



ESTUARY NEWS



NEWSLETTER OF THE PARTNERSHIP FOR THE DELAWARE ESTUARY: A NATIONAL ESTUARY PROGRAM

BEHEMOTHS OF THE BAY

By Jennifer Adkins, Executive Director, Partnership for the Delaware Estuary

This August marks the 400th anniversary of Henry Hudson's discovery of the Delaware Estuary. After getting his ship, the *Half Moon*, stuck on a sandbar off Cape May Point, he eventually realized that the Delaware was not the route he sought to the Pacific Ocean and continued on his quest, heading up the waterway which today bears his name, the Hudson River.

Hudson did not stay long enough in the Delaware Bay to explore its vast and abundant resources, but he did report

that the area would make a good place to settle. Other Europeans were quick to follow, with the Dutch making Lewes, Delaware, one of their first settlements in the "New Netherlands."

Through historic resources, like the 1655 journal of David Pietersz de Vries, we get a glimpse of what the Delaware Estuary was like prior to settlement. After financing the ill-fated

Zwaanendael settlement near Lewes, de Vries traveled to Delaware Bay himself and recognized vast business opportunities in the resources he saw here. A National Park has been proposed in Delaware to recognize the importance of early settlements like Zwaanendael and Swede's Landing in Wilmington. The driver for these new settlements was economic; that is, to gain access to the natural resources of the Delaware Estuary.

continued on page 2



A northern right whale surfaces off the coast of New England. This severely endangered species uses estuaries like the Delaware Bay to feed and raise their young.

Credit: National Oceanic and Atmospheric Administration/Department of Commerce

In this issue...

Updates

- 3 The Schuylkill Action Network Has a New Website!
- 3 Research Reserve Expands Into Delaware Estuary

Species Specific

- 4 Whales of the Delaware Coast
- 6 Sharks of the Delaware Bay
- 7 Atlantic Sturgeon: A Signature Species too Long Forgotten

Making Waves

- 9 Rain Gardens for the Bays Campaign: Landscaping for Cleaner Water
- 10 Measuring the Use Value of Migratory Shorebirds in the Delaware Estuary

For Teachers

- 11 Workshop Back by Popular Demand

Estuary Excursions

- 12 Backyard Stewardship™: Coastal Communities Define Their Shared Habitat as a Horseshoe Crab Sanctuary
- 14 New Eco-attractions Opening in the Delaware Estuary

Events

- 15 Activities and Events Around the Estuary

Behemoths of the Bay continued from page 1

What would Hudson and de Vries have encountered in the Delaware River and Bay in the early 1600s? They likely would have seen many of the same impressive creatures found here today, though in much greater numbers. Signature species of the Delaware Bay, like horseshoe crabs, oysters, and shad, were undoubtedly in great abundance. But did you know that the Delaware was

important new discoveries about these habitats by taking samples and even pictures of the bottom of Delaware Bay, as reported in our Fall 2008 newsletter.

Many things have changed in the Delaware Estuary since Hudson's and de Vries's accounts. From the Revolutionary War, to the Industrial Revolution, to suburban sprawl, the Delaware Estuary has been heavily impacted by human use and

This summer, the City of Cape May will celebrate Henry Hudson's discovery of the Delaware Bay. The National Park Service is working to create a national park that celebrates early settlements in Delaware, and the Delaware History Museum currently features an exhibit on our history of "Whales, Weirs, and Waterfowl." As we celebrate the importance of these people and places

"But did you know that the Delaware was also – and still is today – the home of other large marine life, like sharks, sturgeon and whales?"

also – and still is today – the home of other large marine life, like sharks, sturgeon and whales?

In this issue of *Estuary News*, we explore some of the lesser-known underwater creatures of the Delaware Estuary: the "Behemoths of the Bay." While these creatures have been around for millions of years, we are just now starting to learn about the bay-bottom habitats that support them. In fact, the Partnership for the Delaware Estuary recently made

development. One important thing has not changed – we still have the natural resources that translate into economic opportunities to make this region "a good place to settle." But some of these resources, like sturgeon, are just barely hanging on. By working together – business interests, government agencies, environmental organizations, and informed residents – we can ensure that the generations that come after us have access to those same opportunities.

to our history, let us also celebrate the resources of the Delaware Estuary that made them possible.

Incidentally, Henry Hudson never did find what he was looking for, and he eventually died trying. Perhaps he should have paid more attention to the riches he had already found in the Delaware Estuary. ■

MEETINGS CONTACT LIST

Meetings conducted by the PDE's implementation and advisory committees occur on a regular basis and are open to the public. For meeting dates and times, please contact the individuals listed below:

Estuary Implementation Committee

Jennifer Adkins, Executive Director (Chair)
(800) 445-4935, ext. 102
jadkins@delawareestuary.org

Monitoring Advisory Committee

Edward Santoro, Monitoring Coordinator
(609) 883-9500, ext. 268
edward.santoro@drbc.state.nj.us

Toxics Advisory Committee

Dr. Thomas Fikslin, Branch Head
(609) 883-9500, ext. 253
thomas.fikslin@drbc.state.nj.us

Fish Consumption Advisory Team

Dr. Thomas Fikslin, Branch Head
(609) 883-9500, ext. 253
thomas.fikslin@drbc.state.nj.us

Science and Technical Advisory Committee

Dr. Danielle Kreeger, Estuary Science Director
(800) 445-4935, ext. 104
dkreeger@delawareestuary.org

Delaware Estuary Education Network

Lisa Wool, Program Director
(800) 445-4935, ext. 105
lwool@delawareestuary.org

Polychlorinated Biphenyls Implementation Advisory Committee

Pamela Bush, Esq.
(609) 883-9500, ext. 203
pamela.bush@drbc.state.nj.us



The Schuylkill Action Network Has a New Website!

This spring, the Schuylkill Action Network launched its new website at SchuylkillWaters.org. This redesigned website offers two distinct sections. Its public portion allows newcomers to explore both the benefits of joining and the many demonstration projects its six workgroups have carried out across roughly 2,000 square miles of the Schuylkill River Watershed. Its private portion, meanwhile, permits over 100 members to log in to a secure intranet where they can schedule meetings, send automated messages, upload documents for download, post late-breaking news and more.

The mission of the Schuylkill Action Network is to improve the water resources of the Schuylkill River Watershed by working in partnership with state agencies, local watershed organizations, water suppliers, local governments, and the federal government to transcend regulatory and jurisdictional boundaries in the implementation of protection measures. The Partnership for the Delaware Estuary is a founding member of the Schuylkill Action Network, and has led the development of SchuylkillWaters.org.

While you're online, check out recent changes to the Partnership for the Delaware Estuary's website at DelawareEstuary.org as well. These seek to improve navigation among the nonprofit's growing list of on-the-ground projects, each of which is tailored to a specific audience like community leaders, corporations, scientists, and teachers. Visitors from all walks of life should now be able to find information faster than before, all while enjoying a new design.

For more insight into the changes taking place at DelawareEstuary.org and SchuylkillWaters.org, please call Shaun Bailey and Lisa Wool, respectively, at (800) 445-4935. To become a member of the Schuylkill Action Network, please visit SchuylkillWaters.org and select "Get Involved" from the menu.



The Partnership for the Delaware Estuary served as project leader on behalf of the Schuylkill Action Network's 100-plus partners during the year-long development of the group's new website and online communications hub, SchuylkillWaters.org.

Research Reserve Expands Into Delaware Estuary

The Jacques Cousteau National Estuarine Research Reserve expanded its presence into the Delaware Estuary on May 1 when it formally dedicated the Cousteau Center at Bridgeton in



Credit: Cousteau Center at Bridgeton

Located at 31 West Commerce Street in Bridgeton, New Jersey, the Cousteau Center will serve as a satellite office for the Jacques Cousteau National Estuarine Research Reserve based in Tuckerton.

Cumberland County, New Jersey. This brings the total number of National Estuarine Research Reserves working in the Delaware Estuary to two when you include the Delaware National Estuarine Research Reserve on the other side of Delaware Bay, just outside Dover, Delaware, on the St. Jones River.

The Cousteau Center at Bridgeton is housed within the David Sheppard House, a historic building that was recently restored to serve as a 21st Century coastal resource center. Four full-time professionals will work at this satellite office, along with 20 to 30 volunteers. Together they will seek to advance environmental science, aid local educators, and inform those managing coastal resources throughout southern New Jersey.

Classes and workshops of both a formal and informal nature will take place at the Cousteau Center. These will address concerns of great importance to Cumberland County, including sustainable economic development, conservation of coastal resources, like Atlantic sturgeon, for example, and environmental monitoring in the Delaware and Cohansey Rivers.

The National Estuarine Research Reserve System is a nationwide network of protected areas established for long-term research, education and stewardship. This partnership program between the National Oceanic and Atmospheric Administration and numerous coastal states protects more than 1 million acres of estuarine land and water, which provides essential habitat for wildlife; offers educational opportunities for students, teachers and the public; and serves as living laboratories for scientists.

For more information regarding the Cousteau Center at Bridgeton, please contact Lisa Calvo at (856) 575-5580 or calvo@hsl.rutgers.edu. ■

Whales of the Delaware Coast

By Suzanne Thurman, Executive Director,
Marine Education, Research & Rehabilitation Institute, Inc.

The Delaware coast plays host to a variety of marine mammals, including whales, dolphins, porpoises, seals, and manatees. Nearly 40 different species frequent our shores and inland waterways throughout the seasons of the year, utilizing the area as a feeding ground, migratory pathway, and summer residence.

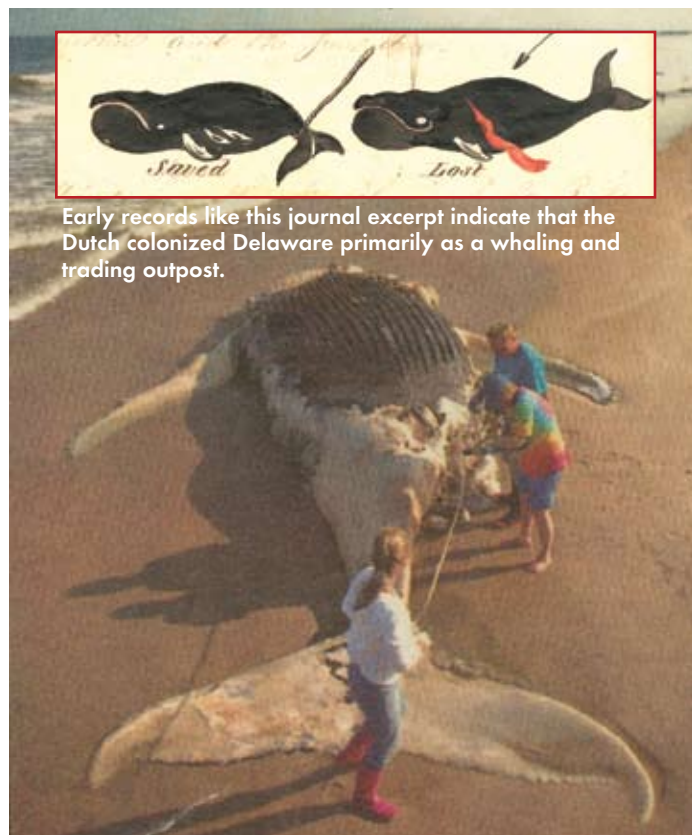
Delaware boasts one of the nation's more unique ecosystems in terms of species biodiversity. Acting as a true border state, this area attracts both northern and southern species at the farthest extent of their ranges. In addition to the more commonly occurring species, such as Atlantic bottlenose dolphins and harbor seals, we have documented species as rare as the northern bottlenose whale, the manatee, and the more common fin whale.

Numerous species of large whales pass by our shores, impressive by virtue of their massive size alone. Our coast experiences both mysticetes (baleen whales) and the smaller odontocetes (toothed whales). They swim past our coast during their annual spring and fall migrations as they travel between birthing and feeding grounds. Mother-and-calf pairs utilize our bays as weaning and feeding sanctuaries, where adult females can teach their young the art of foraging for prey.

The large whales are the baleen whales, which include the largest animal on Earth, the great blue whale. These giants reach lengths of 100 feet and weigh a massive 200,000 pounds. With a blubber layer measuring two feet thick, and a tongue that weighs four tons, this animal would compare in weight to 35 elephants.

Great blue whales survive on microscopic plankton, consuming four tons per day during their peak feeding time. Thus, the largest animal in the world survives by eating the smallest. Although great blue whales reside in more northern climates, and would therefore not be common here, there are records of past sightings and strandings that have occurred in our area.

The species of large whale most common to Delaware waters is the 55-foot humpback whale. Mother-and-calf pairs are often sighted offshore by charter-boat captains during the late summer and early fall. Mothers will care for their young for approximately one year before weaning and then separating. Humpbacks are noted for their hauntingly melodic courtship songs, which the



Early records like this journal excerpt indicate that the Dutch colonized Delaware primarily as a whaling and trading outpost.

Members of the MERR Institute's stranding team assess a young female humpback whale stranded at Cape Henlopen State Park in Lewes, Delaware, in October of 2006. Located in Lewes, the MERR Institute provides rescue and stranding response for marine mammals and sea turtles stranded in Delaware.

male will "sing" for many hours at a time while suspended in the water in an inverted position. The notes of these songs have often been compared to classical music compositions.

Humpbacks engage in acrobatic-like behaviors, much to the delight of whale watchers and other nature enthusiasts. "Breaching," "lob tailing" and "spy hopping" are common behaviors for these surprisingly agile creatures. Breaching occurs when the whale leaps completely out of the water and then crashes down with the full enormity of its weight. The same is true of spy hopping, though this maneuver only consists of a half-leap out of the water.

Humpbacks have a unique dark-and-light pattern on their tail flukes, which serves much like its fingerprint. This pattern makes them easily identifiable in the wild due to their common behavior of lob tailing, or lifting their tail flukes straight out of the water. Photo identification of the tail flukes is conducted on a regular basis by researchers. These photos are then cataloged so that individual whales can be monitored in their natural habitat throughout their lives.

Other large whales that can be spotted offshore include the 80-foot fin whale, the second-largest of the whale species, weighing in at 150,000 pounds. Sei and minke whales also join their

larger cousins, searching for their preferred prey of small fish, krill and plankton, which they filter out of the sea with their bowl-like mouths, squeezing the ocean water through hundreds of baleen, or bone-like plates that hang suspended from their upper jaw. Their prey then becomes trapped in the bristles located on the inside edge of their baleen.

Our rarest whale species is the severely endangered northern right whale, which reaches lengths of 60 feet and weighs 60 tons. With only 350 individuals left in the world, it is especially thrilling to see them alive and swimming along our coast. These whales are often sighted near Indian River Inlet and the Delaware Bay. **Once believed to be a primary feeding ground for mothers and calves, the Delaware Bay is still a favorite stop for these plankton feeders.** Maternal loyalty to feeding sites causes the mothers to return to the Bay to teach their calves how to feed where they themselves once learned the art of filtering food from the plankton-rich waters.

Numerous species of smaller-toothed whales (odontocetes) also appear along our coast at different times of year. These include the diminutive seven-foot pygmy sperm whale, pilot whale, and numerous species of dolphins. The sperm whale, largest of the toothed whales at 45 feet, is rarely seen in Delaware waters, but has stranded in nearby Assateague, Maryland. Rare beaked whales are included in this group, such as the Blainsville's beaked whale, True's beaked whale, and northern bottlenose whales.

In July of 2006, the Delaware Estuary experienced the unlikely stranding of a mother-and-calf pair of northern bottlenose whales. These whales reside in the North Atlantic and were therefore a long way from home when they appeared in Delaware. Initially stranding alive, the pair was first sighted on the New Jersey side of the Delaware Bay. The calf was sighted alive at Delaware's Prime Hook Beach the following day, and the mother was subsequently found dead, floating off Cape Henlopen, Delaware. The necropsy revealed that the mother whale had died as a result of ingesting a plastic aerosol-can lid, which was lodged in the sphincter between her stomach and intestines, ultimately causing starvation and death.

This open-ocean species is rarely seen by humans since they spend much of their time in the deep canyons and submarine trenches of the North Atlantic. As a result, very little is known about this elusive animal. She has since become part of the archives of the Smithsonian Institution, where previously no specimen of her kind had ever existed. By way of her tragic death, she provided us with the gift of knowledge regarding her species. She has also become an ambassador for the campaign against marine debris and the vast harm that it causes to animals and

humans alike.

The whales of the Delaware coast, along with other species of marine mammals, are considered endangered or threatened species, and as such they are protected by federal law; namely, the Marine Mammal Protection Act and the Endangered Species Act. When one of these animals becomes ill, injured or dies, this often results in a stranding situation for the animal. It is the role of the Marine Education, Research and Rehabilitation Institute (MERR) to provide rescue and stranding response for any species of marine mammal or sea turtle when it strands in Delaware. Our facility, located in Lewes, Delaware, provides short-term care, stabilization, and assessment for these endangered and threatened marine species. In addition, we contribute to research and provide education and outreach on the subject of marine mammals, sea turtles, and their habitats.



As this 17th Century watercolor shows, Dutch colonists in Delaware viewed the potential harvest of whale oil as a huge economic bonanza, and they were willing to risk their lives in attempt to cash in.

Marine animals strand due to many causes, including boat strikes, fisheries interactions, entanglements, ingestion of plastics and other marine debris, toxins in the marine environment, oil spills, and natural causes. The MERR stranding team provides care for these animals and tries to determine the cause of the stranding. Stranded marine animals serve as important indicator species regarding ocean health, and they teach us most of what we know about these endangered marine species. We at the MERR hope to continue to assist with the conservation and protection of these magnificent creatures through our education and rescue efforts so that they continue to grace our seas for generations to come.

Please report marine mammal and sea turtle sightings and strandings by calling the MERR's 24-hour stranding hotline at (302) 228-5029, or visit the MERR website at www.MERRInstitute.org. ■

SHARKS of the Delaware Bay

By Jack Carr, Science Education Manager, New Jersey Academy for Aquatic Sciences

You're scared of them! Admit it! Do you ever wonder if there are any of them out there right before you jump into the waves on a lovely summer day? No matter what you've heard about how much more sharks have to fear from man than man has to fear from sharks, somehow your mind tells you that you should be a bit scared. It's not your fault! It happens to everyone.

There is no surprise that we have a healthy fear of sharks. They made terrific monsters in *Jaws* and countless other movies. Even Dora the Explorer had to avoid a school of sharks in order to get to her treasure. However, if you can look past their toothy grins, you will find an animal that is vitally important to the ecological health of the oceans and bays and has never lived up to its fierce reputation.

According to the International Shark Attack File, in the last 337 years, only 20 people have been attacked by a shark in New Jersey and Delaware. Compared to the 81 people killed by lightning in only the last 50 years in those same states, there is far more reason to be terrified of thunderstorms.

There are over 20 species of shark that wander along the Delaware and New Jersey coasts. Some, like smooth dogfish, are abundant summer residents while others, like the once common dusky shark, are increasingly rare. But what about the Delaware Bay? Sharks call the Bay home as well. In fact, it's not uncommon to find all but the truly pelagic (far off shore) species swimming in the Delaware Bay.

The Delaware Bay is quite an important habitat for many sharks. The sandbar shark, also known as the brown shark, is a large coastal species that can be found worldwide in temperate and tropical



Above: Dusky sharks used to be extremely common in the mid-Atlantic region, but now only 1% remain due to overharvesting, mostly off the coast of Asia.

Left: Sandbar sharks are the most common species of shark in Delaware Bay. However, their abundance has dropped 87%, which unfortunately is not bad in comparison to other hard-hit species.

seas. It is the most common large shark in our area and can grow to 10 feet in length. But the Delaware Bay is even more important for smaller sandbar sharks.

Sandbar sharks are a highly migratory species that routinely travels thousands of miles every year from wintering grounds in the tropics to more northerly waters as the temperatures warm. Adult male and female sandbar sharks naturally segregate themselves. Adult males tend to stay in the deeper waters off the coast where they continue to hunt for prey, while pregnant females are drawn to the pupping grounds of the shallower, brackish Delaware Bay. Shark mothers typically fast during pupping season so that they are less likely to eat their own offspring.

From the moment they are born, shark pups are completely on their own. **The Delaware Bay takes over their care, providing young sharks with an abundance of food and warm shallows where they can hide from predators.** When the warmth of summer wanes, the ever-growing pups are large enough to travel south. However, studies indicate that juvenile sharks return to the Bay's nursery areas for many years after their birth.

Sand tiger sharks are another common Delaware Bay species. A slow moving, ragged-toothed animal, sand tigers move into the Bay during the spring and summer. Sand tigers are well known for their unusual embryological development. The largest sand tiger pup eats all of its

siblings – while it's still inside its mother! This is known as intrauterine cannibalism. Because the female sand tiger has two sections of her uterus (called "horns"), she gives birth to only two offspring at a time. Sand tiger pups have a big advantage in that they are rather large at birth, which gives them a nice head start in life. The drawback is that most sharks already have a rather slow reproductive rate, and sand tiger sharks take this to an extreme.

Other smaller shark species also rely on the protective nature of the Bay. Smooth dogfish sharks enter the Bay during the summer, and spiny dogfish sharks enter the Bay in the winter. These two shark species rarely exceed four feet in length. Atlantic angel sharks, which look more like sting-rays, leave the deep water of the ocean and can be found near the mouth of the Delaware Bay.

Although in any given season there may seem to be a lot of sharks, they are mostly juveniles cruising in the Bay, and there aren't nearly as many as there used to be. Some may say that is a good thing; however, the drastic population decline has placed many species of great sharks on the brink of extinction.

Recent studies show that North Atlantic shark populations are in sharp decline. The species exhibiting the smallest rate of decline is the Delaware Bay's beloved sandbar shark, with an 87-percent decrease in population over the last 50

continued on page 8

Atlantic Sturgeon

A Signature Species too Long Forgotten

By Lisa M. Calvo, Executive Director, Seaboard Fisheries Institute,
and Watershed Coordinator, Jacques Cousteau National Estuarine Research Reserve

Caviar may stir images of culinary delight, wealth, and Russian landscapes, but rarely does it bring to mind images of the Delaware River and Estuary. It may come as a surprise to learn that the Delaware River and Estuary supported an important sturgeon fishery and a world-renowned caviar trade.

Caviar is salted and processed fish eggs. Some of the most coveted caviar is produced from the roe of sturgeon, a primitive group of fish that have inhabited the earth for more than 100 million years.

Sturgeon species are distributed worldwide in cold to temperate climates. In total there are 26 species, eight of which occur in North America. Two species are native to the Delaware River: Atlantic sturgeon, or *Acipenser oxyrinchus oxyrinchus*, and shortnose sturgeon, or *Acipenser brevirostrum*.

Historically, the Atlantic sturgeon was an important food source for Native Americans and early settlers. A significant commercial fishery developed in the late 1800s as the fish was highly sought after for its roe to produce caviar. At the peak of the sturgeon fishery in the United States, annual harvests approached 7 million pounds. Much like the "gold rush" there was an American "caviar craze." Harvests dramatically declined in the early 1900s and remained at less than 5% of the record catch through the 1990s. Though the prime of the fishery was short lived, lasting just more than 30 years, it was long enough to present this prehistoric species with new threats to its survival.



Armored but not Protected

Atlantic sturgeon have external bony plates called "scutes," resembling the armor of an ancient warrior. It is an anadromous fish, meaning it spends much of its adult life in salt water, but it spawns in freshwater habitats. Adults travel extensively, wandering among coastal and estuarine habitats, while juvenile Atlantic sturgeon are more limited in movement, spending several years in the rivers and estuaries where they were born before emigrating to coastal waters.

Atlantic sturgeon spawn in the spring, possibly sharing habitat with shortnose sturgeon. They are thought to utilize coarse sand or cobble bottom located in moderate flow conditions, but particular landmarks related to spawning are not well known. Spawning and egg nursery conditions are sensitive to alterations in flow, sedimentation, salinity, and dissolved oxygen, all of which can be impacted by dredging, channelization, and riverbank armoring or erosion.

Atlantic sturgeon can live long, up to 60 years, and become quite large, with record

lengths and weights measuring up to 15 feet and 800 pounds, respectively. They mature at 10 to 12 years in the mid-Atlantic, and unlike other anadromous fishes such as striped bass, which can spawn every year, sturgeon spawn only once every two to seven years.

The unique life history of the Atlantic sturgeon has made it particularly vulnerable to human impacts. Population declines due to overharvesting in the early 1900s have been made worse by environmental alterations associated with saltwater intrusion, pollution, and increased sedimentation, which have impacted critical spawning and nursery habitats and prevented the sturgeon's recovery. Ship strikes and incidental catches associated with other fisheries also pose significant threats.

The Atlantic sturgeon is listed as a species of concern and is undergoing review for federal classification as an endangered or threatened species. This action follows the 1967 federal listing of the shortnose sturgeon

continued on page 8

Credit: Reprinted with permission from the American Littoral Society's "Saving Our Sturgeon" booklet

Atlantic Sturgeon continued from page 7

geon as an endangered species.

The Atlantic States Marine Fisheries Commission's "Interstate Fisheries Management Plan for Atlantic Sturgeon" established a moratorium in 1998 on harvests and calls for at least 20 year-classes of females to be present in any river stock before allowing fishing of the stock. The plan also emphasizes the need for research to evaluate Atlantic sturgeon stock abundances and other important aspects relating to their ecology and restoration.

Attention Renewed

Our ability to restore Atlantic sturgeon and their habitats is limited by our lack of understanding about critical aspects of their population dynamics and our ability to define their essential habitats. In recent years researchers, resource managers, and nonprofit organizations have stepped up their attention to this important species of our coastal waters.

This winter, a new nonprofit organization, the Seaboard Fisheries Institute, dedicated to the protection and conservation of Atlantic sturgeon and other anadromous species of the Delaware Estuary, hosted its first Symposium on Atlantic Sturgeon. The symposium focused on the challenges and opportunities for enhancing our understanding of the Atlantic sturgeon's population

dynamics and ecology with an appreciation that such understanding is critical for developing restoration strategies for the species.

The Symposium drew some 90 scientists, resource managers, industry representatives, nonprofits, and government officials from the Delaware Estuary region and U.S. eastern seaboard, fostering a coast-wide perspective and approach. The level of interest among the Symposium's attendees highlights that the time is right to move forward in building a constituency and knowledge base to support the recovery of this significant species.

Fisheries Biologists, Hal Brundage and John O'Herron, working with the Seaboard Fisheries Institute, are initiating an Atlantic sturgeon tagging effort. This duo, along with several other researchers, are employing acoustic telemetry to investigate important ecological aspects of the Atlantic and shortnose sturgeon in the Delaware Estuary and River. The activity and movement of tagged



An adult shortnose sturgeon is tagged for tracking purposes by Fisheries Biologists, John O'Herron (left) of Amitrone O'Herron, Inc., and Hal Brundage (right) of Environmental Research and Consulting, Inc., while doing research in the Delaware River near Trenton, New Jersey, last June.

Credit: Seaboard Fisheries Institute

sturgeon will be tracked to determine residence and return rates, spawning-site fidelity, and juvenile habitat definition. Such research efforts represent the first phase in the overall development of strategies intended to support the recovery of the species. If successful, we may once again have a future where world-class caviar is associated with the Delaware Estuary and River.

For more insight into the plight of anadromous fishes in the Delaware Estuary, including the Atlantic sturgeon, please visit the Seaboard Fisheries Institute online at www.SeaboardFisheries.org. ■

Sharks of the Delaware Bay continued from page 6

years. Unbelievably, the rates are far worse for others, such as smooth hammerheads, bull and tiger sharks, and the once very common dusky shark. Those species have suffered a 99-percent depletion in their populations.

At these levels, sharks can no longer function as top predators, keeping smaller predator populations in check. Cownose rays, common prey for many sharks, are having a population boom. Unfortunately, their increased numbers are placing scallops and other commercially and ecologically important invertebrate populations at risk.

The cause for this drastic decline is increased fishing pressures to supply Asian

markets with shark fins, the main ingredient in shark fin soup. Finning, the practice of removing a shark's fins, often while it is still alive, and then disposing of the body, is illegal in U.S. waters. Sharks are also caught and killed as bycatch from other fisheries.

The slow maturation and reproductive strategy of sharks makes their population recovery a very slow process, even under ideal conditions. In general, shark populations cannot sustain commercial catch rates of prior years.

The good news is that protective legislation and public outcry have already initiated measures to try to help recover falling

shark populations. However, refraining from purchasing shark products in grocery stores and restaurants may be the only way to give shark populations the time they need to recover.

You may subconsciously – or consciously! – be afraid of sharks, but try to imagine an ocean where sharks are extinct. How successful would "Jaws" have been if Amity Island was terrorized by a striped bass instead of a shark? Sharks are vital to maintaining a healthy ecosystem, and the many species of sharks off the coast of New Jersey and Delaware lend diversity and majesty to our beloved waters. ■

Rain Gardens for the Bays Campaign: Landscaping for Cleaner Water

By *Laura Whalen, Restoration Specialist, Partnership for the Delaware Estuary*

In recent months with the troubled economy, it seems like everyone is trying to think “green” and figure out ways to save or reuse resources that were once thrown away. Rain water, or stormwater, is one of those resources that is often thrown away by sending it down storm drains as quickly as possible without utilizing its benefits. Rain gardens are a good way everyone can save some of that stormwater instead of throwing it away, and rain gardens offer an additional benefit by also helping to clean stormwater before it enters our groundwater and waterways.

Stormwater runoff and flooding are top concerns in the Delaware Estuary because of the damage that can occur when large volumes of rainwater rush off rooftops, driveways, streets, and other impervious surfaces, through storm-drain pipes, and directly into our streams, rivers, and bays, causing severe erosion and destroying habitat. This stormwater also carries many pollutants into streams, which are picked up from impervious surfaces. Rain gardens provide an easy, low-cost way to manage some of these issues in our own backyards while also improving water quality in the Delaware Estuary.

What is a rain garden and how can it help our bays?

According to the Low Impact Development Center, a leading organization in land planning and water quality research, a rain garden is “a garden which takes advantage of rainfall and stormwater runoff in its design and plant selection.” Usually it is a small garden which is designed to withstand the extremes of moisture and concentrations of nutrients, particularly the nitrogen and phosphorus that are found in polluted runoff.

Rain gardens are ideally located close to the source of runoff, such as a downspout or connected to a rain barrel, and serve to slow the stormwater as it travels downhill. This gives the stormwater more time to infiltrate



A newly completed rain garden in Magnolia, Delaware, sits ready to absorb and filter rainwater before it can wash into nearby storm drains and the surrounding St. Jones River Watershed.

and less opportunity to gain momentum and erosive power. The Low Impact Development Center is a great resource for learning more about rain gardens, including various designs, what plants to use, and the best location in your yard. Check out their website for more information at www.LowImpactDevelopment.org/RainGarden_Design. The Low Impact Development Center will also be hosting a new website for the Rain Gardens for the Bays Campaign.

The U.S. Environmental Protection Agency’s (EPA) Region 3 office is promoting the Rain Gardens for the Bays Campaign through its three National Estuary Programs in the region: the Center for Inland Bays, the Maryland Coastal Bays Program, and the Partnership for the Delaware Estuary. The idea came from the 10,000 Rain Gardens Campaign in Kansas City, which was an initiative to establish the Kansas City area as a leader in water quality protection. The Rain Gardens for the Bays Campaign has goals similar to the Kansas City campaign: to educate the public about rain gardens and other stormwater solutions, and to improve water quality in the Delaware Estuary, Delaware Inland Bays, and Maryland Coastal Bays.

Other partners involved in the Rain Gardens for the Bays Campaign include the:

- Delaware Nature Society
- Delaware Department of Natural Resources and Environmental Control’s Watershed Assessment Division
- Sussex County Conservation District
- University of Delaware Cooperative Extension
- University of Delaware Sea Grant Program

In May, the Center for the Inland Bays launched their part of the campaign, called “1,000 Rain Gardens for the Inland Bays,” with several workshops on rain gardens and native plants. The Partnership for the Delaware Estuary’s campaign will also kick off this year with a rain garden installation at a high school in the Estuary. The remainder of the campaign is currently being finalized with the EPA and other partners, so please stay tuned for more details.

For information about the Rain Gardens for the Bays Campaign, or to become a partner, please contact Laura Whalen at (800) 445-4935, extension 107, or LWhalen@DelawareEstuary.org. ■

Measuring the Use Value of Migratory Shorebirds in the Delaware Estuary

By Kelley Appleman, Doctoral Candidate, University of Delaware

Each spring hundreds of thousands of migratory shorebirds visit the Delaware Bay on their journey from South America to Canada's Hudson Bay. Red knots, sanderlings, ruddy turnstones, semi-palmated sandpipers, and other shorebirds stop to feed on horseshoe crab eggs in the shallow waters of the Bay and its tributaries.

The Delaware Estuary provides ideal habitat for both horseshoe crab spawning and for shorebird foraging, making it a site of global importance in the survival of these species. The unique combination of migratory shorebirds and spawning horseshoe crabs on the Delaware Bay is unseen anywhere else in the world, and the allure of observing a natural spectacle draws thousands of wildlife enthusiasts and recreational birdwatchers to the Bay area each year.

In the past decade, bird watching and wildlife observing in general has become one of the fastest growing outdoor recreational activities in the United States. According to the U.S.

Fish and Wildlife Service's "2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation," nearly 21 million

U.S. residents aged 16 years or older traveled a mile or more from their homes to observe wild birds. In the same year, 95,000 people (residents and nonresidents combined) traveled away from their homes to observe wild birds in the State of Delaware.

The Economics of Wildlife

Traditionally, economists rely on the market interaction between the price and quantity demanded of a good or service to provide an estimate of economic value. However, in the case of a public good, like national defense, hiking in the wilderness, or observing wildlife, ordinary markets where a good or service can be bought or sold do not exist, so assigning a dollar value poses more of a challenge to researchers.

In general, recreational uses of the environment can take many forms, and have measurable economic benefits or losses that accrue to those who engage in them. Both private and public, or government actions can affect the quality of these activities at a recreational site or sites, and these can ultimately influence the behavior of individuals.

In order to measure the welfare effects of public actions, economists use data collected from users of a particular recreational activity to estimate economic models that transform these values into monetary equivalents. This is often very useful in benefit-cost analyses, where these values play an important role in making policy decisions.

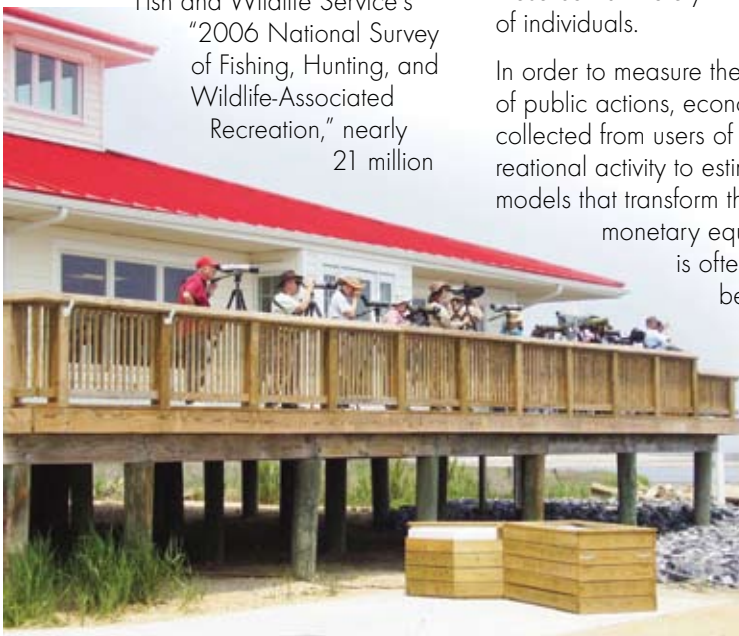
Application to Shorebirds of the Delaware Estuary

The goal of our study was to estimate the value of a recreational trip to view shorebirds on the Delaware Bay during the annual spring migration. Using an on-site intercept survey of 370 recreational bird watchers from May 1 to June 15, 2008, we collected data at three popular birding sites and estimated the maximum amount a household was willing to pay for both a single-day and an overnight trip. Our economic model uses survey responses to a hypothetical scenario in which respondents were asked to state the maximum amount they would be willing to pay before giving up their most recent trip.

The results of our model indicate that mean willingness to pay is \$134/trip/household for a day trip and \$561/trip/household for an overnight trip. In order to aggregate the sampled values to the total population of users, we estimated the number of household trips to two of the birding sites during the migration. Based on our estimate of 3,363 household trips, the present value of the benefits of recreational birding at those two sites during the annual migration is \$15 million. The results of this study will be useful when making important resource-allocation decisions that balance the competing uses of our coastal environment.

EDITOR'S NOTE: Kelley Appleman won the Outstanding Student Talk Award at the Delaware Estuary Science and Environmental Summit in January. In recognition of her accomplishment, the Partnership for the Delaware Estuary is pleased to share her research in Estuary News. ■

Bird watchers look on with interest as shorebirds feed on horseshoe crab eggs during the spring 2008 migration season at the DuPont Nature Center outside Milford, Delaware.



Credit: George Parsons, University of Delaware

Workshop Back by Popular Demand

By Cheryl Jackson, Program Specialist, Partnership for the Delaware Estuary



"Watershed Ed was the most informative, useful, and fun teacher-education training I think I will ever go to!" – Pam from Mt. Penn, Pennsylvania

"We were given a wealth of materials, which I look forward to using in my classroom." – Cindy from Hockessin, Delaware

"This was one of the best workshops I have ever taken. [The] organization, content, and scope were excellent." – Kathy from Moorestown, New Jersey

In July of 2008, 18 teachers from New Jersey, Pennsylvania and Delaware participated in the annual Delaware Estuary Watershed Workshop for Teachers. Beautiful weather, guest speakers, field trips, in-stream testing, and local examples of water-pollution reducing best management practices were just a few of the things that inspired positive feedback from several of our participants. We hope to make this year's Teachers' Workshop as much of a success!

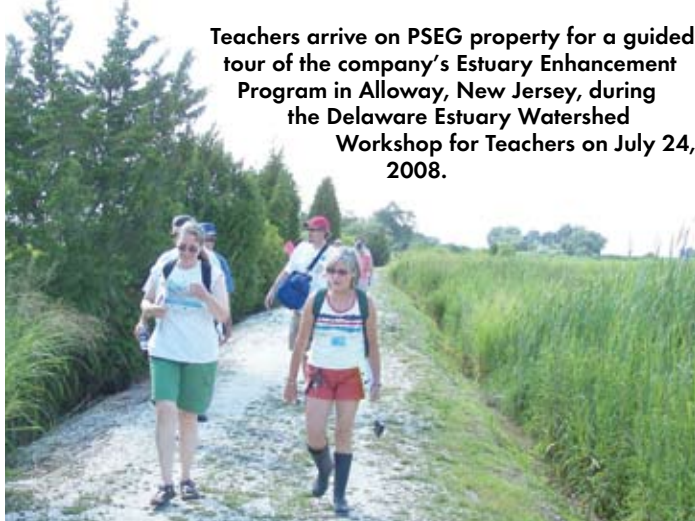
The 13th annual Delaware Estuary Watershed Workshop for Teachers will take place from July 20-24, 2009. An optional Watersheds 101 class will take place the previous week, on July 16. Please visit www.DelawareEstuary.org for workshop and registration information.

Previous workshops have included lunch, guest speakers, field trips, free classroom and educational materials, an overnight stay in Lewes, Delaware, and much more. The Partnership for the Delaware Estuary is able to offer the Teachers' Workshop at a low cost to participants thanks to sponsorships like that of PSEG for 2009. For more information about the Teachers' Workshop, please contact Lisa Wool at (800) 445-4935, extension 105, or LWool@DelawareEstuary.org.

Agenda*

Approximately two days will be spent at Tyler State Park, one touring local examples of best management practices (BMPs) in Bucks County, Pennsylvania, and the last two days travelling to the mouth of the Delaware Bay, with an overnight stay on Thursday night in Lewes, Delaware. Each day's activities begin at 8 a.m. and adjourn at 3 p.m., with lunch provided. Dinner, transportation, and lodging are also included for Thursday evening.

Teachers arrive on PSEG property for a guided tour of the company's Estuary Enhancement Program in Alloway, New Jersey, during the Delaware Estuary Watershed Workshop for Teachers on July 24, 2008.



Monday: Introduction

Location: Tyler State Park

- Introduction / Orientation
- Presentation: Delaware River Basin Commission
- Activity: Watershed delineation
- Activity: Canoeing the Neshaminy
- Activity: Stream walk and mapping
- Activity: Biological and chemical analyses of a stream

Tuesday: Upper Portion of Watershed

Location: Tyler State Park

- Overview of the day
- Introduction to stormwater and best management practices (BMPs)
- Presentation: Climate change
- Activity: "Sum of the Parts"
- Activity: Macro classroom
- Presentation: BMPs for real people

Wednesday: Middle Section of Watershed

Location: Tyler State Park

- Overview of the day
- Tour of BMPs, which may include:
 - Porous pavement
 - Green roof
 - Active construction site
 - Agricultural BMPs
 - Riparian buffer planting site

Thursday: Lower Section of Watershed

Location: Travel From Tyler State Park to Philadelphia, New Jersey, and Lewes, Delaware

- Tour: Fairmount Water Works Interpretive Center
- Travel to, and tour of, Southwest Water Pollution Control Plant
- Travel to, and introduction to, PSEG's Estuary Enhancement Program, Alloway, NJ
- Activity: Hands-on wetlands (bring boots if you can)
- Travel to Lewes, Delaware, aboard bus, review of assignments, and brainstorming session
- Dinner on your own in Rehoboth

Friday: Estuary Section of Watershed

Location: Various Locations in Southern Delaware

- Breakfast
- Overview of the day and travel
- Tour: *MY Del River* oil-spill response boat
- Presentation: Horseshoe crabs: Ecological Research and Development Group
- Tour: University of Delaware Native Plant Garden
- Activity: Seining in the Delaware Bay
- Travel back to Tyler State Park, follow-up meeting and evaluation
- Approximate ETA back at Tyler State Park 5:30 p.m. (dependent on traffic conditions) ■

*Agenda subject to change

Backyard Stewardship™

Coastal Communities Define Their Shared Habitat as a Horseshoe Crab Sanctuary

By Glenn Gawry, President, Ecological Research & Development Group

The future survival of the world's four horseshoe crab species will ultimately depend on the preservation of spawning habitat; a challenging prospect in light of the ever-increasing human density along the same beaches horseshoe crabs rely on for propagation (breeding). With few exceptions, they do not spawn within protected habitats. They come ashore where humans live, play, and work. Sometimes they are accepted; often they are exploited or even reviled.

The Delaware Bay encompasses the world's largest horseshoe crab spawning habitat. However, the vast majority of this habitat runs along the shorelines of coastal communities. If we are to be successful in protecting the horseshoe crab species, it is essential to inform and engage these bayshore communities as conservation partners, because they are the ultimate stewards of the habitat these animals depend on for survival.

From its inception in 1995, the Ecological Research & Development Group (ERDG), a nonprofit organization whose primary mission is the conservation of the world's four horseshoe crab species, has recognized the importance of building an engaged community to achieve wildlife conservation. Backyard Stewardship, the ERDG's community-based sanctuary program started in 1999, was designed to encourage coastal communities around the world to declare their shared habitat a horseshoe crab sanctuary and promote



There is no need to guess where loyalties lie upon arriving in Slaughter Beach, Delaware. This Delaware Bayshore community has dedicated itself to the conservation of horseshoe crabs since declaring itself a sanctuary nearly one decade ago.



Horseshoe crabs spawn without interference inside a sanctuary established by the community of Prime Hook Beach, Delaware, thanks to assistance given by the ERDG and its Backyard Stewardship Program.

awareness of the species to visitors and neighboring communities.

Whether or not there is a moratorium on the harvesting of horseshoe crabs or regulations restricting beach access, it has little to do with what lies at the core of conservation, i.e., compassion for other living beings. Thus, the purpose of the sanctuary is to change the relationship communities have with their natural resources, which will far outlive the regulatory process.

This is not a state or federal program, nor is there any form of binding resolution between participating communities and the ERDG. It is simply a declaration of the community's desire to watch over this remarkable animal and their shared habitat. The interpretive signs that are posted on each of the sanctuary beaches serve to inform residents and visitors alike about the life cycle of the horseshoe crab and the community's desire to protect them.

In 2000, Broadkill Beach, a small Delaware Bay community in Sussex County, became Delaware's first community horseshoe crab sanctuary. Since then, the ERDG has established five additional Delaware Bay sanctuaries in the communities of Prime Hook Beach, Fowler Beach, and Slaughter Beach in Sussex



Credit: Ecological Research & Development Group

An interpretive sign welcomes visitors to the bayshore of Slaughter Beach, Delaware, where the community has established a horseshoe crab sanctuary thanks to the assistance of the Ecological Resource & Development Group.

mariner, its survival represents a story of remarkable evolutionary success that, unlike ourselves, has managed to harmonize with the environment it depends on for survival for over 445 million years. And, by its survival, it contributes significantly to the balance of nature. However, we must be mindful, for when we

“Never doubt that a small group of thoughtful, committed citizens can change the world. Indeed, it is the only thing that ever has.”

—MARGARET MEAD

County, as well as Kitts Hummock and Pickering Beach in Kent County, protecting over 14 miles of the world's most productive horseshoe crab spawning habitat. This spring, Camp Arrowhead, located on Indian River Bay, near Millsboro in Sussex County, will become Delaware's seventh sanctuary. The small Delaware Bay community of Fortiscue, the self-proclaimed “Weakfish Capital of the World” in Cumberland County, will become New Jersey's first.

For those communities who have come to admire this ancient

devalue a life to nothing more than a food resource for another species, or a commodity, it becomes much more difficult to engage a broader global community around its conservation.

Ultimately, the ERDG plans to expand this program to coastal communities throughout the world, wherever horseshoe crabs spawn. For more information about the ERDG and to watch a video about its Backyard Stewardship™ Program, please visit www.HorseshoeCrab.org. ■

ESTUARY EXCURSIONS

New Eco-attractions Opening in the Delaware Estuary

By Shaun Bailey, Marketing and Communications Coordinator, Partnership for the Delaware Estuary

For whatever reason, many people cannot afford a vacation this year, but not to worry. There are thousands of attractions right here in the Delaware River Watershed, especially for nature lovers and children who are curious about their surrounding environment. Here are three brand-new, or newly expanded destinations worthy of a day trip with family and friends.

Schuylkill River Trail

A recreational pathway traveling 130 miles along southeastern Pennsylvania's Schuylkill River, from the Delaware River in Philadelphia all the way west to Pottsville, Pennsylvania, is now over one-third complete. Planners celebrated their progress while cultivating new supporters during a Trail Towns Conference convened on March 19 by the Schuylkill River Heritage Area in Pottstown.



Credit: R. Kennedy for the GPT/MC

Most Philadelphians are familiar with the Kelley Drive portion of the Schuylkill River Trail. In time, this will extend all the way east to Fort Mifflin, on the Delaware Riverfront, and as far west as Pottsville, Pennsylvania.

in Schuylkill County. The latter section even intersects with the Appalachian National Scenic Trail, which stretches from Georgia to Maine, and has long been popular among hikers and backpackers.

Visit www.SchuylkillRiver.org to see how you can access this unique recreational resource, or call (484) 945-0200 to participate in the trail's ongoing expansion or maintenance.

Featured on ecoDelaware.com: Delaware Children's Museum

Once it opens in September, experts estimate the Delaware Children's Museum will annually expose upwards of 135,000 visitors, most of them children, to a range of issues affecting the Delaware Estuary. This 15,000-square-foot family attraction is being constructed at a price tag of \$11 million inside a renovated building located at

Credit: Lee H. Skolnick Architecture & Design Partnership for the Delaware Children's Museum



This artistic rendering of the Delaware Children's Museum's planned EConnect exhibit depicts a wide variety of concepts the Partnership for the Delaware Estuary has championed for years, like ecotourism, green roofs, and habitat conservation.

the riverfront Shipyard Shops in downtown Wilmington, Delaware.

According to the museum's website, its EConnect exhibit will allow children to "roll up their sleeves and discover the workings of nature for themselves, with activities such as a highly interactive stream table that allows kids to understand everything from water locks to wind power." Other exhibits sporting environmental themes will include the "Funky Forest," an outdoor, science-themed playground, and the museum's three-story centerpiece called "The StratoSphere."

Admission to the Delaware Children's Museum will range between \$8 and \$10. Discounted group passes and

annual family memberships will both be available for purchase. Please visit www.DelawareChildrensMuseum.com for further details, or call (302) 654-2340.

Featured on ecoDelaware.com: DuPont Environmental Education Center

The DuPont Environmental Education Center is scheduled to open on September 19 at the western end of Wilmington, Delaware's downtown Riverwalk, conveniently located off Exit 6 on Interstate 95. This four-story, 14,000-square-foot facility is being constructed along the tidal Christina River inside the 212-acre Russell W. Peterson Urban Wildlife Refuge. A raised footbridge is also being constructed to prevent foot traffic from damaging the fragile ecosystem nearby.

This urban nature center will be staffed by employees of the Delaware Nature Society. Attractions will include year-round exhibits and activities focused on a wide variety of urban environmental issues. Amenities will include a boardwalk, catering area, multi-purpose room, classrooms, and viewing decks within sight of an ecologically sensitive marsh that began being restored in 1998.

For more insight into the progress of this new nature center, please visit www.DelawareNatureSociety.org, or call Manager, John Harrod, at (302) 239-2334. ■



Construction continues at the DuPont Environmental Education Center, now taking shape at the western end of Wilmington, Delaware's downtown Riverwalk. Note the billboard's illustrations depicting how the structure will appear on September 19, when it officially opens to the public.

ESTUARY EVENTS

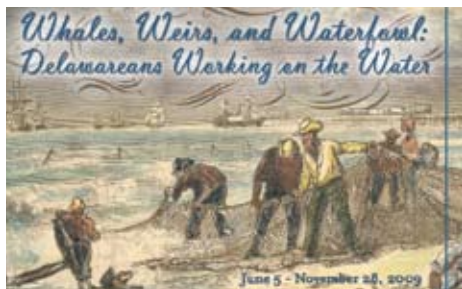
Featured on ecoDelaware.com:

Whales, Weirs, and Waterfowl

June 5 to November 28

Wilmington, DE

People have been making their living off the Delaware Bay since 1632, when Dutch Explorer, David de Vries, established a new whaling village and trading post in Swanendael, meaning "Valley of the Swans," near modern-day Lewes, Delaware. Explore these stories and others during a limited-time exhibition at the Delaware History Museum, where anglers, crabbers, tongers and more will be profiled. Learn more by logging on to www.HSD.org.



Save the Date

Experience the Estuary Celebration

October 8, from 5:30 to 8:30 p.m.

Camden, NJ

Dine beside sharks and other marine animals during the Partnership for the Delaware Estuary's annual fundraiser, the Experience the Estuary Celebration, on October 8 inside the Adventure Aquarium, where this year's theme will be "Dive Into the Delaware." Attendees will have an opportunity to bid on both silent and live auction items while enjoying dinner and drinks, live music, and the chance to network with hundreds of other supporters. Every dollar raised will be used to help protect and enhance the tidal Delaware River Watershed. Call Elizabeth Horsey at (800) 445-4935, extension 101, for details or to find out how you can help support this event. ■

Coast Day Corner

The Delaware Estuary is unique because it spans three different states: Delaware, New Jersey, and Pennsylvania. Each state's coastline has its own distinct culture, habitats, and wildlife. It's no wonder then that each state has its own Coast Day celebration. Visit one of the free festivals below for a guaranteed good time. Each one offers children's activities, tours, and marine-themed exhibits portraying all things Delaware Bay.

Southeastern Pennsylvania Coast Day

September 20, from 11 a.m. to 4 p.m.

Philadelphia, PA

If you haven't attended Southeastern Pennsylvania Coast Day in a few years, you won't believe your eyes to see it now. This festival has grown in size every year since relocating in 2007 to Penn's Landing, just outside the Independence Seaport Museum. Visit www.DelawareEstuary.org/News_CoastDay.asp for details as they become available.

Featured on ecoDelaware.com:

Delaware Coast Day

October 4

Lewes, DE

To see the grand daddy of all maritime festivals, plot a course for Delaware Coast Day in Lewes on the first Sunday of October. Among dozens of attractions is a popular Crab Cake Cook-off, but you better refine your recipe fast. The deadline to enter is August 7. Log on to www.Ocean.UDel.edu/CoastDay for more insight.

Coast Day NJ

October 11, from 11 a.m. to 4 p.m.

Cape May, NJ

Visitors to Coast Day NJ will have the option of browsing among exhibits stationed around Cape May's beautiful harbor, or engaging in a guided tour led by naturalists from the Nature Center of Cape May. Check out www.NJMSC.org/CoastDay.html for more info, including details surrounding the Coast Day NJ Photo Contest and a coupon for a free tour.



Partnership for the Delaware Estuary
One Riverwalk Plaza
110 South Poplar Street, Suite 202
Wilmington, DE 19801

ADDRESS SERVICE REQUESTED

US POSTAGE
Non-Profit Org
PAID
Wilmington, DE
Permit #1885

Partnership for the Delaware Estuary, One Riverwalk Plaza, 110 South Poplar Street, Suite 202, Wilmington, DE 19801

Partnership for the Delaware Estuary: a National Estuary Program

The Partnership for the Delaware Estuary, Inc., is a private, non-profit organization established in 1996. The Partnership leads collaborative and creative efforts to protect and enhance the Delaware Estuary and its tributaries for current and future generations. The Partnership is one of 28 National Estuary Programs. To find out how you can become one of our partners, call the Partnership at 1-800-445-4935 or visit our website at www.DelawareEstuary.org.

Estuary News encourages reprinting of its articles in other publications. *Estuary News* is produced tri-annually by the Partnership for the Delaware Estuary, Inc., under an assistance agreement (CE-993985-09-0) with the U.S. Environmental Protection Agency (EPA). The purpose of this newsletter is to provide an open, informative dialogue on issues related to the Partnership for the Delaware Estuary. The viewpoints expressed here do not necessarily represent the views of the Partnership or EPA, nor does mention of names, commercial products or causes constitute endorsement or recommendation for use. For information about the Partnership for the Delaware Estuary, call 1-800-445-4935.

Partnership for the Delaware Estuary, Inc.

Jennifer Adkins, Executive Director
Tel: (800) 445-4935 / Fax: (302) 655-4991
E-mail: jadkins@delawareestuary.org

Environmental Protection Agency

Irene Purdy, EPA Region II
Tel: (212) 637-3845 / Fax (212) 637-3889
E-mail: purdy.irene@epa.gov

Amie Howell, EPA, Region III
Tel: (215) 814-5722 / Fax: (215) 814-2301
E-mail: howell.amie@epa.gov

Pennsylvania

Andrew Zemba
Department of Environmental Protection
Tel: (717) 772-5633 / Fax: (717) 783-4690
E-mail: azemba@state.pa.us

Delaware

John Kennel
Department of Natural Resources and Environmental
Control
Tel: (302) 739-9255 ext. 109 / Fax: (302) 739-7864
E-mail: john.kennel@state.de.us

New Jersey

Kerry Kirk Pflugh
Department of Environmental Protection
Tel: (609) 663-7242 / Fax (609) 777-1282
E-mail: kerry.pflugh@dep.state.nj.us

Delaware River Basin Commission

Bob Tudor
Tel: (609) 883-9500 ext. 208 / Fax (609) 883-9522
E-mail: robert.tudor@drbc.state.nj.us

Philadelphia Water Department

Howard Neukrug
Tel: (215) 685-6319 / Fax: (215) 685-6207
E-mail: howard.neukrug@phila.gov

Editor

Shaun Bailey, Marketing and Communications
Coordinator, Partnership for the Delaware Estuary

Layout & Design

Janet Andrews, LookSmartCreative