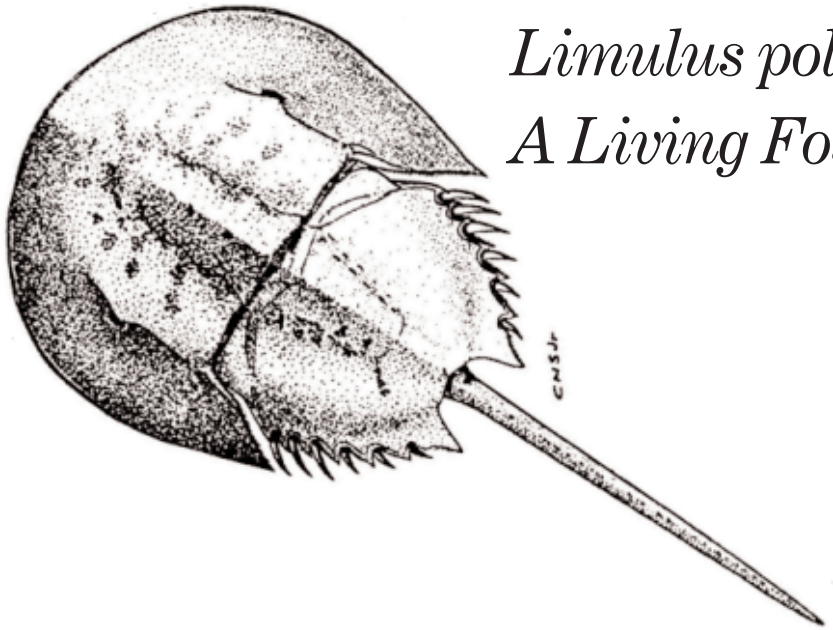
U.S. Fish & Wildlife Service

The Horseshoe Crab

Limulus polyphemus

A Living Fossil



A Primitive Ancient Creature

Horseshoe crabs are evolutionary survivors that have remained relatively unchanged in appearance for 350 million years. The horseshoe crab is not actually a true crab, but a member of an ancient group of arthropods, closely related to spiders and scorpions. There are four species of horseshoe crabs around the world and only one in North America. The species in North America is the most abundant in the world and ranges on the Atlantic Coast from Maine to the Yucatan Peninsula.

Amazing Spectacle

In the late spring and early summer, horseshoe crabs arrive on the beaches in mass to lay their eggs. The peak of spawning on the Atlantic coast occurs in Delaware Bay where thousands of crabs will arrive on the sandy beaches in May and June. Delaware Bay provides an excellent spawning area for crabs because the sandy beaches are protected from harsh wave action, and the beach's sand and pebble mixture is perfect for incubating horseshoe crab eggs.

Crabs arrive on the spawning beaches during the high tides of full and new moons when the water rises highest on the beach.

When the female is ready to lay her eggs, she crawls up to the high water line on the beach with a male attached to her. The male clasps onto the female's shell with a modified pair of claws, and then she drags him around during the spawning process. In addition to the attached male, several other males may also attempt to fertilize the female's eggs by arranging themselves on and around the spawning couple on the beach during the egg-laying process. A female may have five or more males attempting to mate with her in a single egg laying episode.

During spawning, the female crab partially buries herself in the sand while she deposits a cluster of about 4,000 tiny green eggs. In an evening of egg laying, a female crab can lay several egg clusters, and she may spawn repeatedly over several nights to lay up to 100,000 eggs or more!

New Life Beginning

The eggs will hatch within two to four weeks and the larvae will emerge from the sandy beaches and enter the water during a high tide nearly a month later. The larvae look like miniature tailless adult horseshoe crabs.

After hatching, horseshoe crabs will spend their first few years of life on the tidal flats and move out further from shore as they get older. Adults spend their winters in deep bay waters and off-shore areas. As spring approaches, the crabs move in mass toward the beaches to prepare for spawning.

Since horseshoe crabs have a hard shell, they must molt to grow. Horseshoe crabs will molt at least six times in their first year of life and about 18 times before they reach sexual maturity. Females are generally larger than males and may molt more than males to reach that larger size. Once crabs are sexually mature, which takes at least 9 years, it is believed they won't shed their shells again. When the male crab completes his final molt, his first set of claws becomes modified into a boxer-glove shape that he uses to clasp onto a female for spawning. Adult crabs may live another 8 to 10 years, making the total life span of a horseshoe crab as long 20 years.

Physical Characteristics

The horseshoe crab has a unique and primitive body structure. The body is composed of three parts, the prosoma (head), opisthosoma (central area), and telson (tail). The horseshoe crab's name is derived from the prosoma, resembling the shape of a horse's shoe. The telson helps the crab to flip itself over if it is turned over by waves on the beach. As dangerous as the telson may look, it is not venomous or used as a weapon by the crab.

Horseshoe crabs have several pairs of eyes. Their two large compound eyes on their prosoma are sensitive to polarized light and can magnify sunlight 10 times. A pair of simple eyes on the forward side of the prosoma can sense ultraviolet light from the moon. In addition, multiple eye spots are located under the prosoma, with more on the underside of the tail. Horseshoe crabs occasionally swim upside down and may once have used these eyes more than they do today.

Horseshoe crabs use book gills to get oxygen from the water. They are called book gills because the parts of the gill

are in small flaps that resemble the pages of a book. If these primitive gills are kept moist, horseshoe crabs can remain out of water for up to four days. Crabs that get stranded on the beach during spawning will bury in the sand or fold themselves in half to conserve water until the tide rises again.

Horseshoe crabs have no jaws or teeth. Instead, they have an impressive array of spiny mouth bristles at the base of five pairs of legs to maneuver food items such as razor clams, soft-shelled clams and marine worms into their centrally located mouth. To chew its food, the crab must simulate walking movements.

The Shorebird Connection

The largest population of horseshoe crabs in the world is found in Delaware Bay. During the spawning season, many eggs are exposed to the beach surface by wave action and the digging action of mating crabs. Once an egg is exposed to air, it can dry out quickly, preventing it from hatching, however, it still plays a vital role in the ecosystem. These exposed eggs are the primary food source for migrating shorebirds that are making the journey from South America to the Arctic along the Atlantic Flyway.

Delaware Bay hosts the second largest population of migrating shorebirds in North America. The shorebirds in the Atlantic Flyway use only a few areas for feeding and rest on their trip from South America to the Arctic. More than 1 million shorebirds fly nonstop from places as far away as Peru, Suriname and Argentina's Tierra del Fuego – as much as 5,000 miles. More than half of the total flyway population of red knots, ruddy turnstones, and semipalmated sandpipers depend on Delaware Bay's horseshoe crab eggs as a rich and critically important food supply. Hundreds of thousands of other migratory birds representing several species may also converge on Delaware Bay during mid to late May.

Every year nature provides an incredible spectacle in late May as these ravenously hungry birds start arriving. They can double their weight in less than two weeks by eating thousands of horseshoe crab eggs per bird. Then they fly on to their summer breeding grounds in the Arctic.

The Medical Connection

Of all marine species, horseshoe crabs have contributed the most to medical and physiological research. Most of what we know about human vision was drawn from a Nobel Prize-winning scientist's work with cells found in horseshoe crab eyes.

Horseshoe crab blood also plays a vital role in human medicine. The straw-colored, copper-based blood turns blue when exposed to high concentrations of oxygen. Horseshoe crab blood contains primitive large blood cells called amoebocytes. A clotting agent called Limulus Amoebocyte Lysate (LAL) is derived from the amoebocytes of the horseshoe crab. When the LAL comes in contact with bacterial toxins, a clotting reaction occurs. Pharmaceutical companies test the sterility of vaccines, drugs, prosthetics, and other medical devices using LAL, and currently there is no synthetic substitute that has passed FDA approval for the LAL test.

Threats to Survival

Human development has threatened horseshoe crab survival in other parts of the world and also threatens them in the U.S. Human disturbance can adversely affect spawning activities. Beach development and shoreline modifications prevent crabs from reaching sandy areas to lay their eggs or strand them once they reach spawning areas. Recreational vehicle traffic on beaches can crush the crabs and destroy their nesting habitat. Potential oil spills from barges or tankers also pose threats to breeding and young crabs. These human activities not only harm crabs, but also interfere with feeding and resting activities of millions of migrating shorebirds at a critical time in their lives.

Horseshoe Crab Harvest and Management

In the late 1800's and early 1900's, up to 4 million horseshoe crabs were harvested annually and used as fertilizer or animal food. Currently, crabs are harvested for bait in conch and American eel fisheries on the Atlantic Coast. Horseshoe crabs saw a substantial increase in harvest in the 1990's, which spurred the need for management on a coast wide scale.

In 1998, the Atlantic States Marine Fisheries Commission (ASMFC), a management organization with representatives from each state on the Atlantic Coast, developed a horseshoe crab management plan. The ASMFC plan and its subsequent addenda established mandatory state-by-state harvest quotas, and created the 1,500 square mile Carl N. Shuster, Jr. Horseshoe Crab Sanctuary off the mouth of Delaware Bay.

Active management, as well as innovative techniques used by fishermen to conserve bait have successfully reduced commercial horseshoe crab landings in recent years. Conch and eel fishermen have been using mesh bait bags in their traps, so they can only use a portion of one crab per trap, compared to using a whole crab in each trap. The bait bags have reduced the demand for bait by 50 to 75 percent in recent years. Research is also being done to identify alternative baits for the conch and eel fisheries, to further reduce the need for horseshoe crabs.

Although restrictive measures have been taken in recent years, populations are not showing immediate increases. Because horseshoe crabs do not breed until they reach 9 or more years of age, it may take some time before the population measurably increases.

What the Future Holds

Unfortunately, we often learn the value of a species after its population is decimated. However, in the case of horseshoe crabs, we know their ecological role, importance to the biomedical industry, and their importance in the commercial fishery. We have the opportunity to manage and protect horseshoe crab populations at a sustainable level and also provide enough crabs for their ecological and commercial uses now and in the future.

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