Researcher’s breakthrough ensures future supplies of the medically vital horseshoe crab

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NEW HAVEN — Carmela Cuomo plunged her hand into a fish tank and stirred the bottom with a spoon, creating a swirling cloud of sand, gravel, and tiny horseshoe crabs.

The hatchlings — visible best under a microscope — are the fruits of 11 years of experimentation spurred by what was almost a dare from a colleague: Would it be possible to rear horseshoe crabs from the ghostly, translucent hatchling stage to their spiky-tailed, fully armored adulthood?

“Could we get them to mate in captivity?’’ Cuomo said, describing the challenge. “We joked about wine and candlelight.’’

Last year, by tweaking everything from the water temperature to the kind of sand in the tanks, Cuomo, an associate professor and coordinator of the marine biology program at the University of New Haven, succeeded in getting captive horseshoe crabs to spawn from May to October — yielding more eggs than she knew what to do with. Some are still hatching.

Horseshoe crabs are ancient, dating back more than 300 million years. But the animals, which look like a medieval helmet, have also come to play an important role in the modern economy.

Their milky blue blood is used to ensure the safety of drugs and medical devices and is the basis of a multimillion-dollar industry that depends, in part, on two Massachusetts companies that take blood from crabs: Associates of Cape Cod in East Falmouth, and Charles River Laboratories International, of Wilmington. The animals are also used as bait for conch and eel fishing.

There appears to be no immediate need for horseshoe crabs grown in captivity. But Cuomo is focused on the future and sees the potential for biomedical companies and conservationists alike to be interested in such a technique if anything were to happen to the horseshoe crab population. There is evidence of a decline in the Northeast’s population. The Atlantic States Marine Fisheries Commission in 2004 reported that the horseshoe crab stock had declined in Narragansett Bay and declined or remained stable since the mid-1970s around Cape Cod.

Horseshoe crab blood is effective in detecting certain kinds of bacteria, including microbes like E. coli or the pathogen that causes meningitis. It is also critical for a test heavily utilized by the medical device and pharmaceutical industry to ensure the safety of its products.

Horseshoe crabs probably evolved the ability to detect the toxins as a kind of bodily defense, said Foster Jordan, a senior vice president of Charles River Laboratories. It was first discovered that horseshoe crab blood clots in the presence of certain bacteria in the 1950s. A component of the blood, limulus amebocyte lysate, was found to be responsible for this detection ability.

Jordan said that about 400,000 crabs are taken from the East Coast by the biomedical industry each year, and returned once a portion of the blood has been drained. His company takes crabs in South Carolina. He estimated that the worldwide market for products based on tests that utilize horseshoe crab blood is worth more than $200 million.

Although it can be difficult to measure the overall population, recent work on a horseshoe crab census found reasons for concern, said Dan McKiernan, deputy director of the state Division of Marine Fisheries. Beach surveys in Massachusetts have found some lone females laying eggs without any males to fertilize them, he said.

This year, the Division of Marine Fisheries adopted regulations to protect the crabs when, during full and

new moons, they appear on beaches to lay their eggs. Rules that went into effect last week prohibit the harvesting of crabs for five days around the full and new moons in May and June. The state's catch limit is 165,000.

Cuomo normally studies sediment geochemistry and how it affects bottom-dwelling organisms. But on her own, she invested thousands of dollars and filled her basement with tanks of baby horseshoe crabs that would, during a full moon, kick up out of the gravel on the bottom.

Cuomo is pleased that she seems to have discovered a way to set the right mood in the tank and is moving on to the next challenge: optimizing a diet.

By separating the hatchlings into different groups, she is looking at whether tweaking the protein content of their food, or using ingredients that range from brine shrimp to fish food, can speed up horseshoe crab development, getting them more quickly to bleeding size.

As she sat at the microscope last week, watching the hatchlings swim in and out of the field of view, she couldn't help but notice: "They're adorable.''

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