

***Limulus***  
**Spawning Activity**  
**on**  
**Delaware Bay**  
**Shores**  
**1990**



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## ABSTRACT

On 8 June 1990, the spawning population of *Limulus polyphemus* on the beaches of Delaware Bay was estimated to be 1,240,700. The majority of these crabs were located between 38°55'N and 39°12'N. Crab numbers on the New Jersey beaches were four times greater than on the Delaware beaches. The P.M. high tide estimate was 2.9 times greater than the A.M. high tide. The average ratio of males to females was 2.19:1.

## INTRODUCTION

The American Horseshoe crab, *Limulus polyphemus*, was first reported in Chesapeake Bay, during the early years of British settlement of the New World. But they were already well-known to the American Indian who used them for food, to fertilize crops, and as utensils. The telsons were used to tip fish spears and the carcasses were used to bail out their canoes.

Delaware Bay horseshoe crabs have been heavily harvested for fertilizer and for livestock feed for over two centuries. Reported harvests dropped from over 4 million annually during the 1870's to between 1.5 and 1.8 million a year during the 1880's to the 1920's. From then on the population decline was dramatic. By the 1960's the reported commercial harvests averaged 42,000 crabs annually. Through the 1970's and early 1980's, the harvests were so meager, records were no longer kept.

In recent years, the resurgence of the Delaware Bay population and new uses for horseshoe crabs have led to increasing annual harvests. Among these were the discovery of a special clotting system in their blood which has led to

the commercial production of material to detect endotoxins in pharmaceutical drugs and medical devices; bait for eel, conch and catfish is presently the prime use.

Research on ecological aspects of the horseshoe crab, particularly on the value of the eggs in migratory shore bird energetics, has also added to our perception of the significant role that *Limulus* plays in coastal ecology.

In the first *Limulus* census ever taken, Shuster and Botton (1985) estimated the 1977 peak population of horseshoe crabs spawning in Delaware Bay to be 273,000 individuals. A review of data collected during fish and clam surveys on the continental shelf led Botton and Ropes (1987) to estimate that ninety percent of the standing stock of *Limulus polyphemus* is located between Virginia and New Jersey. These points of reference and visits in recent years from foreign scientists, from Europe and Asia, to view the spectacle of spawning, reinforced what has been commonly accepted, that Delaware Bay is the site of the largest concentration of horseshoe crabs anywhere in the world. Even though the above indicated that the population had made a remarkable recovery, there has been concern over the increasing harvests of horseshoe crabs.

Since the horseshoe crab fishery is no longer being monitored and additional uses of the crabs reflect the importance of the species as well as impacts on the species, now seems to be an appropriate time, before another decline occurs, to better understand the population. This is necessary to protect and better manage this unique resource. We have as an example the experience in Japan. There, due to overfishing

and land reclamation which destroyed key spawning areas, the Japanese horseshoe crab, *Tachypleus tridentatus*, was almost extinct and now is considered a national treasure (Nishii, 1975; Mikkelsen, 1988). It is clear, from the Japanese experience and the widely fluctuating harvest data for Delaware Bay since 1870, that loss of large numbers of crabs, for bait or through destruction of spawning grounds, could also lead to a disastrous decrease in *Limulus polyphemus*.

### PROCEDURE

This survey was conducted to estimate the size of the adult population of horseshoe crabs in Delaware Bay. Since the majority of horseshoe crabs usually migrate toward Delaware Bay shores in late spring to spawn, coincident with full moon high tides, this is an opportune time to take a census of the adult portion of the total population. This study was conducted during the full moon high tides 8 June 1990. Data was collected by volunteers in both New Jersey and Delaware.

Volunteers counted the number of crabs in randomly selected 10 meter increments along several beaches. Females and males were counted and it was reported whether the crab was a single specimen, in a mated pair, or a mating group. The number of crabs in the water and the number of stranded crabs was also estimated. A tabulation sheet was supplied to each volunteer or group of volunteers.

### RESULTS

Analysis of the survey/census data indicates that the peak spawning population of crabs on 8 June 1990 was 1,240,679 crabs with 81.2% in

New Jersey and 18.8% in Delaware. Thirteen beaches in New Jersey and twenty-two beaches in Delaware were surveyed, with some of these beaches being surveyed both at the peak of the A.M. and P.M. high tides. The P.M. tide population of spawning individuals was 2.9 times higher than the A.M. tide population.

Delaware's main spawning beaches were Cedar Beach, South Bowers and Kitts Hummock (38°55' to 39°06'N). Cooks Beach, Highs Beach, Moores Beach, East Point and Thompsons Beach were the principal beaches on the New Jersey side (39°07' to 39°12'N).

While the estimate of the population size is considerably higher than the 1977 estimate of 273,000 crabs (Shuster and Botton, 1985), the percentages of the crabs on the New Jersey and Delaware side, in this survey, were comparable to the numbers reported in 1977. The uneven distribution of crabs along the Delaware Bay shore has been attributed to the flood tide which runs stronger and longer into the eastern side of the Delaware Bay and the crabs follow the predominant current (Shuster 1958). The current upbay estimate is considerably higher than that of the 1977 composite. In 1979, Seabreeze, Fortescue, Thompsons and Moores beaches were estimated to have 9,300 crabs (Shuster and Botton, 1985). This upbay increase is consistent with the concept that greater numbers of continental shelf adults would produce a greater upbay spawning migration. Our survey indicated an estimate of some 231,050 crabs on these beaches.

In the 1977-1979 survey, Shuster and Botton (1985) reported sex ratios, male:female of 3:1 to 5:1. The 1990 sex ratio of males to females was lower and slightly variable between

beaches. The average was 2.19 males to every female. Males did outnumber the females in all but 5 of the 58 ratios and the ratio increased with the increase in numbers associated with the P.M. high tide. Roosevelt Inlet in Delaware had the highest male to female ratio of 9:1.

This difference is not peculiar to Delaware Bay; it occurs elsewhere, as in the study by Rudloe (1980) in Gulf of Mexico waters. She found a higher male to female sex ratio with the P.M. high tide which might be explained, in part, by repeated breeding by the males.

## DISCUSSION

A peak spawning population of 1,240,700 horseshoe crabs was estimated from the 1990 census. Although this number is an estimate and is not believed to be the total adult population, the population has not been at this level since the 1920's. But, when compared to 1850's data (Fowler, 1908), of estimates ranging from 750,000 to 1,000,000 crabs within 1 km of the beach, the numbers which are impressive today still fall short of the early records. Does this mean that the Bay is no longer capable of sustaining such a large population, or is this still a species suffering from overfishing?

Few landings are now reported by commercial fishermen and the number of crabs harvested along the beach during their spawning period is not recorded, but it is estimated that over 1 million limuli are harvested annually for bait. In addition, U.S. Food and Drug Administration has reported 130,000 crabs bled in 1989 for the production of *Limulus Amebocyte Lysate*. Afterwards, these crabs are returned, alive, to the water. This practice is beneficial according to

the study of Rudloe (1983). She reported a 10% higher mortality rate in bled crabs than in unbled crabs. Thus, the lysate industry does not seem to pose a great threat to the population of horseshoe crabs, except in localities where the population is already small. It seems, therefore, that the loss of habitat and overfishing for eel, conch and catfish bait are more crucial to the survival of the horseshoe crab.

## SUMMARY

It seems appropriate to take steps to install an annual census of spawning horseshoe crabs along the Delaware Bay shores, as a means not only of better understanding population dynamics of the species, but to provide data invaluable to fishery management specialists.

The 1990 census was instituted on the basis of a perceived need to better understand the horseshoe crab population of Delaware Bay. The results indicate that the census was successful as the first, all-day, all-bay shoreline survey.

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