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April 26, 2023

Dear Drs. Carmignani and Nelson,

I am writing to strongly support the proposal submitted by Sharl Heller and the Southeastern Massachusetts Pine Barrens Alliance to list the American horseshoe crab, *Limulus polyphemus,* as a Massachusetts Species of Special Concern. Listing *Limulus* now is necessary and timely, both to protect and rebuild the sadly and severely diminished American horseshoe crab, and to protect and rebuild the many other species that depend on them.

I am the Founder and former Director of Harvard Medical School's Center for Health and the Global Environment, an Associate in Harvard's Department of Organismic and Evolutionary Biology, Director of the non-profit The Program for Preserving the Natural World, and recipient of a Nobel Peace Prize. Today, my work is focused on the urgency and necessity of preserving a biologically rich and diverse world.

Our earth is now entering its sixth mass extinction. The last one, some 65 million years ago, was caused by a giant asteroid striking the Earth. This one we are responsible for. As a result of human activity, we are now losing species at rates of 1000 times, and more, higher than expected background extinction rates.

Horseshoe crabs are 475 million years old. An enduring, resilient species, they evolved shortly after the dawn of animal life, and have survived each of the planet's mass extinctions. When, 250 million years ago, 97% of life in the sea perished, they endured. Sixty-five million years ago, when the great dinosaurs perished, horseshoe crabs endured. Now, though, they are threatened by us, whose presence here by comparison is but the blink of an eye.

Horseshoe crabs in Massachusetts have experienced alarming declines for years. In the 1960s, when fishermen and regulators considered horseshoe crabs pests, state-subsidized bounty programs destroyed thousands of them. In the decades that followed, hundreds of thousands more were killed in the horseshoe crab bait fishery, and hundreds of thousands were taken from the sea to be bled by the biomedical industry. The 2023 biomedical take in Massachusetts will be its

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highest take ever, further increasing pressure on this already beleaguered animal.

Today only a very small number of horseshoe crabs come onto Massachusetts beaches to lay their eggs. Over the years, the take has been so high, horseshoe crabs have shown little sign of recovery, and the fishery, no longer profitable on the beach, has moved offshore where horseshoe crabs are scraped off the seafloor with trawlers. It's hard to imagine how Massachusetts could sanction using an animal that takes 10 to 12 years to reach maturity as bait. It's illegal here to take lobsters bearing roe. Why is it permissible to take egg-bearing horseshoe crabs en route to, or on their way to, spawning beaches?

Horseshoe crabs are a "foundational" species. In abundance, their eggs, overturned by massive numbers of spawning horseshoe crabs, provide essential food for hundreds of thousands of migrating shorebirds, and for many species of small forage fish and sand shrimp that in turn support larger fish and other birds. Pull at this singular thread in a coastal food web and it frays. That is where we are now.

Horseshoe crabs have given much to humans over the years – fertilizer for our fields; an understanding of the foundation of human vision through Nobel-prize winning research on the lateral eye of the horseshoe crab; and, through the capacity of horseshoe crab blood to clot in the presence of potentially dangerous endotoxin, an assay which has safeguarded our vaccines, injected drugs, and implanted medical devices.

Over half the medicines used by humans are originally derived from nature – aspirin from willow trees, statins from various fungal species, blood thinners from moldy clover, and ACE inhibitors from the venom of pit vipers, for example – but eventually synthetic versions of these drugs replace the natural sources. The cancer treatment paclitaxel, for example, was originally derived from the bark of the Pacific yew tree (*Taxus brevifolia*). The drug, in danger of short supply due to the limited number of these trees, is now being produced semisynthetically from other species of yew grown on plantations. Synthetic alternatives to the horseshoe crab blood assay are on the market, and major pharmaceutical companies are adopting them.

Horseshoe crabs are already listed as endangered by the IUCN in Asia, where their numbers have plummeted by as much as 90 percent. The IUCN lists them as endangered in New England. There's no reason to take any horseshoe crabs for bait, and no need to take so many for blood when synthetic alternatives are available.

Horseshoe crabs have been generous to us. We owe them a rest, before it's too late. The only way to replenish this diminished population, and return it to robustness, along with the multitudes of shorebirds that depend on its eggs -- and whose numbers are also in severe decline -- is to list the horseshoe crab as a Species of Special Concern. Only then will these ancient animals receive the care and respect they need and deserve.

I am asking you to reply to my letter and to address my concerns.

With respect and admiration for the important work that you do,

Eric Chivian M.D.