



Miracle Workers

The compound eyes of the horseshoe crab are attributed to numerous optical discoveries

What has 10 eyes, at 360 million years old predates the dinosaurs, and is found on the Delaware Bayshore? The horseshoe crab, of course!

Many locals know of the horseshoe crabs' interrelationship with the migrating shorebirds that devour their exposed eggs on their northward journey to Arctic nesting grounds. The Delaware River is on the Atlantic Flyway; think of it as a highway for avian migrations. Migration is a survival strategy that is prompted by any number of variables: food availability, safer nesting sites, predation, better weather conditions, and favorable breeding locations. The shorebird migration is triggered by all of these. They leave the Southern Hemisphere early in May and the Delaware Bayshore is a critical stopover site en route to their Arctic nesting grounds.

The birds' arrival on the Bay coincides with the horseshoe crab spawn. These exposed eggs are critical fuel/food after the birds have traveled nonstop for thousands of miles; the eggs allow them to fatten up for the next leg of their journey northward. Ultimately the Arctic will provide vast expanses where shorebird nests are well-camouflaged on the ground, and numerous insects hatch for feeding both adults and young.

Horseshoe crabs are important for another reason. Their blood saves human lives by ensuring that vaccines, implant devices, and medical tools are free of dangerous bacteria like *E. coli* or salmonella. In the early 1950s, Fredrick Bang discovered that horseshoe crab blood cells contained a clotting agent that bonds with hazardous endotoxins produced by gram-negative bacteria. A product containing horseshoe crab blood was developed. Called Limulus ameobocyte lysate or LAL, when exposed to deadly bacteria it reacts, alerting medical technicians to their presence. Prior to its approval in 1970 scientists used huge numbers of rabbits to test for bacteria, observing them for symptoms or death. And now there is a newer substance that pharmaceutical companies are employing for saline/water testing that will likely be a replacement for all the LAL tests. With the continual increase in demand for LAL this is good news for the crabs. Although it is believed that most survive the bleeding, there is nonetheless some mortality associated with the process.

In the 1950s it was also discovered that chitin, a material found in the crab's carapace, contains wound-healing characteristics. Some bandages and sutures use this chitin because of its unique antiseptic properties, placing more stress on the horseshoe crab population.

On other medical fronts, Dr. Keffer Hartline won the Nobel Prize in 1967 for optic research utilizing crabs to study the optic nerve's electrical impulses. The compound eyes of the horseshoe crab are often claimed to have been responsible for more optical discoveries than any other living creature. This research may lead to an understanding of how to correct human vision abnormalities. Someday the horseshoe crab's ten eyes may save your two.

In my 30+ years of involvement in the conservation community, the horseshoe crab has been at the center of a number of protection controversies. During the month of May the Delaware Bay plays host to the crabs' largest and most viable population in the

world. But their numbers have been threatened by over-harvest for bait. NJ adopted restrictions to help protect the crabs but many other states did not, so the population remained at risk. Today the Atlantic marine fishery regulators have instituted protective measures that transcend state boundaries. Some biologists don't consider these regulations to be sufficient to sustain horseshoe crab or shorebird populations.

Spawning habitat is continually diminished by beach erosion. Conservation organizations have replenished sand in prime areas but nature's forces are persistent. The conservation community is also concerned about any possible impediments created by aquaculture equipment on the crabs' shoreward movements. Tending aquaculture equipment can also disturb feeding shorebirds. US Fish and Wildlife has developed conservation measures/ regulations to protect the federally endangered red knot (a shorebird migrant). Biologists and the aquaculture community both work very hard to find common ground.

The interdependence of species and people's use of the resource remains complex. Economics, protection, conservation, and sustainability all converge in a cocktail of diverse opinions that are equally problematic.

But on a final note of optimism, people care. Hundreds of volunteers following detailed marching orders are coordinated by the conservation community in a rescue effort called ReTurn the Favor. On the Bayshore horseshoe crabs are often stranded in rubble. Some also find themselves in the predicament of needing to be flipped over. They can often right themselves, but occasionally a helping hand from a volunteer saves their lives. The Western Hemisphere Shorebird Reserve Network and NJ Fish and Wildlife lead local conservation organizations in this effort. Citizens United to Protect the Maurice River, Inc., the Wetlands Institute, The Nature Conservancy, Conserve Wildlife, NJ Audubon, and others coordinate their teams of volunteers in this effort. Last year 100 crew leaders led 698 rescue

walks during which 85,746 crabs were assisted on 21 beaches. Since 2013, 2,500 rescue walks saved 361,755 crabs. And the overall effort has resulted in a greater understanding, by these volunteers and their recruits, of the Bayshore's resources and needs.

To learn more about horseshoe crabs, the University of DE's Sea Grant Program has many wonderful materials online for teachers and the community at large.