# March of the Horseshoe Crabs

## The ungainly creatures' importance to human health is often overlooked — except by the helpful folks who assist in their annual migration ashore

By Jeanne Shook | Photograph by Ariane Mueller

On beaches all along the Delaware Bay, the mating ritual of horseshoe crabs has played out for millions of years during the annual breeding season.

The horseshoe crab was walking the ocean floor long before the first T-Rex was hatched. In fact, this ungainly arthropod has survived half a billion years. And yet, one of the oldest living species on the planet doesn't have a week dedicated to it on the Discovery Channel, or its own Facebook page (like Mary Lee, the great white shark). Dismissed by many as ugly and useless, this Rodney Dangerfield of sea creatures often "gets no respect."

Horseshoe crab blood turns blue when oxidized, due to the presence of copper. Lab technicians extract the blood for its lifesaving qualities.

Well, in some quarters it does. Those who take the time to get up close and personal with the horseshoe crab know differently: This is an animal whose appearance belies its significance to mankind, and is worthy of not only respect but also our thanks.

"If you've ever had a flu shot, know someone with a pacemaker or joint replacement, or have given your pet a rabies vaccination, you owe a debt of gratitude to the horseshoe crab," says Glenn Gauvry, founder and president of the Ecological Research & Development Group. "Vaccines, injectable drugs, intravenous solutions, and implantable medical devices, both for humans and animals, are tested for the presence of the life-threatening bacterial endotoxin using a test that comes from the blood of horseshoe crabs."

But that remarkable anti-bacterial property doesn't guarantee these blood donors' protection. "The biggest threat to horseshoe crabs is ignorance and indifference," notes Gauvry, who is trying to change all that. In 1995, in the absence of any horseshoe crab advocacy groups, he founded the nonprofit ERDG, a network of volunteers, academics and government agencies dedicated to the conservation of the world's four horseshoe crab species (one in North America and three in Southeast Asia.) According to Gauvry, one of the keys to the creatures' longevity is that they are "generalists" that can adapt to a changing environment. "It's why they've survived 470 million years," he explains. "If one thing goes wrong, it doesn't wipe them out. … It's been part of their successful model for so long."

**HOW TO FLIP A HORSESHOE CRAB**
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## Medical miracle worker

*Limulus polyphemus,* the species found along the Atlantic coast, is not a crab at all but rather a type of marine arthropod. And though it may have more in common with spiders and scorpions, the horseshoe crab is harmless. Contrary to what some believe, it doesn't sting and it's not venomous. Its tail may appear threatening, but it simply serves as a rudder/navigational tool and to assist the animal in righting itself when flipped onto its back.

Horseshoe crabs spawn along the East Coast from Maine to the Gulf of Mexico, but Delaware Bay is the "sweet spot." The bay's hospitable temperature, combined with low-energy wave action, sheltered inlets and tributaries, shallow waters, and proper salinity combine to create the largest horseshoe crab spawning ground in the world. During the breeding season each spring, local beaches are the epicenter of all the action, as hundreds of thousands of horseshoe crabs congregate for their annual mating ritual.

But the welcoming confluence of factors here doesn't eliminate every peril. Crabs making their way onto the beach sometimes overturn, becoming stranded in the sand. An estimated 10 percent of them will die from exposure or predators, unless humans lend a helping hand.

A trademarked ERDG program dubbed Just flip 'em! was launched in 1998 to encourage that simplest act of compassion: to gently lift any overturned crab one encounters by its shell — never by its tail — and flip it over. Even a child can do it, and Gauvry believes that once you "engage the passionate heart" with that first flip, it becomes more difficult to ignore the next one. "The next thing you know, you realize you're an ambassador." And saving a single horseshoe crab can, ultimately, save someone's life.

Photograph by Ariane Mueller

Mating horseshoe crabs are attracted to the temperate waters and calm wave action of the Delaware Bay. Sometimes as many as five or six male crabs will try to attach to the larger female crab at the same time.

That lifesaving capacity was discovered in 1953, when Johns Hopkins University scientist Frederick Bang began conducting experiments on *Limulus polyphemus* blood. Horseshoe crabs are true "blue bloods": Unlike red human blood that's oxidized with hemoglobin, this creature's blood contains copper, which turns blue when oxidized. In humans, white blood cells fight infection, but horseshoe crabs possess amebocytes that create an immediate gel-like substance that instantly seals off bacteria, halting the spread of infection in their bodies. This discovery led to further research, revealing that the blood of horseshoe crabs is very sensitive to endotoxin, a component of nasty bacteria like *E. coli.*

In the 1960s, Bang and fellow researcher Jack Levin developed a test that detected the presence of endotoxin in human blood. By introducing amebocytes into a sample, they created the compound Limulus amebocyte lysate and used it to test the purity of pharmaceuticals, medical equipment, and supplies that come in contact with the human bloodstream. Once the U.S. Food and Drug Administration approved the LAL test in the 1970s to ensure the safety and purity of a vaccine, injectable drug, or implantable device, it was "game on" in the harvesting of horseshoe crabs. In short order, their blood became big business for the pharmaceutical and biomedical industries.

The good news for this animal population is that, at U.S. blood procurement facilities, approximately one-third of a crab's blood is drawn, with most of the crabs harvested returned to the water afterward. The mortality rate for bled crabs is estimated to be 10 percent to 15 percent.

Beyond this important role in supporting human health, horseshoe crabs play a crucial part in maintaining ecological balance along Delaware Bay. Demonstrating one of nature's most enduring partnerships, spawning season signals the arrival of hundreds of thousands of migratory birds that feast on the crabs' eggs deposited in bay beaches' sand. As many as 11 species rely on the fatty, nutrient-rich eggs for energy and sustenance, including the endangered red knot, which migrates each year from South America to its breeding grounds in the Arctic.

Other shorebirds and sea turtles join the buffet line; the upshot is that while each female crab can deposit up to 80,000 eggs each spring, only about 10 percent of those eggs hatch and reach adulthood.

## By the numbers

Each May and June, hundreds of volunteers also swarm the beaches in coastal communities along Delaware Bay. As "census takers," their job is to systematically count horseshoe crabs coming ashore to spawn. Initiated in 1990, these surveys provide critical data that assist the Atlantic States Marine Fisheries Commission's Horseshoe Crab Management

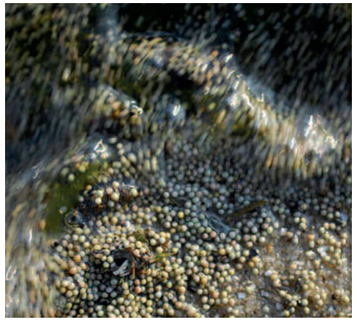
Photograph by Kevin Fleming

## Training to Take Part

• **The Ecological Research & Development Group** oversees Prime Hook and Broadkill beaches for the yearly horseshoe crab surveys there. Participation in a training workshop is required; volunteers under 18 years of age must be accompanied by an adult. Visitors are welcome to tag along, ask questions and learn about the crabs, but are not permitted to participate in the counting and recording of data unless properly trained. For details, go to horseshoecrab.org/act.

• **The Delaware National Estuarine Research Reserve**, which includes Kitts Hummock Beach, Ted Harvey Wildlife Area and North Bowers Beach, holds training sessions each year in late March/early April. Returning volunteers must be retrained once every three years. Call (302) 739-6377.

• **The Delaware Center for the Inland Bays** gathers data throughout six horseshoe crab spawning sites on Rehoboth Bay, Indian River Bay and Little Assawoman Bay, with the largest concentration counted at James Farm and Tower Road. While no formal training is required, a kickoff meeting is held prior to the first survey each year. However, walk-in volunteers are welcome at any of the sites. For further information, visit inlandbays.org/projects-and-issues. ■



**The endangered red knot relies on horseshoe crab eggs for sustenance during its annual migration. Female horseshoe crabs can deposit up to 80,000 eggs each spring.**

Board in establishing yearly harvesting quotas for both bait fisheries and LAL manufacturers. Although bait overharvesting — for use in commercial eel and conch fisheries — has been severely curtailed since the mid- to late-1990s, this aspect is still closely monitored. For the 2018 season, the board set an overall harvest limit of 500,000 males (females are off limits) encompassing Delaware, New Jersey, Maryland and Virginia.

Planned with the precision of a military operation, all surveys take place on the same 15 nights, coinciding with high tides during the new and full moons between April 27 and July 1.

At the designated hour, from the St. Jones Reserve in Kent County to the inland bays in coastal Sussex, volunteers arrive wearing an assortment of gear, including rubber boots or waterproof shoes, work gloves and headlamps, and equipped with insect repellant and flashlights. Working in teams, they count off a predetermined number of steps, then place a one-meter-square quadrat — a PVC-frame sampling plot — in the shallow surf, as the crabs attempt to make their way on shore. Once the quadrat is laid flat, the volunteers record the number of male and female crabs huddled within it. All groups continue this procedure until the entire length of their assigned beach has been covered. (Female horseshoe crabs are 25 percent to 30 percent larger than the males, making them easy to identify. However, sometimes as many as five to six males attach themselves to one female, so volunteers must often dig deep to find them.)

Working late in the evening — and sometimes into the early-morning hours — sloshing around in water and swatting off bugs raises the question: Why do people do this?

For Matt Babbitt, site manager of the Abbott's Mill Nature Center in Milford, the appeal is obvious: "The awe of seeing an entire beach covered in horseshoe crabs is like nothing else. Each summer is just as amazing as the last." And for families with kids, "there are plenty of teachable moments," adds Babbitt, who has been conducting horseshoe crab surveys on Slaughter Beach since 2015.

Sara Anderson, a lifelong birder with an interest in marine biology, has been spurred to volunteer by ecological concern. She cites the connection between "the decline in the number of horseshoe crabs spawning in the Delaware Bay" and the continued drop in the shorebird population, "especially the red knot." A resident of Arlington, Va., Anderson and her husband have a vacation home near Bowers Beach, which enables her participation in the yearly count each spring.

The Delaware National Estuarine Research Reserve, which encompasses 6,200 acres of the Delaware Bay watershed and includes Kitts Hummock Beach, Ted Harvey Wildlife Area, and North Bowers Beach, is home to one of the most successful volunteer-based wildlife surveys in the country. Under the supervision of environmental scientist Drexel Siok and education coordinator Margaret Pletta, volunteers are required to attend one of three training sessions. (See "Training to Take Part" at left.)

When Lewes residents and nature enthusiasts Pat and Betty Robb Breen learned that DNERR was looking for survey volunteers, they signed up, though Pat



Photographs by Kevin Fleming

**During high tides on the full and new moons in May and June, "census takers" count horseshoe crabs on beaches along the Delaware Bay. Volunteers, some wearing headlamps, work in teams, placing a one-meter-square quadrat — a PVC-frame sampling plot — on the sand, then record the number of male and female crabs within it.**

was skeptical about being "trained" to count horseshoe crabs. "How difficult could it be," he wondered? But in the DNERR classroom he learned something important — "how to tell the difference between the male and the female!"

The Breens, along with other volunteers, were also instructed to measure their strides in preparation. According to Pat, "This all made sense the night of the survey, because once we started counting at our assigned section of beach, we needed to make sure that each quadrat was placed within the correct number of paces."

For Betty Robb, "the late-night experience on the beach was a bit surreal. … We're so used to seeing the crabs in the daytime washed up on the beach, almost like debris. So seeing them in motion, and in such large numbers, was truly remarkable," she says.

Part of the Breens' "late-night experience" included finding a tagged horseshoe crab inside their quadrat. During training, DNERR advises volunteers to be on the lookout for crabs with a numbered ID tag fastened to their shell. The U.S. Fish & Wildlife Service uses these identifiers to track the animals' migration patterns, longevity and mortality rates, which — supported by the data from the spawning surveys — help determine the yearly harvesting quotas.

### Spawning future caretakers

The future survival of the horseshoe crab species will ultimately depend upon the preservation of its spawning habitat. To that end, ERDG initiated its trademarked Backyard Stewardship initiative in 1999, a sanctuary program designed to encourage coastal communities to declare their shared habitat a horseshoe crab conservation area.

According to Gauvry, "ERDG is the only organization that has been successful in convincing residential landowners to designate their private beaches as horseshoe crab sanctuaries." Broadkill Beach was the first such community, followed by the Delaware bayshore communities of Pickering Beach, Kitts Hummock, Slaughter Beach, Prime Hook National Wildlife Refuge (Fowler Beach), Prime Hook Beach, and most recently, Camp Arrowhead on Rehoboth Bay. To date, more than 16 miles of prime horseshoe crab spawning habitat has been protected through this program.

"Creating a sanctuary is simply a community's expression about how they view their beach and the natural resource they share," says Gauvry. "The purpose of the sanctuary is to change the relationship communities have with their natural resources, which will far outlive the regulatory process."

Slaughter Beach became a backyard sanctuary in 2004

Photograph by Ryan Hulvat

when lifelong resident Bill McSpadden approached Gauvry following the establishment of the Broadkill program. A self-described "avid flipper," McSpadden says that the sanctuary initiative was a natural fit. "Slaughter Beach people get it, given that they live in a conservation area. … If you understand the ecological importance, you're more apt to get involved."

After the program was pitched to the town council and won approval, the owners of 300 properties signed on. That same year, Slaughter Beach formally adopted the horseshoe crab as its official town symbol. McSpadden views the beach community's primary role as public educator and caretaker. Often, he says, residents walking the beach will signal each other from a distance, indicating with a wave that they've "got it covered." But for all the progress that's been made towards conservation, McSpadden finds continued misconceptions about horseshoe crabs troubling: The uninformed, he laments, still consider them worthless, complaining that "when they die, they smell. … They're a nuisance."

**At Mispillion Harbor Reserve, from left, Michael Oates, Jeanne Meher Covert and Ken Lewis fasten U.S. Fish & Wildlife ID tags to horseshoe crabs to monitor their migration patterns.**

## Preserving a habitat

Just north of Slaughter Beach, at the Mispillion Harbor Reserve near Milford, sits the DuPont Nature Center. DNREC's Division of Fish & Wildlife owns and operates the facility, which serves as an educational resource featuring interactive exhibits and hands-on displays relevant to the natural history and ecology of Delaware Bay. Surrounded by an estuary that's home to more than 130 species of birds, fish, shellfish and other animals, the nature center "is internationally known" for horseshoe crabs and migrating shorebirds, according to Lynne Pusey, who manages the facility.

During the peak of the horseshoe crab spawning season and shorebird migration, on-site visitors can get a real-time view of all the activity. A "nature cam," located on a beach across the harbor, offers a 360-degree view, with live streaming available on the center's website, de.gov/dnc.

Visible from the deck of the center is another key aspect of protecting horseshoe crabs: the final stage of a habitat restoration and flood control project at Mispillion Harbor Reserve. Part of DNREC's Bayshore Initiative, the work is part of ongoing efforts to restore Back Beach, a critical horseshoe crab spawning ground. Hurricane Sandy in 2012, along with rising sea levels and subsequent coastal storms, have caused "a lot of erosion of Back Beach, a hot spot for red knots and horseshoe crabs," says Jeremey Ashe, a Division of Fish & Wildlife construction manager. Since the project was initiated in 2016, DNREC has "more than tripled the amount of sand out there in an effort to increase horseshoe crab spawning availability," with hopes that red knots and other shorebirds will follow, he notes.

Scheduled for completion in time for

## Horseshoe Crab-Themed Events

**May 19:** Peace, Love and Horseshoe Crab Festival, DuPont Nature Center near Milford. For info: de.gov/dnc.

**May 23:** "Prehistoric Wonders" lecture by Glenn Gauvry of the Ecological Research & Development Group at the DuPont Nature Center. Pre-registration requested: Call 422-1329 or email lynne.pusey@state.de.us.

**May 26:** Horseshoe Crab & Shorebird Festival, Milton Memorial Park and Prime Hook National Wildlife Refuge. For info: historicmilton.com.

**June 2:** 10th Horseshoe Crab Blessing and Dharma Assembly, 10 a.m., at Pickering Beach, north of Bowers Beach; contact Glenn Gauvry at ERDG@horseshoecrab.org. Buddhists and non-Buddhists are invited to this ceremony, which will be followed by a shoreline walk to help stranded horseshoe crabs return to their marine habitat. ■



Photograph by Ariane Mueller

this year's spawning season, Ashe says the goal is to "create an environment conducive to spawning," which includes a lower beach slope. He predicts that "we'll see more horseshoe crabs here than Slaughter Beach eventually."

With limited money — and manpower — provided by public agencies or private enterprises, conservation efforts remain primarily in the hands of volunteers willing to literally engage one-on-one with this living fossil. But to become an "ambassador" for the species, one need not be a scientist or a marine biologist. "Moving your heart to a place where this animal is worthy of your effort," says Gauvry, is the first step toward environmental stewardship.

Then there's that "Aha!" moment. Wes Allen, a lifelong resident of Milford, has been surveying horseshoe crabs on Delaware beaches for three years, serving as a crew leader for the last two. One evening following a count, as he was heading off the beach with that night's data, Allen was struck by the magnitude of what had just taken place. In his solitude, he thought about the "amazing connection these crabs have with humans and shorebirds." And that's when it hit him: "This same scene has played out for millions of years. It's awe inspiring." ■

*Jeanne Shook is a regular contributor to Delaware Beach Life.*

## To Learn More

More information and learning opportunities about horseshoe crabs can be found at:

**Delaware Natural Resources & Environmental Control** at dnrec.delaware.gov

**Delaware Nature Estuarine Research Reserve**, de.gov/dnerr

**Delaware Center for the Inland Bays**, inlandbays.org

**DuPont Nature Center**, de.gov/dnc

**Ecological Research & Development Group**, horseshoecrab.org

**Delaware Nature Society at Abbott's Mill Nature Center**, delawarenaturesociety.org ■