Living fossils stirring under Great Bay Waters

Each spring, visitors gather at the edge of Great Bay to watch horseshoe crabs emerge from its waters. Their anticipation builds as they wait to witness an ancient routine, one that may date back over 200 million years to a time when horseshoe crabs first lived on earth.

Horseshoe crabs migrate to Great Bay's shores each spring to mate and spawn. Their spawning routine begins with male horseshoe crabs waiting along the water's edge for females to arrive; when they do, a male crab uses his hook-like claws to grasp the female's shell. The female then pauses every few feet to dig a hole and deposit thousands of small green eggs, which the male fertilizes as he is pulled over the nest. After they finish spawning, the horseshoe crabs move back into deeper waters, and our knowledge of their behavior becomes murky. While the spawning behavior of horseshoe crabs has been well studied, little is known about what horseshoe crabs do at other times or the ecological consequences of their actions.

Wan-Jean Lee, a graduate student in the zoology department at UNH, is focusing her doctoral research on understanding horseshoe crab behavior and how it affects the Great Bay Ecosystem. Studies she began in 2007 have shown that, after the spawning season, horseshoe crabs remain in shallow waters through the fall to forage on Great Bay's mudflats. During this time, horseshoe crabs are busy digging on the muddy bottom at high tide looking for shellfish and worms. To find their prey, horseshoe crabs scuttle along the bottom, stopping multiple times to probe into the mud to determine the availability of food, before settling in to dig deep and feed in an optimal location. Their exploratory digging inadvertently disturbs other organisms in the sediment, and Wan-Jean's studies have demonstrated that the number of invertebrates found in the recently dug pits was much lower than in undug areas (*Figure 1*).

As they feed, horseshoe crabs seek small shellfish—their favorite food. However, in some parts of Great Bay shellfish are less abundant than worms. In the process of searching for shellfish, the horseshoe crabs may injure the worms or displace them to other parts of the mudflat. It is unknown what becomes of these worms. This summer, Wan-Jean will investigate the diet of horseshoe crabs in Great Bay to determine whether all the animals that were 'lost' as a result of digging are later eaten by the horseshoe crabs.

By stirring up the sediments as they dig, horseshoe crabs may also create conditions for bottom-dwelling species that cannot exist elsewhere, thereby influencing the distribution of species and biological diversity of the estuary. To determine the role an animal plays in shaping an ecosystem, scientists often investigate the consequences of its absence. Some of you may have noticed PVC pipes and garden fencing on the mudflats at Sandy Point last summer. These structures were set up to keep horseshoe crabs out of the study areas. Wan-Jean will use their absence to understand how sediment characteristics and invertebrate species composition differ in areas of mudflat that have been dug by horseshoe crabs compared to those areas that are undisturbed. Unfortunately, large amounts of green algae drifted into the exclosures and disrupted last year's experiment, so it will be repeated again this summer.

Horseshoe crabs have outlasted the dinosaurs in their longevity on the earth, but so much remains to be learned about their behavior and ecological roles. Although many of their behaviors appear simple, they may have complex ecological consequences. The next time you watch a horseshoe crab at the water's edge, consider all the mysteries of its life beneath the waters of Great Bay.

Wan-Jean Lee, Graduate Research Fellow, GBNERR
And Kathy Mills, Research Coordinator, GBNERR

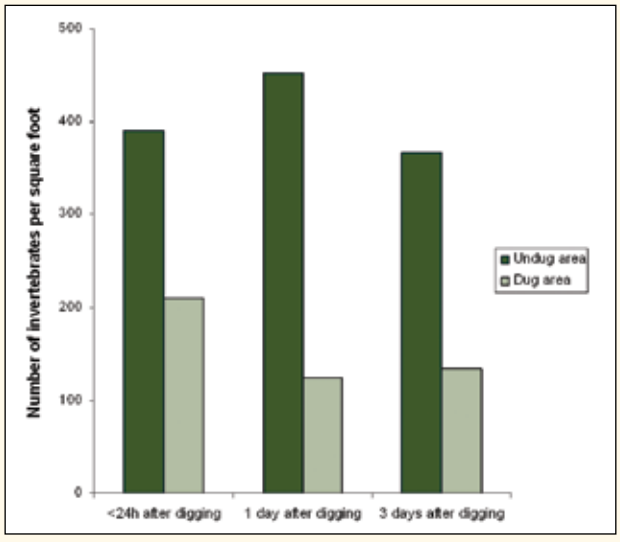

Figure 1. Comparison of the number of invertebrates in horseshoe crab pits versus undug mudflat areas at three points in time.

Horseshoe crabs burrow in the mud seeking a meal.

Twenty Years of Volunteering

We cannot say it often enough. We could not run our programs or our Center without our dedicated volunteers. But we can also say we would not exist if it had not been for the effort and dedication of volunteers.

As we celebrate the 20th anniversary of the Reserve, I would like to acknowledge the role that the residents of the towns around Great Bay played in working together as volunteers to have the Great Bay Estuary made part of the National Estuarine Research Reserve System. None of them were paid and their efforts have made all the accomplishments of the Reserve in the last 20 years possible.

Most of us know the story, but for those who may not, in 1973 Greek oil tycoon, Aristotle Onassis planned to build the world's largest oil refinery at Durham Point, supply it with freshwater from Lake Winnipesaukee and then have the oil pumped back and forth to a terminal at the Isles of Shoals via a pipeline through Great Bay, Newington, Portsmouth and then go out from Rye. Residents along the Bay and in the town of Durham knew something was up when locals started talking about strangers who were pulling up to the farms around Durham Point and offering "wads of money" for the land.

Community members called for a meeting, which was held in the library at UNH, and decided they had to find out what was going on and to keep people informed. That night "Save Our Shores" was created. Its leader was a 27 year old housewife, Nancy Sandberg. She energized the citizens of Durham and eventually involved lobstermen, fishermen, hotel and motel owners and soon almost 8,000 people had joined the SOS cause. Sharon Meeker of Lee organized hundreds of volunteers to get out information to the public through handouts, newsletters and circulated petitions. As Foster's newspaper wrote, "it was largely a brigade of housewives that brought Onassis down." When the town of Durham demanded that the refinery be put to a vote in March of 1974, the refinery proposal was voted down 1,254 to 144.

Evelyn Brown of Durham was one of the founders of SOS and even though the oil refinery was defeated she and others realized that there were other threats to the Great Bay Estuary. In 1983 she and a group of friends met and made plans for an organization that would serve as a "land trust, watchdog agency, and educational center for Great Bay and its tributary rivers." This became the "Great Bay Estuarine System Conservation Trust." With their backing and the help of Chris Simmers, from the Office of State Planning, Great Bay became part of a federal/state program in 1984 which ultimately led to the federal recognition of the Great Bay National Research Reserve in 1989.

The designation made the Great Bay part of the National Estuarine Research Reserve System. Under the auspices of NOAA and with its state partner NH Fish and Game, the Reserve purchased the Sandy Point property and with volunteers cleared the property and put in the boardwalk and began its role as outlined in the original Great Bay Trust's constitution. A role that 20 years later is still being played.

Many local citizens remember the fight over the Onassis oil refinery but are to this day unaware of the battles that followed. These battles, to stop an airport on the Greenland/Stratham town line, massive housing developments in Newmarket and Durham, stopping the town of Exeter from dumping landfill into the Squamscott River and others, were fought by local concerned citizens to save and protect the Great Bay Estuary. The volunteers who formed the SOS and Great Bay Trust (now the Great Bay Stewards) are still out there and are still involved in the protection and conservation of the Estuary. You can find these people and new volunteers in the UNH Marine Docent program, the Great Bay Stewards, groups from local corporations and schools who do community service on the lands of the Reserve, Great Bay Coast Watch, conservation groups in the towns that surround Great Bay and its tributaries, the volunteers at the Discovery Center and those involved in the land stewardship program.

The need to protect Great Bay is still great and the opportunities for volunteering are many. We hope that this 20th anniversary year you will find the time to support one of the many groups that are continually working to keep the Great Bay Estuary a healthy part of the Seacoast and an integral part of our lives.

Sheila Roberge
Volunteer Coordinator, GBNERR