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Coastlines November 2003 - Issue 13.5



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Investigating Changes in the Mudflats of a Central Californian Estuary

Intertidal mudflats are rich habitats that host a wealth of invertebrates, which in turn support migratory shorebirds, foraging fish including sharks and rays, and marine mammals such as harbor seals and sea otters. But estuaries are few and far between in California, and many estuaries that originally had extensive mudflats have been degraded by urbanization.

However, Elkhorn Slough, a small estuary in central California, boasts some of the richest and most extensive mudflat communities remaining in the state. Elkhorn Slough is a National Estuarine Research Reserve (NERR), which is owned and managed by the California Department of Fish and Game, NOAA and the Elkhorn Slough Foundation (ESF), a non-profit organization. The Reserve and ESF practice science-based management of Elkhorn Slough and its watershed, and support applied



conservation research.

One critical question is this: Are the mudflat communities of Elkhorn Slough still healthy and diverse? Recently, the 2003 Elkhorn Slough Conservation Research Award was presented to Katherine ("Tabby") Fenn in honor of her work addressing this very question. She documented dramatic changes in natural communities occurring since the 1970s, involving changes in species composition and abundance. Her study suggests that the observed changes may be the result of erosion of mudflat habitats caused by creation of an artificial harbor mouth in 1947.



However, she found no decrease in native species richness, and no increase in exotic species abundance in these mudflat communities - reassuring news for an estuary subject to pollution and invasions by exotic species.

In the 1920s, George MacGinitie carried out pioneering taxonomic research on Elkhorn Slough invertebrates, collecting and describing species. But his surveys were not quantitative, and thus there was no real baseline of what communities were like at that time. We will never know how these communities were altered in



later decades by events such as the 1947 widening of the estuary mouth to accommodate the newly created Moss Landing harbor, increased agricultural pollution in the watershed, and construction of the nearby Moss Landing power

plant. There are simply no "before" data for a "before/after" comparison.

But in the 1970s, researchers at Moss Landing Marine Laboratories (MLML) carried out the first quantitative assessments of mudflat communities, providing a baseline for future studies. Ms. Fenn repeated and expanded the sampling regime developed by these researchers, with mentoring from the original MLML team. She collected coffee-can cores of mud along transects at four stations in the main Slough channel, then sieved, sorted, identified and counted all the invertebrates she found.

Ms. Fenn's results revealed a statistically significant shift in taxonomic composition and abundance patterns of invertebrate communities between the 1970s and the present. What can these changes be attributed to?

otters in the water

Fenn reviewed three factors that could be driving changes: exotic species, water quality, and tidal erosion. She concluded that evidence for the latter was most compelling. In these decades, tidal erosion appears to have altered habitats much more dramatically than the other two factors.

The mudflat changes that occurred between the 1970s and the present are of concern, because they suggest that human

development has altered invertebrate communities and therefore food webs.

Other results were more reassuring, however. There were few significant differences in invertebrate communities between the 1990s and 2001, suggesting that rates of change may have slowed in the last decade. Also, the total number of species collected in 2001 was similar to data from the 1970s, so by this index, biodiversity has not decreased. Indeed, Fenn's results reveal that invertebrate communities are still rich in species, despite the threats from pollution, power plant intake, tidal erosion, harvesting, and other human activities. In addition, Fenn found no significant pattern of increase in the variety or abundance of exotic species over time.

Fenn's study also revealed very patchy distributions of invertebrate species. She

sampled at three different tidal heights (0.0, -0.2, and -0.4 meters below mean low water) and found that at a given site, a single animal group (e.g., worm, bivalve, crustacean) dominated a given tidal height. However, the particular group varied between sites. Therefore, a comprehensive taxonomic survey would only be obtained by sampling at all three tidal heights at all sites. Past monitoring studies were only done at one tidal height.



She also found startling alongshore variation in community composition: cores along the same transect only one meter apart were often radically different. This suggests that to adequately characterize a large site, more samples must be taken along the shoreline than had been done previously.

Ms. Fenn's work will help to improve the quality and focus of future monitoring studies, including studies currently being done by MLML, funded by the Monterey Bay National Marine Sanctuary.

The Elkhorn Slough Conservation Research Award is given to a junior researcher whose investigations inform estuarine conservation. The award is sponsored by the Elkhorn Slough Foundation and Elkhorn Slough NERR. Each year, dozens of local students, faculty, and other researchers complete short-term scientific investigations at the Reserve. Fenn, who now works as steward for the Natural Reserves at the University of California at Santa Cruz, did this work as a part of her Master's thesis at Miami University in Ohio. Such investigations complement the long-term monitoring programs coordinated by ESF and ESNERR.

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Estuarine Research for Managers Now Online

Timely and practical information for coastal and estuarine managers is now available for free by subscribing to Coastal and Estuarine Science News (CESN), a new technology-sharing program from the international Estuarine Research Federation (ERF). The Coastal and Estuarine Science News is a one-year pilot project funded by the Oceans and Coastal Protection Division of the U.S. EPA.

The goal of the program is to promote information-sharing among researchers working in coastal and estuarine sciences and resource managers who may benefit from their research. Each quarterly issue of CESN summarizes, in layman's terms, the scientific findings of papers published in the respected journal *Estuaries: an International Journal of Coastal Science*, and focuses on management applications of research. Summaries will also be distributed through existing electronic coastal management newsletters and websites, and through a listserv hosted by ERF. The inaugural issue of the CESN series is now available on the ERF website.

For further information, or to subscribe to CESN, visit the Estuarine Research Federation website at www.erf.org [EXIT disclaimer ►](#).



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Methylmercury: Don't Dismiss Fish Consumption Advisories!



mental abilities on a lifelong basis.

Don't dismiss warnings concerning methylmercury contamination in fish! This is especially important if you're a woman between 14 and 44 years of age, have small children or are pregnant, because methylmercury exposure can potentially affect

The Warnings

The U.S. Food and Drug Administration (FDA) and the U.S. EPA are recommending that women from 14 to 44 years of age not eat more than 12 ounces of any fish or more than 6 ounces of freshwater fish per week. For children age 12 and under, the limit is only 2 ounces. They also recommend that no king mackerel, swordfish, shark or tilefish be eaten at all.

Methylmercury is a potent neurotoxin (poison) that can cause birth defects, learning disabilities, blindness, paralysis, loss of muscular control and death. Children of women who consume fish and seafood containing methylmercury during pregnancy

may be at special risk of brain and nerve damage. Such damage could result in neurological disorders such as attention deficit disorder, language delay, and learning difficulties.

Up to 10 % of American women between 16 and 49 years old have mercury levels above EPA guidelines, according to a March 2001 report by the U.S. Department of Human Health and Services (Centers for Disease Control and Prevention). There are nearly six million such women. Such women give birth annually to 370,000 babies that are at potential risk of developmental problems because of prenatal mercury exposure.

Coal-burning power plants are a major source of mercury emissions to the atmosphere. Prior to establishing new, more stringent regulations for mercury emissions from coal-burning power plants, the U.S. Congress required EPA to conduct an independent study of mercury toxicology.

In July, 2000, the National Research Council (NRC) of the National Academy of Sciences published a report entitled "Toxicological Effects of Methylmercury". This report concluded that EPA's reference dose for methylmercury was scientifically justified for protection of public health. This reference dose is the basis for the recommended weekly fish consumption rates.

State health departments currently list more than 2,500 fish consumption advisories due to mercury contamination. Largemouth bass, bowfin, and chain pickerel contain high levels of mercury in many states. However, few people who eat fish from methylmercury-contaminated waters are aware of such warnings, and many people ignore the warnings.

What's more, few advisories warn about the cumulative effects of eating contaminated fish. For instance, if someone ingests the reference dose by eating a meal of large-mouth bass or a tuna sandwich, should that person avoid eating any more fish of that type that might contain mercury?

There is a general misconception that commercially harvested fish and seafood cannot be sold in this country if they contain more than the FDA action limit of 1.0 part per million (ppm) of mercury. In recent years, the FDA has not tested for methylmercury in domestic or imported marine fish or other seafood. As a result, some states, such as California, now require grocery and seafood stores to post federal mercury warnings for fresh, frozen and canned seafood.

Toxic effects on plants and animals

Methylmercury can cause sublethal effects in animals, including impaired growth and development, adverse effects on the cardiovascular system, reduced reproductive success, liver and kidney damage, and behavioral abnormalities. As a neurotoxin, methylmercury can cause decreased motor skills, tremors, the inability to walk, convulsions and death. High methylmercury levels may have contributed to the deaths of some Florida panthers, since panthers typically consume large amounts of fish. Effects on plants include growth inhibition, decreased chlorophyll, and leaf and root damage.

Sources, transport and bioaccumulation

Mercury is a natural element which occurs in certain minerals. Bacteria can convert elemental mercury to gaseous methylmercury, which can be absorbed by other organisms. Methylmercury is then passed on to small fish, larger fish and the many animals that feed on those fish, including man. As it passes up the food chain, methylmercury is biomagnified at each successive level, resulting in concentrations in top predators that can be several million times the initial concentrations in water or sediments. For wildlife and humans, the primary source of methylmercury exposure is consumption of fish.

The amount of mercury in the atmosphere is estimated to have increased as much as ten-fold since the beginning of the industrial revolution. This increase has occurred worldwide and is due largely to burning of fossil fuels. Of the estimated 158 tons of mercury emitted annually into the atmosphere by human activities in the U.S., approximately 87% comes from point combustion sources, primarily coal burning power plants. Electrical power plants built in the 1940s to 1970s are the largest industrial source of mercury emitted into the atmosphere. The Clean Air Act, passed by Congress in 1970 and amended in 1977 and 1990, exempts such older plants from new air pollution standards.

What can be done?

An expert panel on mercury and atmospheric processes concluded that if all mercury releases were stopped today, it could take 50 years for methylmercury levels in fish to return to pre-industrial levels. Skinning, filleting and trimming the fat from fish does not significantly reduce the mercury concentration, nor is mercury removed in the cooking process. In fact, mercury concentrations are higher in fish after cooking, because cooking removes moisture.

For women of child-bearing age and young children, the most important thing to be aware of is not to consume more than the recommended amounts of the fish listed on the fish consumption advisories.

Currently, there is no effective national education campaign that focuses on realistically evaluating the dangers of consuming freshwater and marine fish and seafood. Since coal-fired electrical power plants are the largest known source of man-made mercury emissions, reduction of mercury-containing emissions would be necessary for reducing atmospheric mercury.

State legislatures in 13 states, primarily in the Northeast, and the U.S. Congress are currently considering bills that would eliminate or reduce mercury in products such as thermometers, electrical switches, and dental amalgams. The health and environmental threats posed by methylmercury will only be reduced through public education, use of new technologies and stricter regulations regarding air pollution.

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***EstuaryLive!* Streaming Estuaries**

The Albemarle-Pamlico National Estuary Program (APNEP) in North Carolina is fortunate in having several National Estuarine Research Reserves (NERRs) located within its boundaries. One, known as the Rachel Carson NERR, is located across Taylor's Creek from the Town of Beaufort in Carteret County. Rachel Carson NERR is made up of several islands: Carrot Island, Town Marsh, Bird Shoal, Horse Island, and Middle Marsh. It is also the birthplace of *EstuaryLive!*



EstuaryLive! is a unique program which offers participants an interactive "virtual" field trip through the use of Internet technology. It is the brainchild of Susan Lovelace (former Education Coordinator at Rachel Carson) and Bill Lovin, owner of Marine Grafics, Inc. Funding is largely provided by NOAA.

EstuaryLive! brings students into the field through live streaming video. Field trip leaders at Rachel Carson NERR are the eyes, ears, and hands for this virtual field trip, as they explore the salt marsh, surf and estuarine habitat with the camera following them. Students and others around the world, sitting in their classrooms, offices, or homes, can e-mail questions and comments about the field trip as it is happening. All communication is done in real time, with only a several-second delay due to satellite transmission times. Usually about 2,000 students participate in each spring and fall session.

EstuaryLive! has two main objectives: 1) Enable students to experience the estuary's wonders, who otherwise might not have the opportunity to visit; and 2) Provide an educational experience corresponding to North Carolina's standards for science and other curricula. *EstuaryLive!* also offers opportunities for education in mathematics, reading and writing, technology, and social studies. Even literature can be taught, as demonstrated by the use of Rachel Carson's writings on estuaries, *Under the Sea Wind* and *The Edge of the Sea*.

EstuaryLive! field trips ordinarily last two days, often including a night excursion. The program is varied in order to keep participants and students engaged. Sessions can be general or devoted to specific topics. Graduate students conducting research on particular subjects often present their research.



In 1998, when cellular modem technology was fairly new, the initial *EstuaryLive!* used microwaves to broadcast images from the Reserve via a 56K dial-up connection to the Internet. But the real challenge was to provide audio (sound) along with visual images. In early broadcasts, the voice of the program, "Estuary," would type a narrative in a chat window. Students in their classrooms would type their questions, and "Estuary," using her experience as a Reserve educator, would type the answers.

Now, technological advances allow both video and audio transmissions to be broadcast from the island Reserve via microwaves to a variety of receptors. The stream is usually sent over a high-speed T-1 Internet line, though satellites also have been used. The result is a high-quality visual with crisp audio feed direct from the field-trip site.

Real-time interaction with the field team is now effortless. Questions and comments from audiences from around the world are still received via e-mail, but they are communicated to the field team almost instantaneously through headsets and microphones. The field team then responds, frequently using actual examples from the field.

Expanding and improving the *EstuaryLive!* experience for teachers and students is a priority. In the fall of 2000, a session from the Masonboro Island NERR near Wilmington, North Carolina, demonstrated that this approach will work in other venues. During June 2001, experienced *EstuaryLive!* teachers from New Jersey,

Ohio and North Carolina gathered at Rachel Carson Reserve to help expand the program by producing their own one-day field trips, to take back to their schools and communities.

In observance of National Estuaries Day in the fall of 2002, NEPs and NERRs in North Carolina, Louisiana, New Jersey, Florida, and Washington produced their own "virtual" fieldtrips. These fieldtrips were broadcast throughout the day and were complemented by a "brown-bag" lunchtime broadcast from the Chesapeake Bay Reserve near Washington, DC., hosted by the U.S. EPA and NOAA.

Participation in *EstuaryLive!* broadcasts is a high priority for the APNEP, because the appeal and utility of Internet-based learning is indisputable. APNEP recently produced an *EstuaryLive!* session focusing on the Neuse River basin. The Neuse is 1 of 5 major basins in the APNEP region, covering an area of approximately 30,000 square miles in 36 counties in North Carolina and 19 counties in southeastern Virginia.

Feedback on *EstuaryLive!* has been positive and widespread. A survey of educators in 2000 revealed that 70% of participants were studying the estuary either as part of a life science curriculum or as part of North Carolina social studies (North Carolina is approximately 16% estuary). Fully 85% of participating teachers incorporated this experience in their curriculum. Following field trips, 70% of students completed projects or reports about their experience, while 5% were traditionally tested.

Many partners have helped to bring *EstuaryLive!* to life. The Carolina Estuarine Reserve Foundation (CERF), the Reserve's non-profit partner, has supported the program from the beginning, as has the state Department of Public Instruction's Emerging Technology office, which is the main Internet streamer. The Center for Math, Science and Technology Education at East Carolina University funded sessions through corporate donations and engaged staff and students to develop content. The University of North Carolina has sponsored sessions, while Duke University Marine Laboratory serves as the program's host site. The Rachel Carson Reserve, which manages and staffs the program, is part of the North Carolina Department of Environment and Natural Resources. Finally, Marine Grafics, Inc., through contributions of time, expertise, money and equipment, strives to produce the best *EstuaryLive!* programming possible.

This exciting outreach effort and partnership is the pride of the the Rachel Carson NERR and the Albemarle - Pamlico NEP. To find out more about *EstuaryLive!* go

to: www.estuarylive.org [EXIT disclaimer](#)



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www.apnep.org [EXIT disclaimer](#)



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Towards a Sustainable Coastal Sediment System on Cape Cod

A natural coastal sediment system consists of sediment sources, sediment transport processes, and sediment sinks where sediment accumulates, such as beaches and tidal flats. Left to itself, a natural coastal sediment system is constantly on the move, maintaining a balance between sediment supply and sediment loss. However, this equilibrium can be affected by man's activities.

The Town of Falmouth is located on the southern tip of Cape Cod, Massachusetts. It faces the Atlantic Ocean on the south and Buzzards Bay, a National Estuary, on the west. The sea thus surrounds Falmouth on two out of three sides. Falmouth once hosted a railroad for beach-bound tourists, a guano-processing factory that converted seabird guano to fertilizer, and a saltworks that produced sea salt. In the last century, coastal development boomed, as in many other coastal areas nationwide.

As Falmouth's coast became developed, residents tried to keep beaches, inlets and coastal bluffs in place. Stone and concrete groins were built to keep beaches from moving. Jetties were built to keep coastal inlets from filling in. Coastal bluffs were encased in concrete revetment or boulder riprap to keep them from eroding, in order to protect the houses perched on top. Much of the armoring was done in the latter half of the 20th century, following major hurricanes.



Such "hardening" is known as coastal armoring. But in trying to keep these coastal landforms in place by armoring them, Falmouth may have inadvertently caused its sandy shoreline to disappear even faster.



[View large map of Cape Cod shoreline change, 1840s to 1994](#)

In 1999, the Town's Planning Board Chairman, Jude Wilbur, raised concerns about the effect of coastal armoring on Falmouth's beaches. Dr. Wilbur, a coastal geologist, believed that coastal armoring could have damaged the shoreline by interfering with natural sand supply and movement. He questioned whether the Town's expenditures on coastal armoring projects were wise.

In 2000, following a public forum, the Board of Selectmen appointed a volunteer Coastal Resources Working Group (CRWG) to study the issue. The CRWG's mission was to: 1) Identify key factors determining the current condition of the sediment system along the south shore; 2) Explore reasons for the current condition; 3) Develop future scenarios of the shoreline based on physical processes and coastal management practices; and 4) Provide community outreach.

Erosion rate (foot/year)

The CRWG includes coastal geologists, educators, consultants, coastal landowners, ecologists, and a retired engineer and boat captain. They studied Town records, photographs, maps, scientific literature on coastal processes, rates of shoreline change, coastal regulations and management guidelines, and historical information. They took field trips, measured beach profiles, and consulted with experts. Scientists at nearby Waquoit Bay National

Estuarine Research Reserve analyzed land use using GIS and inventoried coastal armor in the field.

This spring, the CRWG issued their report. The CRWG found that in the last 30 years, the average erosion rate has increased by a factor of 5 to 10. This startling finding is based on new erosion rate data from the 2002 Massachusetts Shoreline Rate Change Study, which was produced for the Massachusetts Office of Coastal Zone Management by Rob Thieler and Jim O'Connell of the Woods Hole Oceanographic Institution Sea Grant Program.

The CRWG found that more than half of the coastal parcels along the south shore have been armored. Of these parcels with armor, about half are Town-owned. The inventory includes 70 groins, 10 jetties and 94 revetments. Furthermore, local sea level has risen by about 13 inches in the last century, and is expected to rise 19 inches over the next 100 years.

The dramatic increase in erosion of the south shore in fact appears to be due to a deficit problem: the sand supply has been cut off and sand transport has been blocked, so the coastal sediment system cannot renew itself. Sand supply to beaches is not keeping up with beach erosion because eroding coastal bluffs that

were important sediment sources have been armored. Jetties and groins are blocking sediment from moving along the shore and instead are diverting sand far offshore, to be lost from the system. Rising sea level has drowned the shoreline, compounding the problem.

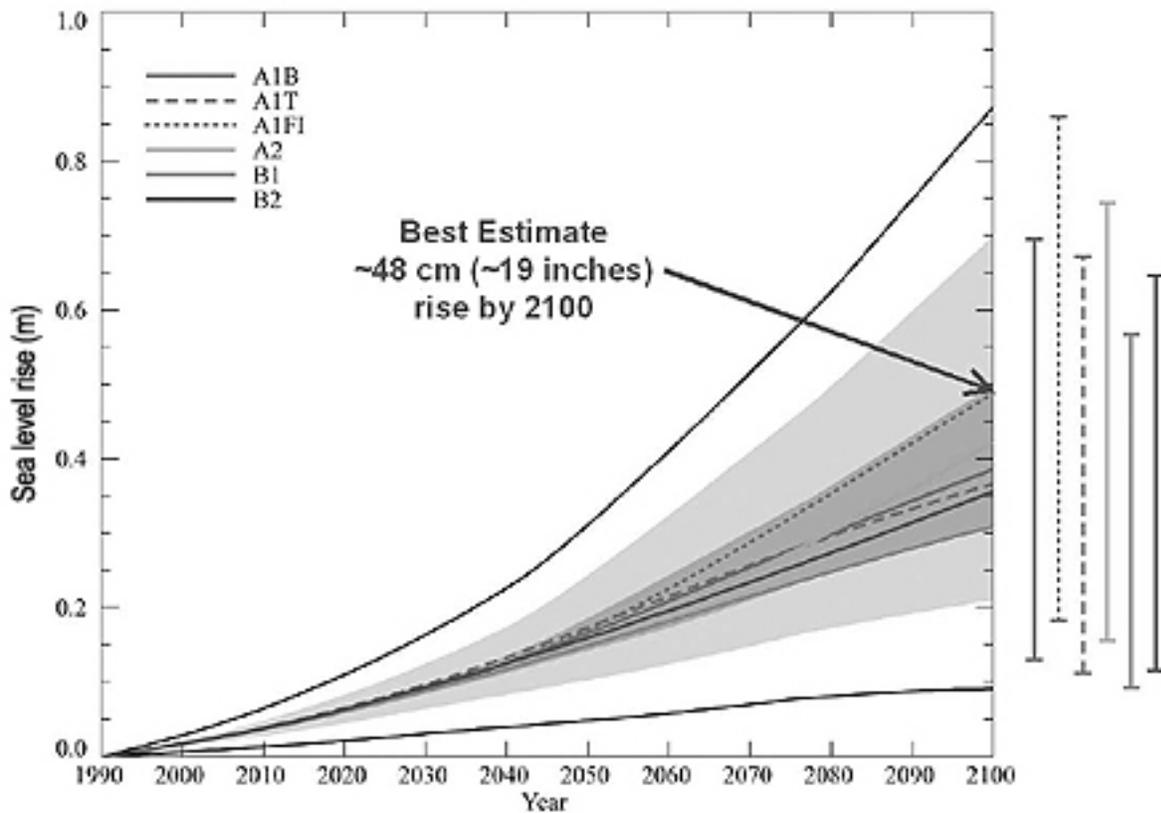


In short, the CRWG confirmed that the coastal system has been badly damaged by coastal armoring and rising sea level. In the words of the CRWG's ex-chairman, Rob Thieler, a coastal geologist with the U.S. Geological Survey, "The coastal sediment system is broken."

The CRWG evaluated two scenarios for the next 100 years. In the "No-Action" scenario, if present coastal practices are not changed, beaches will continue to be lost at an ever-increasing rate, and only artificially maintained beaches will be present in 2100. The shoreline will be narrower and contain few coastal dunes. Property damage from storms will be greater because protective beaches and dunes will no longer be present. Public access, coastal vistas, and habitat will suffer. Public funds will need to be spent on coastal armoring to protect coastal properties, which will worsen erosion, which will increase the need for armoring. Sea level will continue to rise and drown the shoreline.

But the future could be brighter if Falmouth helps the shoreline to be more self-sustaining. In this alternative scenario, sediment would be freer to move because there is less coastal armor. As a result, beaches and dunes would be wider because there would be enough sand in the coastal system to sustain these landforms. The Town would be better able to protect itself against storm damage because protective beaches and dunes will exist to buffer storm waves. Vulnerable public infrastructure would be moved inland from the current shoreline, reducing

public risk. Public access, vistas and recreation would improve, as would coastal habitat.



To achieve this vision, the CRWG proposes a 100-year action plan to: 1) Acquire and protect coastal open space, particularly sediment sources; 2) Encourage coastal buffers; 3) Start beach nourishment combined with removal or loosening of armoring, beginning with an experimental approach on Town parcels, 4) Encourage a "Coastal Pathway" and coastal ecotourism; 5) Develop economic incentives for naturalizing the coast; 6) Improve coastal regulations; 7) Provide public outreach to stakeholders, and 8) Change coastal management to emphasize planning, mitigation, problem prevention, and letting Nature do the work of sustaining the shoreline.

The CRWG's next task is to educate the public about the coastal sediment system. The biggest challenge? Persuading people to adopt coastal management practices based on working with natural coastal processes, not against.

Contact: Dr. Jo Ann Muramoto, Chairman, Coastal Resources Working Group, (508) 833-6600, Email: muramoto@cape.com. The report is available on the Town's website at www.town.falmouth.ma.us [\[EXIT disclaimer\]](#) and at the website for the Coastal Ocean Institute, Woods Hole Oceanographic Institution

(www.whoi.edu/institutes/index.htm , select "Coastal Ocean Institute").



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Maryland Bays Group Aims for Better Forests

Forests are generally considered the best land type for protecting water quality and wildlife habitat. Forests have one of the lowest nutrient export rates of any major land use and represent a natural feature which significantly protects water quality and mitigates flooding. Throughout the mid-Atlantic region and southeastern United States, however, timberland is yielding to plantation-style management, severe wetland degradation, and development.



That is why in Maryland, a group of foresters, landowners, and local, state and federal resource managers have devised a plan to promote forest retention and biological diversity in forests. Their vision includes incentives, tax breaks, and policy changes to prevent hydrological impacts and make it easier for landowners to retain older growth and hardwood forests. At the same time, they see forests and forestry as a preferred land use and the forest products industry as a key to maintaining biological prosperity on private lands.

Last year, the Maryland Coastal Bays Program assembled an unlikely group of foresters, scientists, environmentalists, and landowners. The subject: serious loss of forest to development in the northern part of the watershed and a change from the native hardwood/pine mix to loblolly

monoculture in the less-developed southern area. The odd bedfellows faced a daunting challenge - protecting biological diversity, water quality protection, property rights and wood production.

Located in what the Cornell Lab of Ornithology calls a place of "hemispheric significance" for songbird migration along the Atlantic Flyway, the 190,000-acre coastal bays watershed and its forests have seen significant changes over the past two decades. Development, subdivision of large tracts of forests, and statewide incentives for planting loblolly pine have led to declines in frog, turtle, salamander and songbird populations and are blamed for water quality impacts, especially in the northern bays.

From 2000 to 2020, 11.5 percent of the forests in the Coastal Bays watershed are expected to be lost to development. Analysis of 15-year trends show decreases in oak, hickory, gum and cypress populations which are already far below their natural numbers.

Unfortunately, the bulk of the remaining hardwood forests are in the northern part of the watershed. These are the Assawoman and Isle of Wight Bays, where planning forecasts show that 30-35 percent of the forests will be lost over the next 20 years, leaving less than 25 percent of each watershed with forest cover.

With these challenges in mind, the Natural Resources Conservation Service, Maryland Department of Natural Resources Forestry and Wildlife divisions, county planning staff, university herpetologists, private foresters and landowners, and the director of Worcester County Economic Development spent six months devising a plan to change it all.

The group focused on the state's Conservation Reserve Enhancement Program (CREP) which pays landowners for planting grass or trees along streams or ditches. A supplement to the federal Conservation Reserve Program, CREP creates incentives for loblolly pine planting by not offsetting the cost differential between pine and hardwood trees. Hardwoods generally cost three to eight times more than pine, plus about \$5 for each tree shelter, not generally used for pines. At harvest, pine brings in around \$2,000-6,000 per acre, versus hardwoods at about \$500 per acre.

The group has come up with a plan to use an up-front incentive payment for planting hardwoods. The state, private and federal sources are now being reviewed and amounts debated. The money will help encourage more hardwood plantings for

wildlife without punishing property owners. A debate over whether to raise hardwood minimum planting requirements prescribed by the state's CREP program was scrapped over fears that raising minimum planting requirements would simply decrease enrollment.

Among the plan's 43 recommendations was a call to either eliminate taxes on forestland or provide tax relief for lands containing hardwood, riparian, and older growth forests or extensive forested wetlands. Details are being hashed out so that local legislators can target relief funds. The plan also calls for a one-time tax credit for property owners who develop a forest stewardship plan. It also asks for sales tax exemptions for all equipment and pollution control devices used in primary and secondary wood production.

One urgent need is to change how forestry practices alter wetlands. Ditch-digging, road-building, truck tracks and bedding in wet areas is compromising natural hydrology in forestland. To avoid these problems, the plan calls for ditch plugging after tree harvesting is complete, maximum road widths to help diminish ditch sizes, and a change in laws to stop developers from using forestry ditch management exemptions to drain wetlands for development. The state will also be setting up pilot project areas to demonstrate the use of harvest techniques which can achieve environmental, recreation, and forestry goals. In the Coastal Bays watershed, more input will be sought on how state forestland is managed.

Maryland's Forest Conservation Act (FCA) mandates keeping percentages of development project in forest or paying into a mitigation fund. The group has asked for a policy change which would require that FCA funds only be used to create large, contiguous parcels rather than small, fragmented or non-contiguous areas (such as the margins of ball fields, recreational facilities or roadside strips).



To preserve water quality, the plan also calls for mitigation to be provided in the same subwatershed where the forest is being lost. To target the most valuable areas, the state is helping to identify where groundwater recharge areas, sensitive areas, wellhead protection zones, and high quality songbird habitat occur together, so planners can get the most out of easements.

The plan also calls for Worcester County Commissioners to remove golf courses from "allowable uses" on agriculturally zoned land, because golf courses typically remove much forest cover.

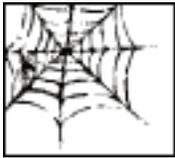
The most difficult step of implementing most of the actions remains, but the Forestry Group has helped to ensure a smoother transition from plans to actions. The final report is available at <http://www.mdcoastalbays.org> 

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What's New in the San Juan Bay Estuary Program?

San Juan Bay Estuary is located in the most densely populated area of Puerto Rico, near the city of San Juan. Approximately 622,000 people live in the 97-square-mile watershed, and 70% of its area is urban. This urban setting poses challenges for managing this tropical estuary system, but it also offers opportunities for public outreach because San Juan is a popular tourist destination.

San Juan Bay Estuary became part of the National Estuary Program in 1992, becoming the only NEP estuary outside the mainland U.S. Local government agencies, community leaders, scientists and the U.S. EPA prepared the Comprehensive Conservation and Management Plan (CCMP), which addresses four issues: 1) water and sediment quality, 2) fish and wildlife habitat, 3) aquatic debris, and 4) public involvement. The CCMP outlines 49 action items to restore and preserve this beautiful tropical estuary system.

Now, after ten years of scientific studies, public meetings, coordination and hard work, the San Juan Bay Estuary Program (SJBEP) is embarking in earnest on implementing their CCMP.

The San Juan Bay Estuary Program (SJBEP) has a team committed to implementing their CCMP. As the new Executive Director, Brenda Torres, stated: "Two different teams are needed for developing and implementing a Management

Plan. The people who develop it focus on research, while the people who implement the actions focus on management of projects."

Many implementation projects are being initiated this year. One of these, the Indicators Program, has particular importance and value for the SJBEP goals. A Long-Term Environmental Indicator program will help ascertain the effectiveness of implemented conservation/restoration efforts in the SJBE. Various environmental indicators integrating chemical, physical and biological phenomena will be examined to understand trophic and ecological complexity. These indicators include water and sediment quality, biological productivity and respiration, biotic distribution, and biota-pollutant interactions. This 4-year project will provide an important evaluation system.



Projects involving habitat and wildlife restoration include a Mangrove Restoration Project in Laguna del Condado. This project, which is partly sponsored by the NOAA Restoration Center, consists of planting hundreds of red mangrove trees along the Condado Lagoon, which is in the heart of the city. A Reef Enhancement Project will restore reef habitat by placing approximately 100 reef balls with coral heads throughout the lagoon. An underwater trail in Condado Lagoon will provide visitors with an amazing educational tour of ocean life and restoration projects. Such projects will make the Condado Lagoon an "environmental sanctuary" in the heart of the San Juan tourist district.

Together with the Fish and Wildlife Service, the SJBEP will be removing the invasive plant *Melaleuca quinquenervia* (Cayepu) in strategic areas of the estuary, and replacing it with native wetland vegetation. An aggressive reforestation plan is also being conducted in Islote Juan Perez, an island in the center of the mangrove-covered Piñones State Park. Mangrove trees in this area were severely impacted by Hurricane Hugo in 1995.

In terms of public education, the Program is working with the Department of Environmental and Natural Resources and with the Puerto Rico Tourism Company on various ecotourism projects throughout the estuary. There is an ongoing education campaign and school curriculum toolkit for teachers to use in their schools.



To encourage public involvement, the SJBEP conducted their first Bay Day (Festival del Estuario: Dos Ventanas; Tierra y Mar) where music, education, local environmental art and passive sports blended together. There were activities for children at a park for non-motorized inflatables, more than 25 environmental expositions, local "artesanos" selling environmental art, diving classes, kayaks and many other family activities. Bay Day also provided the setting for a formal agreement between the Program, community leaders, members of the legislature and numerous government agency directors, including EPA Caribbean Division Director Carl Soderberg.

The SJBEP is also participating in the 2003 International Coastal Clean Up, which is held annually worldwide on the third weekend of September and organized by The Ocean Conservancy. This will engage communities in solid waste management initiatives, and will help increase public awareness of the Program. This activity, combined with the 2004 International Clean Up Conference that will be held in Puerto Rico, will address many CCMP action items, particularly in the area of cleaning up aquatic debris. All of these projects and others will have a positive effect on the San Juan Bay Estuary.

The new SJBEP management team, which consists of an Executive Director, Environmental Manager, Public Outreach Coordinator and Office Manager, is determined to restore the natural environment of San Juan Bay, which has been adversely affected for many decades. All of the SJBEP staff and volunteers look forward to achieving their goals!

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Invasive Species Assessed

Last month, a team of approximately 25 aquatic invasion biologists, taxonomists, and National Estuary Program (NEP) staff, carried out a week-long rapid assessment of floating docks and piers in estuaries from New York to Portland, Maine. Last year, the Office of Wetlands, Oceans, and Watersheds' NEP funded a planning workshop, working with the Massachusetts Institute of Technology Sea Grant Program, that started this assessment. Participating scientists came from locations as far away as Wales, the Carolinas, and Seattle. The workshop established several goals for the assessment, including: (1) identification of exotic species not previously identified in the eight estuaries, (2) development of a baseline of native and exotic aquatic species in those estuaries, and (3) determining the presence of new invasive species that could threaten the health of the estuaries' ecosystems and of their shellfish fisheries, which are major contributors to the economies of the estuarine watersheds. Although complete identification of all species collected will take several months, preliminary findings indicate the presence of at least several new exotics in the surveyed estuaries.

The National Geographic Society filmed the effort for two-days for an upcoming segment on its "Explorer" television program. Articles about the survey appeared in local Portland, Portsmouth papers and can be accessed at the following websites <http://www.pressherald.com/news/local/030805invasive.shtml> [article no longer available], and <http://www.seacoastonline.com/news/08042003/news/43140.htm> [article no longer available]. For more information, contact Marilyn Katz at (202) 566-1246.



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NOAA Awards \$1.7 Million Grant to Restore America's Estuaries



The National Marine Fisheries Service (NMFS), an agency of the National Oceanic and Atmospheric Administration (NOAA), and Restore America's Estuaries (RAE) have announced a \$1.7 million grant to continue a three-year partnership to restore habitat vital to the conservation of America's coastal fisheries. The grant will provide more than \$3.4 million in 2004 for fisheries habitat restoration in 11

estuaries nationwide.

This award will allow RAE to continue habitat restoration projects that benefit marine, estuarine and riparian habitats in the Gulf of Maine, Narragansett Bay Long Island Sound, Hudson-Raritan Estuary, Chesapeake Bay, Albemarle and Pamlico Sounds, Tampa Bay, Louisiana's Mississippi Delta, Galveston Bay, San Francisco Bay, and Puget Sound.

For information on NOAA, visit <http://www.nmfs.noaa.gov/habitat/restoration/>

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. For further information on Restore America's Estuaries, visit

<http://www.estuaries.org/> [EXIT disclaimer ►](#)





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Free Watershed Academy Web Training CD Now Available

The Watershed Academy's online training program, Watershed Academy Web is now available on a free CD as well as on the Internet. This training CD contains 44 modules on the primary elements of watershed management, including watershed ecology, watershed management, and analysis and planning.

The CD also includes all the materials needed for the training certificate earned by over 500 individuals such as scientists, local, state and federal employees, community leaders, consultants, college students and teachers. The CD format allows users to save their limited web access time by moving through the training modules quickly and efficiently.

For more information on the Watershed Academy and the certificate program, please visit <http://www.epa.gov/watertrain/>



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NEW NERR! NOAA Announces Designation of the San Francisco National Estuarine Research Reserve

The National Oceanic and Atmospheric Administration (NOAA) and the State of California have announced the designation of the San Francisco Bay National Estuarine Research Reserve (NERR). The reserve will be the 26th in the national federal-state NERR partnership, the third in California, and the first addition to the program since 1999.

San Francisco began the application process to join the NERR program in 1989. Dr. Jaime Kooser will be the manager for the new NERR, which will focus on tidal marsh restoration, research, education, and stewardship programs. San Francisco has lost thousands of acres of tidal wetlands due to development of the region, but over the past 5 years various partnerships and programs have restored close to 11,500 acres. One goal of the new programs will be to help facilitate the planning and restoration of 25,000 additional acres.

The San Francisco Bay NERR is a partnership between NOAA, San Francisco State University's Romberg Tiburon Center, California State Parks, the Solano Land Trust and the Bay Conservation and Development Commission. The reserve covers over 3,700 acres in two sites: China Camp State Park (1,640 acres) in San Rafael, Marin County, and the Rush Ranch Open Space Preserve (2,070 acres) located

near Fairfield and Suisun City in Solano County.

For information on the new San Francisco Bay NERR, visit

<http://nerrs.noaa.gov/SanFrancisco/welcome.html> . For further

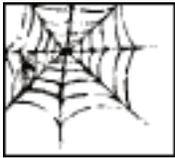
information on the National Estuarine Reserve System, visit <http://nerrs.noaa.gov/>

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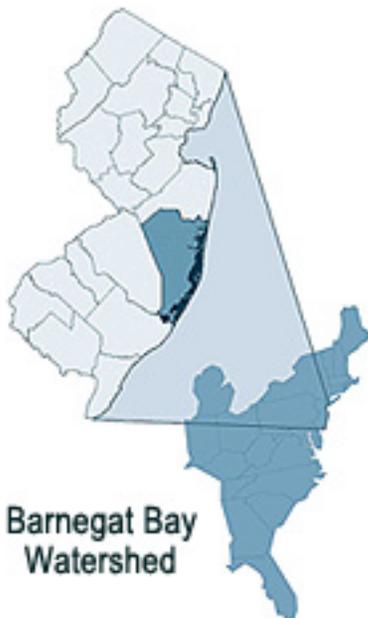


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A "Ground Breaking" Partnership For The Barnegat Bay Estuary Program

Introduction

Barnegat Bay is a magnificent estuary, providing habitat for many native and migratory species. Clean water and open space, combined with opportunities for recreational fishing, swimming, and boating, have attracted numerous tourists and rapid development to the Barnegat Bay watershed in the last 50 years.



But development and urbanization have increased impervious area in the watershed, caused protective vegetation to be removed, and compaction of sandy soils. As a result, there is reduced groundwater recharge, and fresh water inputs to Barnegat Bay have changed. The resulting stormwater runoff from urbanized areas of the watershed is the most significant source of pollution threatening the Bay.

Historically, stormwater management has relied largely on the use of stormwater basins to collect and detain water. The Barnegat Bay Estuary Program (BBEP) recognized that these basins provide an excellent opportunity to improve water quality, replenish ground water, and help maintain

wetlands. An estimated 3,000 basins exist in the Barnegat Bay watershed, though many do not function adequately. The BBEP agreed to take a broader look and consider what can be done to make these basins function more like living ecosystems in order to improve habitat, increase groundwater recharge, improve water quality, and protect downstream wetlands.

Background

Barnegat Bay was accepted into the National Estuary Program for its aesthetic, economic, and recreational values. The Barnegat Bay Advisory Committee identified three major areas of management concern: nonpoint source pollution and degrading water quality; habitat loss and alteration; and human activities and competing uses.

These three themes are the focus of the Comprehensive Conservation and Management Plan (CCMP) for Barnegat Bay. This Plan contains many action items to maintain the quantity and quality of freshwater inflows to the bay, including retrofitting retention and detention basins and restoring stormwater basins to increase infiltration of stormwater runoff and groundwater recharge.

Project Overview

The Barnegat Bay Estuary Program has literally forged a groundbreaking partnership with various Federal, State, and County agencies to use innovative stormwater management practices. A major goal of this project is to restore soil health in the existing basins and restore native vegetation. By focusing on restoring physical, chemical and biological functions of the soil, groundwater recharge will increase and nonpoint source pollution will be reduced. The use of vegetation in stormwater management systems is important because plants absorb and filter out nutrients and pollutants and improve water quality. Such living stormwater management systems are sometimes referred to as "Rain Gardens."

Many partners are working together in this endeavour. The Ocean County Planning Board is coordinating the project, using a grant from the New Jersey Department of Environmental Protection. The USDA Natural Resources Conservation Service (NRCS) provided technical guidance. The Ocean County Mosquito Commission, Health and Engineering Departments and the Ocean County Soil Conservation District identified basins that have failed to recharge runoff. The Ocean County Road Department is assisting in the renovation of the basins.

Restoring Soil Health

Some 80% of the soils in the Barnegat Bay watershed are mapped as sands or loamy sands. These coastal plain soils have rapid infiltration rates ranging from 6-20 inches per hour. In a wooded, undisturbed condition, sandy soils absorb and infiltrate precipitation and produce little or no runoff for most storm events.

Soil porosity determines how quickly rainfall percolates through soils to the groundwater deep below the surface. Soil porosity refers to the amount of pores in soil, including large, medium, and small pores. The greatest concentration of large pores, called macropores, is closest to the surface. Macropores act like a funnel, allowing water to enter the soil as saturated flow to a maximum depth. Rainwater typically follows the channels created by roots of native plants.



Soil porosity of undisturbed, uncompacted soils is greater than that of compacted soils. Soil compaction occurs when native vegetation is removed and when heavy equipment crushes the large macropores into a massive cohesive layer. This increases soil bulk density, which slows the infiltration of water into soil. Groundwater recharge decreases, and the amount of stormwater runoff increases.

Coastal plain soils are very susceptible to soil compaction. High soil bulk densities indicating soil compaction are found in many stormwater basins. Soil compaction causes basins to hold water for extended periods, making it difficult to establish vegetation, increasing habitat for disease-carrying mosquitoes, and reducing groundwater recharge.

Previous studies conducted by the Natural Resource Conservation Service, an engineering firm (Schnabel Engineering), and the Ocean County Soil Conservation District have confirmed that many basins are compacted near the surface and have standing water.

Project Implementation

Following recommendations provided by the NRCS and the Ocean County Soil Conservation District in 2002, work began with restoring the hydrologic functions of three stormwater basins in Dover and Manchester Townships in Ocean County. Work is currently underway on two additional basins.



Restoring the physical function of a basin basically involves a "dig and drop" process to restore soil porosity so that plants and soil organisms can thrive and the soil can infiltrate rainwater. The restoration procedure involves the following steps.

Before restoration, the basin is evaluated to measure soil bulk density, depth of compaction, and to classify soil texture. In the coastal plain of New Jersey, soils are generally very acid. If soil testing indicates high pH, lime and gypsum are provided to help balance nutrients and encourage plant growth.

Compost from the Ocean County recycling center is then added to each basin to support soil organisms. This organic matter is spread over the bottom of the basin and is mixed into the soil throughout the excavation process.

Finally, the basin is seeded with a mixture of drought-tolerant and native grasses. Native shrub and tree seedlings are planted to mimic a natural wooded depression or rain garden. Native plants reduce or



eliminate the need for mowing, and help to capture and cleanse stormwater, which can then percolate down through the soil to recharge groundwater.



Results and Accomplishments

This project has demonstrated the importance of improving soil health in stormwater management. Results from the restored basins show that runoff is being adequately infiltrated; within one day following a major storm event, these basins are dry. Before restoration, the basin in Manchester Township held water for 29 years, and the basins in Dover Township held water for 6 years.

Protection of public health has also benefited. Prior to restoration, residents in nearby neighborhoods voiced concerns about mosquitoes that were breeding in standing water in basins. Following restoration, the risk of mosquito bites fell, because mosquito breeding habitat had been eliminated.

This project shows that basins can be renovated as low-maintenance living systems that effectively treat and infiltrate stormwater. The methods and materials needed to restore healthy soils and vegetation are simple and easily obtained. Renovation provides a cost-effective alternative to building new stormwater treatment facilities. Finally, the use of native plantings reduces or eliminates mowing needs, cleanses stormwater runoff, recharges groundwater, is visually attractive, and provides wildlife habitat.

As the need for control of nonpoint pollution increases, soil profile restoration in stormwater basins will be an important tool for improving water quality and water supply. As the Barnegat Bay Estuary Program works to restore the entire estuary, improving stormwater management will continue to be a top priority.

To obtain a copy of the report, *The Impact of Soil Disturbance During Construction*

on Bulk Density and Infiltration in Ocean County, New Jersey, go to www.ocscd.org. For further information, refer to Soil Quality Urban Technical Note No. 2, March 2000, prepared by the Soil Quality Institute, Natural Resources Conservation Service, U.S. Department of Agriculture.

For further information, contact:

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