

To: ASMFC Horseshoe Crab Management Board

Date: 9/26/2017

I have been collecting, supplying and returning *Limulus* that are used in the production of *Limulus Amebocyte Lysate* for over 40 years. None of my *Limulus* are ever used as bait. All of my crabs are marked and returned to the estuary where they were collected. I have cooperated and worked with state, regional and federal regulators in order to educate and inform them of my activities. I file monthly "Trip Level Reports" with the Massachusetts Division Of Marine Fisheries. These "confidential" (Under Chapter 130 Massachusetts General Law) catch reports include my permit #, the date that I fished, what time I went out, how long I fished, where I fished (MA is divided into over 325 specific areas), what port I fished from, what method I use to catch, how many crabs I collected, how many male, how many female, permit number of who I delivered them to etc. Having been supplying and returning biomedical crabs, in the same area for decades, my reports indicate that there is no shortage of *Limulus*. There is no increase in time or effort to collect the same # of crabs year after year. This indicates a very sustainable fishery in every respect. Right now, today, there are tens of thousands of shed *Limulus* shells washed up all over the shoreline of Pleasant Bay and the Bay bottom is also covered with tremendous numbers of recently shed *Limulus* shells.

I have been a member of the ASMFC Advisory Panel for Horseshoe Crabs, from the state of Massachusetts since the creation of the AP. When *Limulus* were first being discussed as a species to be regulated by the ASMFC it was going to be an American Eel/Horseshoe Crab advisory group because at the time *Limulus* were primarily thought of as bait for *Anguilla rostrata*. It soon became evident that very few members of the public wanted to discuss eels but many people wanted to talk about the Horseshoe Crab. The two species are now regulated independently by the ASMFC.

Every state from Florida to Maine is different. Certainly New England states vary in climate and fauna from the southern coastal states. Being from Massachusetts I see different behavior exhibited by species that are found elsewhere along the Atlantic coastline. When we at ASMFC speak of the *Limulus* fishery along the eastern coast of the US the "rufa" species of Red Knots is perpetually entwined in the discussion. South of New York has generally been considered as the area most noted for the northern migration of shorebirds. Cape Cod, where I live, is considered more of a southern migration staging area. We do have a healthy shorebird migration in the Spring but apparently not to the extent of our southern neighbors.

I, like many people, am a bird enthusiast. I very much enjoy recording video of shorebirds and songbirds and I have many dozens of hours of digital recordings that are very helpful in identifying different avian species and what they are feeding on. It is in July and August when I see the greatest numbers of migratory Red Knots here on the elbow of Cape Cod. They are primarily flocking and feeding on juvenile Blue Mussels (*Mytilis edulis*). The Knots are on their way back from the arctic breeding grounds and heading toward their southern habitat where food is plentiful. Red Knots often fly to the southern tip of South America although some groups stay along the southern coast of the US during our winter.

I am writing this in order to respond to the draft of the AP Conference call that we had on September 21, 2017. My comments will touch on just a few studies that I find interesting and informative. There is much literature available that touches on the diet of Red Knots and Limulus. On the following pages I am going to include a few quotes and references regarding diet of Horseshoe Crabs and Red Knots starting with the quote from USFWS from 2001:

- **“Economic Assessment of the Atlantic Horseshoe Crab”** prepared and published by the U.S. Fish and Wildlife Service in 2001 stated:

“Scientists remain uncertain whether the presence of horseshoe crab eggs is essential to the viability of shorebird populations or whether these populations would find substitute food sources if horseshoe crab eggs became unavailable. In addition little evidence exists indicating whether shorebirds which feed on horseshoe crab eggs have greater reproductive success as a result.”

At some point the sentiment expressed in the above statement has changed. It is now commonly stated as fact that Red Knots (*rufa*) absolutely require horseshoe crab eggs in order to reach their nesting sites in the arctic tundra. All of the other subspecies of Red Knots travel the world north to south, from the west coast of the USA, to Great Britain, Siberia, Australia, New Zealand, Africa and elsewhere. None of them rely on *Limulus* eggs to survive. All eat a widely varied diet of invertebrates.

Away from Delaware Bay, Red Knots (*rufa*) feed primarily on molluscs and bivalves:

- *“The prey of Georgia coast red knots were dwarf surf clams (*Mulina lateralis*), and knots in South Carolina fed mainly on coquina clams (*Donax variabilis*). Food resources available to knots on the Virginia coast where knot densities were highest, were blue mussels (*Mytilus edulis*)”.* (Brian Harrington and Winn 2001)

Brian Harrington, author of **“Flight of the Red Knot”** (no relation to Jay Harrington) documented thousands of Red Knots feeding on blue mussels (*Mytilus edulis*) in Pleasant Bay (Cape Cod) in 2008 and 2009. That feeding behavior, on Cape Cod, has also been observed and documented every year since then up until last year 2016.

Interestingly on the Red Knots’ return to South America for the winter, around the shores of Tierra del Fuego, Brian Harrington again notes that:

- *“Mussels are the knots dietary staple of the season.”* (Food For Flight).
- *“For the Knots, bivalves are among the most satisfying of delicacies. The birds’ digestive systems have evolved accordingly, becoming exceptionally well suited for processing shellfish. Some other shorebirds find the shells of their prey indigestible and have to regurgitate them in pellets... The Red Knot is more fortunate:when it swallows mussel*

spat or a surf clam, it's gizzard grinds shell along with everything else and the waste passes through the entire digestive tract. " (P. 36 **The Flight of the Red Knot, Brian Harrington**)

Horseshoe Crabs (*Limulus polyphemus*) are voracious predators often competing for the same prey that shorebirds, ducks, geese and humans depend on.

In 1948 Harry Turner of the Woods Hole Oceanographic Institute published his report "Propagation of the Soft Shell Clam". Turner reported that "*One adult Limulus eats about one square foot of moderately seeded soft shell clams in a day.*" Turner also showed that a single three inch *Limulus*, held in a tank, ate 99 out of 100 one half inch soft shell clams within a period of 72 hours.

While crabs are adaptable, omnivorous and opportunistic feeders their chemoreceptors are finely tuned to locate their favorite prey, bivalves. I would like to note some research of the dietary habits of *Limulus*:

- "*Crab guts were literally stuffed with an average of nearly 400 blue mussels, Mytilus edulis averaging 6.3 mm in length.*" (**Botton and Haskin, 1984**)
- "*Bivalves comprised the vast majority of the ingested food during all seasons. As many as 465 nut clams, (Nucula proxima), 166 surf clams, 230 razor clams (Ensis directus) and 230 dwarf tellins (Tellina agilis) were found in individual crabs.*" (**The American Horseshoe Crab, Harvard University Press 2003**)
- "*Similar to crustaceans in appearance, the horseshoe crab, Limulus polyphemus, is a significant predator of the soft-shell clam. It will also eat hard clam seed up to the 5/8 inch range (15 mm). Horseshoe crabs burrow under the sediments to find their prey.* (**Gef Flimlin, Marine Extension Agent, New Jersey Sea Grant Marine Advisory Service; Brian F. Beal, Assistant Professor of Marine Ecology, University of Maine of Machias**)

When the AP discusses the fact that well over 30 million large horseshoe crabs live around Delaware Bay I find it surprising that a fishery commission never discusses the effect and implications of *Limulus* feeding on bivalves and other extremely important species. Multiply the stomach contents of a single *Limulus* (above) times 30 plus million animals and you are talking about billions of shellfish being consumed on a daily basis. For instance; if in one day every horseshoe crab consumed 400 blue mussels that would be over 12,000,000,000 in one single day. I do not believe that every *Limulus* is suddenly going to gorge on mussels exclusively but I just use that as an example of the effect that tens of millions of *Limulus* are having on their ecosystem. That fact that *Limulus* is a voracious predator should be acknowledged and incorporated by ASMFC regulators.

I have read a study, done in the mid-Atlantic region, in which shorebirds (*not Red Knots*) were held in captivity and fed a diet of *Limulus* eggs or alternatively worms. The shore birds that ate the worms put on weight much faster than the birds that were fed *Limulus* eggs.

Having an older brother who lives in Kodiak, AK I am reminded of the story of the decline of the Steller Sea Lion populations in the Gulf of Alaska and the Aleutian Islands. Many attributed the decline to the overfishing of Pollock even though Pollock stocks were in very good shape. Fishing was banned for years. Pollock stocks soared while the Steller's numbers continued to decline. It was later determined that Pollock was not a fish that provided enough nutrition for the Sea Lions and that the Pollock were decimating the herring population on which the Stellers traditionally thrived. Many references to that issue can be found online.

None of these anecdotes/stories that I am relating have any definitive relationship to the *Limulus* / Red Knot discussion. I do think that it is worth opening up a dialogue about the possibility that the relationship of *Limulus* to shorebirds may need to be expanded.

I have been extremely fortunate to spend much of my life observing the interactions of life in the natural world. It is often the case that when a person, such as myself, comments on my observations they are considered "anecdotal" because they have not been "peer reviewed". I believe that other members of our AP feel that their observations are considered anecdotal as well.

Thank you for your time and for the opportunity to express some of my thoughts as a member of the HSC Advisory Panel.

Sincerely,

Jay Harrington



Specialists in Endotoxin and Glucan Detection

10 OCT 2017

Atlantic States Marine Fisheries Commission
1050 N. Highland St.
Ste. 200
Arlington, Virginia 22201

RE: Response to proposed use of confidential data in ARM and Stock Assessments.

Dear Commissioners,

Associates of Cape Cod, Inc. (ACC) has participated in a catch and release fishery of horseshoe crabs (HSC) in the New England region for well over 40 years. Although ACC does not participate in the Delaware Bay biomedical collection, we do have a strong contingent interest in management of this proximal east coast fishery. ACC shares the desire for a healthy and sustainable population of HSC's, however, we are deeply concerned about the proposals that may compromise or remove the protection of confidential company data that is protected by law. ACC is the smallest company in this segment and we rely upon the confidentiality of the fishery data since we compete against much larger corporations, and sharing of that data would put us at a competitive disadvantage.

Conservation efforts surrounding the bait industry have reduced overall harvest of the animal but mortality remains at 100% and is orders of magnitude greater than the biomedical mortality. The biomedical industry has a greater than 40 year history of being a catch and release fishery. Current research indicates that the impact of a biomedical fishery is minimal to the animals, and data from the ASMFC clearly demonstrates that the biomedical catch and release fishery has a very small impact on overall mortality.

A periodic review of the biomedical mortality is supported, but the data does not support that a change in strategy is needed at this time. The bait industry is the leading cause of mortality and should be regulated accordingly as is currently done. To require the biomedical mortality data to be included in the ARM when it is such a small percentage of the number of crabs harvested will not add real value to the ARM. While this may seem inconsequential at first glance, the risks do not outweigh the benefit. The risks involved in including the biomedical data in the ARM process is as follows:

- A. The variable data could require quotas for the biomedical industry based on output from unreliable estimates of red knot populations. If biomedical harvest were to be limited, this poses a direct impact to human health. The horseshoe crab blood is used specifically to make LAL, which is a product used to detect life threatening bacteria in any vaccine, medicine, or medical device that enters a human body. There is no alternative that is as

reliable or accurate, and to prevent this product from being manufactured could directly affect the availability of vaccines, drugs, diagnostics or medical devices. There are times when an unanticipated increase in LAL production is needed, such as during pandemics and outbreaks like those in our recent past. Examples are bird flu, swine flu and measles. To establish quotas on the biomedical harvest when the mortality estimates are so minimal is irresponsible.

- B. The release of biomedical data in the Delaware Bay region as an aggregate may not in theory compromise the confidentiality of those biomedical facilities, but in reality it would do just that. The companies in that region are not created equal and the data, even as an aggregate, would give telling data from the main source company in the Delaware Bay region. This would by default, make the data available to the other companies as each company could mathematically determine the competitor's information based on what came out of the Delaware Bay region and vice versa.

Review of harvest data over the past 14 years indicates that conservation efforts have reduced overall harvest rates and that overall harvest and related mortality is well below the thresholds set by the ASMFC and individual states that often opt for a more conservative approach to quota management.

The majority of BMPs formalized in 2011, including live release, had been in practice for decades in some instances. Our operations are widely scrutinized by local, state and federal authorities, as well as US and international regulators, customers, and internal quality control. We take our current reporting responsibilities very seriously, and have performed to expectations.

Conclusion:

Associates of Cape Cod, Inc. commends the efforts of the horseshoe crab ARM subcommittee and the fine work done in an effort to stabilize populations of both the horseshoe crab (HSC) and red knot in the Delaware Bay region. The relationship between the biomedical facilities and fisheries managers is longstanding and productive. Over 40 years of conservation efforts have proven to be effective. Given the data, it would be reasonable to conclude that the biomedical fisheries are of little, if any, impact. Therefore, a change to the ARM and /or stock assessments that can potentially release confidential information and increase the risk of possible negative impact to an industry that provides such a vital and important product is unwarranted. I do appreciate your attention to this most important matter and ask that this material is available for the annual meeting in October.

Best regards,



Brett Hoffmeister
LAL Production Manager

Horseshoe Crab

Activity level: High

Committee Overlap Score: Low (SAS overlaps with BERP)

Committee Task List

- TC/SAS – All Year: Benchmark stock assessment
 - SAS & TC - January/February: Data Workshop
 - SAS – March and May: in-person Assessment workshops
 - SAS – January-August: data collection, analysis, report writing
 - TC – July: review benchmark assessment report
 - SAS – August: 3 day Peer Review Workshop
 - SAS Chair – October: Present the stock assessment to the Board
- TC – March 1st: Annual compliance reports due
- ARM & TC – Fall: Annual ARM model to set Delaware Bay specifications, review red knot and VT trawl survey results

TC Members: Rachel Sysak (NY, TC Chair), Lindsey Aubart (GA), Tiffany Black (FL), Gregory Breese (USFWS), Jeff Brunson (SC), Jeff Brust (NJ), Joanna Burger (Rutgers), Ellen Cosby (PRFC), Jeffrey Dobbs (NC), Steve Doctor (MD), Adam Kenyon (VA), Mike Millard (USFWS), Scott Olszewski (RI), Derek Perry (MA), Steve Poland (NC), Linda Stehik (NMFS), Chris Wright (NMFS), Jordan Zimmerman (DE), Kristen Anstead (ASMFC), Michael Schmidtke (ASMFC)

SAS Members: John Sweka (USFWS, SAS Chair), Jeff Brust (NJ), Jeffrey Dobbs (NC), Michael Kendrick (SC), Scott Olszewski (RI), David Smith (USGS), Rachel Sysak (NY), Richard Wong (DE), Kristen Anstead (ASMFC), Michael Schmidtke (ASMFC)