Horseshoe crabs touch lives and livelihoods throughout coastal Delaware

Ancient mariner

Dennis Littleton, a.k.a. Delmarva Dennis, maneuvers his pontoon boat across the quiet, moonlit waters of Indian River Bay off the sandy beaches of Burton's Island, about five miles north of Bethany Beach. Years of sun and wind have etched a permanent Clint Eastwood-like squint on the weathered face of this eco-adventure guide and self-educated naturalist. The lean and lanky Ocean View native is leading a group of tourists to witness firsthand a sight that has been repeated on beaches like this one every spring for more than 350 million years.

As the boat approaches the shoreline, the scene can only be described as awe-inspiring. Hundreds of dinner plate-size horseshoe crabs clamber along the vast stretch of sand in search of mates. "This is a prehistoric scene I've been watching my whole life, and it's always incredible to be reminded of how enduring nature is," Littleton says.

Throughout the night, males mate with the females and fertilize eggs deposited in the sand. The entangled crabs work their way across the beach, leaving distinctive trails in their wake. By morning, most of the crabs have traveled back to the ocean. In two weeks, the buried eggs will hatch and float back out to sea like tiny plankton, getting early nutrition from a protective yolk sac until they have developed enough to feed on their own.

Unfertilized eggs left in the sand become a feast for a dozen species of migratory shorebirds that fly nonstop from South America to gorge on the horseshoe crab eggs laid throughout the region. During their annual spring migration back north from late May to early June, the birds may double their weight

Story by Lenora Dannelke
Photographs by Ryan Hulvat

Horseshoe crab blood turns blue after it's extracted because of its copper compounds. Here a lab technician draws blood from a live crab, after which it will be returned to the waters where it was caught.

during the eating frenzy. "It's an amazing and intricate balance of nature," Littleton says. And a delicate one, as well.

Although North America's lone surviving variety of horseshoe crabs, or *Limulus polyphemus*, inhabits the Atlantic waters from the Gulf of Mexico to New England, the world's largest concentration of these creatures is found in the Delaware Bay, primarily between Woodland Beach and Lewes. Yet, due to changes in the environment, including shoreline development and other habitat degradation, the natural spawning areas of the horseshoe crab have been greatly depleted. In 2001, the National Oceanic and Atmospheric Administration created a 1,500-square-mile horseshoe crab preserve in federal waters off the mouth of the Delaware Bay, an area stretching from Avalon, N.J., to Fenwick Island, where fishing for these animals is prohibited.

Depletion of the crab population could leave the migrating birds unable to gain enough weight to continue the journey to their Arctic breeding grounds. "Some bird populations — particularly the red knots — could be wiped out without an adequate supply of eggs," says Ann Rydgren, a member of the board of directors of the Delaware Audubon Society.

Each spring, so many horseshoe crabs emerge from the ocean floor to mate on beaches from New Jersey to Virginia, that they were once considered a nuisance. An early Dutch map of the Delaware Bay was found with the handwritten notation, "Cockroach Bay, " a direct reference to the abundance of these prehistoric creatures, which are actually more closely related to spiders and scorpions rather than crabs. Developing during the Paleozoic Era, horseshoe crabs managed to survive an age when glaciers or volcanic activity caused 95 percent of marine life to perish. Today, they number among the few hundred remaining creatures considered living fossils, which provide direct links to the earliest days of life on Earth.

Horseshoe crabs are more relevant to human life than most people might imagine. "Most people don't go through a day of their lives that hasn't been affected by horseshoe crabs," says Dennis Littleton. "If you've ever had a vaccine, it's been tested with LAL, which comes from horseshoe crab blood."

LAL, the pharmaceutical product Limulus Amebocyte Lysate, is a derivative of a naturally occurring compound in the arthropod's blood. Horseshoe crabs, lacking an immune system, rely on components of LAL in their bloodstream to fight bacteria, fungi and viruses. In laboratories, LAL is used extensively to detect bacterial contamination in antibiotics, immunizations and implant organs, such as kidneys.

BioWhittaker, a division of The Cambrex Corporation, a life sciences company, is one of only a handful of laboratories in this country that process LAL, an

industry that now tops $50 million in annual revenue. The Chincoteague, Va., facility extracts horseshoe crab blood to create the pricey product — valued at an estimated $15,000 a quart.

To extract the blood, technicians at BioWhittaker set the horseshoe crabs on wooden racks, then insert a stainless steel tube into the animal's circulatory system, which allows the blood to drain into a bottle. About one-third of the horseshoe crab's blood is removed, an amount regenerated in less than a week. Within 24 hours of bleeding, the live animals are returned to the same waters from which they were taken. Although the industry takes every precaution to safeguard the precious resource on which it depends, the average mortality rate from the bleeding procedure is between 10 and 15 percent.

The color of horseshoe crab blood has an almost science fiction-like quality. Although clear when first extracted, the liquid gradually deepens to a startling shade of blue. "Their blood is based on copper, rather than iron," explains Lee Hardt, who works in the formulations department at BioWhittaker's Walkersville, Md., facility. "That's why it turns blue when it oxidizes." The blood is centrifuged to separate the white blood cells — the specific element used in the creation of LAL — from the unneeded plasma.

Horseshoe crabs also contribute to human health via a substance found in their shells, called chitin. Chitin is used in producing contact lenses and skin creams. The addition of chitin sutures and in wound dressings for burn victims helps to reduce healing time by 35 to 50 percent. Nobel Prize-winning discoveries made by Keifer Hartline in 1967 on the human eye stemmed from studies on the optic nerves of horseshoe crabs. And important developments in AIDS, cancer, and leukemia research using crabs are currently being reported in the United States and Japan.

All the medical uses for horseshoe crabs mean jobs for people who catch them. Waterman T.W. Bowden contracts his 47-foot shrimp boat, *Christopher*, for the exclusive purpose of collecting horseshoe crabs for BioWhittaker's Chincoteague facility. Bowden finds satisfaction in the fact that the horseshoe crabs he dredges from the ocean do not meet the dire fate of those harvested for bait. "This is better, 'cause we don't kill 'em," says Bowden, who delivers barrels of the living animals to the laboratory, where a saline solution is sprayed over their gills to ensure the creatures' health.

Though not a delicacy for humans, horseshoe crabs have proved irresistible to eel and conch and are used as bait in these multimillion-dollar seafood industries. The crabs are caught with dredging boats that scoop them off the ocean floor. Yet, the over-harvesting of the crabs has left some fishermen facing an uncertain economic future, as Delaware Bay watermen can derive up to half of their income from eel and conch fishing.

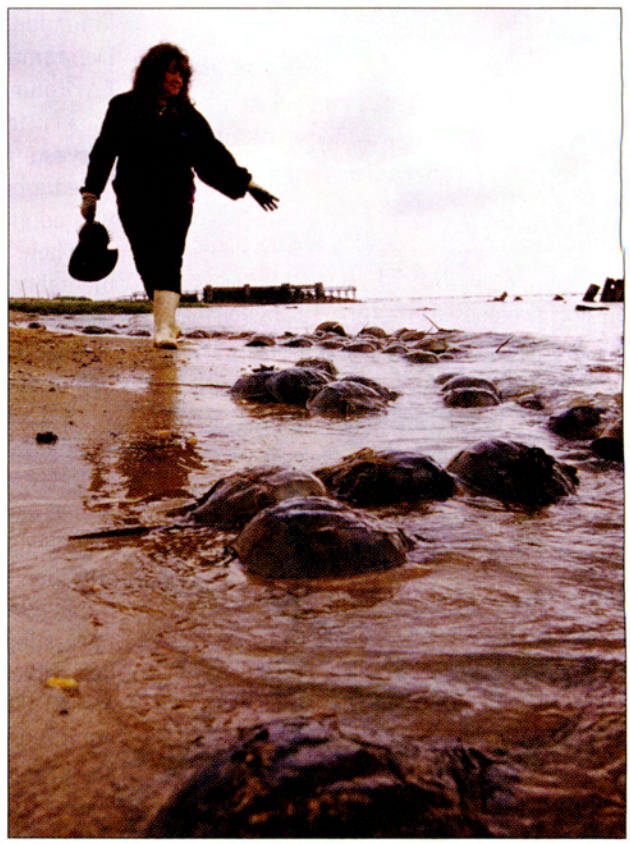
Last year, for the first time, Frank "Thumper" Eicherly, a Bowers Beach fisherman, was selected as one of "the fabulous five." He's referring to Delaware's lottery system for crab-dredging licenses. In order to limit the use of horseshoe crabs as bait, five fishermen are selected at random to receive permits for harvesting these animals each year. "There have been so many restrictions imposed on harvesting in other states that I was getting calls — a lot of them — from watermen in Maryland and Virginia, wanting to buy bait from me. They couldn't find enough to meet their needs. These people were having a hard time just trying to keep the bills paid and their families fed, so I do what I could to help them out."

To combat the over-harvesting of the crabs for bait, Delaware in May imposed a drastically reduced limit on the horseshoe crab harvest, which set off a series of legal actions by both watermen and the state. As of publication of this story, the court had upheld the state's tighter harvest limit, but the watermen had vowed to continue to fight it.

To help reduce the eel and conch fishermen's need for horseshoe crabs, researchers at the College of Marine Studies in Lewes have been working to create an artificial bait that works as well as the crabs. Working under the guidance of Dr. Nancy Targett, who initiated the project in 1994, graduate student Kirstin Ferrari isolated the chemical attractant that makes the crabs so effective as bait. Field trials began in 2002, but the possibility of a patented artificial bait is still years away. Some watermen, unable to wait that long, have implemented their own conservation techniques.

Eicherly developed a bait bag, a reusable plastic mesh pouch containing one quarter of a horseshoe crab, as a replacement for the whole crab usually used in a conch bait pot. These bags not only reduce the number of horseshoe crabs required, without a reduction in conch catches, but have the additional benefit of extending the effective fishing time, since the fine mesh prevents non-target species from eating the bait.

The success of bait bags has resulted



Wanda Garber, a licensed hand-harvester, picks up horseshoe crabs that she will sell as bait to eel and conch fishermen.

Advocacy in action:

The Ecological Research and Development Group

While numerous conservation groups have an interest in horseshoe crabs, these creatures are the *raison d'etre* of the Ecological Research and Development Group, based in Milton. "We are the only group whose sole focus is on the four surviving species of horseshoe crabs," says Glenn Gauvry, who founded the organization in 1995.

Gauvry became fascinated with horseshoe crabs while stationed at Dover Air Force Base in the late 1960s. Later involvement with oiled wildlife rehabilitation raised his concerns about the delicate ecological balance in the Delaware River. "It occurred to me that the horseshoe crab *did not have* an advocate. No organization was concerned for the species solely for itself," Gauvry says.

Preventing and mitigating damage to native wildlife populations and habitat from human activity became the mission of the organization. "I realized the ERDG could make a difference, and we have," Gauvry says.

By coordinating government, industry and environmental group efforts, the ERDG is striving to maintain the horseshoe crab population. The group promotes scientific research, environmental management and educational programs in communities and schools. A museum-grade model of the female horseshoe crab, developed for classroom use by the ERDG, has been adopted by the Delaware Department of Education. The organization's Web site, www.horseshoecrab.org, presents a spectacular array of information on these animals.

The ERDG has no political agenda, and does not participate in lobbying. Nor did it support the harvesting moratorium proposed in January — a position that seems odd at first glance. "We look at the horseshoe crab population as a whole. A moratorium in New Jersey and Delaware would have a ripple effect," Gauvry explains. "It's been established that there are genetic differences in horseshoe crab populations throughout their spawning range, from Florida to Maine. A ban on harvesting in certain states would mean that bait would be obtained from different areas — and that could put other populations in jeopardy."

The ERDG is developing this country's first and only horseshoe crab museum and research center. Gauvry hopes to see the institute, to be located next to the old Milton theater on Union Street, completed within the next two years. A capital campaign for the $6 million project is under way. "We've acquired two buildings, and the architectural plans have been drawn," Gauvry says. The institute will work to raise awareness of the horseshoe crab's importance to the local, national and international scenes.

in Virginia mandating their use. Through grant funding from NOAA, the Ecological Research and Development Group, a Milton-based non-profit conservation organization, provided the bags at no cost to fishermen. In partnership with ERDG, Kent-Sussex Industries, a non-profit employment foundation in Milford, has manufactured and distributed more than 6,000 free bait bags to fishermen in Maryland, Delaware, Virginia and New Jersey. The project expanded last year with 7,000 bait bags allocated to fishermen in New York, Connecticut, Rhode Island and Massachusetts.

Eicherly and the ERDG are currently experimenting with yet another bait alternative, using LAL's plasma byproduct. This normally discarded substance is being injected into menhaden, a bait fish, to make it more attractive to conch.

Although most horseshoe crabs destined for bait are gleaned in large quantities from the ocean, some are hand-harvested from beaches. Permits for hand-harvesting, which specify times, locations, and quantity limitations, are issued by the Delaware Department of Natural Resources and Environmental Control. In 1997, permits curtailed this practice of hand-harvesting so much so that the slogan "Feed a bird and starve a waterman" was adopted in protest.

"There was definitely a 'gold rush' mentality in the early 1990s," says DNREC fishery scientist Stew Michels. "Horseshoe crabs could be sold for a dollar a piece, and all kinds of people were out there picking them up and selling them to fishermen."

Today, fewer than 50 permits are issued each year and hand-harvesting has been limited to daylight hours, on specified days. Port Mahon is the only public beach in Delaware where hand-harvesting is still allowed. Stiff penalties, which can range between $100 and $1,000 per crab, plus court costs, are imposed upon violators, and DNREC agents work overtime during spawning season to enforce the law.

Wanda Garber, a hand-harvester from Dover, arrives at Port Mahon, with her dog, Lady, an hour before sunrise on a Tuesday morning to stake out her stretch of beach for "picking" — the local term for gathering — horseshoe crabs which she sells for bait. Garber wears a tiny gold horseshoe crab charm on a chain around her neck, an emblem of the respect she has for these animals. She begins by picking up horseshoe crabs that have been stranded on the rocks. "Those wouldn't have survived anyway, so I take them first," explains Garber, tossing the animals into the back up her pickup truck.

Although compliant with the law, Garber and other hand-harvesters are occasionally harassed by passionate birders, who view this activity as a threat to the survival of migrating birds. "Those people could be out here picking crabs off the rocks every day to rescue them, but where are they? They're not here now," observes Garber.

Audubon's Ann Rydgren says, "Our official policy is supportive of local watermen licensed for hand-harvesting. We have a much bigger problem with dredging. That destroys the environment."

Early this year a consortium of conservation groups sought a moratorium on the harvesting of horseshoe crabs for bait in Delaware and New Jersey. Although the Atlantic States Marine Fisheries Commission rejected the proposal, compromise measures will be implemented in 2004. These changes, adopted under emergency rules, include a reduction in quotas and a harvesting ban from May 1 to June 7.

"There are a lot of economic issues," says Eric Stiles, New Jersey Audubon Society's vice president of conservation. "We support economic displacement compensation for watermen who will be deprived of income. The Delaware Bay ecotourism industry, however, is larger than the eel and conch industries of the entire Atlantic coast. It's not just a matter of birds versus jobs, but jobs versus jobs."

Efforts to preserve this aquatic treasure come in many forms. Since 1990, an annual survey of the spawning horseshoe crab population, coordinated by Bill Hall, a marine education specialist at the College of Marine Studies, takes place on select beaches throughout Delaware and New Jersey on specified nights in May and June. The U.S. Geological Survey/State Partnership Project relies on the efforts of volunteers. (Those interested in participating in the census can

obtain additional information on-line at http://www.ocean.udel.edu/mas/bhall/hsccensus/index.html

The USGS recently hired Eicherly and his vintage schooner, the *Maggie S. Myers*, for a scientific mission. The waterman accompanies such leading scientists as Dr. Carl Shuster, the world's top authority on horseshoe crabs, to various locales to tag the creatures. Tags help monitor the movement and lifespan of the horseshoe crabs, providing a database for research.

"Full Moon Walks" are held throughout the year at Cape Henlopen State Park, but the most popular ones are during horseshoe crab season, when landings tend to peak during high tide on full and new moon nights in May and June. (Call 645-6852 for more information.) Some years the walks are relocated to Broadkill Beach when horseshoe crabs are scarce at the park's beaches. "Variable conditions, like cooler temperatures and winds creating a lot of waves, keep them from coming ashore," says naturalist Jennifer Multhopp. "People often call and want to know the best day or place to see the horseshoe crabs — but they don't show up on a fixed schedule."

Because several hundred thousand of these animals perish on Atlantic coast beaches each year during spawning season, unable to right themselves after being turned over on their backs by rough surf, the ERDG sponsors a "Just Flip 'Em" program that encourages anyone strolling along a beach to help in rescue efforts. By giving these gentle creatures a helpful turn, lifting them by their helmet-shaped shells rather than the delicate tails, they can continue on their journeys back to the sea. The fierce-looking appendages are harmless — in fact, touching the underside of a horseshoe crab will result in just the tickling caress of six pairs of legs.

Ensuring the survival of these creatures, whose numbers have dwindled from a multitude of species to just four varieties worldwide, is the goal of the ERDG. (See box on page 72.) "Human activities have made it difficult for indigenous species to survive. They need our protection," says ERDG president Glenn Gauvry, "Horseshoe crabs can survive everything but our indifference. In Japan, they're revered as a national treasure."

When the Japanese horseshoe crab, *Tachypleus tridentatus*, was threatened with extinction in 1975, the government established a protection center, which was later turned into the Kasaoka City Horseshoe Crab Museum. Japanese schoolchildren study horseshoe crabs extensively, learning about their value to humans, and searching for ways to save the species.

Dennis Littleton does what he can as an individual to help in their preservation, making a solo kayak journey in the early hours of the morning each day during spawning season, freeing hundreds of horseshoe crabs entangled in the tall grasses of the salt marshes of Delaware Bay inlets.

"When just one egg out of over 100,000 buried in the sand will reach adulthood, each horseshoe crab I can save counts," he says. "Horseshoe crabs have endured countless millennia on their own, but without human intervention their future is in question." ■

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Inside a walk-in cooler, fisherman Frank Eicherly quarters a horseshoe crab that he will use in a bait bag, a reusable plastic mesh pouch used in a conch bait pot. The bags reduce the number of horseshoe crabs used as bait, without a reduction in conch catches.