

Horseshoe Crab

Limulus polyphemus

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DESCRIPTION

Taxonomy and Basic Description

Despite their name, horseshoe crabs are not true crabs. The horseshoe crab, *Limulus polyphemus*, is the only member of the Arthropoda subclass Xiphosura found in the Atlantic. Unlike true crabs, which have two pairs of antennae, a pair of jaws and five pairs of legs, horseshoe crabs lack antennae and jaws and they have seven pairs of legs, including a pair of chelicerae. Chelicerae are appendages similar to those used by spiders and scorpions for grasping and crushing. In addition, horseshoe crabs have book lungs, similar to spiders and different from crabs, which have gills. Thus, horseshoe crabs are more closely related to spiders and scorpions than they are to other crabs. Their carapace is divided into three sections: the anterior portion is the prosoma; the middle section is the opithosoma; and the “tail” is called the telson. Horseshoe crabs have two pairs of eyes located on the prosoma: one anterior set of simple eyes and one set of lateral compound eyes similar to those of insects. In addition, they possess a series of photoreceptors on the opithosoma and telson (Shuster 1982).



Horseshoe crabs are long-lived animals; after attaining sexual maturity at 9 to 12 years of age, they may live for another 10 years or more. Like other arthropods, horseshoe crabs must molt in order to grow. As the crab ages, more and more time passes between molts, with 16 to 19 molts occurring before a crab becomes mature, stops growing and switches energy expenditure to reproduction. Adult horseshoe crabs feed on a variety of bottom-dwelling organisms including marine worms, shellfish and decaying animal matter. The larvae and juvenile stages are preyed upon by many species of fish and birds and adult horseshoe crabs are known to be a food item for the threatened loggerhead sea turtle, *Caretta caretta* (Keinath et al. 1987).

Horseshoe crabs are also harvested for use in biomedicine. A clotting agent in the crab's blood, known as *Limulus* Amoebocyte Lysate (LAL), is used to detect microbial pathogens in medical intravenous fluids, injectable drugs and supplies (Rudloe, 1983). Biomedical companies purchase large crabs, which are harvested by trawlers or by hand from spawning beaches. The crabs are transported to the LAL production facility, bled, then transported back to the general harvest vicinity and released alive. LAL is currently used worldwide as the standard (FDA required) test for microbial contamination in injectable pharmaceutical products (Walls and Berkson 2000). Horseshoe crabs have also been used in eye research and the development of wound dressings and surgical sutures. In addition, horseshoe crabs are currently the primary bait used in the whelk and eel fisheries along the Atlantic coast (ASMFC 1998).

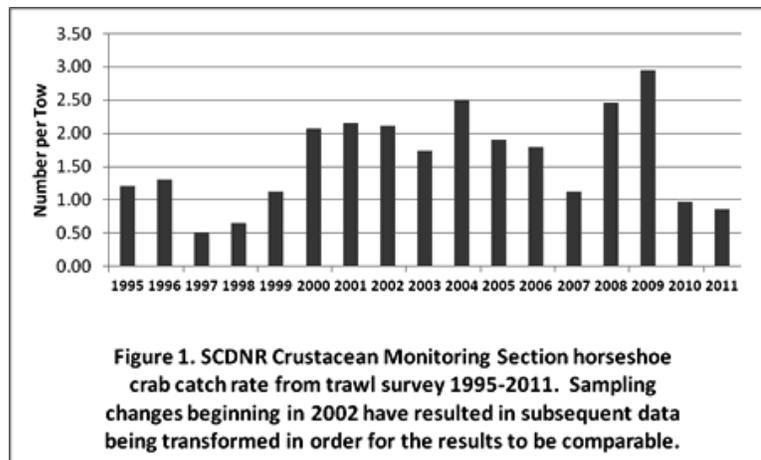
Status

This species is not currently listed as threatened or endangered; however, horseshoe crabs are an important species, both commercially and ecologically. Ecologically, horseshoe crabs are an important component of coastal food webs. In particular, horseshoe crab eggs are the primary source of fat for at least 20 species of migratory shore birds (Harrington 2001). Larval and juvenile crabs are also food for many species of fish and invertebrates, while adult crabs are favored by loggerhead sea turtles and sharks (Keinath et al 1987). In addition, horseshoe crabs have been shown to be a controlling factor in benthic species composition through their feeding activities. There is great concern about the harvest of horseshoe crabs in the mid Atlantic and how it affects the red knot, *Calidris canutus*, another imperiled species (Piersma and Barker 2000).

POPULATION DISTRIBUTION AND SIZE

Horseshoe crabs are relatively common in trawls in South Carolina. Based on research trawl collections, we are able to get some ideas of relative abundance. However, there is no estimate of population size at this time.

The range of the horseshoe crab extends from northern Maine to the Yucatan Peninsula. They are particularly abundant in Delaware Bay, the center of their distribution, and in coastal areas between Virginia and New Jersey. Different populations of horseshoe crabs are thought to inhabit every major estuary along the Atlantic coast. Each population can be differentiated from the others based on size of adult crabs, the color of their carapace and pigments present in their eyes. In South Carolina, horseshoe crabs can be found in shallow estuarine areas and offshore habitats near the continental shelf.



HABITAT AND NATURAL COMMUNITY REQUIREMENTS

Adult horseshoe crabs are benthic animals. Early each spring, as estuarine water temperature approaches 20°C (68°F), adult horseshoe crabs move inshore to seek suitable spawning habitat along intertidal beaches of the sea-islands. The characteristics associated with preferential spawning locations are the presence of large intertidal sand flats near the spawning beach, a depth to reducing layer greater than 30 cm (12 inches) from the surface and accretional, rather than erosional, sediments (Thompson 1999).

Throughout the spring, females with males attached to their carapace follow flooding tides high onto the beach, where they excavate nests and deposit thousands of eggs. During mating, the

male grasps the female's carapace and fertilizes her eggs as she deposits them in the nest cavity. Oftentimes, other unattached "satellite" males may also fertilize some of the eggs. Mating and nesting coincide with high tides. Nests are excavated by the female on the intertidal zone of sandy beaches and eggs are laid in clusters. Spawning activity is especially heavy during nighttime spring tides. Females nest several times per season, usually returning to deposit more eggs on subsequent high tides. After approximately two weeks, depending on temperature, moisture and oxygen levels, larval horseshoe crabs emerge from the nest. Larval horseshoe crabs are semi-planktonic for about three weeks before their transition to a benthic existence. They then settle to the bottom and assume a benthic existence, typically spending their first two years in intertidal sand flat habitats near beaches where they were spawned. Adults return to deeper estuary bays and continental shelf waters after the breeding season (Thompson 1999).

CHALLENGES

Resource managers are concerned that the health of horseshoe crab populations along the northeastern coast of the United States is impacted by overharvest (Widener and Barlow 1999; ASMFC 2001). New fishery regulations have been promulgated through individual states and the Atlantic States Marine Fishery Commission (ASMFC) fishery management plan for the East Coast (ASMFC 1998). In South Carolina, the harvest of horseshoe crabs is limited to the LAL industry and a permit has been required since 1991. Recent studies suggest that between 10 and 20 percent of crabs harvested for LAL production do not survive, even though the Food and Drug Administration mandates that they be returned to the water alive. The main challenge to conservation in South Carolina is providing high quality habitat for horseshoe crabs.

CONSERVATION ACCOMPLISHMENTS

A fishery management plan is now in place for horseshoe crab through the ASMFC. States must comply with goals of the plan and provide updates on horseshoe crab status. In states that allow harvest of horseshoe crabs for bait, stringent reductions have reduced the harvest from high levels seen in the late 1990s to hopefully more sustainable levels. Crabs in the ACE Basin were once harvested in small numbers; however, South Carolina prohibited this activity in 1991. This has been accomplished by improved monitoring and management of the commercial fisheries, effort reduction, state catch quotas, and seasonal and area closures. Increased funding has led to establishment of a long term trawl survey and standardized methodology for beach spawner and egg surveys, most of which takes place in Delaware Bay and offshore. Basic research has increased in recent years, and public awareness has been heightened to support conservation measures.

CONSERVATION RECOMMENDATIONS

- Determine the long-term trends in horseshoe crab spawning stock size and how those relate to environmental and other factors such as harvest.
- Determine the trophic impacts of horseshoe crab eggs and larvae on feeding shorebirds how this is influenced by habitat change.
- Although harvest to LAL bleeding is limited and there is no bait harvest, population trends should continue to be monitored closely.

- Avoid beach renourishment during horseshoe crab spawning season because the importance of low energy beach front as spawning and juvenile nursery habitat for horseshoe crabs.

MEASURES OF SUCCESS

The measurement of success will be stable population trends for horseshoe crabs in South Carolina, as well as the wildlife species, particularly shorebirds, that depend upon the eggs and larvae as a food source.

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