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Horseshoe Crab Recovery Coalition Comments: Proposed Work Group Recommendations on Biomedical Best Management Practices

Executive Summary

In October 2011, the Atlantic States Marine Fisheries Commission's Horseshoe Crab Biomedical ad hoc working group met to codify best practices governing the bleeding of horseshoe crabs in the production of LAL. Despite more than a decade of scientific advances and a deepening understanding of the impacts of bleeding on horseshoe crabs, the BMPs have not been meaningfully revised since that time.

The goal of the Horseshoe Crab Recovery Coalition (HCRC) is a phaseout of the biomedical harvest replaced by widespread adoption of an already available synthetic alternative for endotoxin testing. Multiple laboratories have demonstrated recombinant test reagents to be equally effective and provide the reliability of a renewable resource rather than relying on the unsustainable practice of bleeding wild animals.

Until the phaseout becomes complete, the coalition is proposing revisions to the BMPs to address the following deficiencies:

- They are not mandatory or specific and there is little or no regulatory oversight.
- Key data are not available to NGOs and the public-at-large.
- The process is optimized for the blood product and not for the health of the crabs.
- There is no consequence to killing horseshoe crabs: in fact, the Atlantic States Marine Fisheries Commission and the U.S. Fish and Wildlife Service encourage bleeding of bait crabs as a "conservation measure." However, states like Massachusetts use this loophole to purchase bait crabs from other states that are bled and enter the bait market in that state through a so-called rent-a-crab program.
- Finally, there is no adaptive process to reduce the impacts of biomedical bleeding and no assessment of metrics to reduce crab mortality.

The HCRC's newly proposed BMPs are designed to address these deficiencies through a variety of measures including:

- Calling for reduction in the mortality of bled crabs to less than 5 percent and total mortality from the entire capture-to-release process of less than 7 percent.

- Reform the practice of storing crabs in ponds or pens prior to bleeding. Under normal conditions, holding time should be limited to less than 24 hours, and bled crabs should be released within 24 hours after the bleeding process.
- Selecting only healthy and undamaged crabs for bleeding.
- Improved reporting and Increased transparency in reporting the number and sex of the crabs selected for bleeding, as well as those that are rejected.
- Developing a coastwide system of marking bled crabs to avoid rebleeding in the same year.
- Discontinuing the bleeding of bait crabs, which is currently practiced in Massachusetts.
- Regular auditing by regulatory agencies to ensure compliance with the revised BMPs.
- Increasing the number of horseshoe crabs that actually spawn.

The coalition believes its best practice proposal is aligned with United Nations Sustainability Development Goals for Biodiversity and will help to ensure the health of U.S. horseshoe crab populations until the phaseout of the biomedical harvest is complete.

The following pages provide more detail on our proposal and how it should be implemented and monitored.

Signed by members of the Horseshoe Crab Recovery Coalition

American Littoral Society	New Jersey Audubon
Center for Biological Diversity	North Carolina Wildlife Federation
Connecticut Audubon	One Hundred Miles
Delaware Audubon	Revive and Restore
The Delaware River Keeper	The Safina Center
The Forest Keeper	Shark River Cleanup Coalition
Georgia Audubon	Southeast Massachusetts Pine Barrens Alliance
Maryland Ornithological Society	The Wetlands Institute
Mass Audubon	Wild Cumberland
National Audubon Society	

Background/History

The Horseshoe Crab Biomedical *ad-hoc* Working Group (WG) met on October 3, 2011 to discuss the biomedical process and begin building a biomedical best management practices document, as tasked by the Horseshoe Crab Management Board at its August 4, 2011, meeting. The meeting opened with a brief background on the biomedical industry, its impacts, and the board’s task, followed by a period of public comment. The WG received written public comment from the Horseshoe Crab Conservation Association of Massachusetts, and Amanda Dey of New Jersey. Discussion by the WG was conducted in a closed-door setting, in anticipation that potential confidential and proprietary information may be discussed. The WG produced a report presenting the biomedical process broken down by steps, with the best management practices (BMPs) that are associated with each step. Some areas for improvement, through training and other methods,

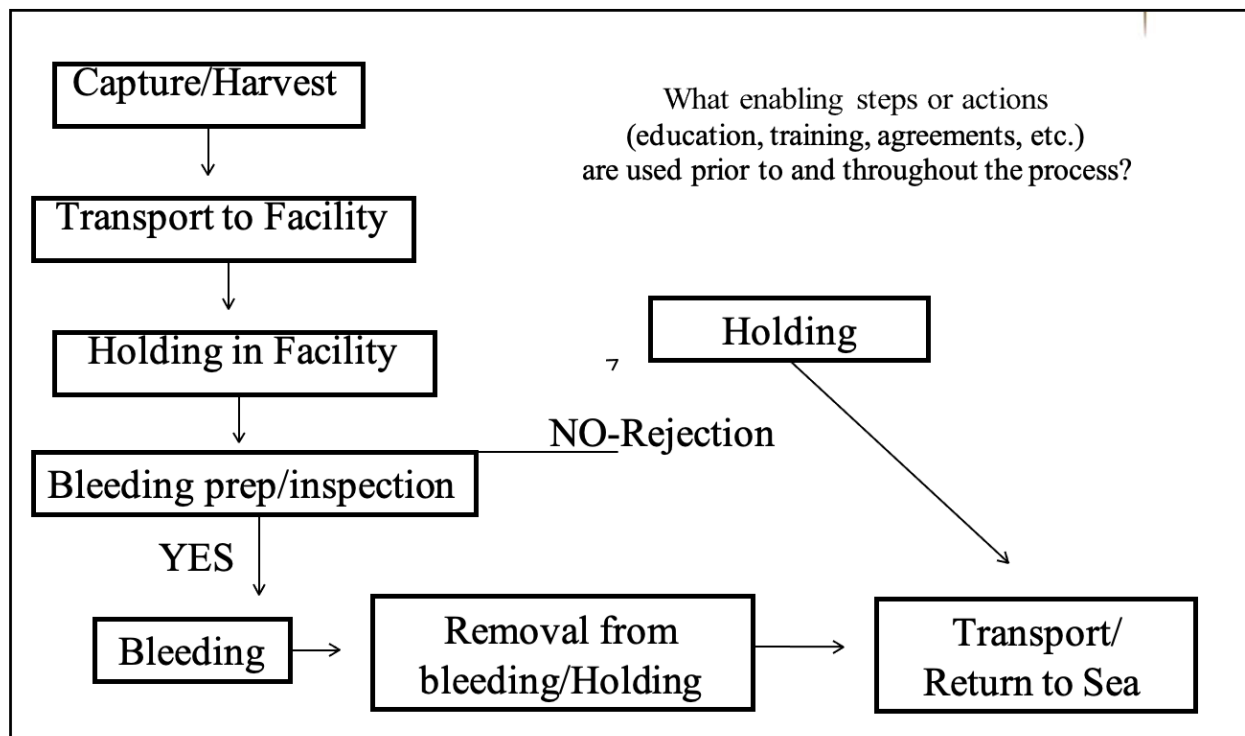
were identified. Additionally, the group felt that future discussions would likely be necessary as practices continue to evolve.

These recommendations were never formally adopted as required standards and have not been revised since 2011. The Horseshoe Crab Recovery Coalition recommends the following revised BMPs be adopted.

The following comments follow the format of the original BMP but are updated reflecting recommendations from scientists involved with the Horseshoe Crab Recovery Coalition.

Development of Biomedical Best Management Practices

In 2011, the WG based its discussion of BMPs on the following step chart. The scope of discussion for the BMPs was limited to the collection, bleeding, and release of crabs collected solely for biomedical purposes. However, the WG recognized that these same practices must also be used when collecting crabs that will ultimately go to the bait industry to ensure a quality product for the biomedical and bait industries.



HCRC Recommended Updated BMPs

By 2027, biomedical facilities will reduce the mortality of bled crabs to ≤ 5 percent, and total capture-to-release mortality of all biomedical crabs collected to ≤ 7 percent (including culled at sea, culled at dock, dead on arrival at lab, bled and unbled mortality in lab, dead on release). This more accurately captures the impact of biomedical industry collection and use of horseshoe crabs.

Registered fishers will play a key role in collecting data on number, sex, and status (condition) of crabs during collection and transport, after bleeding, and upon release at sea.

Capture/Collection:

- Biomedical collection in the Carl Shuster Reserve is discontinued.
- For targeted horseshoe crab trawl tows (biomedical-only and combined bait and biomedical collection), use reasonable tow times to reduce injury and stress, recommended at 15 minutes bottom time (winches locked).

For hand collection of horseshoe crabs, crabs should not be stacked in the bottom of a boat (stacked upside down and left uncovered in direct sun); holding containers must be used to reduce stress, direct sunlight (high temperatures) and desiccation. Proper care and handling of horseshoe crabs must be exercised while collecting, sorting, and placing crabs in holding containers.

Proper care, handling, holding:

- At all times, crabs should be picked up with two hands by the carapace.
- Crabs should never be held by the telson.
- Crabs should never be tossed or thrown.
- Crabs are always be placed right side up (legs down) in holding containers and stacked no more than 3 crabs deep.
- Crabs are to be inspected for standardized markings that indicate whether an individual was bled in the current collection year; release such crabs immediately.
- Holding containers must be well aerated and light in color to reduce heat inside the container.
- Crabs are to be kept cool, moist, and shielded from direct sunlight.
- Released crabs are placed right side up in shallow water (hand collection) or individually into deeper water (trawl/dredge collection); do not throw, toss, or dump crabs *en masse*.
- Healthy crabs are stacked in holding containers, no more than 3 crabs deep to reduce stress and injury during transport to biomedical facility.
- Data to be collected by registered fishers during collection:
 - Sort and record the number, sex, and status of crabs:
 - Healthy crabs: to be transported to biomedical facility.

- Released crabs: juveniles, dead, injured, unsuitable for bleeding and reason (due to small size, too slow, too old/dull shell).
 - A record of crabs collected, culled at sea and culled at dock are required for annual capture-to-release biomedical harvest reports (ASFMC [Addendum III](#)).
 - Avoid exposure to direct sun, extreme temperatures as well as rapid temperature changes; containers with horseshoe crabs are to be kept covered with wet cloth to protect against direct sunlight.
- Night harvesting is recommended during periods of excessive heat (≥ 75 degrees Fahrenheit)
- Upon landing, if crabs are sorted and released at dock (“culled at dock”) before transport to bleeding facility, collectors should follow the above handling and recording procedures.
- Biomedical staff will educate collectors in proper holding, handling, and careful sorting and transport techniques and release site requirements. Rigorous sorting, and release at capture site, of crabs unsuitable for bleeding will reduce the number and mortality of such crabs transported and unnecessarily held at bleeding facilities.
- All collectors and their employees are provided a written copy of procedures and sign a training document to indicate they understand the required procedures.
- Specify collection requirements, best management procedures, and expectations of collectors and their designees/employees in written contracts. Annually audit horseshoe crab collectors on implementation of best management procedures (collection, handling, holding, transport) of horseshoe crabs to biomedical facilities.

Transport to Biomedical Facility

- Transport crabs in enclosed box trucks to maintain a cool temperature and moisture, reduce desiccation (exposure to wind) and exposure to sun.
- Before and during transport, maintain temperature between approximately ambient water temperature at time of collection and 10°F below the ambient water temperature.
- Maintain good ventilation while stacked in holding containers. Limit number of horseshoe crabs stacked in any container to no more than 3 crabs deep, with crabs placed right-side up, legs down to minimize stress and damage to other horseshoe crabs.
- Transport to bleeding facility immediately after landing; do not hold crabs overnight. Institute the ability of biomedical labs to accept delivery and secure crabs indoors (in environmentally controlled conditions) outside of normal business hours.
- Minimize travel time.
- Keep bins and horseshoe crabs covered (e.g., wet cloth) to protect against desiccation.
- Secure containers in the transport vehicle.

Holding at Facility/Preparation for bleeding/Bleeding

- Limit holding time, under normal circumstances, at the facility to less than 24 hours.
- Minimize exposure to fresh water.

- Follow above procedures for proper care and handling when sorting horseshoe crabs and moving them between bins and within the facility; at all times, crabs in containers are kept indoors, moist, and out of direct sun.
- Inspect crabs for health and damage, selecting only undamaged and healthy crabs for bleeding (do not bleed injured, juvenile, too small, too slow, too old/dull shell).
- Crabs to be bled are placed in containers right-side up, feet touching bottom and not stacked (only one crab deep) to reduce stress. Maintain this condition during sorting or in holding bins throughout the bleeding process, including post-bleeding holding period.
- Record the number, sex, and status (healthy, slow, dead) of bled crabs required for annual capture-to-release biomedical harvest reports (required by [ASFMC Add. III](#)).
- Maintain same level of care for rejected crabs (unbled) while being held until release at sea. Crabs rejected for bleeding should be placed in containers right-side up, stacked no more than 3 crabs deep, and released immediately to a waiting collector/delivery person for transport and release. Do not delay the release of unbled crabs until bled crabs are ready for transport and release.
- As with bled crabs, record the number and sex of crabs rejected for bleeding (unbled) and reason (injured, too slow, too small, too old/dull shell). Report the sex and number of unbled crabs and cause for rejection for annual capture-to-release biomedical harvest reports.
- If not medically necessary for a sterile bleed (by heart puncture), discontinue the use of sharp knives to hack epibionts from the carapace of crabs. This practice causes stress and injury that may be unnecessary.
- Maintain clean, sanitary conditions during bleeding.
- Avoid bleeding crabs more than once per year.
- Develop a coastwide system of marking crabs (not USFWS tags) such that all collectors can easily identify by sight, and immediately release, crabs already bled in the current collection year.
- If crabs are marked to avoid re-bleeding, ensure that the mark is residual and not harmful to the crab.
- Upon arrival at the facility, all crabs to be bled will be measured and weighed.
- Measurements will include inter-ocular distance (OID) and Prosomal width (PW), and total blood volume (ml) will be estimated for each crab using 25 percent of wet weight ⁽¹⁾; the blood volume extracted (ml) will not exceed 30 percent of an individual crab's total blood volume.

Bleeding

- Given a higher mortality from bleeding during the breeding period, the process for Horseshoe crabs collected and bled during the breeding period ⁽²⁾ (the period while not in the wintering area) must be restricted in the following ways.
 - Only males may be bled from April – July; females bled in this period have mortality rates as high as 29% ⁽²⁾
 - Bleed females August to October, after main breeding period.

- An 18-gauge sterile needle will be used. This should be inserted through the membrane in the hinge to extract a predetermined amount of blood from each crab (not to exceed 30% of total blood volume of an individual). If less blood is collected from the crab, suction will not be used.
- The bleeding lab will report (for each crab)
 - Total estimated blood volume (ml) and hemolymph (ml) extracted (not to exceed 30 percent of total blood volume).
 - Type of needle used.
 - Discontinue practices of timed bleeding periods and discontinue allowing crabs to bleed until rate slows.
- Perform internal audits to maintain quality control over written procedures.
- Perform weekly audits of metrics: number and sex of bled crabs and mortality during pre-bleeding, bleeding, and post-bleeding processes.
 - Total mortalities of bled crabs (intake to discharge from biomedical facility) that exceeds 15 percent will be cause for temporary suspension of bleeding activities until deficient handling/holding/bleeding practices are identified and corrected.
 - If deficiencies are corrected but mortality/injury are not reduced to 15 percent or less, reduce amount of blood drawn per crab to 25 percent or less of total blood volume (ml).
 - If mortality cannot be brought to 15 percent or less within two (2) weeks following initial suspension of bleeding activity, the permit/license to bleed crabs may be suspended until the biomedical facility develops changes to procedures that reduce bled crab mortality to 15 percent or less and prove the efficacy of new procedures to an independent assessor (not related to biomedical industry or fisheries agencies).
- Biomedical facilities will account and report the number and sex of unbled crabs and their status (dead, injured, too slow, too small, too old) in annual capture-to-release biomedical harvest reports. To date, the number of unbled crabs have not been required to be reported in annual biomedical harvest figures; unbled crabs range in number from 12,331 to 63,324 per year (avg. 31,238/year); 2004 to 2019 ⁽³⁾.

Post-Bleeding Holding

- Recognizing that the horseshoe crabs are now stressed from the bleeding process, maintain the same level of care.
- Minimize holding time in biomedical facility to less than 24-hours post-bleeding.
- When returning crabs to the water, if not being returned to the area of capture, ensure that conditions (salinity, water temperature, etc.) are similar to those found at the harvest site.
- While in holding, keep horseshoe crabs in the dark to minimize movement and injury.
- Keep horseshoe crabs well-ventilated, moist, and allocate only a suitable number of crabs to holding containers – no stacking, allow crabs to rest on bottom of container to reduce post-bleeding stress and injury.

- Crabs placed into containers for transport and release at sea should be right side up and stacked no more than 3 crabs deep.
- Crabs should not be out of salt water for more than 24 hours.
- All crabs must be processed in less than 24 hours and placed back in saltwater holding tanks after processing.

Return to Sea

- Whenever feasible, crabs should be returned to capture location within 36 hours or less from time of capture.
- Use same care in handling and transport when crabs are returned to the water.
- Include return written instructions and requirements within contract with collectors, if applicable
- Periodically audit horseshoe crab collectors on implementation of BMPs for returning crabs to sea.

Summary of Data to be collected by registered fishers during collection, before transport to biomedical facility, and post-bleeding before release at sea:

Monitoring disposition of all crabs collected for biomedical use: To ensure thorough monitoring, all crabs collected for biomedical use must be tracked from the time of capture until release (bled or not bled).

1. This will be done by registered fishermen only, who will report the following:
 - a) The location of the catch.
 - b) The number of crabs caught.
 - c) The number and sex of injured, killed, rejected for bleeding that are released at sea and released at dock, the number of healthy crabs transported to biomedical facility.
 - d) After capture, all crabs judged suitable for bleeding will be marked, the fishermen will mark the crab and will report the health of crabs at marking and at release.
 - e) The number and condition of crabs transported and delivered to bleeding labs
 - f) The disposition of each crab after bleeding including:
 - i. The number, sex, and relative health of the crab at the dock (healthy, injured, slow, dead)
 - ii. The number, sex, and relative health of crabs at release to sea (same as above)
 - g) The time from first capture to release.
2. An oversight (peer group) will monitor the data collected for each segment of the crab's movement from initial collection to release. The data will be reported to a mutually agreed upon group or agency who will release mortality and injuries data for each state within two weeks of the end of each quarter.

Thresholds for allowable mortality and injury at each stage will be determined by the oversight (peer review) group. The group shall be composed of experts who have demonstrated expertise in

the ecology of horseshoe crabs and shall not contain experts representing any commercial interests.

Overarching practices for all steps

- Generate written procedures for all handlers of horseshoe crabs, covering all steps in the process from collection to release.
- Keep horseshoe crabs cool, moist, and covered, avoiding direct sunlight.
- Establish a dialogue among collectors, the biomedical company, and the state regulatory agency to address concerns and challenges.
- Have a written contract between collectors and the biomedical company, outlining practices and expectations.
- Perform audits of the various steps in the biomedical use process and contractors/employees throughout the process
- Ensure proper monitoring and recording of mortality and injury at each step in the chain of custody.

Other concerns: bleeding of bait crabs

- Dual use of bait horseshoe crabs for biomedical practices should be prohibited.
- Eels and whelk fisheries are depleted, and HSC bait harvest should decline on its own, but not if bait fishermen can sell crabs to the biomedical industry.
- The bleeding of bait crabs will prop up an unnecessary bait harvest and institutionalize the death of hundreds of thousands of crabs/years rather than moving the biomedical industry toward a less lethal, more sustainable industry.
- Bait crabs from a given state or region are now sold to other states/regions for bleeding and entry into the purchaser's bait market (e.g., MA rent-a-crab, see Addendum III) or may be returned to the fisher – either way their fate is unknown. This practice undermines conservation efforts (e.g., in Del. Bay Region) and rewards states/regions that continue to overfish their HSC populations (e.g., NY & New England Regions).
 - (Action: disallow sale of bait crabs outside the region of landing, e.g., bait crabs harvested in the Del. Bay region can only be sold to states within the Del. Bay Region – NJ, DE, MD, VA).
- Biomedical reps. claim that bait crabs receive the same level of care as biomedical-only crabs (i.e., only passively bled). This is doubtful. The biomedical industry is secretive, there is no oversight, facilities do not assess in-house mortality or allow independent assessment of mortality or best management practices. There is no reason to trust that the biomedical industry is not bleeding bait crabs to death.
- The biomedical industry has dismissed all biomedical mortality studies to date on the basis that the studies “did not follow industry best management practices.” Industry BMPs were adopted in 2011 after most biomedical mortality studies were conducted. The 2011 BMPs are non-specific and non-measurable, and each biomedical facility is alleged to use additional unpublished practices. If industry BMPs are not measurable and

unknown, they cannot be reasonably replicated in biomedical mortality studies – this is an industry gambit.

- Starting in 2018, the number of bait crabs bled has not been reported in annual bait or biomedical harvest figures. This decreases public information and transparency of these two industries. The bleeding of bait crabs will prop up an unnecessary bait industry.

Review of Bleeding Mortality reports

Given recent findings and the wide variation in testing conditions and mortality results in bleeding studies, a formal peer review of the published studies needs to be undertaken. Publication of such a report could reduce some of the conflicting views currently expressed by various interests. Such a report could also frame future research avenues.

Summary

This report recommends revised BMPs for the various steps throughout the biomedical process, from harvest to release. The Horseshoe Crab Recovery Coalition continues to advocate for phaseout of the biomedical harvest replaced by widespread adoption of a equivalent synthetic alternatives for endotoxin testing. Until that time, we believe these BMP recommendations will help to reduce horseshoe crab mortality and protect this iconic species.

Literature Cited:

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⁽²⁾ A.S. Leschen* and S.J. Correia. 2010. Mortality in female horseshoe crabs (*Limulus polyphemus*) from biomedical bleeding and handling: implications for fisheries management, Marine and Freshwater Behavior and Physiology Vol. 43, No. 2, 135–147

⁽³⁾ ASMFC, Review of the Interstate Fishery Management Plan, Horseshoe Crab, Fishing years 2004 to 2017. <http://www.asmfmc.org/species/horseshoe-crab>.

