

## Questions and Answers

### **Why are horseshoe crabs special?**

Horseshoe crabs are an ancient species, estimated to be 450 million years old. The species has survived three major extinction events throughout their existence.

These crabs – which are actually technically more closely related to spiders or scorpions than crabs - are a key part of our coastal ecosystem. Their eggs help nourish marine ecosystems and provide an important energy source for migrating shorebirds and numerous fish species, especially vitally important forage fish. The crabs provide an additional resource when eggs hatch and emerge into the sea. At sufficiently large populations, spawning horseshoe crabs lay so many eggs they carpet beaches with an energy rich food source. Benefits continue for birds and fish when eggs hatch and larvae emerge into tidal waters.

### **What is happening with horseshoe crab populations?**

The bait and biomedical harvest of horseshoe crabs along the Atlantic Coast is, for many populations, insufficiently managed and regulated. Tragically, the coast's largest population of horseshoe crabs, in Delaware Bay, began collapsing as unregulated crab harvests grew from about 100,000 a year to 2.5 million crabs in 1998. As a result, egg densities on Delaware Bay beaches crashed from approximately 50,000 per square meter to 5,000 per square meter. More than 20 years later, crab populations have still not recovered, and many of the Atlantic coast populations are still declining.

The threats facing crabs also pose a peril to migratory shorebirds like the Red Knot, a threatened species that depends on abundant horseshoe crab eggs as a critical food source during its nearly 10,000-mile migration to its Arctic nesting grounds. Other species that are in decline, like weakfish and striped bass, also feed on the eggs. Forage fish, too, flourish by feeding on hatched larvae, thus providing more prey for sportfish higher in the food chain.

### **What is behind this dramatic decline?**

Horseshoe crabs are staring down multiple threats – being harvested as bait for commercial fishing of whelk and eel, and by biomedical suppliers who bleed the crabs and sell the bioactive component, *Limulus amoebocyte lysate* (LAL), to biomedical and pharmaceutical companies for testing pharmaceuticals for toxicity. While crabs taken for bleeding are supposed to be released back into waterways, it is estimated that up to 30 percent die as a result of the process. (*Source for 30%: Maloney, Phelan et. Al., Plos Biology, 2018*). In addition, they are caught as “bycatch” in the nets of commercial fishing operations trawling for scallops, clams and other bottom-dwelling species.

## **How are birds impacted by the loss of horseshoe crabs?**

Populations of migratory shorebirds are collapsing. Research done along the Delaware Bay has shown that the cause of the decline is lack of food – namely horseshoe crab eggs. Without this important energy source, shorebirds already energy-depleted by long journeys from southern wintering areas die trying to make it to breeding areas in the Arctic. If they do arrive, they often lack energy to lay eggs or care for their young. The lack of horseshoe crab eggs is caused by over-harvesting of adult crabs – primarily females – for bait, and by industrial-scale bleeding of crabs for lysate, a biomedically important compound.

The overall crisis facing birds has been well documented in recent studies in the journal *Science* as well as the National Audubon Society's report, [Survival by Degrees: 389 Bird Species on the Brink](#). Both were published in October 2019. Shorebirds have been among the hardest hit populations, suffering a 37 percent decline since 1970. The *rufa* Red Knot population has declined by roughly 75 percent at key stopover points like the Delaware Bay since 2000, according to the U.S. Fish and Wildlife Service. Of all declining shorebird species, the six that stop in Delaware Bay during spring migration and feeding on horseshoe crab eggs have declined the most.

## **What are the other impacts of the horseshoe crab's decline?**

In addition to the well-documented impacts on shorebirds, ecosystems along the Atlantic coast are also significantly affected. These impacts reverberate into local communities and towns that depend on recreational sportfishing, birding and eco-tourism activities as key parts of their economies.

For example, horseshoe crab eggs are consumed by nearly all fish species in the Delaware Bay. Thus, the decline in horseshoe crabs has contributed to declines in the productivity of forage and game fish populations, like the weakfish. This loss, in turn, has impacted Delaware Bay communities by contributing to the collapse of recreational fishing and declines in bird-related tourism. Delaware Bay was once known as "the weakfish capital of the world", but without the fish, marinas, restaurants, and hotels are all suffering from lack of anglers and the dollars they spend.

Similarly, as the number of shorebirds on Delaware Bay fell from 1.5 million - earning it the distinction as one of the most abundant bird concentrations in the world - to less than a few hundred thousand, birding tourism also decreased. This economic loss further exacerbated the plight of bayshore communities.

## **What has been done to recover horseshoe crabs? Why isn't it enough?**

In 2008, the state of New Jersey enacted a moratorium on the harvest of horseshoe crabs for bait, recognizing that the species provided far more value to the Delaware Bay ecosystem than as bait. The Atlantic States Marine Fisheries Commission (ASMFC), the body that manages coastal fisheries, then moved to establish a management system that attempted to account for the role horseshoe crabs play in supporting Red Knots.

Despite these efforts, the Red Knot was listed as a threatened species under the Endangered Species Act in 2014. There is ample evidence that the volume of crab eggs has not recovered enough to support Red Knots and other shorebirds, despite the current management strategy. After six years of prohibited female horseshoe crab harvest, and limited male harvest, the number of adult females, which produce the eggs, remains unchanged.

While bait harvest continues with some regulation, the biomedical suppliers that harvest horseshoe crabs are barely regulated. The ASMFC relies on the industry's self-reporting to estimate mortality and long-term impacts to bled crabs, and by law, is not required to disclose these details to the public. Last but not least, there is still significant bycatch of horseshoe crabs in other fisheries.

The bottom line is that fisheries management agencies are managing horseshoe crabs for population stability, not to recover the species to the level needed to provide flourishing marine ecosystems. We must pursue other strategies to achieve the recovery of our marine ecosystems.

## **What about places outside of the Delaware Bay?**

Delaware Bay is one of the most important stopover points for shorebirds, but other shorelines are important as well. The status of horseshoe crab populations in other states and regions varies greatly. While more information is needed, such as that comparable to the Virginia Tech dedicated horseshoe crab trawl survey in Delaware Bay, horseshoe crabs in other regions are in trouble.

Horseshoe crabs are a vital part of any nearshore ecosystem but in many places have been prevented from fulfilling their role of generating productivity for other species by persistent, unregulated harvests. This is why our coalition is working outside of the Delaware Bay to recover horseshoe crabs. Additionally, reforming bait or biomedical harvest in one state may well lead to increases in other states. We must focus on recovering this species across the entire Atlantic coast.

### **Are there alternative ways to test medicines and medical devices for toxicity?**

Horseshoe crabs have been integral to the safe production of vaccines and injectable medications for the past 40 years. This is an ecologically unsustainable practice, given the mortality rate of crabs used for bleeding and the resultant impact on shorebirds and marine-life. Fortunately, a synthetic alternative, known as recombinant Factor C (rFC), dramatically reduces the need for animal products in endotoxin testing. Recent studies confirm the synthetic product is bioequivalent to LAL derived from horseshoe crabs. The synthetic is being used by Eli Lilly for its U.S. Food and Drug Administration approved migraine medication Emgality, and it is under active consideration by other companies. Shifting toxicity testing to rFC is an extraordinary opportunity for the biomedical and pharmaceutical industries to significantly contribute to the conservation of horseshoe crabs and the birds that depend on them. *(Source: Maloney, Phelan et. Al., Plos Biology, 2018)*

### **How does the cost of the synthetic alternatives compare?**

Cost estimates for the synthetic are comparable to natural LAL, but the synthetic is far easier to create and sustain production. Wider adoption of the synthetic would make it cost effective as production ramps up and competition enters the marketplace. rFC is also more sustainable and socially responsible, consistent with the biopharma industry's commitment to the "Replacement, Reduction and Refinement" (3Rs) strategy governing of the use of animals in scientific procedures.

### **Why isn't the synthetic rFC more widely used?**

Because the synthetic is not included in the U.S. Pharmacopeia, which sets the standards for drug manufacturing and testing, pharmaceutical companies wishing to use the synthetic in their drug testing must demonstrate to the FDA that for each drug, the synthetic is comparable or better than LAL. There is little incentive to do this when LAL, which has been the gold standard test, is included in the U.S. Pharmacopeia. Pharmaceutical companies can use the synthetic in their manufacturing processes – such as testing the water used in developing drugs and medical devices, but until and unless there is a critical shortage of horseshoe crabs, there is no incentive to switch.

Several companies are now manufacturing rFC. Once the U.S. and Japanese pharmacopeias include rFC, and as it becomes more available, major biopharmaceutical companies will likely continue to adopt the synthetic version in testing, especially if they understand the value of each and every crab to the marine ecosystem and the economic health of rural communities.

## **What do the LAL producers need to do to reduce mortality in bled crabs?**

It will take time for the biopharma industries to transition from using LAL to rFC for toxicity testing medical devices, intravenous equipment and drugs. Until then, the companies bleeding crabs and producing LAL must adhere to best practices that reduce mortality. This can be accomplished by reducing stress to crabs during transport to the bleeding facilities, limiting amount of blood extracted from each crab and returning crabs to the locations from which they were harvested. The ASMFC does not have jurisdiction over the activities of LAL producers, so states must provide regulatory oversight to ensure compliance with best practices.

## **If there is a synthetic alternative to LAL, is there a synthetic bait alternative?**

Researchers have worked on a bait alternative to reduce or eliminate the need to harvest horseshoe crabs with varying degrees of success. The key to driving this market is reducing bait harvest – not vice versa. Only when bait harvest is reduced to be in line with ecological needs will fishing operations start to look for cost-effective alternatives.

## **What about the eel and whelk fisheries that use horseshoe crabs for bait? How are these species faring?**

The main use of horseshoe crabs for bait are for whelk and American eel. The ASMFC has no management plans for either, nor any restrictions on the harvest. Consequently, whelk and eel fishers report virtually no data on their catches. Independent studies, however, show the average size of whelk is declining, a key indicator of population collapse. Worse, the American eel was proposed for federal listing in 2008 and 2015, also indicating a declining population. It is counterintuitive to endanger horseshoe crabs to use as bait in quickly declining fisheries.

## **What do we need to do to recover horseshoe crabs?**

- We have launched a coalition to support the following goals:  
Manage horseshoe crab bait fisheries to ensure that populations are large enough to support the needs of other species like the Red Knot and weakfish that consume their eggs.
- Institute policies that reform the horseshoe crab bleeding industry to reduce mortality and other impacts.
- Encourage pharmaceutical companies to adopt the use of the synthetic LAL alternative (rFC) for use in testing procedures.

- Raise awareness of the importance of the horseshoe crab by engaging volunteers in efforts to conserve crabs along the Atlantic coast.

By pursuing these goals, we aim to fully restore horseshoe crabs by 2030.

### **Who is part of the coalition?**

The coalition is made up of organizations across the Atlantic coast, from fishing captains to bird conservation organizations to biomedical companies, that all understand the critical role horseshoe crabs play in our marine ecosystem. You can see the latest list of coalition partners [HERE](#)

### **Why is a coalition needed?**

Only a multifaceted coalition that includes a broad spectrum of partners can stem the tide of this ecological crisis and realize all the natural benefits of fully restored populations wherever they occur on the Atlantic coast. The health of the horseshoe crab population affects:

- Sport fisheries and the economies based on them
- Sea turtle populations
- Shorebird populations
- Recreational fishing and other tourism economies.

Our partnership represents the most powerful approach to ensuring that local, state and national decision-makers take informed and appropriate action to restore crabs quickly so the public can enjoy the benefits.

### **How will the coalition achieve its goals?**

The coalition will be working to energize conservationists, legislators, policymakers and the public to care more about the health of our waters and the marine and birdlife. Some states may require legislative or regulatory reform. Others may need strong stewardship programs to protect the health of horseshoe crabs along our beaches and barrier islands. We also expect to work with the biopharmaceutical industry on wider adoption of a synthetic alternative to horseshoe crab blood used in toxicity testing, and to ensure that LAL suppliers adhere to guidelines and best management practices that reduce mortality as well as adverse effects from the bleeding process. Each state has its own set of challenges and each will require its own set of solutions.