Wildlife Populations: Horseshoe Crab

Background

Horseshoe crabs (*Limulus polyphemus)* are both ecologically and commercially important. They lay their eggs on sandy beaches in spring and summer, primarily during new and full moon cycles. Migrating shorebirds rely heavily on their eggs to supply energy required to complete their migration. Horseshoe crabs are also important to the medical industry. Biomedical companies catch horseshoe crabs for their blood, from which they produce Limulus Amebocyte Lysate (LAL). LAL is used to detect contamination of injectable drugs and implantable devices; it is the most sensitive means available for detecting endotoxins, which are part of the outer membrane of the cell wall of certain bacteria, such as *E. coli* and *Salmonella*. Finally, in some states horseshoe crabs are harvested commercially for bait to catch American eels, catfish, and whelk. New Jersey adopted a moratorium on the harvesting of horseshoe crabs in 2008, with an exception for the nonlethal collection of blood from horseshoe crabs for biomedical purposes. Horseshoe crabs are a particularly important species in New Jersey because the Delaware Bay is the center of horseshoe crab spawning abundance on the Atlantic coast.[1]

Adult Horseshoe Crab (Getty Images, 2019)

Adult horseshoe crabs spend the winter months in water 20 to 60 feet deep on the continental shelf. Increased water temperature and daylight stimulate adult migration toward sandy beaches for spawning. The peak migration in the Delaware Bay generally occurs during the evening full moon tides in May and June. Females dig a shallow hole, ranging from 5 to 30 centimeters deep, within the intertidal zone and deposit their eggs in clumps while males fertilize the eggs. Adverse weather can negatively affect spawning by disrupting spawning sites, driving animals off the beach, diminishing the number of pairs able to spawn, or preventing them from coming to the beach at all.[2]

Horseshoe crabs molt numerous times as they grow from the larval stage, shedding their exoskeleton at least 16 or 17 times before reaching sexual maturity. Horseshoe crabs require nine to ten years to reach maturity, when they cease to molt, and may reach a maximum age of twenty years.[2]

Status and Trends

Horseshoe crabs are currently managed under Addendum VII of the Atlantic States Marine Fisheries Commission (ASMFC) Fishery Management Plan for Horseshoe Crab (http://www.asmfc.org/species/horseshoe-crab).[3] A 2019 stock assessment evaluated the status of several regional populations, including the Delaware Bay region.[4] High harvest levels during the 1990s led to rapid population declines in the mid-Atlantic region. Management actions taken in 2004 and 2006 halted the population decline, and recent stock assessment results indicate the Delaware Bay population of horseshoe crabs appears to be recovering.

Within the Delaware Bay region, there are a number of surveys that provide information on population status. Although variability exists among the surveys, common trends are evident. In particular, longer time series indicate a rapid decline in abundance during the 1990s followed by apparent stability.[3] Results of the New Jersey Ocean Trawl Survey show a significantly decreasing trend from 1988 to 2010 (Kendall's tau = -0.59, $p<0.05$) and a weakly significant increasing trend from 2011 to 2019 (Kendall's tau = 0.5, $p = 0.06$) (Figure 1).[5]

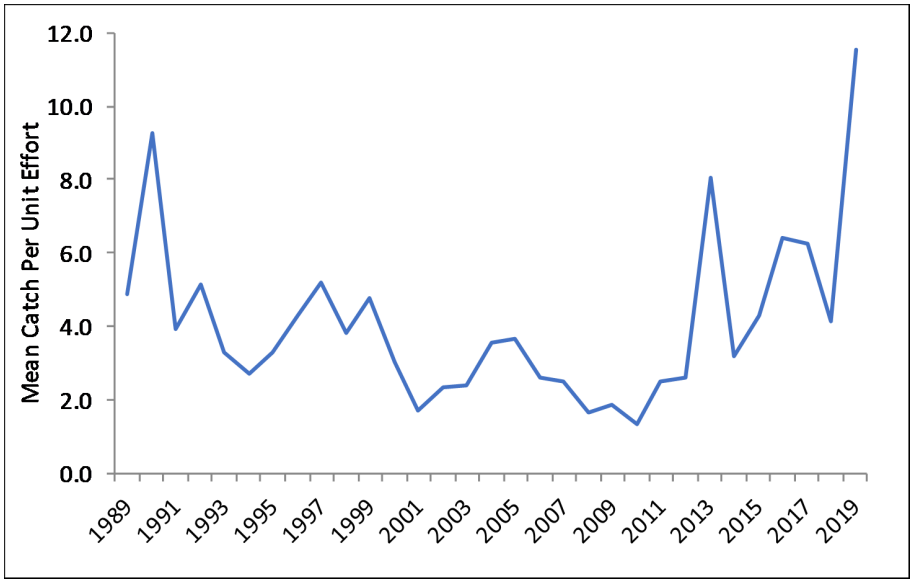

Figure 1: New Jersey Ocean Trawl Survey stratified arithmetic mean catch per unit effort of horseshoe crabs for combined April, August and October samples (1988 to 2019).[5] The stratified mean is derived by calculating the means for each stratum within the sampling area, multiplying each individual stratum mean by its stratum weight (percentage of area the stratum occupies within the entire sample area), then summing the weighted strata means.

Harvest restrictions implemented in 2004 and 2006 have significantly reduced horseshoe crab harvest both coastwide and in the Delaware Bay region relative to the peak harvests in the late 1990s, with a moratorium on bait harvest in New Jersey that went into effect in 2008. Despite an earlier lack of response to these management efforts, this region's horseshoe crab population appears to be slowly recovering. Yet there are other factors (e.g., bycatch, illegal harvest, environmental trends, ecosystem interactions), which have been difficult to quantify and account for in management of this species. For example, large bait harvests of the 1990's focused primarily on breeding-age crabs, particularly females which are favored for bait.[3] Population recovery following these large harvests was expected to be slow as horseshoe crabs are thought to take 10 years to reach spawning age.

Although horseshoe crabs may no longer be harvested for bait in New Jersey, a few biomedical companies are authorized to capture horseshoe crabs, extract a quantity of blood for the production of LAL, then release the crabs. There is some mortality associated with this practice. The most recent stock assessment used a mortality rate of 15% of all bled crabs; this rate was determined based on an analysis of recent literature and includes some level of uncertainty.[4] Figure 2 shows the number of horseshoe crabs that are harvested coastwide for bait and biomedical purposes.[4] Reduced food availability may also be affecting population recovery. For instance, there has been a significant decrease in surf clam (*Spissula solidissima*) populations, a major prey item of horseshoe crabs, in the mid-Atlantic region over the last two decades.[6] Another factor that may be inhibiting population growth is loss of habitat, particularly spawning beaches in the Delaware Bay. Both New Jersey and Delaware are taking steps to protect and enhance bayshore beaches to ensure suitable spawning habitat.

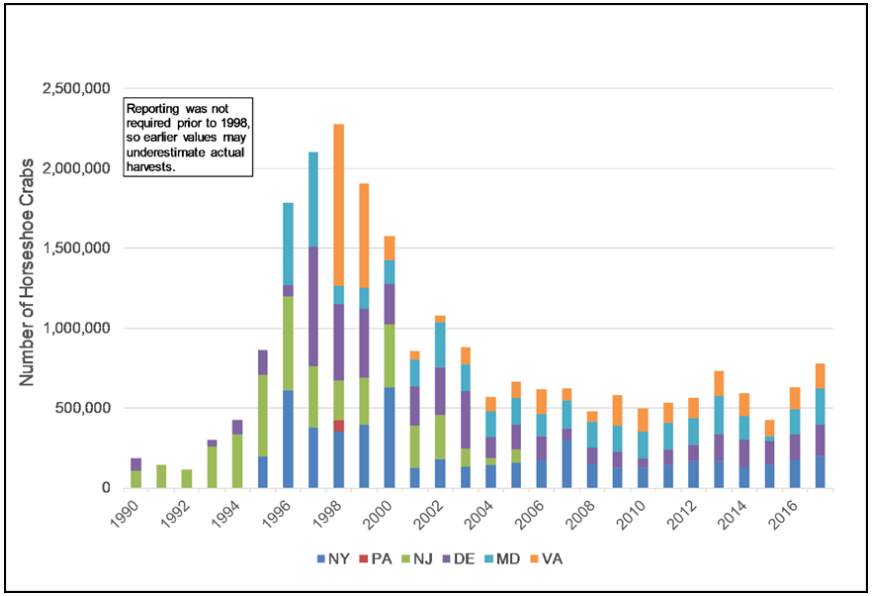

Figure 2: Total number of horseshoe crabs harvested annually in the mid-Atlantic states (1990 to 2017).[4]

Because of the importance of horseshoe crab eggs as a primary food source for several species of migratory shorebirds, especially red knots, studies of horseshoe crab egg density have been performed since 1985. These studies have found a dramatic decline in horseshoe crab egg density from peak numbers in 1991, which corresponds with the period of intense harvest during the mid-1990s and early 2000s. Egg surveys conducted in Delaware and New Jersey found essentially no change in egg density from 2005 through 2014.[7]

Mispillion Harbor, DE, continues to be an important shorebird foraging area with very high egg densities. The harbor is protected in all weather conditions and may enjoy earlier, warmer water temperatures; both aspects favor horseshoe crab spawning.

Spawning Horseshoe Crabs (Getty Images, 2019)

Outlook and Implications

Management efforts by the states and ASMFC led to a decrease in harvest of horseshoe crabs from over 2 million per year (coastwide) in the late 1990s to an average of approximately 750,000 per year from 2009-2017, with a high of around 1 million crabs in 2017.[4] The importance of horseshoe crabs to species such as the red knot requires that horseshoe crab abundance be sufficient to support not only the human use, but needs of other species as well. To achieve these goals, the ASMFC developed a multispecies management framework that includes horseshoe crabs and red knots.[8] In 2013, the Adaptive Resource Management (or ARM) model was implemented, which identifies an optimum harvest strategy for the Delaware Bay region, considers the utility of crabs to both ecosystem dynamics and human use. The current harvest option prohibits harvest of female crabs from the Delaware Bay region but allows a harvest of ~500,000 male crabs allocated among the states based on historic performance.

In addition to harvest restrictions, since 2003 there have been substantial efforts to reduce human disturbance on NJ Bayshore beaches. Restricting access to important beaches on the Delaware Bay prevents the disturbance of breeding horseshoe crabs and feeding shorebirds. Horseshoe crab spawning habitat restoration has continued since 2013. With initial funding from the National Fish and Wildlife Foundation, Community Foundation of NJ, and the Department of Interior, over one mile of spawning beach in Cape May and Cumberland Counties was restored after Hurricane Sandy (2013-2014). Dyers Cove in Cumberland County and Cooks Beach in Cape May County were restored in 2016 and 2019, respectively, by the American Littoral Society who is also conducting experimental work to increase elevation/revegetation of marsh damaged by salt hay farming.[9,10] Over 10,000 acres of Delaware Bay marsh were previously diked and farmed. Continued restoration efforts are expected to increase populations of horseshoe crabs and red knots (see http://www.restorenjbayshore.org/).

Given the life history of horseshoe crabs, population growth will be slow and may be hindered by factors such as continued human use, habitat loss, food availability, illegal harvest, and incidental mortality; however, NJDEP is taking steps, such as a harvest moratorium and beach replenishment, to protect this keystone species for the maximum benefit of all users.

More Information

For more information, visit www.asmfc.org, under "Fisheries Management" select "Horseshoe Crab."

More information on red knots is available in "Wildlife Populations: Red Knot" in the NJDEP Environmental Trends series at https://www.nj.gov/dep/dsr/trends/.

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