

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION

DIVISION OF FISH AND WILDLIFE

MARINE FISHERIES ADMINISTRATION

BUREAU OF MARINE FISHERIES

**NEW JERSEY HORSESHOE CRAB
MANAGEMENT AND MONITORING PROGRAM 2024
AND
MANAGEMENT AND MONITORING PROGRAM
PLANNED FOR 2025**

Report By: Danielle Dyson

**Submitted to the Atlantic States Marine Fisheries Commission
as a Requirement to Addendum IV to the
Interstate Fishery Management Plan for Horseshoe Crab**

July 2025

I. Introduction

In May 2006, the New Jersey Department of Environmental Protection (Department) implemented Amendments to N.J.A.C. 7:25-18.16, Horseshoe Crab, *Limulus polyphemus*, requiring a two-year moratorium on the harvesting of horseshoe crabs in the commercial bait fishery. The moratorium was scheduled to lapse prior to the 2008 fishing season. In February 2008, the New Jersey Marine Fisheries Council failed to approve an indefinite extension of the moratorium proposed by the Department. However, prior to the June harvesting season, the State of New Jersey took legislative action (NJ P.L. 2008, Title 23:2B-20) to indefinitely prohibit the harvest and possession of horseshoe crabs from New Jersey waters. Repeal of these statutes will take further legislative action by the State of New Jersey.

II. De Minimis Status

Based on recent year's harvest, New Jersey would qualify for *de minimis* status. However, given the level of importance of New Jersey's waters to the life cycle of horseshoe crabs, New Jersey is not requesting *de minimis* status.

III. 2024 Horseshoe Crab Fishery

A. Fishery Dependent Monitoring

As a result of a moratorium on commercial harvest of horseshoe crabs for bait enacted in 2008, there were no landings of horseshoe crabs in New Jersey for 2024. No fishery dependent monitoring was therefore conducted.

B. Scientific and Education Research Harvest

Any individual or organization intending to collect horseshoe crabs in New Jersey for research or educational purposes must obtain a scientific collecting permit. The New Jersey Marine Fisheries Administration issued 24 scientific collecting permits in 2024 to organizations that interacted with horseshoe crabs.

Scientific collecting permits that allowed for the collection of horseshoe crabs were issued in 2024 to the following types of organizations:

- Aquariums and science centers, for educational displays
- Federal agencies (NMFS, USFWS), for research and educational purposes
- Colleges and universities, for research and education purposes
- Public educational organizations, for educational displays, teaching programs
- County science and technology vocational-technical schools, for teaching programs
- Environmental consultants, for resource monitoring and environmental assessments
- A watershed advocacy group to conduct a spawning survey in portions of Raritan Bay

All Scientific Collecting Permit holders must submit an annual report identifying all organisms collected and the final disposition of those organisms. From the final reports provided, 241,568 horseshoe crabs were collected under scientific collecting permits for research, educational

purposes or environmental assessments. This number is excluding the permit for the biomedical facility, whose numbers are reported within the biomedical confidential data.

C. Biomedical Harvest

Limuli Laboratories in Cape May Court House, NJ on Delaware Bay, operating under a Division of Fish and Wildlife (Division) Scientific Collecting Permit, utilizes horseshoe crabs for the production of Limulus Amoebocyte Lysate (LAL). This biomedical company may collect, **by hand or trawl**, limited numbers of horseshoe crabs in defined locations and at defined time periods. Limuli Laboratories is also in possession of an Exempted Fishing Permit issued by the National Marine Fisheries Service (NMFS) to collect limited numbers of horseshoe crabs **by trawl from** [REDACTED].

Under the terms of the Scientific Collecting Permit issued by the Division, Limuli Laboratories must complete biomedical collection forms (following the questionnaire format suggested in Addendum III for the utilization of horseshoe crabs by the biomedical industry) documenting the collection, handling, transportation, and bleeding of all horseshoe crabs captured. At the time of this writing, Limuli Labs has submitted reports for the 2024 collecting season **with annual numbers for harvest crabs shown in Figure 1.**

*** CONFIDENTIAL DATA ***				
ASMFC Horseshoe Crab Biomedical Collection Reporting Worksheet Fishing Year <u>2024</u>				
Name(s) of Biomedical Company/ies:	Limuli Laboratories			
State of Landing:	New Jersey			
	Male	Female	Sex Unidentified	Total
Number of biomedical-only (not counted against state bait quota) horseshoe crabs collected	[REDACTED]			
Number of biomedical-only horseshoe crabs rejected onboard vessel due to mortality	0	0	0	0
Total (bait and biomedical) number of horseshoe crabs transported to bleeding facility	[REDACTED]			
Number of biomedical-only horseshoe crabs rejected at bleeding facility due to mortality	331	136	0	467
Number of biomedical-only horseshoe crabs bled	[REDACTED]			
Number of bait horseshoe crabs bled	[REDACTED]			

***Addendum III to the Horseshoe Crab Fishery Management Plan requires sex-specific collection and mortality information be reported for horseshoe crabs harvested for biomedical use. Please make all possible efforts to identify number or percentage of Male and Female crabs contributing to the Total number in each row.

Figure 1. Numbers of horseshoe crabs collected for fishing year 2024 by Limuli Laboratories.

D. State Shorebird Monitoring Data

New Jersey's work with shore bird monitoring includes: 1) Monitoring the recovery of shorebirds on the Delaware size by two methods: Bay migration stopover: monitoring rates of mass gain and a year-to-year trend; estimating stopover population bay wide aerial and ground survey, and mark-and-resighting methods; 2) monitoring horseshoe crab egg surface egg densities (as an index of shorebird foraging conditions) and horseshoe crab egg cluster sampling through the Endangered and Nongame Species Program. Additional data can be acquired from NJ staff should it be required.

Delaware Bay Aerial Count – In 2024 peak numbers for red knots increased again (25,667) indicating a greater use of Delaware Bay by red knots with improved foraging conditions over the last two years. Aerial and ground survey does not account for turnover; (the total number of knots moving through Delaware Bay stopover, May 1 to June 7).

Egg Cluster Sampling Synopsis 2024:

Cluster abundance:

The overall average cluster abundance for 2024 was 29.36 clusters/m², making the year above average for the years 2015-2024, which averages 21.20 clusters/m².

The average cluster abundance for 2024 during sampling weeks 2 and 3, when migrating shorebirds were present at the Delaware Bay stopover and feeding, was 32.919 clusters/m², above the 21.344/m² average for the years 2015-2024.

Weeks 1 and 2 had more clusters present than any other year during the same time period over the ten-year dataset, with 33.48/m² for week 1, and 26.92/m² during week 2. For comparison, the previous average cluster density for week 1 for the years 2015-2023 was 3.98/m². This year's high cluster count for week 1 elevated that average to 7.26/m² for the ten-year dataset. Due to the incidence of high cluster abundance from early in the season, most beaches exhibited consistent cluster abundances throughout the six-week sampling period.

Week 3 (37.57/m²) was above average (2015-2024, 19.234/m²), and week 4 (27.7919/m²) was also above average (2015-2024, 23.474/m²).

The peak week for cluster abundance occurred during week 3, when normally the peak occurs during week 5. Furthermore, the week with the second highest cluster abundances occurred in week 1, when normally cluster density during week 1 is the lowest abundance of the season. The average during the peak week was 37.57/m², which is above average for the years 2015-2024 (31.658m²).

Compared to the previous year (2023), cluster abundance increased significantly (50% or more) at Money Island, Pierces Point, Cooks Beach, Sunray, and Cape Shore Labs. Cluster abundance increased across 14 of the 16 beaches monitored, with the exception of Moores Beach and Dyers Cove, which both reflected a decrease in cluster abundance.

Surface egg abundance:

The overall average surface egg abundance for 2024 was 7,618.64/m², making the year above average for the years 2015- 2024, which averages 7,569.206/m².

The average surface egg abundance for 2024 during weeks 2 and 3, while migrating shorebirds were present in the Delaware Bay stopover and feeding, was 5,653.282/m², which is above the average of 3,578.1773/m² for the years 2015- 2024.

During week 1, the overall average for surface egg abundance was significantly above average at 6,033.12/m² when compared to the average for years 2015-2024, at 1,129.104/m². Week 2 (5,024.11/m²), was above average for the ten year study period (2,255.104/m²), with week 3 remaining above average at 6,282.45/m² when compared to the 10-year average of 4,861.637/m². Week 4 (17,373.90/m²) was also considerably above average (2015-2024, 10,842.218/m²). However, weeks 5 (6,296.000/m²) and 6 (6,294.28/m²) were below average for surface egg abundance (13,507.8/m² and 9,102.508/m², respectively) when compared to averages for years 2015-2024.

The peak week for surface egg abundance occurred during week 4, at 17,373.90/m², placing the peak week of the 2024 season above average when compared to the average peak week of surface egg abundance for years 2015-2024 (16,808.571/m²).

Impressions for the season During sampling week 1, there was both a high abundance of egg clusters and a relatively dense presence of horseshoe crabs present on the beach to spawn. Multiple factors influence spawning, including, but not exclusive to, the water temperature of the bay, air temperature, wind speed, wind direction, and the salinity of the water when altered by high amounts of rainfall.

The water temperature of Delaware Bay did not touch 59 degrees Fahrenheit until one day on May 4, for two consecutive days on May 10 and 11, then remaining above 59 degrees on May 19 for the duration of the spawning season (Figure 1). Additionally, the air temperature was not excessively high, reaching only the low to mid-80s for spurts of only one or two consecutive days until June.

In the absence of the other influencing factors mentioned, the main factor seemingly contributing to a dense early spawn appears to be a lack of high wind speeds and a lack of rainfall, keeping shallow coastal waters amply saline and gentle enough to allow for slow-breaking high tidal waves, making ideal conditions for easy spawning early in the season.

Figure 1:

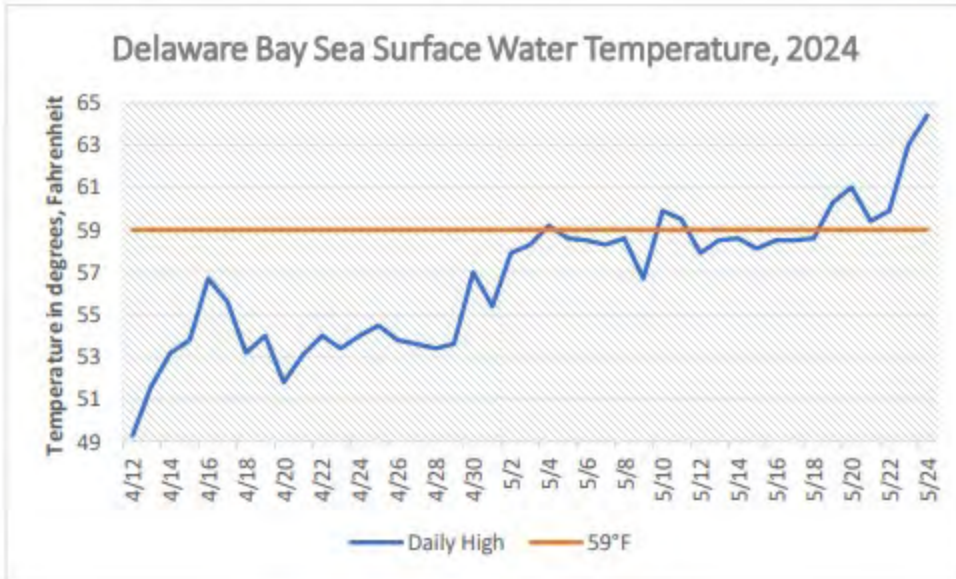


Figure 1: Delaware Bay daily high sea surface water temperature, in degrees Fahrenheit, Delaware Bay, April 12-May 24, 2024. Sea surface water temperature data provided by Seatemperature.info

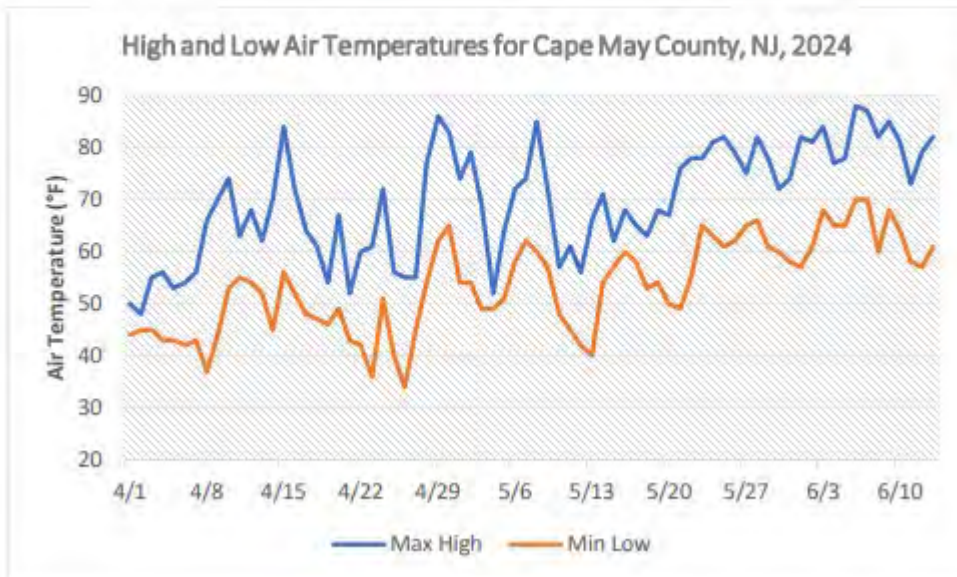


Figure 2: High and low air temperatures, in degrees Fahrenheit, for Cape May County, NJ, April 1-June 13, 2024. Air temperature data provided by Accuweather.com

The peak week for egg clusters/spawning activity occurred during the third week of May whereas during the previous 9 years of data, the peak for egg clusters had occurred early in June. Additionally, the second highest cluster abundance was measured in week 1 of May, which normally has very few clusters. These peaks seem to be very heavily influenced by this year's lunar cycle, correlating with a new moon occurring the first week of May, and the full moon illuminating the third week of May.

Although the egg cluster abundance for this year was above average when compared to the ten-year dataset, surface egg abundance was only average. The weather remained mild throughout the season, with few storms. As a result, there was not much wave action to erode egg clusters, buried to a depth of up to 20cm. Luckily, there were still enough eggs to supply shorebirds with ample food throughout the stopover period. Additionally, the high abundance of clusters remaining in the sand will hopefully boost horseshoe crab recruitment.

E. Fishery Independent Monitoring

The Ocean Trawl Survey began in 1988 and is conducted five* times per year between Cape Henlopen Channel and Ambrose Channel (entrances to Delaware Bay and New York Harbor, respectively) with 39** stations collected for April, June, August, and October cruises and 30 stations collected during January cruises. Historically, total number per tow and total weight per tow were collected along with individual lengths (prosomal widths) and presences/absence data for amplexus scars on females. Since 1999, crabs have been enumerated and weighed by sex. Recent stock assessments for horseshoe crab have used a combined index for surveys conducted in April, August, and October. Stratified arithmetic mean indices of abundance by sex (male / female / juvenile) for these months are shown in Figures 8 - 10.

*No April cruise was conducted in 2019. No cruises ran from April 2020 – December 2021 due to the COVID-19 pandemic. No October cruise was conducted in 2024.

** Sampling was reduced to 30 stations for the October 2022 and April 2023 cruises.

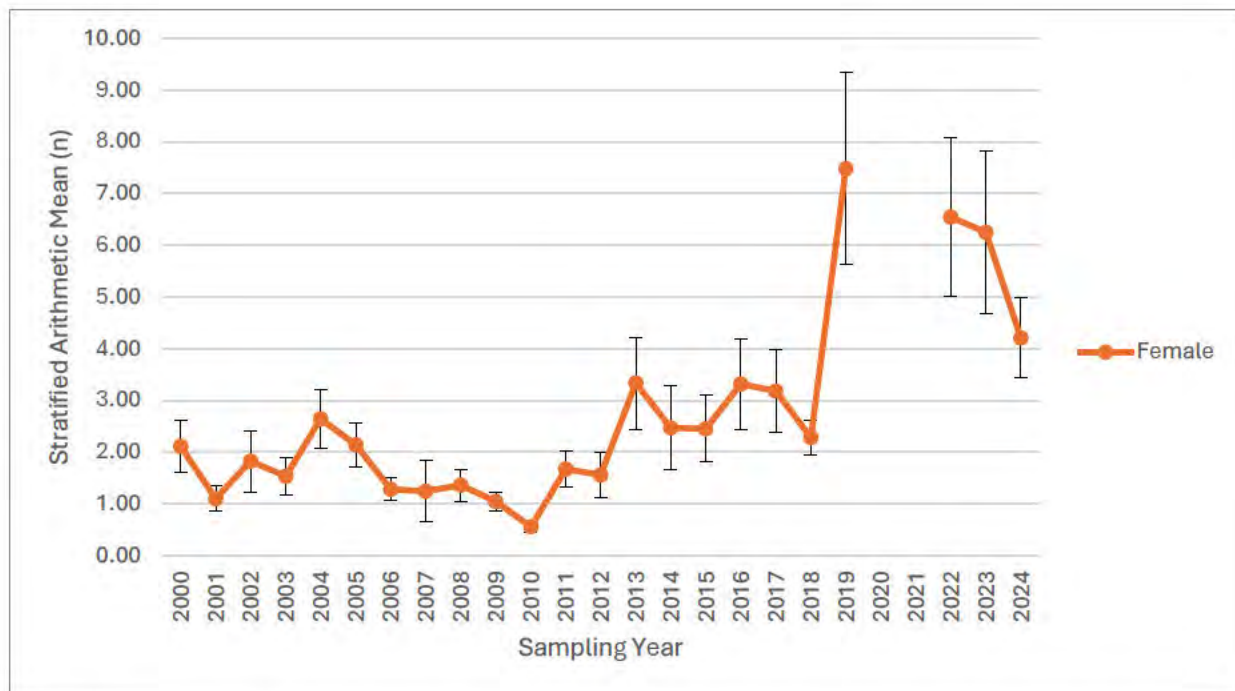


Figure 8. Stratified arithmetic mean number of female horseshoe crabs caught per tow on the New Jersey Ocean Trawl Survey.

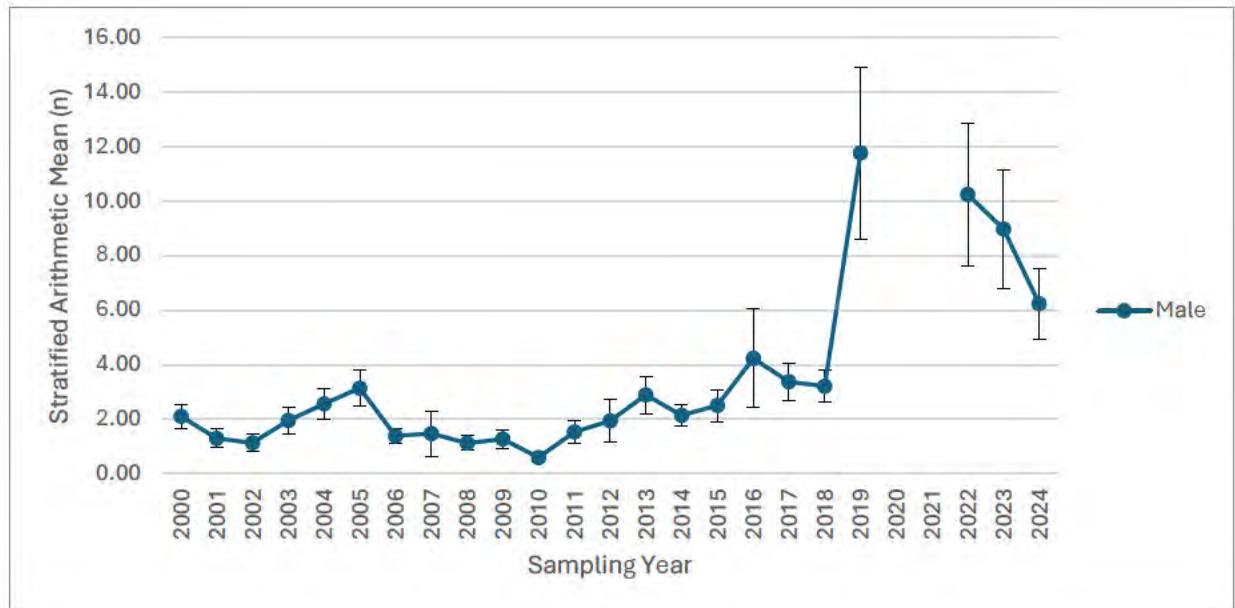


Figure 9. Stratified arithmetic mean number of male horseshoe crabs caught per tow on the New Jersey Ocean Trawl Survey.

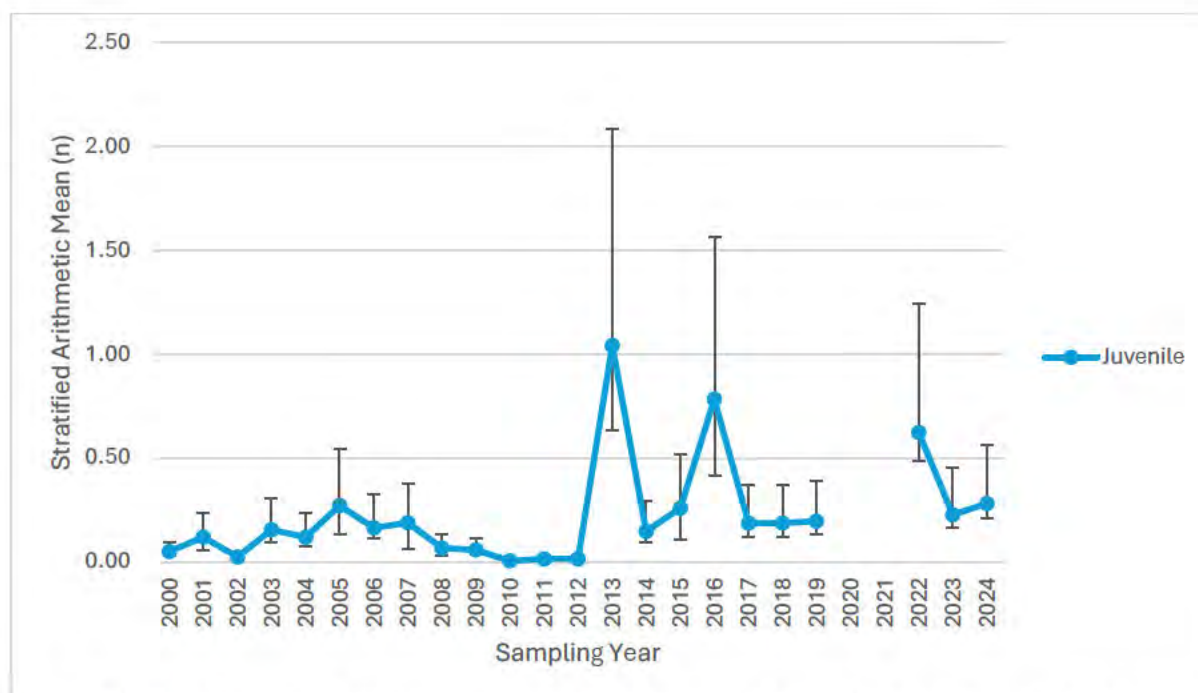


Figure 10. Stratified arithmetic means number of juvenile horseshoe crabs caught per tow on the New Jersey Ocean Trawl Survey.

F. Juvenile Trawl Survey Data

A monthly juvenile finfish trawl survey has been ongoing in New Jersey portions of the Delaware Bay since 1991 from April – October apart from no cruises running in 2020 due to the COVID-19 pandemic. Nursery habitat is being identified through a New Jersey 16-foot trawl survey in Delaware Bay that primarily collects young of year and juvenile horseshoe crabs in the nearshore shallow waters of Delaware Bay. Historically, only the presence/absence of horseshoe crabs were recorded. However, since 1998, crabs have been enumerated and measured by sex. Results of the survey (all months combined) from 1998 through 2024 are shown in Figures 11 – 14 (CPUE by sex) and Figure 15 (frequency distributions of size by sex).

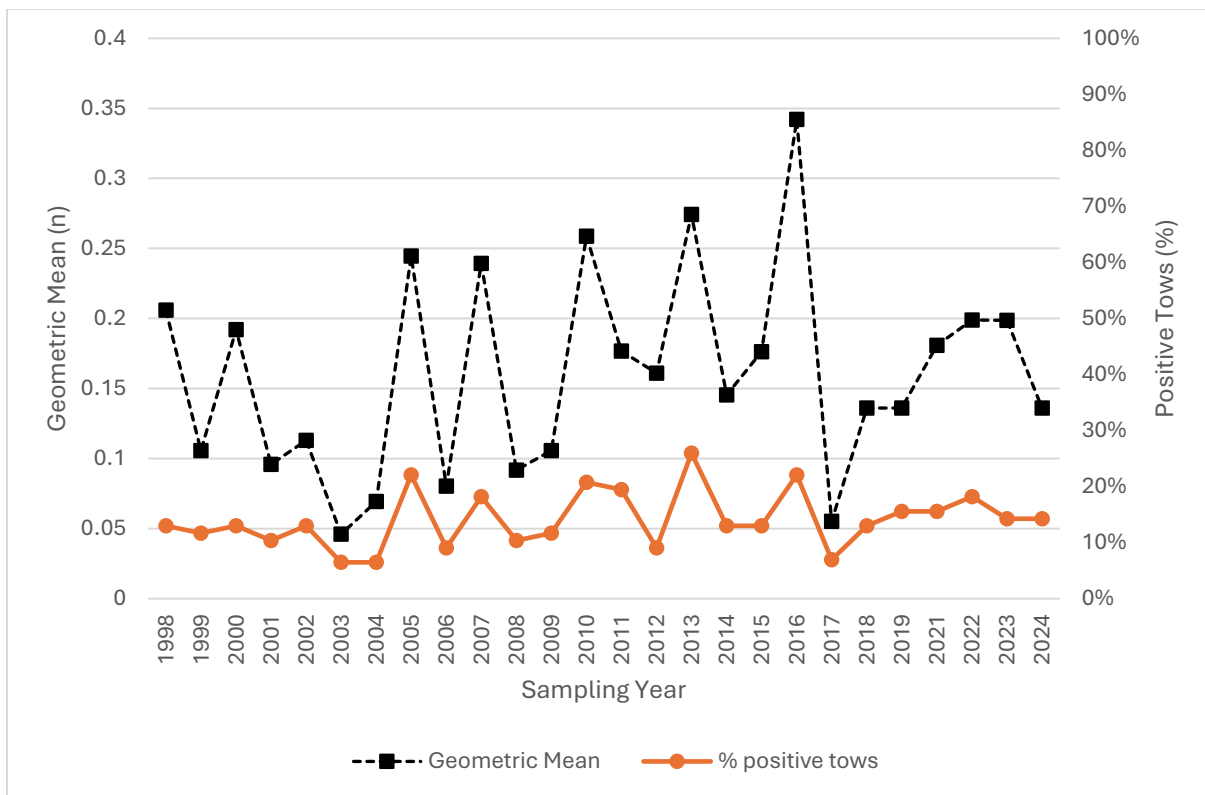


Figure 11. Geometric mean number of female horseshoe crabs caught per tow on the New Jersey Delaware Bay Trawl Survey.

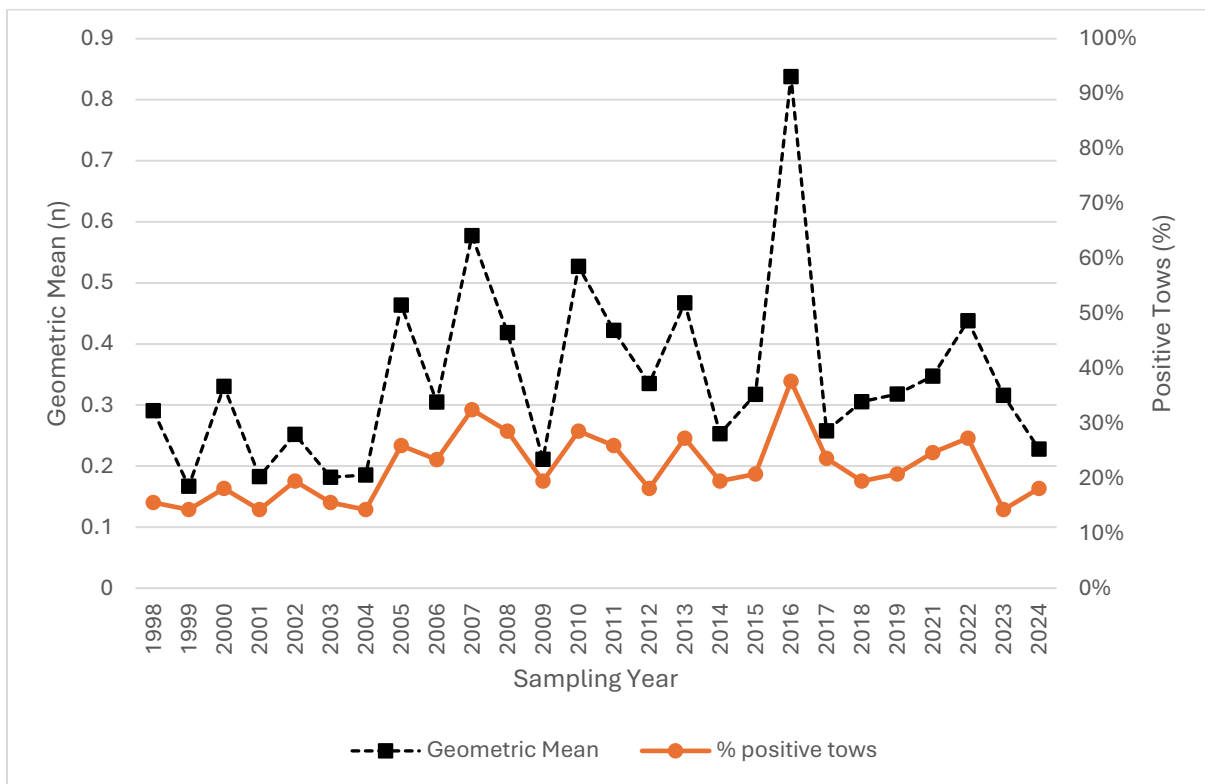


Figure 12. Geometric mean number of male horseshoe crabs caught per tow on the New Jersey Delaware Bay Trawl Survey.

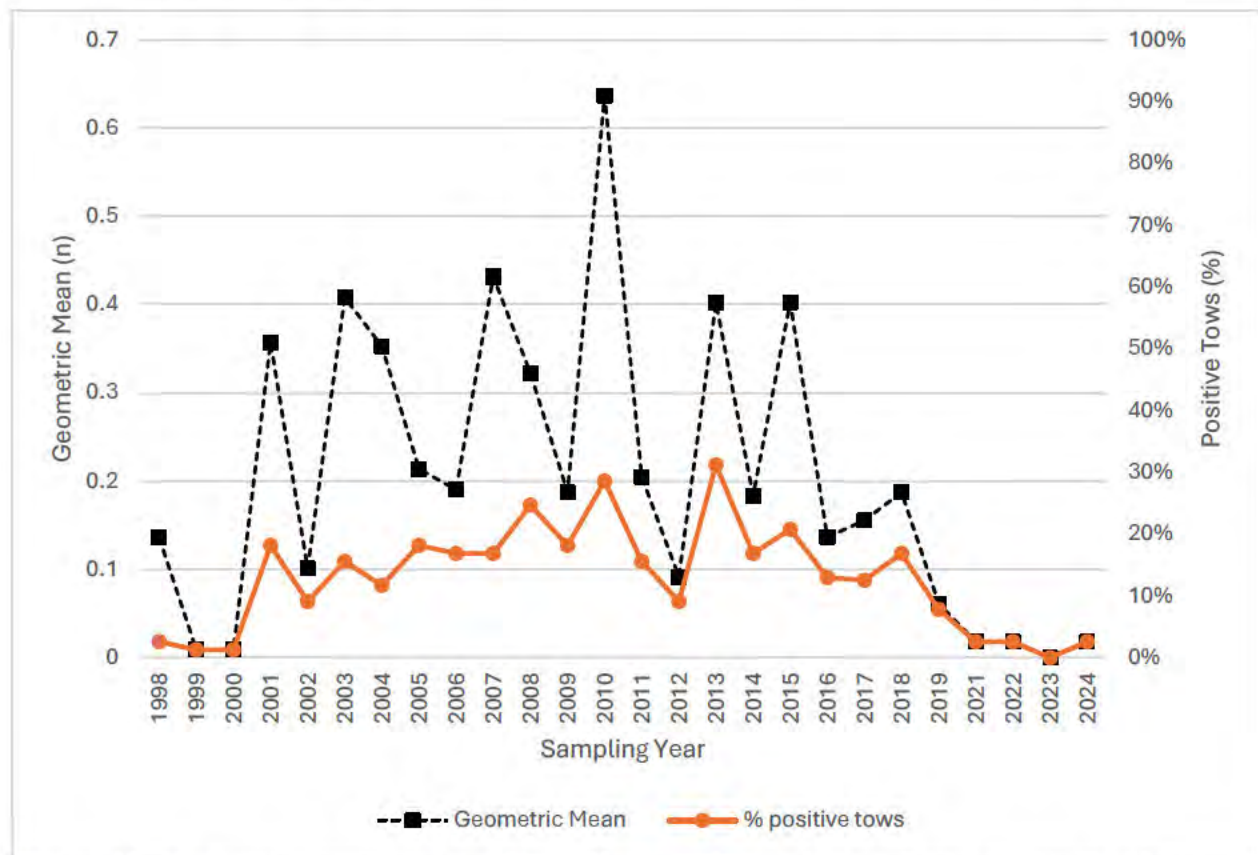


Figure 13. Geometric mean number of juvenile horseshoe crabs caught per tow on the New Jersey Delaware Bay Trawl Survey.

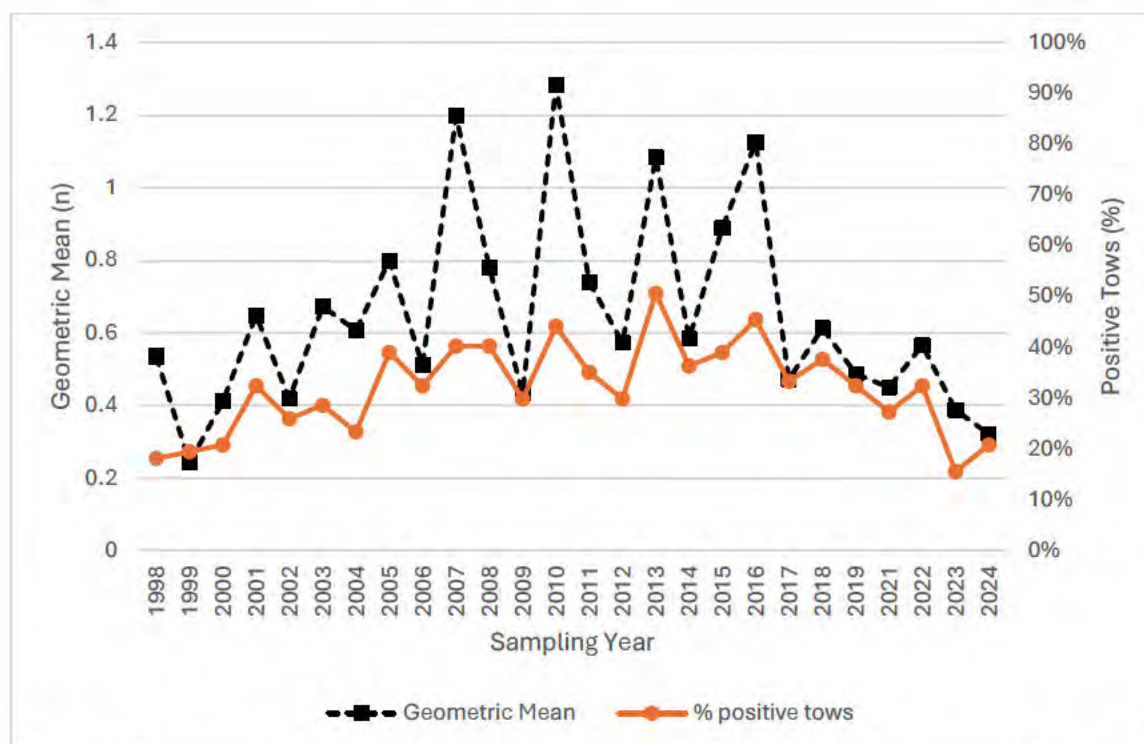


Figure 14. Geometric mean number of all horseshoe crabs caught per tow on the New Jersey Delaware Bay Trawl Survey.

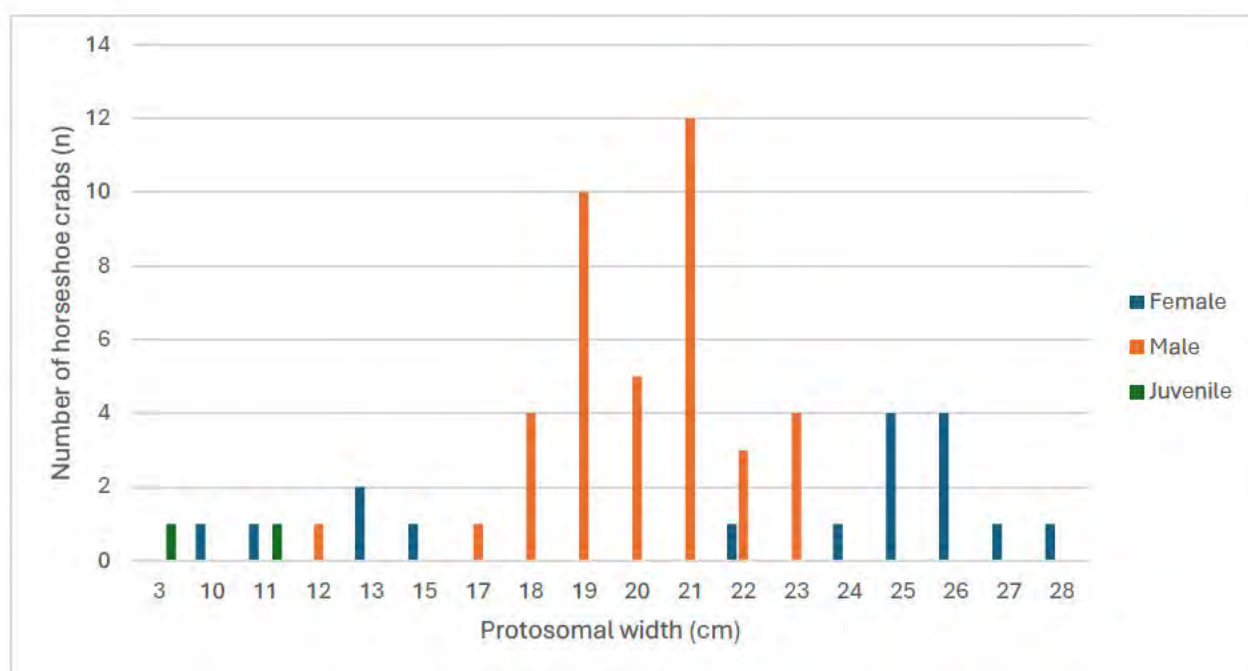


Figure 15. Horseshoe crab length frequencies by sex from the Delaware Bay trawl survey.

IV. Planned Management Programs for 2025

A. Changes from previous years

No changes from previous years.

B. 2025 Monitoring Programs

The moratorium on commercial bait harvest in New Jersey, enacted in 2006, ended as of December 31, 2007. The New Jersey Department of Environmental Protection (Department) proposed a rule to extend the moratorium indefinitely, beginning before the commercial season in 2008. This proposal, however, was vetoed by the New Jersey Marine Fisheries Council (Council), and the Department was unable to implement any management measure.

Subsequently, bills to prohibit the harvest and possession of horseshoe crabs from New Jersey waters were passed in both the New Jersey Senate and Assembly. These bills were signed into action by the Governor of New Jersey in May 2008 (NJ P.L. 2008, Title 23:2B-20). The control of horseshoe crab management is therefore above the jurisdiction of the Department. Harvest and possession of horseshoe crabs from New Jersey waters is prohibited until further legislative action is taken to amend or repeal the current statutes.

New Jersey will continue to conduct all of the fishery independent monitoring programs during 2025 and beyond. This includes the New Jersey Ocean Trawl and the Delaware Bay Trawl Survey. The one exception is the Surf Clam Inventory which lost its funding source (State-Federal Interjurisdictional (IJ) program) in 2012 and was officially concluded in 2019 mainly due to the stocks of surf clam being almost non-existent in NJ Territorial waters with no signs of recovery. The funding has been allocated to other projects. Results of the continuing surveys will be provided in annual compliance reports at a minimum and can be provided upon request from the Technical Committee or other ASMFC body.

New Jersey will continue to assist in the Delaware Bay Spawning Survey to estimate spawning densities on Delaware Bay beaches. Division personnel again assumed responsibility for sampling the horseshoe crab spawning population on Fortescue Beach on the New Jersey side of Delaware Bay, and compiling data from all sampled beaches. Division personnel also received all field data sheets for all beaches that were able to be sampled on both sides of the bay. Datasheets were photocopied and all data were entered in electronic format and submitted all data to the Delaware Division of Fish and Wildlife for analysis.

In the event of a commercial fishing season, New Jersey will resume appropriate fishery dependent monitoring measures.

V. Law Enforcement Reporting

There were no warnings or summons issued for the 2024 fishing year.

Exhibit 2



NJ Department of Environmental Protection
NJ Fish and Wildlife
Marine Resources Administration
PO Box 418
Port Republic, NJ 08241
Phone: (609) 748-2020

2023 Scientific Collecting Permit

Permit Number: 2023- 1848

Date Issued: 03/22/2023

Under provisions of N.J.S.A Title 23:4-52, permission is hereby given to:

Name/Organization	Limuli Laboratories
Address:	6 Eldora Avenue
City, State, Zip	Eldora. NJ 08314
Name:	Benji Swan

To conduct the following activities:

Data will be collected regarding biomedical use of horseshoe crabs. Specifics include number collected, rejected, and released.

Shore Collection of Horseshoe Crabs:

1. No hand collection of horseshoe crabs will be allowed before June 8, 2023.
2. A maximum number of 1200 horseshoe crabs per 24 hours may be collected by hand.
3. Russell Swan and Benjamin Swan will be allowed to hand collect horseshoe crabs in the tributaries of Delaware Bay in the Dividing Creek area using the vessels listed below.
4. Hand collection may take place any day of the week from June through July and none of these crabs may enter the bait market. All horseshoe crabs collected under this permit will be returned to the Delaware Bay at Highs Beach or at West Creek.

At-Sea Collection of Horseshoe Crabs

1. Collecting by use of an otter trawl will occur only from the end of June through December 31, 2023. Fee paid: \$22.00
2. A maximum of 1200 horseshoe crabs may be collected per 24 hours.
3. At-sea collection will only be by commercial otter trawl (5.5" – 6" inch flounder net) by John Ciliberto on the vessel listed below in the waters of the Atlantic Ocean between 2 and 3 nautical

miles off New Jersey from Atlantic City to Cape May. Additionally, horseshoe crabs may be taken by the below trawling vessels operating under the terms and conditions of a valid Exempted Fishing Permit issued by the National Marine Fisheries Service with exempts the below named vessel(s) and owner(s)/operator(s) from the no fishing for or possession of horseshoe crabs with a trawl on board in a section of the EEZ called the Carl N. Schuster, Jr. Horseshoe Crab Reserve. If the summer flounder commercial season is closed, Captain John Ciliberto may keep and land summer flounder bycatch under the terms of the bycatch quota, however, the horseshoe crabs aboard the F/V Barbara Ann or the F/V Margot taken under the terms of the Scientific Collecting Permit issued to Limuli Laboratories may not be included in the total weight of all species used to define the bycatch allowance of summer flounder (i.e. the amount of summer flounder cannot exceed 10% by weight, of the total weight of all species landed and sold). Any other legally permitted species taken during the collection of horseshoe crabs by trawl under the scientific collecting permit may also be sold as long as they comply with existing regulations.

4. Limuli Laboratories will monitor horseshoe crab mortality associated with all steps in the collection, transportation, and bleeding of horseshoe crabs, especially the at-sea culling of horseshoe crabs taken by mobile gear and the result shall be reported in the final report. These data are a New Jersey compliance requirement of Addendum III to the Atlantic States Marine Fisheries Commission's Interstate Fishery Management Plan for Horseshoe Crabs.

At the following locations: Dennis Creek to Cohansey Creek for hand collecting and state waters from Ocean City to Cape May for trawl.

During the following time: June through December 2023

Using the following gear: Hand collecting June to July
Trawl net end of June to December 31

With the following vessel(s):

Name	Registration #	Length (feet)
"Margot" – trawl	908176	41'
Sea Ox – hand harvest	NJ861GD	23'
Luhrs – hand harvest	NJ3493GP	28'

For the following species:

Species	Quantity	Retained or Released
Horseshoe crabs	Various	Released

This permit is subject, but not limited, to the following conditions:

1. Although the permit is issued to the permittee, above, all terms and conditions shall be adhered to by any and all persons listed below as Subsidiary Project Leaders.
2. The person(s) named herein shall have this permit in the permittee's possession when collecting scientific specimens in marine, fresh, or estuarine waters of the State and must present it upon request to any official or citizen.
3. **The holder of this permit shall notify the Marine Law Enforcement Region Office of his/her scientific collecting activities in any of the State's marine, fresh, or estuarine waters at least 24 hours in advance of the activities. Notification must be made by**

emailing the Marine Enforcement Office at njdfwcommercialnotify@dep.nj.gov. Please provide the following information in the email: permit #, sampling activity, sampling location, and telephone number.

4. A report of the organisms collected (species, numbers, specific location where taken, dates of sampling) and a final report for the study for which the permit is requested shall be sent to NJ Fish & Wildlife, Marine Resources Administration, Scientific Collecting Permit, P.O. Box 418, Port Republic, NJ 08241. Mail the report no later than four (4) weeks after the expiration date of this permit or upon request for permit renewal, whichever is earlier.
5. Additional permits may be required for species listed by the United States Government as endangered or threatened. Special provisions may apply.
6. This permit does not convey the right to trespass.
7. Violation by the permittee or any Subsidiary Permit Holders of any term or condition of the permit or any State law or regulation promulgated pursuant to N.J.S.A. Title 23 or 50 or N.J.A.C. 7:25 or 7:25A shall render this permit null and void and may subject the permittee and/or Subsidiary Permit Holder to prosecution in addition to permit revocation. Applications for future permits may also be denied.
8. The holder of this Scientific Collecting Permit is also required to have in his/her possession a "Special Permit for Research" from the Division of Watershed Management, Bureau of Marine Water Monitoring, P.O. Box 405, Leeds Point, NJ 08220, prior to the taking of shellfish (clams, oysters, mussels) for scientific purposes from the marine or estuarine waters of the State that are designated "Conditionally Approved", "Restricted", "Prohibited", or "Suspended" (N.J.S.A. 58:24-3, and N.J.A.C. 7:12-2). A chart of these designated waters may be obtained from the Bureau of Marine Water Monitoring or by visiting www.nj.gov/dep/wms/bmw.
9. If the Permittee is conducting research, this permit does not confer any rights beyond the collection of samples. Any commercialization of the research, including but not limited to, patenting, licensing, trademarking, copyrighting, or any other type of legal protection or agreement, must be negotiated with the Department separately from this permit. In addition, if the Permittee develops any invention, apparatus, computer program, discovery, or other intellectual property, the Department will own the entire right, title, and interest throughout the world to each such property right and to patents and copyrights protecting the same. The Department's ownership shall be unaffected by any termination, revocation, or expiration of this permit.

This permit cannot be transferred and expires on 12/31/2023.



Jeff Brust, Chief
Marine Resources Administration

- c: Deputy Chief Jason Snellbaker, Bureau of Law Enforcement-Marine Enforcement Region Office
Capt. Brian Scott, Bureau of Law Enforcement-Marine Enforcement Region Office
Lt. Christopher Wozniak, NJ State Police – Marine Service Bureau
Deborah Watkins, Bureau of Marine Water Monitoring

Note for collection of:

- ☒ Horseshoe crab
- ☐ Terrapin
- ☐ Shellfish (hard/soft clams, mussels, oysters or other bivalve mollusks)
- ☐ Endangered or threatened species

Subsidiary Project Leaders:

Russel Swan	Benjamin Swan	James Layton
Jeremiah Layton	John Ciliberto	

Exhibit 3



NJ Department of Environmental Protection
NJ Fish and Wildlife
Marine Resources Administration
PO Box 418
Port Republic, NJ 08241
Phone: (609) 748-2020

2024 Scientific Collecting Permit

Permit Number: 2024- 1848

Date Issued: 02/14/2024

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Name/Organization	Limuli Laboratories
Address:	6 Eldora Avenue
City, State, Zip	Woodbine, New Jersey 08270
Name:	Benji Swan

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3. At-sea collection will only be by commercial otter trawl (5.5" – 6" inch flounder net) by John Ciliberto on the vessel listed below in the waters of the Atlantic Ocean between 2 and 3 nautical

miles off New Jersey from Atlantic City to Cape May. Additionally, horseshoe crabs may be taken by the below trawling vessels operating under the terms and conditions of a valid Exempted Fishing Permit issued by the National Marine Fisheries Service with exempts the below named vessel(s) and owner(s)/operator(s) from the no fishing for or possession of horseshoe crabs with a trawl on board in a section of the EEZ called the Carl N. Schuster, Jr. Horseshoe Crab Reserve. If the summer flounder commercial season is closed, Captain John Ciliberto may keep and land summer flounder bycatch under the terms of the bycatch quota, however, the horseshoe crabs aboard the F/V Margot taken under the terms of the Scientific Collecting Permit issued to Limuli Laboratories may not be included in the total weight of all species used to define the bycatch allowance of summer flounder (i.e. the amount of summer flounder cannot exceed 10% by weight, of the total weight of all species landed and sold). Any other legally permitted species taken during the collection of horseshoe crabs by trawl under the scientific collecting permit may also be sold as long as they comply with existing regulations.

4. Limuli Laboratories will monitor horseshoe crab mortality associated with all steps in the collection, transportation, and bleeding of horseshoe crabs, especially the at-sea culling of horseshoe crabs taken by mobile gear and the result shall be reported in the final report. These data are a New Jersey compliance requirement of Addendum III to the Atlantic States Marine Fisheries Commission's Interstate Fishery Management Plan for Horseshoe Crabs.

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With the following vessel(s):

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For the following species:

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This permit is subject, but not limited, to the following conditions:

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2. The person(s) named herein shall have this permit in the permittee's possession when collecting scientific specimens in marine, fresh, or estuarine waters of the State and must present it upon request to any official or citizen.
3. **The holder of this permit shall notify the Marine Law Enforcement Region Office of his/her scientific collecting activities in any of the State's marine, fresh, or estuarine waters at least 24 hours in advance of the activities. Notification must be made by**

emailing the Marine Enforcement Office at njdfwcommercialnotify@dep.nj.gov. Please provide the following information in the email: permit #, sampling activity, sampling location, and telephone number.

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5. Additional permits may be required for species listed by the United States Government as endangered or threatened. Special provisions may apply.
6. This permit does not convey the right to trespass.
7. Violation by the permittee or any Subsidiary Permit Holders of any term or condition of the permit or any State law or regulation promulgated pursuant to N.J.S.A. Title 23 or 50 or N.J.A.C. 7:25 or 7:25A shall render this permit null and void and may subject the permittee and/or Subsidiary Permit Holder to prosecution in addition to permit revocation. Applications for future permits may also be denied.
8. The holder of this Scientific Collecting Permit is also required to have in his/her possession a "Special Permit for Research" from the Division of Watershed Management, Bureau of Marine Water Monitoring, P.O. Box 405, Leeds Point, NJ 08220, prior to the taking of shellfish (clams, oysters, mussels) for scientific purposes from the marine or estuarine waters of the State that are designated "Conditionally Approved", "Restricted", "Prohibited", or "Suspended" (N.J.S.A. 58:24-3, and N.J.A.C. 7:12-2). A chart of these designated waters may be obtained from the Bureau of Marine Water Monitoring or by visiting www.nj.gov/dep/wms/bmw.
9. If the Permittee is conducting research, this permit does not confer any rights beyond the collection of samples. Any commercialization of the research, including but not limited to, patenting, licensing, trademarking, copyrighting, or any other type of legal protection or agreement, must be negotiated with the Department separately from this permit. In addition, if the Permittee develops any invention, apparatus, computer program, discovery, or other intellectual property, the Department will own the entire right, title, and interest throughout the world to each such property right and to patents and copyrights protecting the same. The Department's ownership shall be unaffected by any termination, revocation, or expiration of this permit.

This permit cannot be transferred and expires on 12/31/2024.



Jeff Brust, Chief
Marine Resources Administration

- c: Deputy Chief Jason Snellbaker, Bureau of Law Enforcement-Marine Enforcement Region Office
Capt. Brian Scott, Bureau of Law Enforcement-Marine Enforcement Region Office
Lt. Christopher Wozniak, NJ State Police – Marine Service Bureau
Deborah Watkins, Bureau of Marine Water Monitoring

Note for collection of:

- ☒ Horseshoe crab
- ☐ Terrapin
- ☐ Shellfish (hard/soft clams, mussels, oysters or other bivalve mollusks)
- ☐ Endangered or threatened species

Subsidiary Project Leaders:

Russel Swan	Benjamin Swan	James Layton
Jeremiah Layton	John Ciliberto	

Exhibit 4



NJ Department of Environmental Protection
NJ Fish and Wildlife
Marine Resources Administration
PO Box 418
Port Republic, NJ 08241
Phone: (609) 748-2020

2025 Scientific Collecting Permit

Permit Number: 2025- 1848

Date Issued: 02/11/2025

Under provisions of N.J.S.A Title 23:4-52, permission is hereby given to:

Name/Organization	Limuli Laboratories
Address:	6 Eldora Avenue
City, State, Zip	Woodbine, NJ 08270
Name:	Benji Swan

To conduct the following activities: Data will be collected regarding biomedical use of horseshoe crabs. Specifics include number collected, rejected, and released.

Shore Collection of Horseshoe Crabs:

1. No hand collection of horseshoe crabs will be allowed before June 8, 2025.
2. A maximum number of 1200 horseshoe crabs per 24 hours may be collected by hand.
3. Russell Swan and Benjamin Swan will be allowed to hand collect horseshoe crabs in the tributaries of Delaware Bay in the Dividing Creek area using the vessels listed below.
4. Hand collection may take place any day of the week from June through July and none of these crabs may enter the bait market. All horseshoe crabs collected under this permit will be returned to Delaware Bay at Highs Beach or at West Creek.

At-Sea Collection of Horseshoe Crabs

1. Collecting by use of an otter trawl will occur only from the end of June through December 31, 2025.
2. A maximum of 1200 horseshoe crabs may be collected per 24 hours.
3. At-sea collection will only be by commercial otter trawl (5.5" – 6" inch flounder net) by John Ciliberto on the vessel listed below in the waters of the Atlantic Ocean between 2 and 3 nautical miles off New Jersey from Atlantic City to Cape May. Additionally, horseshoe crabs may be taken by the below trawling vessels operating under the terms and conditions of a valid Exempted Fishing Permit issued by the National Marine Fisheries Service with exempts the below named vessel(s) and owner(s)/operator(s) from the no fishing for or possession of horseshoe crabs with a trawl on board in a section of the EEZ called the Carl N. Schuster, Jr. Horseshoe Crab Reserve. If the summer flounder commercial season is closed, Captain John Ciliberto may keep and land summer flounder bycatch under the terms of the bycatch quota, however, the horseshoe crabs aboard the F/V Margot taken under the terms of the Scientific Collecting Permit issued to Limuli Laboratories may not be included in the total weight of all species used to define the bycatch

allowance of summer flounder (i.e. the amount of summer flounder cannot exceed 10% by weight, of the total weight of all species landed and sold). Any other legally permitted species taken during the collection of horseshoe crabs by trawl under the scientific collecting permit may also be sold as long as they comply with existing regulations.

4. Limuli Laboratories will monitor horseshoe crab mortality associated with all steps in the collection, transportation, and bleeding of horseshoe crabs, especially the at-sea culling of horseshoe crabs taken by mobile gear and the result shall be reported in the final report. These data are a New Jersey compliance requirement of Addendum III to the Atlantic States Marine Fisheries Commission's Interstate Fishery Management Plan for Horseshoe Crabs.

At the following locations: Dennis Creek to Cohansey Creek for hand collecting and state waters from Ocean City to Cape May for trawl.

During the following time: June – December 2025

Using the following gear: Hand collecting June to July
Trawl net end of June to December 31

With the following vessel(s):

Name	Registration #	Length (feet)
"Margot" – trawl	908176	41'
Sea Ox – hand harvest	NJ 861 GD	23'
Luhrs – hand harvest	NJ 3493 GP	28'

For the following species:

Species	Quantity	Retained or Released
Horseshoe crab	Various	Released

This permit is subject, but not limited, to the following conditions:

1. Although the permit is issued to the permittee, above, all terms and conditions shall be adhered to by any and all persons listed below as Subsidiary Project Leaders.
2. The person(s) named herein shall have this permit in the permittee's possession when collecting scientific specimens in marine, fresh, or estuarine waters of the State and must present it upon request to any official or citizen.
3. **The holder of this permit shall notify the Marine Law Enforcement Region Office of his/her scientific collecting activities in any of the State's marine, fresh, or estuarine waters at least 24 hours in advance of the activities. Notification must be made by emailing the Marine Enforcement Office at njdfwcommercialnotify@dep.nj.gov.** Please provide the following information in the email: permit #, sampling activity, sampling location, and telephone number.
4. A report of the organisms collected (species, numbers, specific location where taken, dates of sampling) and a final report for the study for which the permit is requested shall be sent to NJ Fish & Wildlife, Marine Resources Administration, Scientific Collecting Permit,

P.O. Box 418, Port Republic, NJ 08241. Mail the report no later than four (4) weeks after the expiration date of this permit or upon request for permit renewal, whichever is earlier.

5. Additional permits may be required for species listed by the United States Government as endangered or threatened. Special provisions may apply.
6. This permit does not convey the right to trespass.
7. Violation by the permittee or any Subsidiary Permit Holders of any term or condition of the permit or any State law or regulation promulgated pursuant to N.J.S.A. Title 23 or 50 or N.J.A.C. 7:25 or 7:25A shall render this permit null and void and may subject the permittee and/or Subsidiary Permit Holder to prosecution in addition to permit revocation. Applications for future permits may also be denied.
8. The holder of this Scientific Collecting Permit is also required to have in his/her possession a "Special Permit for Research" from the Division of Watershed Management, Bureau of Marine Water Monitoring, P.O. Box 405, Leeds Point, NJ 08220, prior to the taking of shellfish (clams, oysters, mussels) for scientific purposes from the marine or estuarine waters of the State that are designated "Conditionally Approved", "Restricted", "Prohibited", or "Suspended" (N.J.S.A. 58:24-3, and N.J.A.C. 7:12-2). A chart of these designated waters may be obtained from the Bureau of Marine Water Monitoring or by visiting www.nj.gov/dep/wms/bmw.
9. If the Permittee is conducting research, this permit does not confer any rights beyond the collection of samples. Any commercialization of the research, including but not limited to, patenting, licensing, trademarking, copyrighting, or any other type of legal protection or agreement, must be negotiated with the Department separately from this permit. In addition, if the Permittee develops any invention, apparatus, computer program, discovery, or other intellectual property, the Department will own the entire right, title, and interest throughout the world to each such property right and to patents and copyrights protecting the same. The Department's ownership shall be unaffected by any termination, revocation, or expiration of this permit.

This permit cannot be transferred and expires on 12/31/2025.



Jeff Brust, Chief
Marine Resources Administration

c: Acting Deputy Chief Brian Scott, Bureau of Law Enforcement-Marine Enforcement Region Office
NJ State Police – Marine Service Bureau
Deborah Watkins, Bureau of Marine Water Monitoring

Note for collection of:

- ☒ Horseshoe crab
- ☐ Terrapin
- ☐ Shellfish (hard/soft clams, mussels, oysters or other bivalve mollusks)
- ☐ Endangered or threatened species
- ☐ Glass eels

Subsidiary Project Leaders:

Russell Swan
Benjamin Swan
James Layton
Jeremiah Layton
John Ciliberto

Exhibit 5



NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
FISH AND WILDLIFE
MARINE RESOURCES ADMINISTRATION
SCIENTIFIC COLLECTING PERMIT
P.O. BOX 418
PORT REPUBLIC, NJ 08241
PHONE: (609) 748-2020



2026 Scientific Collecting Permit

Permit Number: 2026 – 1848

Date Issued: 01/14/2026

Under the provisions of N.J.S.A. Title 23:4-52, permissions is hereby given to:

Name/Organization: **Limuli Laboratories**
Address: 5 Bay Avenue
City, State, Zip: Cape May Court House, NJ 08210
Name: Benjie Swan

To conduct the following activities: Data will be collected regarding biomedical use of horseshoe crabs. Specifics include number collected, rejected, and released.

Shore Collection of Horseshoe Crabs:

1. No hand collection of horseshoe crabs will be allowed before June 8, 2026.
2. A maximum number of 1200 horseshoe crabs per 24 hours may be collected by hand.
3. Russell Swan and Benjamin Swan will be allowed to hand collect horseshoe crabs in the tributaries of Delaware Bay in the Dividing Creek area using the vessels listed below.
4. Hand collection may take place any day of the week from June through July and none of these crabs may enter the bait market. All horseshoe crabs collected under this permit will be returned to Delaware Bay at Highs Beach or at West Creek.

At-Sea Collection of Horseshoe Crabs

1. Collecting by use of an otter trawl will occur only from the end of June through December 31, 2026.
2. A maximum of 1200 horseshoe crabs may be collected per 24 hours.
3. At-sea collection will only be by commercial otter trawl (5.5" – 6" inch flounder net) by John Ciliberto on the vessel listed below in the waters of the Atlantic Ocean between 2 and 3 nautical miles off New Jersey from Atlantic City to Cape May. Additionally, horseshoe crabs may be taken by the below trawling vessels operating under the terms and conditions of a valid Exempted Fishing Permit issued by the National Marine Fisheries Service with exempts the below named vessel(s) and owner(s)/operator(s) from the no fishing for or possession of horseshoe crabs with a trawl on board in a section of the EEZ called the Carl N. Schuster, Jr. Horseshoe Crab Reserve. If the summer flounder commercial season is closed, Captain John Ciliberto may keep and land summer flounder bycatch under the terms of the bycatch quota, however, the horseshoe crabs aboard the F/V Margot taken under the terms of the Scientific Collecting Permit issued to Limuli Laboratories may not be included in the total weight of all species used to define the bycatch allowance of summer flounder (i.e. the amount of summer flounder cannot exceed 10% by weight, of the total weight of all species landed and sold). Any other legally permitted species taken during the collection of horseshoe crabs by trawl under the scientific collecting permit may also be sold as long as they comply with existing regulations.
4. Limuli Laboratories will monitor horseshoe crab mortality associated with all steps in the collection, transportation, and bleeding of horseshoe crabs, especially the at-sea culling of horseshoe crabs taken by mobile gear and the result shall be reported in the final report. These data are a New Jersey compliance requirement of Addendum III to the Atlantic States Marine Fisheries Commission's Interstate Fishery Management Plan for Horseshoe Crabs.

At the following locations: Dennis Creek to Cohansey Creek for hand collecting and state waters from Ocean City to Cape May for trawl.

During the following time: June – December 2026

Using the following gear: Hand collecting June to July
Trawl net end of June to December 31

With the following vessel(s):

Name	Registration #	Length (feet)
Margot – trawl	908176	41'
Sea Ox – hand harvest	NJ 861 GD	23'
Luhrs – hand harvest	NJ 3493 GP	28'

For the following species:

Species	Quantity	Retained or Released
Horseshoe crab	Various	Released

This permit is subject, but not limited, to the following conditions:

1. Although this permit is issued to the permittee, above, all terms and conditions shall be adhered to by any and all persons listed below as Subsidiary Permit Holders.
2. The person(s) named herein shall have this permit in the permittee's possession when collecting scientific specimens in marine, fresh, or estuarine waters of the State and must present it upon request to any official or citizen.
3. **The holder of this permit shall notify the Marine Law Enforcement Region Office of his/her scientific collecting activities in any of the State's marine, fresh, or estuarine waters at least 24 hours in advance of the activities. Notification must be made by emailing the Marine Law Enforcement Region Office at njdfwcommercialnotify@dep.nj.gov. Please provide the following information in the email: permit #, sampling activity, sampling location, and telephone number.**
4. A report of organisms collected (species, numbers, specific location where taken, dates of sampling) and a final report for the study for which the permit is requested shall be sent to NJDEP Fish & Wildlife, Marine Resources Administration, Scientific Collecting Permit, P.O. Box 418 Port Republic, NJ 08241. Mail the report no later than four (4) weeks after the expiration date of this permit or upon request for permit renewal, whichever is earlier.
5. Additional permits may be required for species listed by the United States Government as endangered or threatened. Special provisions may apply.
6. This permit does not convey the right to trespass.
7. Violation by the permittee or any Subsidiary Permit Holders of any term or condition of the permit or any State law or regulation promulgated pursuant to N.J.S.A. Title 23 or 50 or N.J.A.C. 7:25 or 7:25A shall render this permit null and void and may subject the permittee and/or Subsidiary Permit Holder to prosecution in addition to permit revocation. Applications for future permits may also be denied.



8. The holder of this permit is also required to have in his/her possession a "Special Permit for Research" from the Division of Watershed Management, Bureau of Marine Water Monitoring, P.O. Box 405, Leeds Point, NJ 08220, prior to taking of shellfish (clams, oysters, mussels) for scientific purposes from the marine or estuarine waters of the State that are designated "Conditionally Approved", "Restricted", "Prohibited", or "Suspended" (N.J.S.A. 58:24-3, and N.J.A.C. 7:12-2). A chart of these designated waters may be obtained by visiting www.nj.gov/dep/wms/bmw.
9. If the Permittee is conducting research, this permit does not confer any rights beyond the collection of samples. Any commercialization of the research, including but not limited to, patenting, licensing, trademarking, copyrighting, or any other type of legal protection or agreement, must be negotiated with the Department separately from this permit. In addition, if the Permittee develops any invention, apparatus, computer program, discovery, or other intellectual property, the Department will own the entire right, title, interest throughout the world to each such property right and to patents and copyrights protecting the same. The Department's ownership shall be unaffected by any termination, revocation, or expiration of this permit.
10. NJDEP staff may be present to conduct inspections at sampling sites, during transport, at outreach events, or at facilities where specimens are held in captivity.

This permit cannot be transferred and expires on 12/31/2026.



Jeff Brust, Chief
Bureau of Marine Fisheries
Marine Resources Administration

- c: Brian Scottt, Bureau of Law Enforcement – Marine Law Enforcement Region Office
Noreen White, Bureau of Law Enforcement – Marine Law Enforcement Region Office
NJ State Police – Marine Services Bureau
Deborah Watkins, Bureau of Marine Water Monitoring

Note for the collection of:

- ☒ Horseshoe crab
☐ Terrapin
☐ Shellfish (hard/soft clams, mussels, oysters, other bivalve mollusks)
☐ Endangered or threatened species
☐ Glass eels

Subsidiary Permit Holders:

Russell Swan	Benjamin Swan	James Layton
Jeremiah Layton	John Ciliberto	



Exhibit 6

Limuli Laboratories

BAY AVENUE DIAS CREEK
CAPE MAY COURT HOUSE, NJ 08210
(609) 465-6552

State of New Jersey
Department of Environmental Protection
Bureau of Marine Fisheries
PO Box 400
Trenton, New Jersey 08625
Attn: Marine Fisheries Administrator

January 08, 2026

Dear Marine Fisheries Administrator,

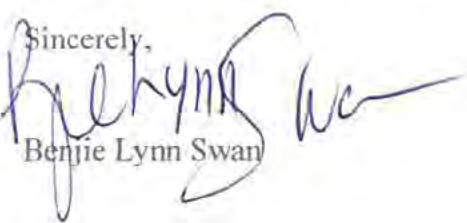
Enclosed are several documents relating to activities conducted under Scientific Collecting Permit No. MFA-SCP 1848 during the 2025 season. Specifically, the ASMFC Horseshoe Crab Biomedical Collection Reporting Worksheet Fishing Year 2025, two sheets itemizing daily collection and the Biomedical Collection Reporting Forms are included.

A total of [REDACTED] horseshoe crabs were collected between June 10th and December 7th of 2025. Of these, [REDACTED] were hand collected along [REDACTED] and [REDACTED] were trawl collected [REDACTED]. Trawl collection of horseshoe crabs was conducted in [REDACTED]. During the 78 fishing excursions, 1,610 horseshoe crabs were rejected on board for minor injuries. Specifics for the fishing trips are detailed in the Biomedical Collection Reporting Forms.

A total of [REDACTED] animals were transported to the facility. Of these, [REDACTED] horseshoe crabs [REDACTED] (%) were utilized and the remainder rejected (4,134 [REDACTED] (%)). The rejections were due to minor injury (2,523 or [REDACTED] (%)), slow movements (1,366 or [REDACTED] (%)), mortality (240 or [REDACTED] (%)) and small size (5). All the horseshoe crabs were released into the waters of Delaware Bay.

I appreciate the State of New Jersey's time and consideration in issuing the SCP. If you need further information, please do not hesitate to contact me.

Sincerely,


Benjie Lynn Swan

ASMFC Horseshoe Crab Biomedical Collection Reporting Worksheet Fishing Year 2025

Name(s) of Biomedical Company/ies:	Limuli Labs			
State of Landing:	New Jersey			
	Male	Female	Sex Unidentified	Total
Number of biomedical-only (not counted against state bait quota) horseshoe crabs harvested			0	
Number of biomedical-only horseshoe crabs rejected onboard vessel due to mortality	0	0	0	0
Total (bait and biomedical) number of horseshoe crabs transported to bleeding facility			0	
Number of biomedical-only horseshoe crabs rejected at bleeding facility due to mortality	117	123	0	240
Number of biomedical-only horseshoe crabs bled			0	
Number of bait horseshoe crabs bled	0	0	0	0

***Addendum III to the Horseshoe Crab Fishery Management Plan requires sex-specific collection and mortality information be reported for horseshoe crabs harvested for biomedical use. Please make all possible efforts to identify number or percentage of Male and Female crabs contributing to the Total number in each row.

**Hand Harvest
June- July 2025
MFA-SCP-1848**

Date Bled	Total
06/11/25	
06/12/25	
06/13/25	
06/16/25	
06/17/25	
06/18/25	
06/19/25	
06/20/25	
06/23/25	
06/24/25	
06/25/25	
06/26/25	
06/27/25	
06/30/25	
07/01/25	
07/02/25	
07/03/25	
07/07/25	

Trawl Data
July-December 2025
MFA-SCP-1848

Date Collected	Total Collected	Date Collected	Total Collected
07/07/25		09/21/25	
07/08/25		09/22/25	
07/09/25		09/23/25	
07/10/25		09/24/25	
07/13/25		09/25/25	
07/14/25		09/28/25	
07/15/25		09/29/25	
07/16/25		10/05/25	
07/17/25		10/06/25	
07/20/25		10/08/25	
07/21/25		10/09/25	
07/22/25		10/15/25	
07/23/25		10/20/25	
07/24/25		10/22/25	
07/27/25		10/23/25	
07/28/25		10/26/25	
07/29/25		10/27/25	
07/30/25		11/02/25	
07/31/25		11/03/25	
08/03/25		11/04/25	
08/04/25		11/09/25	
08/05/25		11/10/25	
08/06/25		11/12/25	
08/07/25		11/13/25	
08/10/25		11/17/25	
08/11/25		11/18/25	
08/12/25		11/19/25	
08/13/25		11/20/25	
08/14/25		11/23/25	
08/17/25		11/24/25	
08/24/25		12/01/25	
08/25/25		12/02/25	
08/26/25		12/03/25	
08/27/25		12/07/25	
08/28/25			
09/01/25			
09/02/25			
09/03/25			
09/07/25			
09/08/25			
09/11/25			
09/14/25			
09/17/25			
09/18/25			

Exhibit 7

Limuli Laboratories

7 BAY AVENUE DIAS CREEK
CAPE MAY COURT HOUSE, NJ 08210
(609) 465-6552
Fax: (609) 465-0313

State of New Jersey
Department of Environmental Protection
Bureau of Marine Fisheries
PO Box 400
Trenton, New Jersey 08625
Attn: Marine Fisheries Administrator

January 28, 2025

Dear Marine Fisheries Administrator,

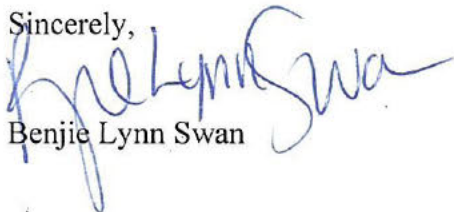
Enclosed are several documents relating to activities conducted under Scientific Collecting Permit No. MFA-SCP 1848 during the 2024 season. Specifically, the ASMFC Horseshoe Crab Biomedical Collection Reporting Worksheet Fishing Year 2024, two sheets itemizing daily collection and the Biomedical Collection Reporting Forms are included.

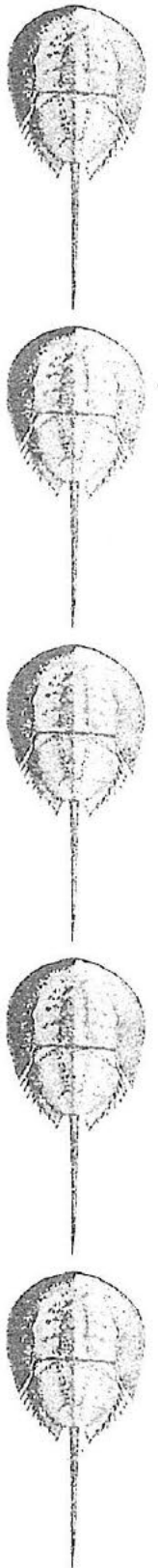
A total of [REDACTED] horseshoe crabs were collected between June 17th and December 9th of 2024. Of these [REDACTED] were hand collected [REDACTED] and [REDACTED] were trawl collected in [REDACTED]. Trawl collection of horseshoe crabs was conducted in State waters off [REDACTED]. During the 85 fishing excursions, 1,185 horseshoe crabs were rejected on board for minor injuries. Specifics for the fishing trips are detailed in the Biomedical Collection Reporting Forms.

A total of [REDACTED] animals were transported to the facility. Of these, [REDACTED] horseshoe crabs [REDACTED] were utilized and the remainder rejected (4,126 or [REDACTED]). The rejections were due to minor injury (2,762 or [REDACTED]), slow movements (853 or [REDACTED]), mortality (467 or [REDACTED]), and small size (44 or [REDACTED]). All the horseshoe crabs were released into the waters of Delaware Bay.

I appreciate the State of New Jersey's time and consideration in issuing the SCP. If you need further information, please do not hesitate to contact me.

Sincerely,


Benjie Lynn Swan



ASMFC Horseshoe Crab Biomedical Collection Reporting Worksheet Fishing Year 2024

Name(s) of Biomedical Company/ies:	Limuli Labs			
State of Landing:	New Jersey			
	Male	Female	Sex Unidentified	Total
Number of biomedical-only (not counted against state bait quota) horseshoe crabs harvested			0	
Number of biomedical-only horseshoe crabs rejected onboard vessel due to mortality	0	0	0	0
Total (bait and biomedical) number of horseshoe crabs transported to bleeding facility			0	
Number of biomedical-only horseshoe crabs rejected at bleeding facility due to mortality	331	136	0	467
Number of biomedical-only horseshoe crabs bled			0	
Number of bait horseshoe crabs bled	0	0	0	0

***Addendum III to the Horseshoe Crab Fishery Management Plan requires sex-specific collection and mortality information be reported for horseshoe crabs harvested for biomedical use. Please make all possible efforts to identify number or percentage of Male and Female crabs contributing to the Total number in each row.

**Hand Harvest
June- July 2024
MFA-SCP-1848**

Date Bled	Total
6/17/2024	
6/18/2024	
6/19/2024	
6/20/2024	
6/24/2024	
6/25/2024	
6/26/2024	
6/27/2024	
6/28/2024	
7/1/2024	
7/2/2024	
7/3/2024	
7/8/2024	

Trawl Collection
July - Dec 2024
MFA-SCP-1848

Date Collected	Number	Date Collected	Number
7/7/2024		9/19/2024	
7/8/2024		9/23/2024	
7/9/2024		9/24/2024	
7/11/2024		9/25/2024	
7/14/2024		9/26/2024	
7/15/2024		9/29/2024	
7/16/2024		10/2/2024	
7/17/2024		10/3/2024	
7/18/2024		10/6/2024	
7/21/2024		10/7/2024	
7/22/2024		10/8/2024	
7/23/2024		10/9/2024	
7/24/2024		10/10/2024	
7/25/2024		10/15/2024	
7/28/2024		10/16/2024	
7/29/2024		10/17/2024	
7/30/2024		10/20/2024	
8/1/2024		10/21/2024	
8/4/2024		10/22/2024	
8/5/2024		10/24/2024	
8/6/2024		10/27/2024	
8/7/2024		10/28/2024	
8/11/2024		10/29/2024	
8/12/2024		10/30/2024	
8/13/2024		10/31/2024	
8/14/2024		11/3/2024	
8/15/2024		11/4/2024	
8/19/2024		11/6/2024	
8/20/2024		11/7/2024	
8/21/2024		11/11/2024	
8/22/2024		11/13/2024	
8/25/2024		11/14/2024	
8/26/2024		11/17/2024	
8/27/2024		11/18/2024	
8/28/2024		11/19/2024	
9/2/2024		11/24/2024	
9/3/2024		11/25/2024	
9/4/2024		11/26/2024	
9/8/2024		12/2/2024	
9/9/2024		12/3/2024	
9/10/2024		12/8/2024	
9/11/2024		12/9/2024	
9/12/2024			

Exhibit 8

Limuli Laboratories

BAY AVENUE DIAS CREEK
CAPE MAY COURT HOUSE, NJ 08210
(609) 465-6552
Fax: (609) 465-0313

State of New Jersey
Department of Environmental Protection
Bureau of Marine Fisheries
PO Box 400
Trenton, New Jersey 08625
Attn: Marine Fisheries Administrator

January 20, 2024

Dear Marine Fisheries Administrator,

Enclosed are several documents relating to activities conducted under Scientific Collecting Permit No. MFA-SCP 1848 during the 2023 season. Specifically, the ASMFC Horseshoe Crab Biomedical Collection Reporting Worksheet Fishing Year 2023, two sheets itemizing daily collection and the Biomedical Collection Reporting Forms are included.

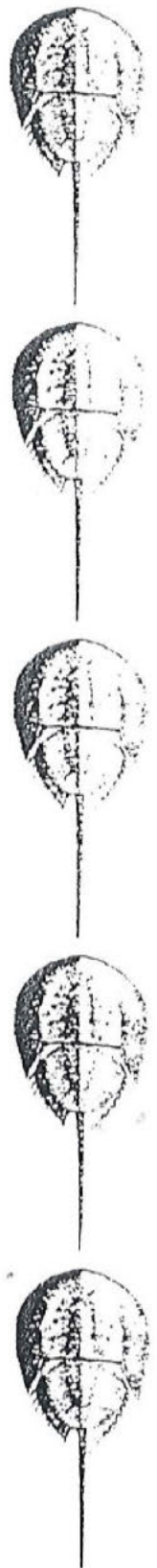
A total of [REDACTED] horseshoe crabs were collected between June 9th and December 21st of 2023. Of these [REDACTED] were hand collected [REDACTED] and [REDACTED] were trawl collected [REDACTED]. Trawl collection of the horseshoe crabs was conducted in [REDACTED]. During the 87 fishing excursions, 1,398 horseshoe crabs were rejected on board for minor injuries. Specifics for the fishing trips are detailed on the Biomedical Collection Reporting Forms.

A total of [REDACTED] animals were transported to the facility. Of these, [REDACTED] horseshoe crabs [REDACTED] were utilized and the remainder rejected (4,568 or [REDACTED]). The rejections were due to minor injury (3,330 or [REDACTED]), slow movements (988 or [REDACTED]) mortality (237 or [REDACTED]) and small size (13 or [REDACTED]). All the horseshoe crabs were released into the waters of the Delaware Bay.

I appreciate the State of New Jersey's time and consideration in issuing the SCP. If you need further information, please do not hesitate to contact me.

Sincerely,


Benjie Lynn Swan



ASMFC Horseshoe Crab Biomedical Collection Reporting Worksheet Fishing Year 2023

Name(s) of Biomedical Company/ies:	Limuli Labs			
State of Landing:	New Jersey			
	Male	Female	Sex Unidentified	Total
Number of biomedical-only (not counted against state bait quota) horseshoe crabs harvested			0	
Number of biomedical-only horseshoe crabs rejected onboard vessel due to mortality	0	0	0	0
Total (bait and biomedical) number of horseshoe crabs transported to bleeding facility			0	
Number of biomedical-only horseshoe crabs rejected at bleeding facility due to mortality	110	127	0	237
Number of biomedical-only horseshoe crabs bled			0	
Number of bait horseshoe crabs bled	0	0	0	0

*****Addendum III to the Horseshoe Crab Fishery Management Plan requires sex-specific collection and mortality information be reported for horseshoe crabs harvested for biomedical use. Please make all possible efforts to identify number or percentage of Male and Female crabs contributing to the Total number in each row.**

**Hand Harvest
June- July 2023
MFA-SCP-1848**

Date Bled	Total
06/09/23	
06/12/23	
06/13/23	
06/14/23	
06/15/23	
06/16/23	
06/19/23	
06/20/23	
06/22/23	
06/23/23	
06/26/23	
06/27/23	
06/28/23	
06/29/23	
06/30/23	
07/05/23	
07/06/23	
07/07/23	
07/10/23	
07/11/23	
07/12/23	
07/13/23	
07/14/23	

Trawl Collection
July - Dec 2023
MFA-SCP-1848

Date Collected	Number	Date Collected	Number
07/16/23		10/01/23	
07/17/23		10/02/23	
07/18/23		10/03/23	
07/19/23		10/04/23	
07/20/23		10/05/23	
07/23/23		10/08/23	
07/24/23		10/09/23	
07/25/23		10/10/23	
07/26/23		10/12/23	
07/30/23		10/15/23	
07/31/23		10/16/23	
08/01/23		10/17/23	
08/02/23		10/18/23	
08/03/23		10/19/23	
08/06/23		10/23/23	
08/08/23		10/24/23	
08/09/23		10/25/23	
08/10/23		10/26/23	
08/13/23		10/29/23	
08/14/23		10/30/23	
08/15/23		10/31/23	
08/16/23		11/02/23	
08/17/23		11/05/23	
08/20/23		11/07/23	
08/21/23		11/08/23	
08/23/23		11/09/23	
08/24/23		11/12/23	
08/27/23		11/13/23	
08/28/23		11/14/23	
08/29/23		11/15/23	
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09/07/23		12/03/23	
09/10/23		12/04/23	
09/11/23		12/05/23	
09/12/23		12/07/23	
09/13/23		12/12/23	
09/18/23		12/13/23	
09/19/23		12/14/23	
09/20/23		12/20/23	
09/21/23		12/21/23	
09/24/23			

Exhibit 9

Traumatic telson avulsion and attempted external stabilization in Atlantic horseshoe crabs (*Limulus polyphemus*)

Nicholas G. Dannemiller^{1,2}  | Kaitlen M. Watson² | Emily F. Christiansen² | Lori S. Westmoreland²

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Abstract

Atlantic horseshoe crabs (*Limulus polyphemus*) are prevalent in public aquarium touch pools. Despite their popularity, the literature concerning medical management under managed care is sparse. Noninfectious conditions include trauma to the exoskeleton and compound eyes; however, injury to the soft tissue connecting the telson and opisthosoma has not been previously reported. This report describes telson avulsion in three Atlantic horseshoe crabs at a public aquarium and attempted external stabilization with a vascular silicone tie in two of three affected animals. The horseshoe crab that received no veterinary intervention suffered a complete telson amputation 1 month after the initial injury. Although the two other horseshoe crabs did well postoperatively, and external stabilization prevented further avulsion or amputation, they still could not right themselves if flipped into dorsal recumbency. All three horseshoe crabs were ultimately euthanized due to animal welfare concerns. To avoid potentially serious telson ligament injury, horseshoe crabs should never be picked up by the telson. The authors recommend that telson ligament injuries be addressed promptly, any inciting cause be mitigated, and external stabilization be considered earlier.

KEYWORDS

animal welfare, aquarium, horseshoe crab, invertebrate medicine, touch pool

1 | INTRODUCTION

The Atlantic horseshoe crab (*Limulus polyphemus*) is an ancient aquatic arthropod and keystone species distributed along the western Atlantic coast of North America (Walls et al., 2002). Atlantic horseshoe crabs (AHCs) play an important role in coastal and nearshore marine ecosystems as a food source for shorebirds, sea turtles, and other aquatic wildlife (Botton, 2009; Walls et al., 2002). In terms of anthropogenic use, AHCs have historically been used as a

laboratory animal model and are a popular bait in commercial eel and whelk fisheries (Atlantic States Marine Fisheries Commission, 2021; Smith, 2022). Most importantly, AHCs and the three other extant species of horseshoe crabs are integral to ensuring the safety of vaccines, injectable medicines, and medical devices globally (Gorman, 2020; Krisfalusi-Gannon et al., 2018; Novitsky, 2009). In 2021, over 700,000 AHCs were collected in the United States for biomedical testing via the *Limulus* amoebocyte lysate test, (Atlantic States Marine Fisheries Commission, 2021) an assay reliant on AHCs hemolymph

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and its unique coagulative properties to detect Gram-negative bacterial endotoxins (Novitsky, 2009). Despite surviving unchanged for approximately 250 million years, habitat degradation and growing anthropogenic demand have resulted in the AHC's classification of "vulnerable" by the International Union for Conservation of Nature's Red List of Threatened Species (Smith et al., 2017).

A full review of the anatomy of the horseshoe crab is beyond this report's scope and has been extensively described elsewhere (LaDouceur et al., 2021; Smith, 2022). Briefly, the body is divided into three distinct sections: a cranial prosoma (cephalothorax), a caudal opisthosoma (abdomen), and a telson (tail). The telson is attached at its base to the terminal bay of the opisthosoma on the midline via the nonchitinous telson ligament and controlled by the telson muscles. The telson ligament is made up of three distinct layers: epicuticle (superficial), endocuticle (middle), and epidermis (deepest) (Krasner et al., 2019). Dorsally, the lateral compound eyes are found rostrally on the rounded prosoma, and a non-chitinous hinge between the prosoma and opisthosoma contains a central arthrodial membrane. Ventrally, horseshoe crabs have a single pair of modified chelicerae, six pairs of appendages, and five pairs of gills with lamellae (i.e., book gills).

Atlantic horseshoe crabs are prevalent in public aquariums in the United States for their ecological importance and distinctive morphology, often found in touch pools alongside elasmobranchs and other intertidal marine invertebrates. Despite AHCs' popularity, the literature concerning medical management under managed care is sparse (Nolan & Smith, 2009; Smith, 2022). Shell and soft tissue lesions are likely the most common infectious disease in managed care environments (Smith, 2022); phycophytal (algal), bacterial, and mycotic infections causing erosion and degradation of the exoskeleton, gills, and deeper tissues have been reported (Leibovitz & Lewbart, 2004; Smith, 2022; Tuxbury et al., 2014). Noninfectious diseases reported in managed care environments include poor water quality, abnormal molting, and hypoproteinemia suspected secondary to nutritional deficiencies (Nolan & Smith, 2009; Smith, 2022). Traumatic injuries to the exoskeleton and compound eyes can occur during collection, transport, or due to high stocking densities (Smith, 2022). This report describes telson avulsions in three AHCs at a public aquarium, attempted external stabilization in two of three affected individuals, and the animal welfare implications of this injury.

2 | CASE SERIES

In February 2021, one male AHC from the North Carolina Aquarium at Fort Fisher (Kure Beach, NC) presented with an injured telson after an aquarium guest picked the animal up out of a touch pool by its telson and dropped it back into the water. This wild-caught AHC was accessioned in 2019 and co-housed in a polygonal, 6400-L, artificial-saltwater, closed-system touch pool with other AHCs, stingrays, and assorted intertidal marine invertebrates. On physical exam, the AHC had a partial avulsion of the left ligament connecting the telson to the opisthosoma but no other external abnormalities. The AHC was

returned to the touch pool but later moved off exhibit after the avulsion worsened. Approximately 1 month after the initial insult and shortly after being moved off exhibit, the telson was completely amputated due to unknown trauma. Without a telson, aquarists reported that the AHC could not right itself if it was inadvertently flipped in dorsal recumbency by conspecifics or after falling backwards when climbing. Staff corrected its abnormal dorsal recumbency frequently when observed; yet, despite this diligent individualized management, the AHC was euthanized in November 2021 due to increasing durations in dorsal recumbency and a deteriorating arthrodial membrane. The AHC was anesthetized with 10 mL/L of 2-phenoxyethanol (Sigma-Aldrich) and euthanized with 1 ml pentobarbital (Covetrus, Inc.) intracardiac through the arthrodial membrane following cessation of limb movement (Murray, 2022; Smith, 2022). No necropsy was performed due to the known cause of the decline.

In June 2022, two male AHCs from the same touch pool were presented with similar telson injuries following unknown trauma. These AHCs were also wild-caught and accessioned in 2019. Aquarists reported that affected AHCs had absent upward mobility and reduced lateral mobility of the telson due to the injuries; consequently, the animals could not right themselves from dorsal recumbency. On physical exam, both AHCs had partial to complete avulsion of the telson ligament connecting the dorsal process of the telson to the opisthosoma, with the telson only attached ventrally (Figure 1). Other exam findings included historically ulcerated lateral compound eyes and missing distal segments from a variable number of the six pairs of appendages arising from the prosoma. Direct apposition of the avulsed telson ligament was not performed due to concern about the tension required and delay following injury; instead, telsons were externally stabilized with a vascular silicone tie (Batrik Medical Manufacturing Inc) in July 2022 to prevent complete traumatic telson amputation (Figure 2).

The AHCs were anesthetized with 2 ml/L of 2-phenylethanol (Sigma-Aldrich) as previously described (Archibald et al., 2019) and held in ventral recumbency with the opisthosoma angled upwards. Using a handheld high-speed rotary tool (Dremel), a 1.5 mm hole was bored approximately halfway between the posterior spine and posterior angle through the dorsal margin of the terminal bay of the opisthosoma on both sides of the telson. A 1.5 mm hole was then bored perpendicular and ventral to the dorsal process of the telson. A vascular silicone tie (Batrik Medical Manufacturing Inc) was threaded through the right hole on the dorsal margin of the terminal bay, then the hole ventral to the dorsal process, and finally out the left hole on the dorsal margin of the terminal bay. The silicone tie was knotted twice on the holes' dorsal aspect through the terminal bay's dorsal margin bilaterally. This provided stabilization for the telsons dorsally but still allowed for lateral movement. Both AHCs maintained independent gilling rates with minimal reaction to the holes being bored, recovered from anesthesia uneventfully, and had no immediate complications.

The AHCs were housed in off-exhibit holding postoperatively and did well initially. Nevertheless, while the silicone tie prevented

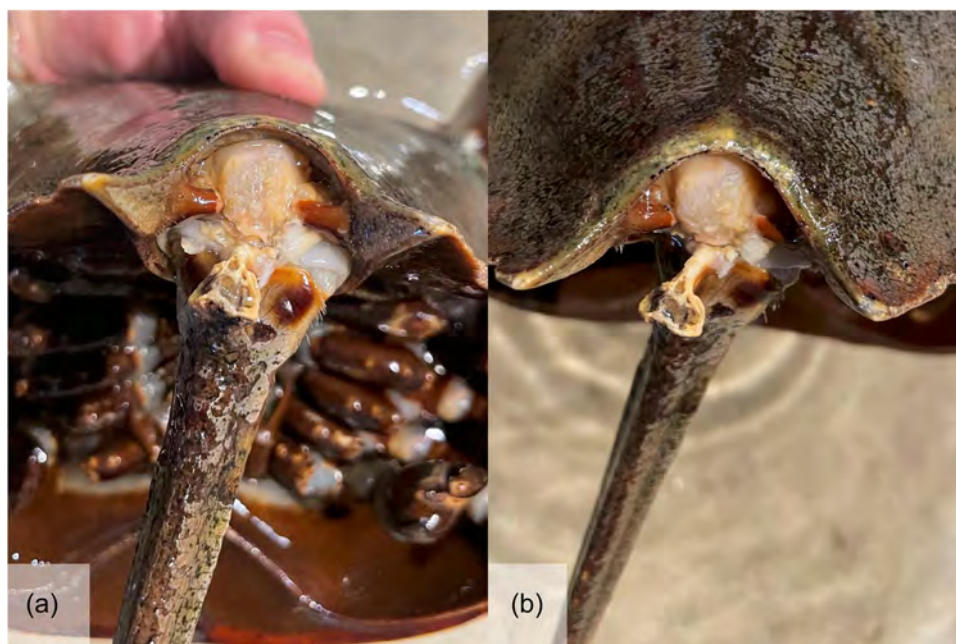


FIGURE 1 (a & b) Two Atlantic horseshoe crabs (*Limulus polyphemus*) with partial to complete avulsion of the telson ligament connecting the dorsal process of the telson (tail) to the caudal opisthosoma (abdomen) with the telson only attached ventrally. Photos courtesy of the North Carolina Aquarium at Fort Fisher.

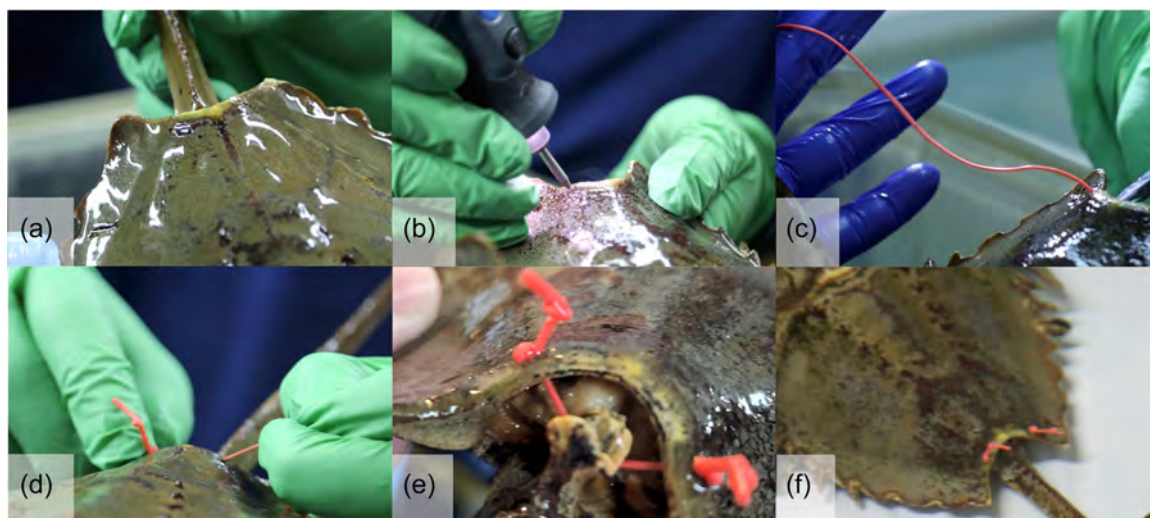


FIGURE 2 External stabilization of traumatic telson avulsion in an Atlantic horseshoe crab (*Limulus polyphemus*). (a) The animal was anesthetized with 2-phenylethanol and held in ventral recumbency with the opisthosoma angled upwards. (b) Using a handheld high-speed rotary tool, a 1.5 mm hole was bored approximately halfway between the posterior spine and posterior angle through the dorsal margin of the terminal bay of the opisthosoma. A 1.5 mm hole was then bored perpendicular and ventral to the dorsal process of the telson. (c & d) A vascular silicone tie was threaded through the right hole on the dorsal margin of the terminal bay, then the hole ventral to the dorsal process, and finally out the left hole on the dorsal margin of the terminal bay. The silicone tie was knotted twice on the holes' dorsal aspect through the terminal bay's dorsal margin bilaterally. (e) The vascular silicone tie stabilized the telsons dorsally but allowed lateral movement. (f) The animal had a minimal reaction to the holes being bored, recovered from anesthesia uneventfully, and had no immediate complications. Photos courtesy of the North Carolina Aquarium at Fort Fisher.

traumatic telson amputation, aquarists reported affected AHCs still could not right themselves if inadvertently flipped in dorsal recumbency. For both AHCs, the silicone tie needed to be replaced 2–3 months postoperatively in September and October 2022,

respectively, due to the breakdown of the silicone material. The avulsed telson ligament never showed signs of healing on serial recheck exams. In December 2022, despite diligent individualized management, both AHCs were euthanized as described above due to

increasing durations in dorsal recumbency and subsequent contact erosion to the arthrodial membrane between their prosoma and opisthosoma. Neither AHC was necropsied due to their known cause for decline.

3 | DISCUSSION

To the authors' knowledge, this is the first report of partial telson avulsion in AHCs under managed care, a severe soft-tissue injury with subsequent animal welfare implications. Although one AHC's telson avulsion was anthropogenic, the other two injuries were suspected to be caused by conspecifics clinging to the opisthosoma forming a "train" or potentially limited maneuverability in the touch pool due to design and thematic inserts. Although monofilament nylon suture has been recommended as the least reactive suture for soft tissue wound repair in AHCs (Krasner et al., 2019), vascular silicone ties were utilized in these cases to provide some flexibility and a closer approximation to normal telson range of motion. The ties needed to be replaced over time likely due to stretch or strain from the telson being flexed as the AHCs moved around and being submerged continuously in a saltwater environment.

A telson with normal mobility and range of motion is biomechanically vital for AHCs for steering underwater and to right themselves if flipped into dorsal recumbency; however, wild AHCs with fully functional telsons also frequently become stranded along the western Atlantic coastline of North America when flipped into dorsal recumbency during spawning season, suggesting other biotic and abiotic factors may prevent these animals from righting themselves. Nonetheless, a wild AHC with a telson avulsion (or worse: a traumatic amputation) would have reduced maneuverability, be predisposed to stranding, and be more vulnerable to predation. Under managed care, an AHC with equivalent telson morbidity raises animal welfare concerns. Even with attentive husbandry, all three affected individuals in this report developed erosive lesions affecting the arthrodial membrane and nonchitinous hinge between the prosoma and opisthosoma due to abrasive contact with underlying substrate during increasing durations in dorsal recumbency and futile attempts to right themselves. In terms of the five freedoms and five domains frameworks (Hadfield & Wahltinez, 2022; Webster, 2016), an AHC with a telson avulsion may be deprived of some if not all of its five freedoms, or the domains of nutrition, health, behavior, and/or choice and control (substituted for mental state) (Hadfield & Wahltinez, 2022). The decision to euthanize the three AHCs in this report was influenced by aquarists' and veterinarians' perception that negative experiences (i.e., stuck in dorsal recumbency) were predominating and affected individuals were ultimately enduring a "life not worth living" under the Quality of Life framework (Hadfield & Wahltinez, 2022; Mellor, 2016; Webster, 2016).

While larval AHCs can regenerate appendages and their telson (Clare et al., 1990), the avulsed telson ligament did not show signs of healing on serial recheck exams of affected individuals. This may have been due to insufficient time elapsing for regeneration, or the

attempted external stabilization was too unstable to promote healing due to repetitive joint movement, especially without direct apposition of the two ends of the avulsed ligament. Wound healing of the nonchitinous arthrodial membrane and telson ligament is thought to occur in three sequential phases: (1) an initial lag period, (2) amebocyte infiltration from the hemolymph, and (3) hyalinization (Krasner et al., 2019). It is possible that the degree of avulsion impaired amebocyte infiltration from the hemolymph or that the telson ligament was diseased before being traumatized. Furthermore, earlier or more aggressive reconstructive surgery could have provided a better opportunity for recovery. Other limitations of this report include: a limited sample size ($n = 3$), all affected AHCs were from a single exhibit and institution, no necropsies or histopathology were performed given the apparent reason for their declining quality of life, and possible bias with severe or late-stage telson avulsions.

Given current biomedical demands for their hemolymph, public fascination, and the increasing need to protect their populations and habitats, AHCs will remain prevalent in managed care environments, including public aquariums. As professional and public opinion surrounding aquatic invertebrate welfare evolves (Hadfield & Wahltinez, 2022; Wahltinez et al., 2022), the husbandry and veterinary care of AHCs will also need to continue to advance and address the health challenges of these unique animals. Finding an AHC in dorsal recumbency for prolonged periods in managed care environments or stranded on a beach in the wild should be considered abnormal (US Fish and Wildlife Service, 2018), and the AHC should be gently righted by manipulating the durable prosoma. To avoid potentially serious telson ligament injury, AHCs should never be picked up by the telson. Regular preventative health exams of all AHCs at public aquariums, especially in touch pools, are encouraged. When identified, the authors recommend that telson ligament injuries be addressed promptly, any inciting cause be mitigated, and external stabilization be considered earlier.

ACKNOWLEDGMENTS

The authors thank Alissa Mones, Caitlin Hepps Keeney, Megan Cabot, Heather Broadhurst, Julie Smith, Ryan McAlarney, Tabitha Elger, and the North Carolina Aquarium at Fort Fisher animal care staff for supporting these clinical cases. The authors thank the dedicated staff and volunteers who provide invaluable supervision and guest education to the North Carolina Aquarium at Fort Fisher Touch Pool.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

ETHICS STATEMENT

An ethics statement is not applicable. All animals were handled and treated as part of normal veterinary care.

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Exhibit 10

Trawl Data
July-December 2025
MFA-SCP-1848

Date Collected	Total Collected	Date Collected	Total Collected
07/07/25		09/21/25	
07/08/25		09/22/25	
07/09/25		09/23/25	
07/10/25		09/24/25	
07/13/25		09/25/25	
07/14/25		09/28/25	
07/15/25		09/29/25	
07/16/25		10/05/25	
07/17/25		10/06/25	
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08/25/25		12/02/25	
08/26/25		12/03/25	
08/27/25		12/07/25	
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09/11/25			
09/14/25			
09/17/25			
09/18/25			

COPY

Limuli Laboratories

Horseshoe Crab Biomedical Collection Reporting Form

COLLECTION INFORMATION

Name of Collector: John Ciliberto Boat Name: margot

Date of Collection: 7/7/25 Method of Collection: Trawl

Area(s) of Collection (specific): [REDACTED]

Estimated Number of Horseshoe Crabs Rejected On-Board Vessel:

Due to mortality: _____ Due to severe injury: _____ Due to minor injury: 15

Due to small size: 1000's Other Reason (Specify): male

Number of Horseshoe Crabs Collected and Transported to Bleeding Location: [REDACTED]

Number of males: [REDACTED] Number of females: [REDACTED]

Number of trawls 4

Trawl 1: Duration <u>1</u>	Number of males <u>[REDACTED]</u>	Number of females <u>[REDACTED]</u>
Trawl 2: Duration <u>1</u>	Number of males <u>[REDACTED]</u>	Number of females <u>[REDACTED]</u>
Trawl 3: Duration <u>1</u>	Number of males <u>[REDACTED]</u>	Number of females <u>[REDACTED]</u>
Trawl 4: Duration <u>1</u>	Number of males <u>[REDACTED]</u>	Number of females <u>[REDACTED]</u>
Trawl 5: Duration _____	Number of males <u>[REDACTED]</u>	Number of females <u>[REDACTED]</u>
Trawl 6: Duration _____	Number of males _____	Number of females _____
Trawl 7: Duration _____	Number of males _____	Number of females _____
Trawl 8: Duration _____	Number of males _____	Number of females _____
Trawl 9: Duration _____	Number of males _____	Number of females _____

Size of net: Headrope 72 Footrope 93 Meshsize: net 6 codend 5/8

I verify that the horseshoe crabs collected under this permit were delivered to a Food and Drug Administration approved biomedical facility for the production of Limulus Amoebocyte Lysate.

John Ciliberto

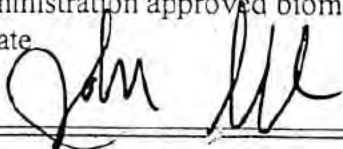
(Collectors Signature)

Additional Comments:

Limuli Laboratories

Horseshoe Crab Biomedical Collection Reporting Form

COLLECTION INFORMATION

Name of Collector: <u>John Ciliberto</u>		Boat Name: <u>Margot</u>	
Date of Collection: <u>8/11</u>		Method of Collection: <u>Trawl</u>	
Area(s) of Collection (specific): [REDACTED]			
Estimated Number of Horseshoe Crabs Rejected On-Board Vessel:			
Due to mortality: _____		Due to severe injury: _____	
		Due to minor injury: <u>30</u>	
Due to small size: <u>1000^s</u>		Other Reason (Specify): _____	
Number of Horseshoe Crabs Collected and Transported to Bleeding Location: [REDACTED]			
Number of males [REDACTED]		Number of females: [REDACTED]	
Number of trawls <u>4</u>			
Trawl 1: Duration <u>1</u>	Number of male [REDACTED]	Number of females [REDACTED]	
Trawl 2: Duration <u>1</u>	Number of male [REDACTED]	Number of females [REDACTED]	
Trawl 3: Duration <u>1</u>	Number of male [REDACTED]	Number of females [REDACTED]	
Trawl 4: Duration <u>1</u>	Number of male [REDACTED]	Number of females [REDACTED]	
Trawl 5: Duration <u>1</u>	Number of male [REDACTED]	Number of females [REDACTED]	
Trawl 6: Duration _____	Number of males _____	Number of females _____	
Trawl 7: Duration _____	Number of males _____	Number of females _____	
Trawl 8: Duration _____	Number of males _____	Number of females _____	
Trawl 9: Duration _____	Number of males _____	Number of females _____	
Size of net: Headrope <u>72</u> Footrope <u>93</u> Meshsize: net <u>6</u> codend <u>5/8</u>			
I verify that the horseshoe crabs collected under this permit were delivered to a Food and Drug Administration approved biomedical facility for the production of Limulus Amoebocyte Lysate  (Collectors Signature)			

Additional Comments:

COPY

Limuli Laboratories

Horseshoe Crab Biomedical Collection Reporting Form

COLLECTION INFORMATION

Name of Collector: <u>John Ciliberto</u>	Boat Name: <u>Margot</u>
Date of Collection: <u>8/28</u>	Method of Collection: <u>trawl</u>
Area(s) of Collection (specific): [REDACTED]	
Estimated Number of Horseshoe Crabs Rejected On-Board Vessel:	
Due to mortality: _____ Due to severe injury: _____ Due to minor injury: <u>25</u>	
Due to small size: <u>10005</u> Other Reason (Specify): _____	
Number of Horseshoe Crabs Collected and Transported to Bleeding Location: [REDACTED]	
Number of males: [REDACTED]	Number of females: [REDACTED]
Number of trawls: <u>5</u>	
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Trawl 2: Duration <u>1</u>	Number of males: [REDACTED] Number of females: [REDACTED]
Trawl 3: Duration <u>1</u>	Number of males: [REDACTED] Number of females: [REDACTED]
Trawl 4: Duration <u>1</u>	Number of males: [REDACTED] Number of females: [REDACTED]
Trawl 5: Duration <u>1</u>	Number of males: [REDACTED] Number of females: [REDACTED]
Trawl 6: Duration _____	Number of males: _____ Number of females: _____
Trawl 7: Duration _____	Number of males: _____ Number of females: _____
Trawl 8: Duration _____	Number of males: _____ Number of females: _____
Trawl 9: Duration _____	Number of males: _____ Number of females: _____
Size of net: Headrope <u>72</u> Footrope <u>93</u> Meshsize: net <u>6</u> codend <u>5/8</u>	

I verify that the horseshoe crabs collected under this permit were delivered to a Food and Drug Administration approved biomedical facility for the production of Limulus Amoebocyte Lysate

John Ciliberto

(Collectors Signature)

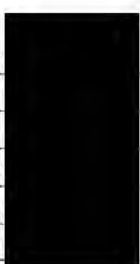
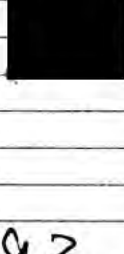
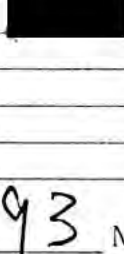
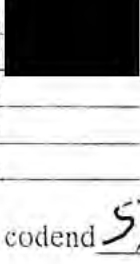
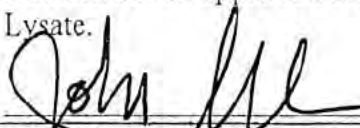
Additional Comments:

COPY

Limuli Laboratories

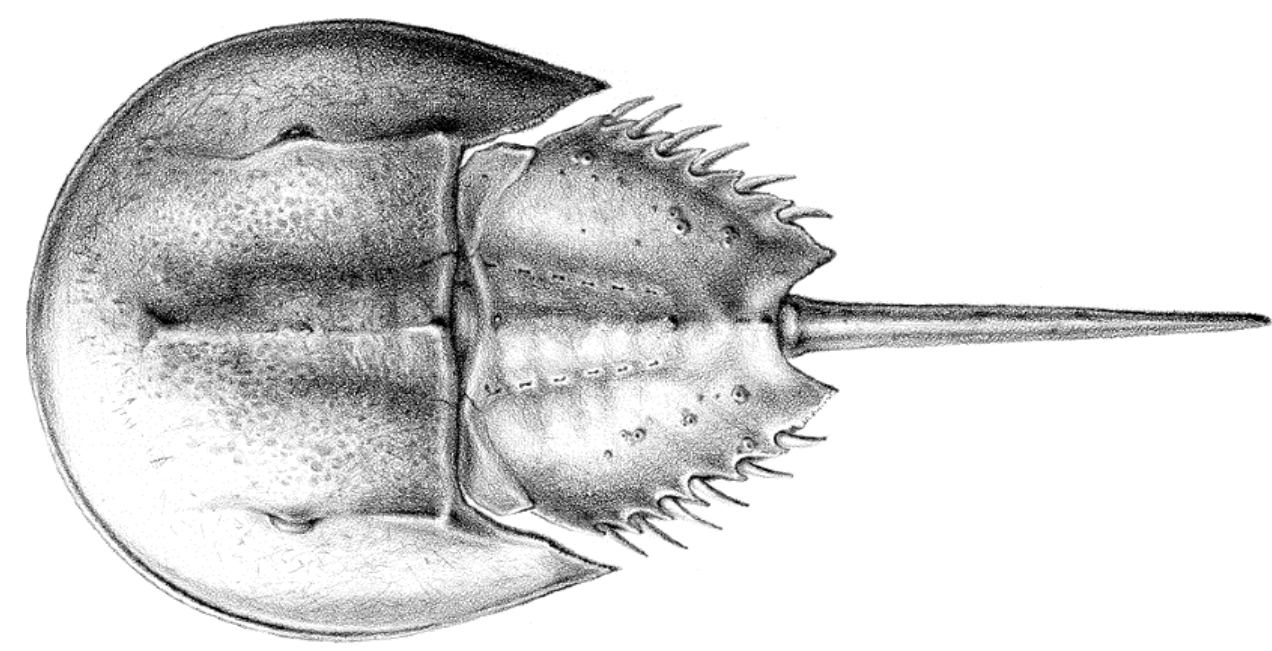
Horseshoe Crab Biomedical Collection Reporting Form

COLLECTION INFORMATION

Name of Collector: <u>John Ciliberto</u>	Boat Name: <u>Margot</u>
Date of Collection: <u>9/1</u>	Method of Collection: <u>trawl</u>
Area(s) of Collection (specific): 	
Estimated Number of Horseshoe Crabs Rejected On-Board Vessel:	
Due to mortality: _____ Due to severe injury: _____ Due to minor injury: <u>20</u>	
Due to small size: <u>10005</u> Other Reason (Specify): _____	
Number of Horseshoe Crabs Collected and Transported to Bleeding Location: 	
Number of males: 	Number of females: 
Number of trawls <u>5</u>	
Trawl 1: Duration <u>1</u>	Number of males  Number of females 
Trawl 2: Duration <u>1</u>	Number of males  Number of females 
Trawl 3: Duration <u>1</u>	Number of males  Number of females 
Trawl 4: Duration <u>1</u>	Number of males  Number of females 
Trawl 5: Duration <u>1</u>	Number of males  Number of females 
Trawl 6: Duration _____	Number of males _____ Number of females _____
Trawl 7: Duration _____	Number of males _____ Number of females _____
Trawl 8: Duration _____	Number of males _____ Number of females _____
Trawl 9: Duration _____	Number of males _____ Number of females _____
Size of net: Headrope <u>72</u> Footrope <u>93</u> Meshsize: net <u>6</u> codend <u>5/2</u>	
I verify that the horseshoe crabs collected under this permit were delivered to a Food and Drug Administration approved biomedical facility for the production of Limulus Amoebocyte Lysate.  (Collectors Signature)	

Additional Comments:

Exhibit 11

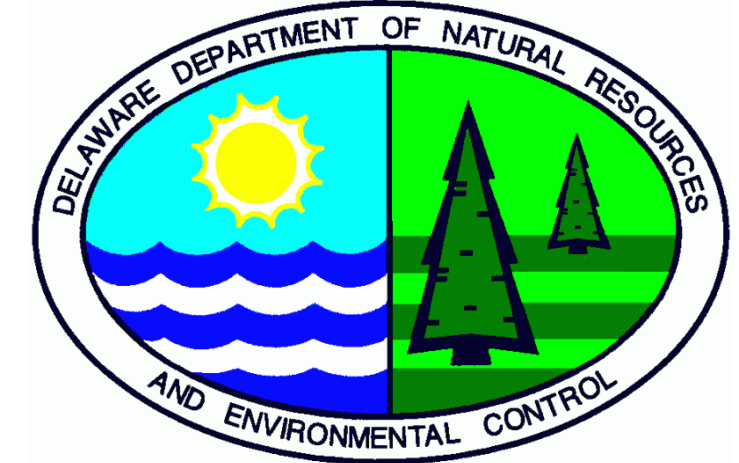


Subtidal Movements of Horseshoe Crabs in the Delaware Bay

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Introduction

The Atlantic Horseshoe Crab (*Limulus polyphemus*) plays a key role in structuring the ecology and economics of the mid-Atlantic. To date, most research has focused on understanding the phenomena of Horseshoe Crab spawning in the Delaware Bay. This is countered by the relative lack of information on the sub-tidal components where they spend the vast majority of their lifespan. Given the multiple demands made upon this invaluable resource, information on this important phase of their life history is critical for the conservation and management of this species.

Objectives

- Identify estuarine residency patterns of Horseshoe Crabs in the Delaware Bay.
- Identify habitat requirements of Horseshoe Crabs.

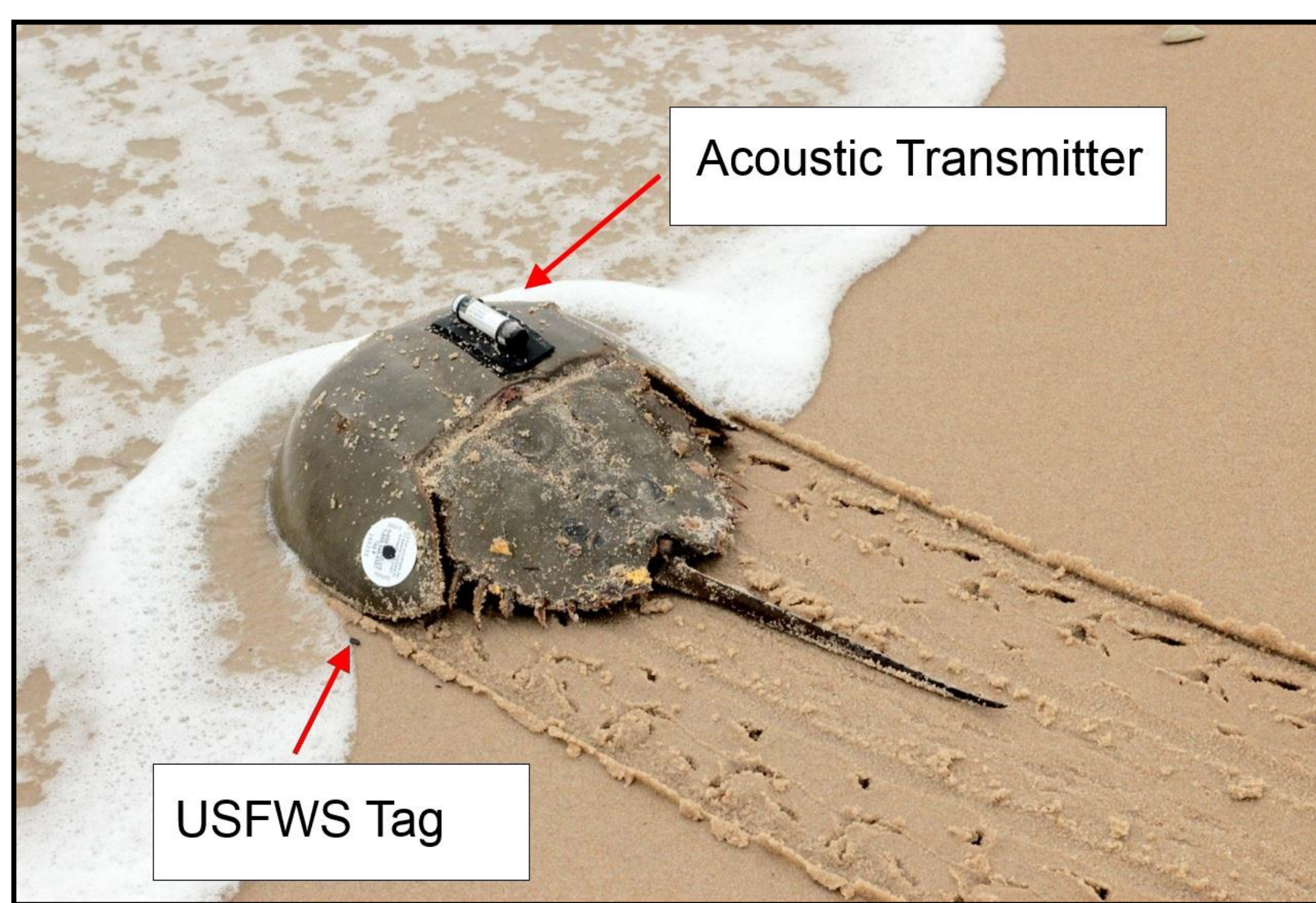


Figure 1. Horseshoe Crab affixed with VEMCO Ltd. V16-4H acoustic transmitter and USFWS button tag at time of release.

Methods

- On June 11 - 13th, 2014, 65 individually coded acoustic transmitters, with three year life spans, (VEMCO Ltd. V16-4H) were externally attached to terminal molt adult Horseshoe Crabs collected on seven known spawning beaches (Figure 1).
- A total of 70 VEMCO VR2W receivers were deployed in the Delaware Bay (Figure 2).

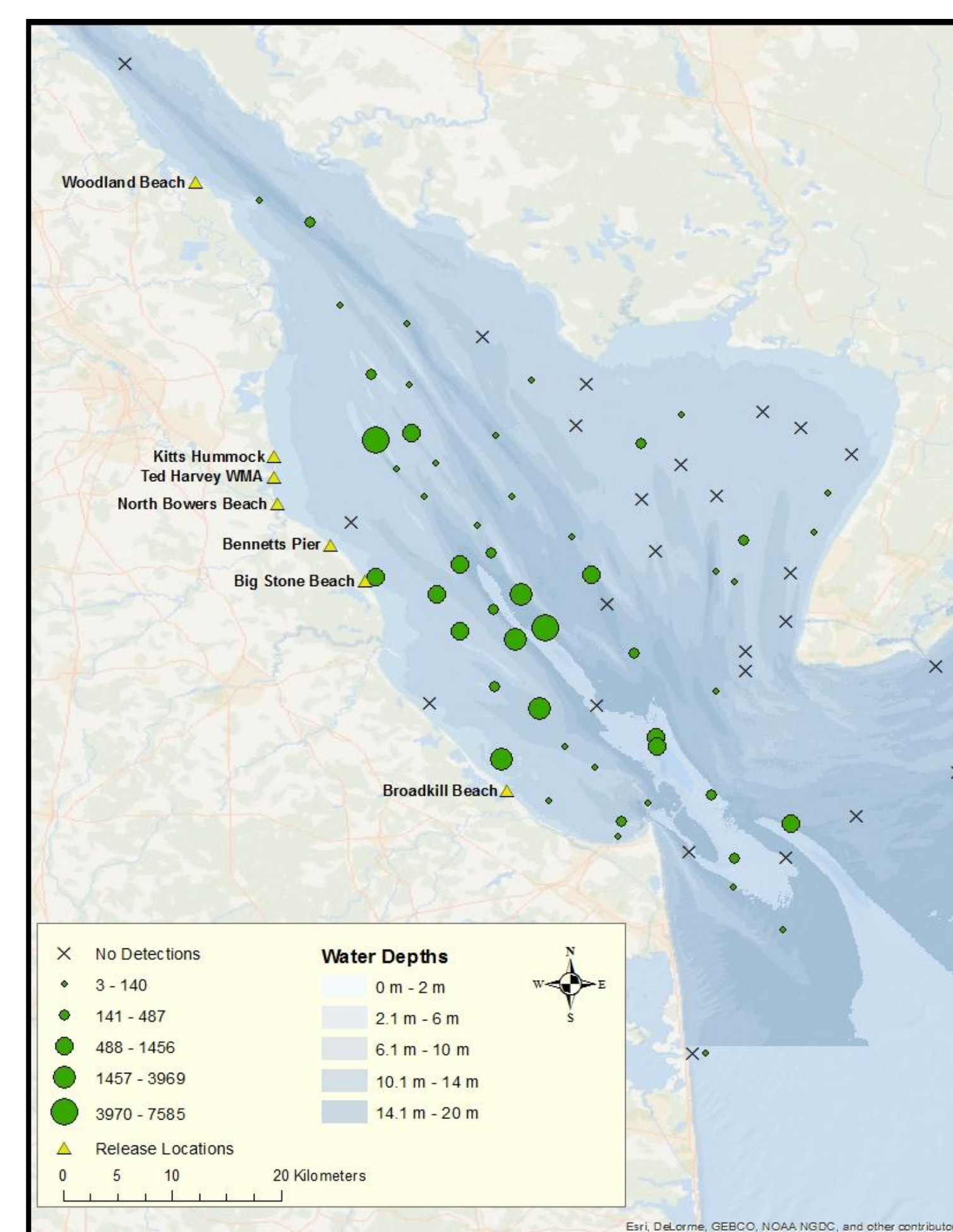


Figure 2. General study area showing the Delaware Bay receiver array, release beaches, and the relative frequencies of Horseshoe Crab detections from June through December 2014.

Results

Table 1. Relative frequency of Horseshoe Crabs detected by Sex in Delaware Bay and number of receivers where each sex was detected.

	Females (n=32)	Males (n=33)
Number of Unique Horseshoe Crabs Detected	27 (84.3%)	22 (66.7%)
Number of Receivers Where Detected	47	35

Results

Monthly Detections

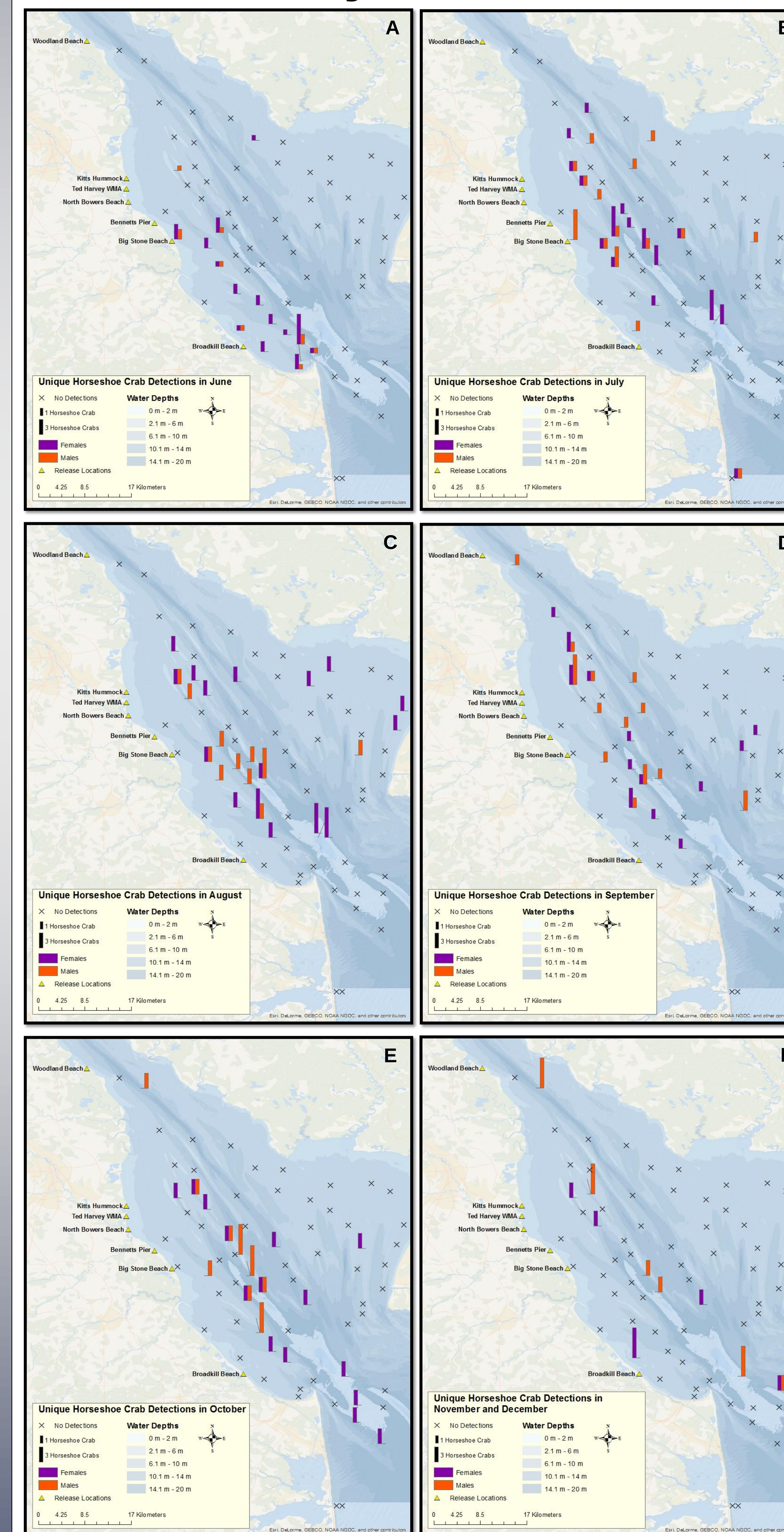


Figure 3. Maps showing the number of unique Horseshoe Crabs detected at receivers in the Delaware Bay, based on sex, for (A) June, (B) July, (C) August, (D) September, (E) October, and (F) both November and December. One receiver in the anchorage was lost and two nearshore receivers have not been downloaded. New Jersey's receivers on the eastern side of Delaware Bay were removed in October.

Summary

- There have been 37,989 Horseshoe Crab detections at 52 of the 70 receivers in the Delaware Bay from June to December 2014.
- To date, 27 females and 22 males have been detected, representing 75.4% of all tagged Horseshoe Crabs.
- Horseshoe Crab detections have been predominately along the western shore of the Delaware Bay.
- In July, two Horseshoe Crabs were detected as far south as the Indian River Inlet.
- Preliminary data suggests females may begin to leave the Delaware Bay in October.

Next Steps

- Dependent on funding, more Horseshoe Crabs may be tagged in June 2015 to better understand sub-tidal movements of the Delaware Bay's Horseshoe Crab population.
- Quantify sex based movements and residency times of Horseshoe Crabs in the Delaware Bay.
- Determine if there are benthic habitat and depth preferences exhibited by tagged Horseshoe Crabs.

Acknowledgements

Many thanks to the Delaware National Estuarine Research Reserve for funding this project, as well as DE Division of Fish and Wildlife, and Heather Corbett (NJDFW) for up keeping receivers. Special thanks to Keith Dunton and Lori Brown for assistance with this poster and to all the DSU students who have assisted with field work.

Exhibit 12

THE AMERICAN HORSESHOE CRAB



Edited by

Carl N. Shuster, Jr.

Robert B. Barlow

H. Jane Brockmann

HARVARD UNIVERSITY PRESS

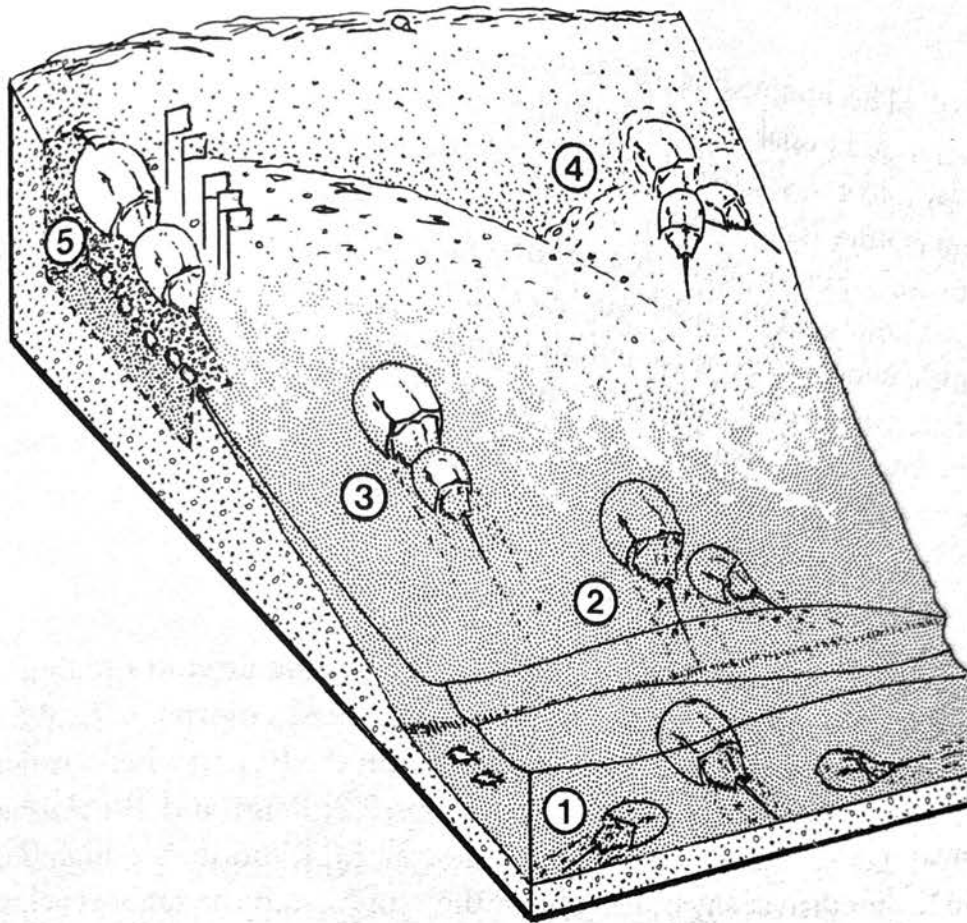
Cambridge, Massachusetts, and London, England

2003

Nesting Behavior

A female horseshoe crab arrives at the beach with a male clasping her carapace. The female is ready to lay eggs and she will spawn all of her roughly 80,000 eggs within just a few days (Shuster and Botton, 1985). She buries herself in the sand (Figure 2.1), bending down the front part of her body (prosoma), pressing forward and pushing the sand from underneath with her walking legs and out behind with the last pair of legs specially modified for digging (Vosatka, 1970) (see Chapter 7). It is easy to track the slow movement of a nesting crab through the sand if you place wire flags on either side of the female's hinge (prosomal-opisthosomal hinge). With these flags to indicate the position of nests, it is possible to dig up the eggs from between the flags after the tide (see Figure 2.1). As she digs, the female makes the water-soaked, fine sediments more fluid by paddling with her legs (thixotropy; Shuster, 1993). The eggs are released in a continuous stream into the fluid sand 5 to 20 cm below the surface (Rudloe, 1979; Brockmann, 1990). As the eggs are laid, the male fertilizes them externally with aquatic, free-swimming sperm (see Chapter 3).

Eggs are laid in discrete clusters of 2,000 to 4,000 (highly variable, from just a few to about 8,000 eggs; Shuster and Botton, 1985; Brockmann, 1990). Newly laid eggs are extremely sticky (Brown and Clapper, 1981) and adhere tightly to one another and to sand grains (Rudloe, 1979). After laying one cluster (which takes 3–15 minutes), the female pushes forward 10–20 cm before laying the next batch of eggs. One visit to the beach usually results in a sequence of two to five egg clusters (a range of one to fifteen egg clusters may be laid). Why don't they



lay all their eggs at once rather than separating them into these distinct clusters? No one knows for sure, but there are a couple of possible explanations. One is that females are spreading the risk so that if a predator comes on a cluster, it will not take all of her eggs. Another possibility is that egg development is affected by crowding (Barber and Itzkowitz, 1982); eggs that are at the center of a clump or in a large clump develop more slowly than those at the edges or in smaller batches (personal observation), so the female may spread out her eggs to increase the rate of their development.

Females often re-nest several times during one tide, readjusting their location as the tide advances or recedes. The same pairs of males and females may return to the same beach across several tides, remaining buried in the mud near shore between tides. Females usually complete their nesting for the year during one week (one tidal cycle) and do not return again until the following year (Brockmann and Penn, 1992). Males, on the other hand, return repeatedly (either attached to different females or unattached), which partially explains why there are more males at the nesting beach than females.

The eggs the female has left behind develop in the sand for 2 to 4 weeks through four embryonic molts (see Figure 5.2), hatching into "trilobite" larvae (see Figure 5.8; Sekiguchi et al., 1982; Sekiguchi,

1988). The nonfeeding larvae remain in their clusters in the sand for several additional weeks until the next tidal inundation, when they swim into the sea (Rudloe, 1979). Within a few weeks, depending on temperature (Laughlin, 1983), the free-swimming trilobite larvae molt into tiny, spiny juvenile horseshoe crabs (Figure 5.7) that live on the near-shore sand flats (Sekiguchi et al., 1982). This means that when a female chooses a place to nest, she is picking out the site where her offspring will develop for that important first month and even, perhaps, where they will spend their first year of life. Female nesting decisions (see Exhibit 2.2) are thus crucial to offspring success.

Why Do Crabs Nest in the High Intertidal?

Horseshoe crabs nest near the top of the tide line around the time of the high tide (in the case of *Libinia* spp., which nest in the high intertidal zone, the time of the high tide is critical for the success of the eggs and larvae). The reason for this is that the high tide line is the area where the crabs can find the most suitable nesting sites. The high tide line is the area where the crabs can find the most suitable nesting sites. The high tide line is the area where the crabs can find the most suitable nesting sites.