estuary news
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Oysters: A Part of Our Heritage

By Joseph Matassino, Director of Development and Communications, Partnership for the Delaware Estuary

One of the many wonderful things about the Delaware Estuary is the manner in which our history, culture, and way of life have become so intertwined with the water and its living resources.

Estuaries are resources for recreation and tourism, and in some regions of the country, like ours, they are also industrial centers and transportation corridors. Yet, despite their different uses and public images, there is one similar over-riding theme for most estuarine communities. This theme is often tied to a species that provides an identity for that region. It's usually the species that brought the early settlers to that region or the species that current residents can see, touch, taste, and want to protect. Can anyone truly appreciate the culture of the Chesapeake Bay without envisioning the blue crab, or visit Key West and not be fascinated about the history and the current culinary sensation of conch?

In the Delaware Estuary there is a species that has defined our way of life for hundreds of years – the eastern oyster. The history of the region, our cultural experiences, and our methods of socialization have all been affected by the presence of the oyster.

Tourists learning about the oyster industry. (Photo by Bill Buchanan)

Oysters have been an important resource in the Delaware Estuary since the time of the earliest human inhabitants. The Lenni Lenape harvested oysters from the shallow waters of the Delaware Bay long before the early colonists. While not too much is known about the oyster industry during colonial times, we do know that the early American settlers relied upon oysters as an important food source. Those who settled along the Delaware Bay Shore, used more sophisticated fishing tools and had larger sailing vessels then the Lenape, enabling them to fish in deeper sections of the Delaware Bay. When the settlements grew into cities, there became an instant market for oysters.

There was also early interest in protecting the oyster. The colony of New Jersey passed legislation in 1719 to prohibit residents from harvesting oysters during the summer spawning season. As the region matured, both Delaware and New Jersey continued to pass laws throughout the 1800's to further protect this resource.

By the 1870's, scientists began researching and keeping records on the status of the oyster-growing regions. Although the results of these studies are varied, generally all were in agreement that the oyster was an extremely valuable product in the economies of Delaware, New Jersey and Pennsylvania. In addition, it was agreed that the supply of oysters could be much increased by better husbandry of the resource and greater reliance on cultivation rather than "wild harvest."

Avid readers of *Estuary News* know that over harvesting and disease spelled the collapse to the oyster industry in the Delaware Estuary, but not before these creatures made their mark on our society. There are certain towns along the Bay Shore that were completely dependent upon the oyster industry including Bivalve and Port Norris, New Jersey. Because of the oyster industry, at one point in the 19th Century, there were more millionaires in Port Norris than anywhere else in the world.

Schooners, like the *A. J. Meerwald*, took fishermen from these small towns out to the oyster beds during harvesting season. The oysters were then shipped to larger cities, including Wilmington, Delaware, and Philadelphia, Pennsylvania where some streets were lined with oyster bars, serving their patrons a creamy soup, with what else, but oyster crackers.

Today, towns like Bivalve still serve as a fishing port, though on a much smaller scale. Fishermen are no longer using the *A.J. Meerwald.* Instead, it has been restored and is used by

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environmental educators as a floating classroom to teach primarily young people (approximately 6,000 per year) about the region's maritime heritage. The oyster bars are no longer around either. They have long since shut their doors, but are remembered fondly as places of hospitality and camaraderie.

A number of efforts are underway to reestablish seedbeds in tributaries to the Delaware Bay. The Delaware Estuary Program is funding a project to reestablish oyster stocks in the Back Creek and Nantuxent Creeks in Cumberland County, New Jersey. With efforts such as this, and with general improvements in water quality, the oyster population in the Delaware Estuary seems to be improving. In fact, the State of Delaware is seeking approval from its legislators to change harvesting laws, to allow for the harvest of oysters in the Delaware Bay this fall, the first allowed since 1995. Oyster harvests in New Jersey were shut down in the early 1990's. New Jersey seed beds were reopened in 1995.

While there are, of course, a number of species with which the residents of the Delaware Estuary can relate, it is the oyster that has truly shaped our region's history.

For more information about the eastern oyster, please refer to the Species Specific article on page 8 of this issue.

updates from delep

Toxics Advisory Committee (TAC)

The PCB expert panel met on February 16, 2001 to continue discussions on design and development of the PCB model. The panel recommended that the to the Delaware River Basin Commission perform data analysis activities, including annual PCB budgets. This data will be presented back to the expert panel at a May meeting for their review.

A revised, expanded version of the overall Delaware Estuary PCB Strategy was presented to the TAC at the February 26, 2001 meeting for comment. Although the document is a 'living document' in that it will continually be updated, the intent is to have the final draft available for presentation at the April 19, 2001 Delaware River Basin Commission meeting. For more information about this meeting, please go to www.drbc.net.

Progress has also been made in the trackdown study, which is designed to identify potential/actual sources of PCBs entering the sewer system and to begin implementing load reduction measures. The cities of Camden, New Jersey; Philadelphia, Pennsylvania; and Wilmington, Delaware have drafted preliminary work plans outlining their method of conducting the PCB trackdowns in their systems. The details of these workplans were the subject of the March PCB Trackdown Workgroup meeting. Implementation of the first phase of monitoring is scheduled for early summer.

Delaware Estuary Environmental Indicators

The Delaware Estuary Program has developed an initial suite of nine land and water environmental indicators. These indicators provide an important benchmark against which organizations and agencies within the Delaware Estuary can gauge the success and impact of their existing efforts, and identify areas that need to be addressed.

To receive a free copy of the Indicators Report, please call the Partnership at 1-800-445-4935.

PCB Public Forums

This past winter, more than 200 individuals from government, academia, non-profits, industry, the media, and the public attended three PCB Public Forums held in Wilmington, Delaware; Philadelphia, Pennsylvania; and Mount Holly, New Jersey.

The purpose of the forums was to provide the stakeholders in the watershed with an understanding of the PCB problems in the Estuary. The human health risks and impacts on fish and wildlife caused by PCBs were presented along with the actions being taken to address the problem as part of the Delaware Estuary PCB Strategy.

The meetings of the DELEP Implementation Teams and Advisory Committees occur on a regular basis and are open to the public. For meeting dates and times, please call the individuals listed below:

Public Participation Implementation Team
Kathy Klein, Partnership for the Delaware Estuary, Inc.
(800) 445-4935, partners@udel.edu

Habitat and Living Resources Implementation Team
Greg Breese
(302) 653-9152

Information Management Advisory Committee
Warren Huff, (609) 883-9500 x237,
whuff@drbc.state.nj.us
or Karl Heinicke, RIMS Coordinator
(609) 883-9500 x 241,
heinicke@drbc.state.nj.us

The Delaware River Basin Commission also has three Committees that serve in the same capacity as the implementation teams:

Water Quality Advisory Committee
John Davis, Widener University
(610) 499-4063,
John.F.Davis@widener.edu

Toxics Advisory Committee
Tom Fikslin, DRBC
(609) 883-9500 x 253,
tfikslin@drbc.state.nj.us

Monitoring Advisory Committee
Edward Santoro, Monitoring Coordinator
(609) 883-9500 x 268,
esantoro@drbc.state.nj.us

Estuary basics

By Cathy Libertz, United States Environmental Protection Agency Region III, Delaware Estuary Program Coordinator

What is a Combined Sewer Overflow (CSO)?

Combined sewer systems were constructed in many early American cities. These systems were built to carry human waste and stormwater from city streets into receiving waters. Originally, combined sewer systems helped to reduce public contact with human wastes, thereby lessening risk to human health. They also provided drainage to avoid flooding of city streets, homes, and businesses.

Under normal weather conditions, a combined sewer system's flow of sanitary wastewater is sent to a treatment plant. Overflow events ("CSOs") occur in a combined sewer system during wet weather. During a major rainstorm, combined sewers do not have enough capacity to carry all of the rainwater and wastewater that flows through its system. When this occurs, the combined wastewater "overflows" untreated wastewater and stormwater into the nearest river, lake, stream, or estuary. Some communities experience CSO conditions as many as 80 times per year. The U.S. Environmental Protection Agency ("EPA") estimates that during major storm events, CSOs discharge 1.2 trillion gallons of raw sewage and stormwater directly into our nation's waterways annually. The sanitary wastewater component of CSOs is maintained at a relatively consistent level, however, the stormwater contribution is highly variable and dependent upon drainage area, surface permeability, and the duration and/or intensity of the rainfall event.

It was once believed that overflows from sewers during wet weather were diluted by high stream levels, however, a 1984 EPA study found more than 40 toxic pollutants present in CSOs, including high levels of metals and toxic organics. The main pollutants found in CSOs are untreated human and industrial wastes, toxic materials like oil and pesticides, and floating debris washed into the sewer system. These pollutants can cause a variety of diseases in humans, including dysentery and hepatitis, and can also harm aquatic life. People can be affected by drinking or swimming in the polluted water, or by eating the contaminated fish. In fact, CSOs have been a major cause of recreational beach closings, shellfish bed closings, and fish kills, negatively impacting the local economy in some communities.

Many of these combined sewer systems are still in operation today. These systems, however, have been retrofitted over time so that they are now connected to sewage treatment plants. Combined sewers serve about 43 million people in an estimated 1,100 communities. Most of the CSO communities are located in the Northeast and Great Lakes regions. More than 75 percent of these communities are located in 11 states (Connecticut, Maine, Michigan, New Jersey, New York, Pennsylvania, Ohio, Indiana, Illinois, Vermont, and West Virginia). Although most of the pollution from CSOs comes from large systems in the densely populated urban areas of the Northeast and Great Lakes regions, more than half of all combined sewer systems are found in cities with fewer than 10,000 people. Therefore, small communities have more systems to be evaluated, monitored, and operated. In the Delaware Estuary Region, Philadelphia has 176 CSOs, Camden/Gloucester has 36, Chester/Delcora has 30, Wilmington also has 30, and Trenton has one.

Locations of communities in the United States with combined sewer systems.

How are CSOs regulated?

The Clean Water Act requires the EPA and States to issue permits for controlling the discharges from CSOs. In April 1994, EPA issued a policy for the control of CSOs, calling for communities with combined sewer systems to take immediate and long-term actions to address CSO problems. Measures specified in the policy include proper operation and regular maintenance of the sewer system, as well as public notification of the occurrence and impact of CSOs. Permittees are responsible for implementing a series of minimum CSO controls, and if necessary, developing and implementing a long-term CSO control plan. These control plans require the identification, evaluation and implementation of various CSO control strategies to achieve water quality standards by the communities. The EPA, state environmental agencies, water quality groups, and local communities are working together to complete these long-term CSO control plans.

For more information about CSOs, please contact EPA Region III's Office of Watersheds at (215) 814-2310, EPA Region III's Website with CSO information at http://www.epa.gov/reg3wapd/cso/ and the EPA Headquarter's CSO Web site at http://www.epa.gov/owm/cso.htm.

Sources: http://www.epa.gov/owm/cso.htm; Pipeline, a publication of the Small Flows Clearinghouse Spring 1996, vol. 2; EPA document 832-F-93-003 – Combined Sewer Overflows in Your Community; DRBC; and EPA staff.

Biosolids: A Recyclable Resource in the Watershed or a Nuisance?

By William Toffey, Biosolids Utilization Manager, Philadelphia Water Department

Author Taro Gomi got it right in her children's book — "Everyone Poops." Whether you flush to a sewer or to a septic tank, everyone contributes to BIOSOLIDS. Formerly called "sewage sludge," biosolids are the mostly organic byproduct of wastewater treatment that is processed to make the material suitable for recycling back to the land. Everyone who flushes has a stake in the proper management of biosolids.

Every individual produces approximately 60 pounds of biosolids annually. In the Delaware River Watershed, with a population of more than 5 million, that comes to approximately 150,000 tons of organic solids per year. Because the successful treatment of wastewater results in a large quantity of biosolids, these solids need to be "managed" whether they are produced at a Publicly Owned Treatment Works (POTW), a community package treatment system, or an individual on-lot septic system. Recycling biosolids has been a preferred management approach for the majority of wastewater facilities.

Since the early 1970s, biosolids recycling has received the support of state and federal environmental policy-makers. Application of biosolids to the land was the option of choice, as it was seen as a natural way of making good use of the nutrients and organic matter which constitutes biosolids.

Recycling and using biosolids

Federal and state regulations distinguish two levels of biosolids treatment processes, known as Class A and Class B. These relate to the reduction of microorganisms of human origin.

Class A, the higher treatment level, produces products like compost and pellets that are safe for homeowner use. Highly processed, Class A products may be used in suburban and urban settings for horticultural applications. These biosolids products have commercial value. Our metropolitan area is served by three biosolids composting facilities that together produce about 150,000 cubic yards of rich soil amendment that is sold to landscapers. Philadelphia produces EarthMate Biosolids Compost that can be purchased at 30 specialty garden centers in Pennsylvania and New Jersey. In addition, many fertilizers sold locally contain biosolids, and many landowners voluntarily use biosolids for their capacity to improve soil conditions.

Class B biosolids are produced using conventional stabilization technologies to reduce odors. Class B biosolids are used by trained operators on land sites on which public access is restricted. For example, the Upper Montgomery Joint Authority (UMJA), in Pennsburg, Pennsylvania, has recycled Class B biosolids to nearby farmlands for over 10 years. Biosolids are used as a source of nitrogen on crops grown for animal feed. UMJA monitors nitrogen concentrations frequently to assure the application rate does not exceed crop uptake. The farms have a fully implemented conservation plan to reduce erosion and runoff.

Sixty percent of biosolids produced in the Delaware River Watershed are recycled to the land.

What happens to the biosolids that are not recycled?

Approximately half of the biosolids not recycled are co-disposed with trash in municipal solid waste landfills. Most Pennsylvania landfills are permitted to accept biosolids for disposal. Biosolids aid in the settling and decomposition of cells of trash, and hasten the generation of methane gas that can be captured and burned to create electricity. The other half of non-recycled biosolids are burned in specially designed incinerators. These are located at the treatment plant. The residual ash from incineration can be reused, but is often landfilled.

What about objections to recycling?

Environmental professionals responsible for biosolids recycling are painfully aware of the deep concern that people have with the practice of biosolids recycling. One issue keenly felt by neighbors to recycling sites is offensive odors emanating from land spreading activities. Unpleasant odors, even if temporary, give rise to concerns for pathogens' transmission, health impacts, quality of life, and property values. Another area of concern is the release of pollutants to ground or surface waters, affecting use of streams and aquifers.

Wastewater professionals and regulators have scientifically-based responses to these issues. They can show that the potential for adverse impacts to soil and water from biosolids recycling is negligible. The wastewater industry is working to improve its practices, to become responsive to community concerns, and to be more open with its information.

At the national level, an Environmental Management System (EMS) for Biosolids is under development. This is a "continual improvement" program for biosolids producers to adopt for their agencies and contractors. The EMS for Biosolids is expected to give the public increased assurance that recycling programs are operated safely and beneficially.

Biosolids recycling is, after all, part of a "virtuous circle." The community whose POTW practices biosolids recycling can be proud of accomplishing nearly 100% recycling —reclaiming "used" water for discharge to streams, and reclaiming "used" nutrients and food for placement back on the land. In addition, soils that receive biosolids are restored to a higher status of organic matter content, infiltration capacity, and moisture content, enabling the soil to resist storm runoff and erosion. Biosolids are not only a product of success in clean water; they are a tool to achieve clean water.

For more information about biosolids recycling efforts check out these web sites: www.biosolids.org, www.dep.state.pa.us/dep/biosolids/biosolids.htm, www.state.nj.us/dep/dwq/sludge.htm, www.agronomy.psu.edu/extension/esi.html, or www.rce.rutgers.edu/pubs/ag.

Horseshoe Crabs Find a Home

On February 5, 2001, the National Marine Fisheries Service banned the harvest of horseshoe crabs in a newly created 1,500 square mile horseshoe crab sanctuary, off the coasts of Delaware, Maryland and New Jersey. The protected waters will start three miles off the Atlantic Coast and extend east for 30 miles, stretching from Peck's Beach, New Jersey to Ocean City, Maryland. This is one of a series of steps environmentalists, scientists, and state and federal fisheries managers have taken to control the harvesting of horseshoe crabs.

The sanctuary will be named the Carl N. Schuster, Jr. Horseshoe Crab Reserve in honor of the retired William and Mary College professor, who is widely considered the world's leading expert on horseshoe crabs.

Professor Robert Knecht graciously thanking his friends and colleagues.

Robert Knecht Honored at the Delaware National Estuarine Research Reserve

On January 26, 2001 the education and research programs of the Delaware National Estuarine Research Reserve, in Dover, were dedicated to Professor Robert Knecht. For the past 12 years, Professor Knecht has served as the co-director of the Center for the Study of Marine Policy at the University of Delaware College of Marine Studies, where he has led numerous local, national, and international projects in coastal and ocean policy. Throughout his remarkable career in academia and government service, he has received the U.S. Department of Commerce's Gold Medal for outstanding performance, an outstanding leadership award from the American Society of Civil Engineers, and the 1999 Julius A. Stratton Leadership Award as "Champion of the Coast." Professor Knecht was instrumental in shaping the federal Coastal Zone Management Program, the Delaware Coastal Management Program, and the Delaware National Estuarine Research Reserve. His efforts have helped to provide for the environmentally sound use of Delaware's coastal resources and helped to guarantee a plan to protect and manage natural estuarine habitats for research and education in Delaware and across the United States.

The Sojourns

Schuylkill River Sojourn
June 2–8, 2001
A seven-day trip down the Schuylkill River from Schuylkill Haven to Philadelphia. Activities, meals, camping and gear shuttles are provided daily. Canoe and kayak rentals are available. Check out the Schuylkill River Sojourn 2000 photo gallery and the Schuylkill River Sojourn 2001 information page at www.schuylkillriver.org. The registration deadline is May 4, 2001. For more information or to register, please call (610) 372-3916.

Delaware River Sojourn
June 15-23, 2001
Paddle the longest free-flowing river in the Eastern United States. This eight-day trip combines canoeing, camping, educational programming, historical interpretations, and more. The Sojourn travels for two days in each section of the river (upper, middle, lower, and estuary). Side trips are taken on the historical canals, into the tidal marshes, and down the scenic tributaries. The itinerary varies from year to year, so there is always something new to discover.

The 7th Annual Delaware River Sojourn

Registration deadline is May 26, 2001. For more information or to register, please call (908) 996-0230.

Lehigh River Sojourn
June 23-28, 2001
Canoe and whitewater raft from Stoddartsville to Easton for six-days, along the dramatic Lehigh River. Visit the Lehigh Gorge State Park and the Walnutport Canal Museum. Educational programming includes everything from massage therapy lessons to the history of zinc. Registration deadline is June 1, 2001. For more information or to register, please call (610) 965-4397 x 16.

Making Waves

A New Partnership Promises Connection between City Kids and the Delaware Estuary

By Mark Fallon, Education Director, Philadelphia City Sail

This past year, The Academy of Natural Sciences and Philadelphia City Sail, Inc. worked together on a pilot program to teach inner city Philadelphia students about watershed science and ecology by using the Delaware Estuary as a classroom. The program was such a success that the organizations are entering a full partnership to keep the program going and develop it further.

The pilot program involves hands-on lessons that take place on the Jolly Rover II, a 75-foot topsail schooner, based at Penn's Landing. Teachers receive pre-trip lesson plans and training, on board data sheets, follow-up lesson plans, and post-tests. On-board experiments (during spring and fall sailing trips) reinforce classroom lessons. Interested students may continue the learning process by joining City Sail's summer program.

For more information on this program, contact Philadelphia City Sail, Inc. at (215) 271-3400 or email them at phcitysail@aol.com. For more information on this or other programs of The Academy of Natural Sciences, please call (215) 299-1000 or visit them at www.acnatsci.org.

Delaware City Enhances its Riverfront

The 19th Century port community of Delaware City (pop. 2,000) can trace its origins back to 1801. Its location at the eastern end of the Chesapeake and Delaware Canal resulted in it becoming both an operating base and a way station for shipping activity between Philadelphia and Baltimore. Delaware City has evolved over the years and, with a little help, is looking to reinvent itself. The town has received financial support from both the state and federal levels to recreate that 19th Century feeling through park improvements, the creation of a canal promenade, and the restoration of historical properties. The Delaware Department of Natural Resources and Environmental Control's Division of Parks and Recreation has committed $200,000 for a brick walkway along the canal, public seating, and Victorian light standards. The Motiva Refinery, in support of Delaware City's ongoing revitalization efforts, sold a strip of land to the city for $1. A parking lot will be built on this land to support visitors to the Fort Delaware State Park and the 3 Forts Ferry. Delaware City is a departure point for the 50,000 annual tourists who visit Fort Delaware on Pea Patch Island.

For more information about Delaware City, contact the Delaware City Town Hall Offices at (302) 834-4573 and ask for a brochure entitled "Delaware City – Port of History."

"You too, can be a Great Gardener" at the 2001 Philadelphia Flower Show.

Philadelphia Flower Show Exhibit Impresses the Judges

The Philadelphia Water Department, U.S. Fish and Wildlife Service, the Delaware Estuary Program, and the Partnership for the Delaware Estuary teamed up at the 2001 Philadelphia Flower Show to present their exhibit "You too, can be a Great Gardener by Practicing Conservation Landscaping!"

The exhibit illustrated that the impacts of daily landscape decisions reach far beyond individual property lines. In order to be a great gardener, you need to plan for landscapes that benefit people, wildlife, and your local watershed. By taking a conservation landscaping approach to gardening, you can help to restore wildlife habitats in small pockets and help to improve water quality.

A brochure was distributed at the Flower Show listing a number of conservation landscaping techniques that gardeners should practice including, testing and recycling nutrients, reducing impermeable surfaces, using native plants, creating habitat, conserving water, and using top dress. A soil conditioner, marketed under the name EarthMate, was used in the exhibit. EarthMate is a byproduct of Philadelphia's sewage treatment process. (For more information about biosolids recycling, refer to the article on page 4).

The exhibit won Best in Show for Education, Special Achievement in Conservation and Education from the Garden Club Federation of Pennsylvania, and The Philadelphia Flower Show Award Presented to a Major Exhibition for an Educational Exhibit of Distinction.

For a free copy of the Conservation Landscaping brochure, please call the Partnership at 1-800-445-4935.

Taking it to the Streets for Earth Day 2001 with Storm Drain Marking

One of the greatest threats to the quality of our region's waterways is from stormwater runoff pollution. Stormwater runoff pollution occurs when rainwater washes over land collecting pollutants such as motor oil, fertilizers, pesticides, and litter. These pollutants wash into storm drains or directly into the Estuary's streams and rivers. In order to address the stormwater runoff problem, the Partnership has taken the initiative to highlight nonpoint source pollution prevention in its programming, which includes the Storm Drain Marking Project.

To date, the Storm Drain Marking Project has involved thousands of volunteers in Philadelphia, Pennsylvania and Camden, New Jersey. This spring, we are continuing our efforts in Philadelphia with the assistance of a Growing Greener Grant from the Pennsylvania Department of Environmental Protection, and in Wilmington, Delaware with support from the Delaware Department of Natural Resources and Environmental Control and the City of Wilmington. Volunteers will be marking storm drains with the message "*No Dumping. Drains to River.*" The volunteers will also be distributing tip cards that explain what the marking means and describe how everyone can help to keep our rivers clean by rethinking some of our day-to-day actions.

Those of you familiar with this project will notice that we are no longer using the word "stencil." Traditionally, our volunteers have used paint to stencil the area in front of storm drains. This time around, we are testing a much more durable product, which has been used successfully in other estuary's across the country. The medallion (see above) we have selected is expected to last up to 14 years, and promises to be much easier for our volunteers to apply to the street.

To learn more about storm drain marking, please call the Partnership at 1-800-445-4935.

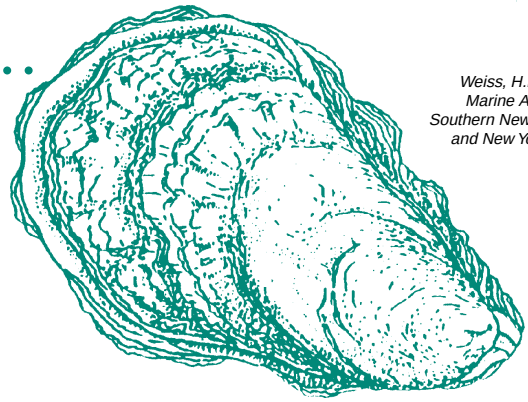
Do these advertisements look familiar?

To learn more, go to the Partnership for the Delaware Estuary's new web site at www.DelawareEstuary.org.

Species Specific

Eastern oyster – *Crassostrea virginica*

By Russell Babb, Fisheries Biologist, New Jersey Division of Fish and Wildlife, Bureau of Shellfisheries



Weiss, H.M., 1995, Marine Animals of Southern New England and New York State.

Introduction

The eastern oyster, *Crassostrea virginica*, has held a long history as a commercially and ecologically important species in the Delaware Bay. Dating as far back as the early 1800's, the Delaware Bay oyster has been known for it's unique taste and high quality meat. It was extremely popular on the oyster market, which contributed significantly to the bayshore communities of New Jersey and Delaware. Throughout the early 1900's, oyster landings ranged from one to two million-bushels annually. Today, oyster production is severely inhibited by a serious disease that affects oysters, not humans. The culprit is a water-borne protozoan parasite called *Perkinsus marinus*, commonly known as Dermo. Dermo was originally detected in the Delaware Bay during the mid-1950's and was essentially undetectable shortly thereafter. However, the disease, associated with abnormally high winter temperatures, resurfaced in 1990, spreading among the oyster population. Although oyster stocks have been significantly affected by disease, habitat loss, and in some cases over-harvesting, the eastern oyster remains an integral part of the Delaware Estuary.

Where Can We Find the Eastern Oyster?

The filter feeding eastern oyster is an estuarine animal with a tolerance for a wide salinity range. The Delaware Bay oyster typically exists in salinities as low as four or five parts per thousand (ppt) and as high as 30-35 ppt. (sea water is normally 35 ppt.), however, the optimal salinity range is believed to be about 14-28 ppt. In the New Jersey portion of the Delaware Bay, oysters are established in areas of suitable habitat extending from Cape May Point to Artificial Island, and in the brackish or lower portions of many tributaries leading into the Bay. The prime market beds in the Delaware Bay (i.e., providing the best growing conditions) range from Ben Davis Point south to False Egg Island. Oysters will grow on almost any type of stable bottom available (e.g., hard mud, sandy mud, clay, gravel, and preferably, other oysters). Oysters do not survive well on sandy bottoms that are coarse grained and unstable. They grow from the intertidal zone to a depth of 30 or more feet. The most productive areas on New Jersey's natural seedbeds and leased grounds range in depth from 6 to 25 feet.

The Mating Ritual

The eastern oyster is a protandric alternate hermaphrodite species. When oysters first mature, they usually function as males, and as individuals grow larger, the proportion of females increases. There is also evidence that the process of switching sexes is reversible during subsequent years. It is relatively unclear what factors influence sex reversal. A number of scientists have linked nutritive stresses, disease pressure, and sex ratios of nearby oysters to sex reversal. Oysters spawn in response to temperature. The first spawning generally occurs when the water temperature reaches 77°F (25°C). Subsequent spawns commonly occur throughout the summer until early-September. The availability of clean substrate, preferably oyster shell, is critical for the successful settlement of juvenile oysters, or spat.

Survival of the Fittest

There is a two-week period for the free-swimming larvae. During most of this period the larvae are passively transported by tidal and wind driven currents. Only in their last few days of larval life do they exhibit a tendency to descend from the water column on slack water, remain on the bottom during ebb tides, and return to the water column on flood tides. In this manner, late stage larvae tend to move toward the headwaters of the Estuary. When they are ready to set, the larva seeks a hard, clean surface upon which to attach. Once a larval oyster attaches, it cements itself to that surface. It will remain there for life unless removed by some external force.

Successful settlement is not the only hurdle oysters face. Once oysters find a suitable substrate, they become vulnerable to a number of new predator organisms. Mud crabs, blue crabs, gastropods, black drum, starfish, skates, and rays all take a toll on oysters. The principal predators in the Delaware Bay are the oyster drills, *Urosalpinx cinerea* and *Eupleura caudata.* Their abundance over the downbay market beds can have a significant effect on whether juvenile oysters survive to reproductive maturity.

Many marine organisms – bryozoans, hydroids, sponges, barnacles, ascidians, tube-building worms and other bivalves – live upon oysters and the affiliated structure of the reefs they create. These, in turn, attract various crustaceans and small fishes. This furnishes, as many fishermen know, a concentrated food source for many recreationally sought fishes such as the weakfish, croaker, and black drum. Numerous animals seek out food and shelter in the interstices of the oyster reef. Various gastropods and fishes, many of which have commercial and recreational value, utilize the oyster community for foraging and spawning habitat.

Conclusion

The oyster plays a significant ecological role in the Bay, and it is the basis of a vast community of organisms. Management efforts by coastal states to bolster the oysters resource not only provide major economic benefits for harvesters and local communities, but add to the overall ecology of estuaries by increasing faunal habitat and diversity, while improving water quality.

A listing of the resources used for this article is available from the Partnership by calling 1-800-445-4935.

Estuary Excursions

Burlington's Swan Story – Palmyra Cove Nature Park

By George Nyikita, Executive Director, Burlington County Bridge Commission

Looking south as you cross the Tacony-Palmyra Bridge into New Jersey, you will catch a glimpse of a small island wilderness. Better known to locals as *The Dunes*, it is home to some of the Estuary's endangered birds and wildlife. This island of greenery, renamed the Palmyra Cove Nature Park, is a project aimed at preserving open space as a place for wildlife to thrive and for people to learn about this unique ecosystem.

Located on the Delaware River at the foot of the Tacony-Palmyra Bridge, the park is bounded by Route 73 and the Pennsauken Creek. The 350-acre tract is being maintained as a wildlife haven under a 30-year management agreement between the Burlington County Bridge Commission and the New Jersey Pinelands Commission.

This area, originally intended to be purely a site to deposit dredge material, has blossomed into a natural haven for many different types of wildlife. The Army Corps of Engineers continues to use a portion of the park as a dredge material site for the ongoing dredge operations along the Delaware River. These materials can be used as a resource for soil blending operations for Burlington County and other regional projects. The Corps operation can be viewed as a prototype for other projects along the Delaware River and can provide economic benefits to other communities along the River.

Palmyra Cove Nature Park is valuable to the community as a place for passive recreation. It is large enough and covered with enough vegetation that a visit feels like a walk in the country,

View of the Tacony-Palmyra Bridge from the Palmyra Cover Nature Park in Burlington County, New Jersey

far from the traffic and congestion of nearby residential and commercial areas. The trails threaded throughout the park make it a pleasant place for walking and jogging. These activities will be encouraged by the addition of low-impact improvements such as bird-watching platforms and benches along the trail. Along the shoreline of the river and at the lagoon in the tidal cove, there will be docks for families to fish and rent canoes.

This environmental initiative has been made possible through a partnership with a mix of state, county and local government entities with private sector and nonprofit involvement. The Nature Park has received funding from many sources including the New Jersey Department of Transportation, the Delaware River Port Authority, Burlington County (through the state's Green Acres program), the Office of Maritime Resources, and the Burlington County Bridge Commission. A number of local organizations have also contributed to this project. This is truly an example of how all levels of government, the private sector and local community organizations can come together for a common good.

The park is open from dawn to dusk so that families, nature lovers and other community members can experience this natural resource. For directions or additional information, please call (856) 829-1900.

Source: Winter 2001 issue of New Jersey Outdoors magazine. For subscription information or to purchase a copy of this issue, please call (609) 984-0364.

(Events Map.eps - USE PMS 3282)

Please use this map to locate the places, towns, or waterways mentioned in articles in this edition of Estuary News. We hope this new feature helps to enhance your knowledge of the Estuary region and encourages you explore its fascinating resources.

Teachers and students page

"Clean Water Begins and Ends with You" Drawing Contest

Congratulations to the Philadelphia Water Department's and the Partnership for the Delaware Estuary's 2nd Annual "Clean Water Begins and Ends With You" Drawing Contest Winners!

9th –12th Grade

1st Prize	George Mathes, Northeast H.S.
2nd Prize	Clifford Fair II, Northeast H.S.
3rd Prize	Kimberly Cruz, Lincoln H.S.
Honorable Mention	Stephen Dalziel, Springside School

6th–8th Grade

1st Prize	Marques Slocum, St. Francis de Sales
2nd Prize	Stephen Mckenna, St. Leo the Great School
3rd Prize	Bobby Meder, St. Leo the Great School
Honorable Mention	John Seing, Our Lady of Angels

3rd– 5th Grade

1st Prize	Jake Shayev, Greenfield School
2nd Prize	Nora Langan, Springside School
3rd Prize	Anna Dichter, Germantown Friends School
Honorable Mention	Lesa Gordinskaya, Loesche E.S.

Kindergarten–2nd Grade

1st Prize	Mohanad Saleh, Solis Cohen
2nd Prize	Christine Ching, Resurrection of Our Lord
3rd Prize	Kahlil Johnson, Dr. Tanner G. Duckrey E.S.
Honorable Mention	Shirley Lu, Solis Cohen

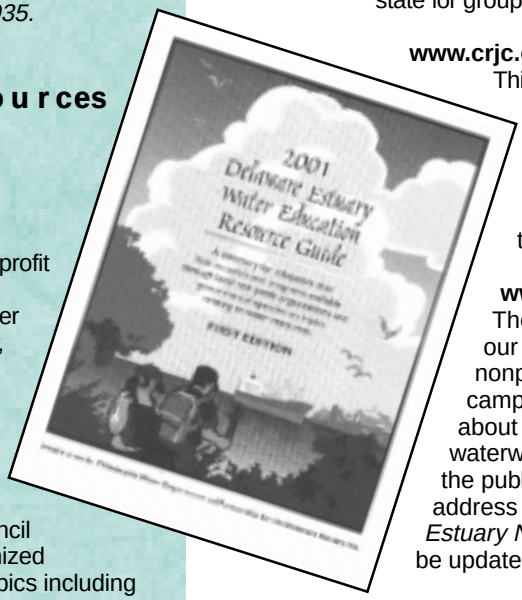
The winning drawings have been assembled into a 16-month calendar and the winning artists will be recognized at an awards ceremony, which will be held in early April. Lastly, look for the first place winning drawings on SEPTA vehicles during the month of April.

Thanks to the Pennsylvania Department of Environmental Protection's Growing Greener Program, and all of the students and teachers who participated in the 2001 Clean Water Begins and Ends with You Drawing Contest.

To request a copy of the calendar, please call the Partnership at 1-445-800-4935.

Recommended Resources

2001 Delaware Estuary Water Education Resource Guide
A directory for educators that lists materials and programs available through more than 130 local non-profit organizations and government agencies on topics relating to water resources. To receive a free copy, please call the Partnership at 1-800-445-4935.



Environmental Connections: A Teachers Guide to Environmental Studies
The Environmental Literacy Council has created an up-to-date, organized resource guide on a variety of topics including waste management, water quality, marine ecosystems, and population studies. This book is a valuable tool for teachers to bridge the gap between textbook learning and real world application. To order a copy of this book, check out their web site at www.enviroliteracy.org.

Make Your Own Watershed Kit
The new, smaller version of EnviroScape supplements the popular model by offering a creative base for assignments or science projects. The cost is $29.95 plus shipping and handling. For more information, please call (703) 631-8810.

Let's Learn About Water
This very popular activity booklet has been reprinted. The booklet explains the history of water use in the City of Philadelphia, identifies the watersheds located within the City and their connection to the Delaware Estuary, explains the natural and urban water cycles, and includes fun games and educational activities. To receive a free copy of the activity booklet, please call the Partnership at 1-800-445-4935.

www.plannersweb.com/sprawl/home.html
Sprawl guide, maintained by the Planning Commissioners Journal's Planners Web site, offers information on key issues associated with sprawl. It also provides a mechanism to search by state for groups or project working to curb suburban sprawl.

www.crjc.org/riparianbuffers.htm
This site of the Connecticut River Joint Commission, offers ten different fact sheets explaining the importance of riparian buffers in different types of environments. Sample fact sheets include forestland buffers, buffers for habitat and agricultural land, and urban buffers. There are also tips on how to create a riparian buffer.

www.DelawareEstuary.org
The Partnership for the Delaware Estuary launched our new web site this April in conjunction with a nonpoint source pollution advertising campaign. The campaign features four images that will educate people about the effects of nonpoint source pollution on our waterways. Each image comes with a tip card to provide the public with the steps they can take on a daily basis to address this type of pollution. See page 7 of this issue of *Estuary News* to view this images. Look for our web site to be updated over the coming months.

Upcoming Delaware Estuary Events and Happenings

Darby Creek Clean-Up at John Heinz NWR
Saturday, April 21, 2001, 8:00 a.m.
John Heinz National Wildlife Refuge at Tinicum
Philadelphia, Pennsylvania
The Refuge invites you to lend a hand to improve habitat for plants and animals. Collect and remove debris along a stretch of Darby Creek. For groups larger than five people, please call (215) 365-3118 to register.

Earth Day
Sunday, April 22, 2001
Help to celebrate the 31st Anniversary of Earth Day by participating in a park clean-up, marking a storm drain, planting a tree, or just enjoying the outdoors.

Earth Day – Eco Walk
Saturday, April 28, 9:00 a.m. – 1:00 p.m.
Brecknock Park, Camden, Delaware
Come out and test your knowledge of the environment while enjoying a stroll down "Eco-Lane" or participate in exciting exhibits and interactive displays. All proceeds will benefit Delaware ENVIROTHON. For more information, please call (302) 739-5361.

Teacher Workshop: Watersheds and Human Impact
Thursday, May 3, 2001, 4:30 p.m. – 6:30 p.m.
Schuylkill Center for Environmental Education
Philadelphia, Pennsylvania
Explore basic watershed concepts as you take a watershed walk through an urban neighborhood. Learn the importance of conserving and protecting water resources, and how you can incorporate these concepts with hands-on activities into the classroom. Pre-registration is required. For more information, please call (215) 482-7300.

DELAWARE NATURE SOCIETY

Native Plant Sale
Saturday, May 5, 2001, 9:00 a.m. – 5:00 p.m.
Sunday, May 6, 2001, 10:00 a.m. – 3:00 p.m.
Ashland Nature Center
Hockessin, Delaware
Shop for ferns, shrubs, trees, grasses, wildflowers, and aquatic plants. For more information, please call the Delaware Nature Society at (302) 239-2334.

How Do Streams Find Their Courses?
Saturday, May 12, 2001, 1:00 p.m.
London Tract Meeting House
Landenberg, Pennsylvania
John Talley of the Delaware Geological Survey will show how the land determines the meanders, oxbows, rapids, and gravel bars along streams. These in turn determine the flora and fauna of streams. This event is jointly sponsored by the Society of Natural History of Delaware and the Pennsylvania White Clay Creek Preserve. To register, please call (610) 274-2471.

The Nature Conservancy® OF NEW JERSEY

Canoe West Creek
Saturday, May 12, 2001
Dennis Township
Cape May County, New Jersey
West Creek is a tidal waterway that borders Eldora Nature Preserve and supports salt marsh grasses and an array of wildlife. Take this rare opportunity to ply the waters and view one of the Bayshore's little-known creeks. This trip is $10 for Nature Conservancy members and $15 for nonmembers. Participants must provide their own canoes or kayaks. For more information, please call (609) 861-0600.

Wildlife Festival: A Diversity of Life
Saturday, May 19, 2001, 8:00 a.m. – 5:00 p.m.
Bombay Hook National Wildlife Refuge
Smyrna, Delaware
A fun and educational family event with games, crafts, music, walking tours, and more. For more information, please call (302) 653-6672.

Delaware Bay Day
Saturday, June 2, 2001
Bivalve, New Jersey
The Delaware Bay Schooner Project's Bay Day celebrates the unique maritime heritage and incredible natural resources of the Bay. The festival will feature street and boat parades, environmental activities for children and adults, blue crab races, oyster shucking contests, river tours, and evening fireworks. For more information, please call (856) 785-2060.

Gloucester County Water Fest
Sunday, June 10, 2001, 11:00 a.m. – 4: p.m.
Scotland Run Park
Clayton, New Jersey
This event, sponsored by the Gloucester County Parks and Recreation Department and the Upper Maurice River Watershed Association, will feature crafts, displays, music, food and fun. For more information, please call (856) 881-0845.

"Water — Is Our Future Draining Away?"
April and May 2001
PA DEP is holding 12 forums across Pennsylvania to discuss the Commonwealth's current and future water resource needs. For dates and locations, please call (717) 772-5807 or visit www.dep.state.us.

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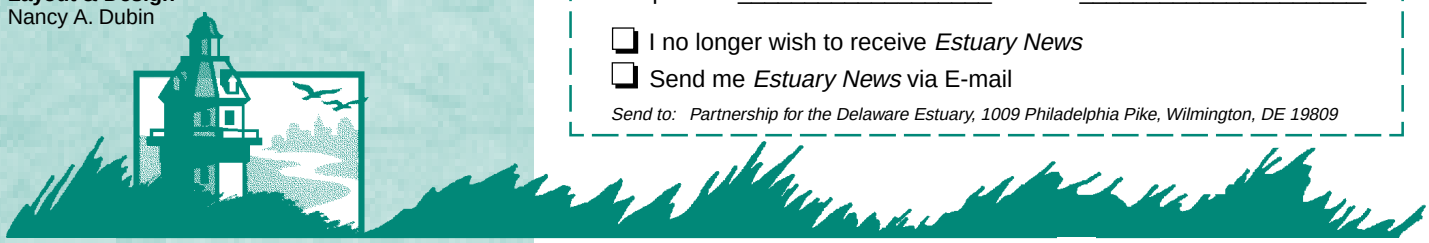

What is the Delaware Estuary Program?

The Delaware Estuary Program (DELEP) is a partnership of governmental agencies, nonprofits, the private sector, and citizens working together to restore and protect the Delaware Estuary. It was established in 1988 and is one of 28 national estuary programs around the nation. The estuary region extends from Trenton, New Jersey to the mouth of the Delaware Bay. To learn more about DELEP activities, visit www.delep.org.

WHO IS THE PARTNERSHIP?

The Partnership for the Delaware Estuary, Inc. is a private, nonprofit organization established in 1996. The Partnership promotes the estuary as a regional resource through public outreach and education. It also serves as the education, outreach, and fundraising arm for the Delaware Estuary Program. To find out how you can become a member, call the Partnership at 1-800-445-4935 or visit our website at www.DelawareEstuary.org.

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