Narragansett Bay Estuary Program

Number 13 • Fall 2008

NARRAGANSETT BAY JOURNAL

# Global Warming: It's Here!

Chip Young

If you don't believe in global climate change—believe in it locally. Because it's already here.

On August 21, U.S. Senator Sheldon Whitehouse chaired a hearing on "Global Warming's Impacts on Narragansett Bay" at the University of Rhode Island's Graduate School of Oceanography (GSO) in Narragansett, R.I. Testifying on the issue were Kate Moran, associate dean of GSO and an international expert on climate change; Grover Fugate, executive director of the R.I. Coastal Resources Management Council, which has just put together a comprehensive plan to deal with sea level rise in the state; John Boothroyd, Rhode Island state geologist; John Torgan, Baykeeper for Save the Bay; and Caroly Shumway, director of conservation science for The Nature Conservancy's Rhode Island chapter.

**Will Waterfire be held in the Providence Place Mall?**

Major themes that emerged from the meeting: global warming is a reality; its impacts are, if anything, understated; we need to plan—and plan now—for a greatly altered geography; the scientific community must frame the issue in terms that the "man on the street" can understand; and the tremendous cost—to everyone—if we fail to act.

"Unequivocal." That one word projected on a huge, single slide by Dr. Moran led off the briefing—meaning that, in the opinion of the vast majority of world's scientific experts, it is unequivocal that global warming is happening, and that humans are the cause of it.

The audience needed only to go outside the auditorium to see a concrete—or rather, watery—example that backed up that statement. Narragansett Bay's average temperature has increased by two degrees Fahrenheit in the last 30 years. In ecological terms, that's a huge jump. The Bay is becoming, environmentally, more like a Mid-Atlantic estuary, like Chesapeake Bay or those in North Carolina. Warmer temperatures increase the occurrence of low oxygen conditions—think suffocating marine life and large fish kills (see "Something Fishy," page 11). Fisheries populations are adapting and changing—possibly for better, possibly for worse, both economically and ecologically. Predatory jellyfish that consume fish larvae before they can mature are now in the Bay earlier and longer than in past years.

Among doubters, scientists are often portrayed as hysterical Chicken Littles, running around screaming about the end of the world.

*—Global Climate Change continues on page 8*

Johan Bjurman at work on a new mural of Narragansett Bay and its marine life, now on display at the Narragansett Bay National Estuarine Research Reserve on Prudence Island. For more on the NBNERR, see page 12. *Photo: Kristin Van Wagner.*

## Climate Change

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Don't miss a thing about the Bay! Visit www.nbep.org to receive future issues of *NBJ* and view web-only features about Narragansett Bay!

# Bay Program Releases "Status and Trends" Report

In August, Governor Deval L. Patrick of Massachusetts signed a $250 million environmental bond measure for land protection, river restoration and other conservation measures. Four years earlier, Rhode Island voters approved a $60 million bond for watershed restoration and open space. Time and again, citizens of the Narragansett Bay region have demonstrated their commitment to natural resources—truly our "common wealth"—by approving funds for environmental protection. By one estimate, roughly $400 million in state and federal funding is spent annually on environmental protection in the two states—on everything from wastewater to wildlife.

On the ground and in the water, these figures represent thousands of individual projects—past, present and future—throughout Rhode Island and Massachusetts. But how do we know which investments are most effective—and which could be put to better use elsewhere? How do we know what's working, and what's not? And how do we anticipate future needs—trends today, such as global warming and sea level rise, which require adaptation and action by communities, government, businesses and voters?

The Narragansett Bay Estuary Program is helping to answer these kinds of questions with a new Status and Trends report on Narragansett Bay, released for public review in September. The report provides a comprehensive look at the environmental condition of Narragansett Bay and its watershed—nearly 2,000 square miles in two states. Worcester and Westerly, Narragansett and Newport—and of course, Providence, Fall River and

*—Status and Trends contintues on page 9*

Narragansett Bay Estuary Program
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# NARRAGANSETT BAY JOURNAL

The purpose of the *Narragansett Bay Journal* is to report on all aspects of the Bay—ecological, economic, scientific, historical and cultural—in order to encourage a new and broader dialogue about the future of Narragansett Bay. *NBJ* is published quarterly by the Narragansett Bay Estuary Program (NBEP).

The *Narragansett Bay Journal* is distributed free throughout the Bay watershed and beyond; bundles are available for distribution on request. Publication is made possible by grants from the U.S. Environmental Protection Agency (EPA) through the National Estuary Program. The views expressed herein do not necessarily reflect those of NBEP, EPA, or the University of Rhode Island.

The *Narragansett Bay Journal* welcomes letters, articles, photographs, story ideas, drawings, poems, cartoons, etc. Most of the material published in the *NBJ* may be reprinted free of charge with permission— for details, contact the editor.





### The Narragansett Bay Estuary Program

The Narragansett Bay Estuary Program is one of 28 National Estuary Programs, a nationwide network of coastal watershed programs created under the Clean Water Act. NBEP's purpose is to protect and restore Narragansett Bay through collaborative action and sound science. Visit us online at **www.nbep.org**. For more information, contact Richard Ribb, Director, (401) 874-6233, **rribb@nbep.org**.



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# from the Director
# Richard Ribb

Narragansett Bay and its watershed are an ecosystem—a complex, interactive community of living organisms (including people) and the nonliving materials of their surroundings. As one of 28 National Estuary Programs created under the Clean Water Act to promote environmental management at the ecosystem level, the Narragansett Bay Estuary Program is developing a new "Status and Trends" report on the Bay and its watershed (story, page 1). Our goal is to characterize the condition of the ecosystem and begin tracking indicators, to measure changes and trends. Early in 2009, we'll host a public forum to present the results. A public review draft of the report is online at **www.nbep.org**. We welcome your comments, so log on and send us your thoughts.

Speaking of changing systems, this issue marks a change in our approach to distributing the *Narragansett Bay Journal.* To reduce costs—and conserve resources—we'll print and mail just one hard copy annually, and initiate a quarterly electronic issue. Subscribe on line to receive the electronic *Bay Journal* as well as notices of upcoming events such as the Narragansett Bay Status and Trends forum. We hope you'll join us in making this transition, so that the *Narragansett Bay Journal* can continue to provide you with news and perspectives regarding our Bay and its watershed.

*—Richard Ribb is director of the Narragansett Bay Estuary Program.*


## To Our Sponsors—Thanks!

The *Narragansett Bay Journal* is published by the Narragansett Bay Estuary Program, with additional funding from:

- ❑ U.S. Environmental Protection Agency;
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- ❑ Private donations.

To find out how you can help make publication of the *Narragansett Bay Journal* possible, contact Thomas Ardito, editor, at (401) 874-6492.


## Subscribe On Line at www.nbep.org!

The *Narragansett Bay Journal* is changing its distribution. Beginning with this issue, we'll print just one paper issue per year—our Fall issue, which we'll continue to mail to subscribers. Our Winter, Spring and Summer issues will be produced as electronic issues only, and will be emailed to subscribers. These changes will reduce our production costs and allow us to resume quarterly production of *NBJ*.

Visit our website to subscribe to both the paper and electronic editions of the *Narragansett Bay Journal*—so you won't miss a thing regarding Narragansett Bay! And by the way—we'll keep your address and email confidential. NBEP doesn't sell its mailing lists, and will use your information strictly for providing you with news and events regarding Narragansett Bay!

Thank you!

## Where's the Bay Calendar?
Lesley Lambert

***The Narragansett Bay Journal*** is going electronic—well, almost. Beginning this fall, we'll print and mail just one paper issue a year. Quarterly, we'll distribute electronic issues of *NBJ*.

We'll no longer publish **Bay Calendar.** To stay up-to-date with happenings around the Bay—and post your own—check out the following on-line calendars:

**Natural News Network (www.natural news.net)** is Rhode Island's own online magazine about your environment—the news and info you need to explore it, have fun outside, keep up with local issues, live greener, and get involved.

**What Grows On in Rhode Island (www. whatgrowsonri.com)** calls itself "Little Rhody's comprehensive 'green' events and activities listing service." This site provides a detailed calendar of everything from council meetings to guided nature walks.

The website of the **Narragansett Bay Research Reserve (www.nbnerr.org)** provides calendars and events, links to tide charts, and updates on research and stewardship activities at Reserve headquarters on Prudence Island.

**The University of Rhode Island** is hosting a series of talks this fall in Kingston, R.I., titled "People and Planet: Global Environmental Change." Learn about global warming, its causes, effects and solutions from scientists who are pioneering the research. The schedule is on line at **www.uri.edu/hc.**

*Lesley Lambert is an environmental scientist with the Narragansett Bay Estuary Program.*

# A Tale of Two Rivers: Taunton River, Buckeye Brook Seek "Wild and Scenic" Status

## U.S. House Recognizes Taunton River's Significance

Carolyn LaMarre

*Protect what you love.* In southeastern Massachusetts, that means designating the Taunton as a national Wild and Scenic River.

The Taunton River is the largest source of fresh water to Narragansett Bay. Its 40-mile course is undammed and free-flowing. The core of the Wild and Scenic designation is to enable communities to preserve the river in a free-flowing condition. However, the road to getting this designation is *not* free-flowing.

In 2001, stakeholders and communities came together to form the Taunton Wild and Scenic River Study Committee, which examined the river's outstanding natural values as well as the economic benefits it provides. After a thorough analysis, the study group recommended Wild and Scenic designation for the Taunton. Ten communities (Berkley, Bridgewater, Dighton, Fall River, Freetown, Halifax, Middleborough, Raynham, Somerset, and Taunton) agreed on the future of the river—and fortunately, we in the Taunton River Watershed have a lot to work with.

Amazingly, the Taunton is the largest undammed coastal river in New England. It flows over 40 miles from one urban center (Taunton) to another (Fall River) and then into Mount Hope Bay, the northeastern corner of Narragansett Bay. Along the way, it passes through forests, farms and wetlands. For the 500,000 residents of the Taunton River Watershed, it is our "source to the sea" providing natural habitats, heritage, beauty, and sustenance. By contrast with Narragansett Bay's other large tributaries, the Taunton flows at a gentle slope, creating a wide, meandering home to 154 bird species and 45 fish species. It provides habitat for rarely seen bald eagles, ospreys, river herring, and a variety of rare fish and plants.

And the past is ever-present along the Taunton River. Over 10,000 years of history have been uncovered at archaeological sites along the river corridor. Prehistoric peoples found the river to be a source of herring and shad for food and fertilizer. The rich agricultural land was put to good use to support their settlements. Native people called it the Great River or "Tetequet" and evidence of stone and wooden fishing weirs has been found. The Pocassets, one of the Wampanoag tribes, settled throughout the area and their heritage is still evident. During the colonial period, the river and its tributaries were a source of power for mills, shipbuilders, textile factories and iron forges. It was also a reliable way to transport goods to the Bay for export to other ports.

Today, there are parks and trails along the river's shores. From Taunton's Gertrude Boyden Wildlife Center on the Three Mile River (an important stopover for migrating birds) to Dighton State Park (home to mysterious ancient petroglyphs) to Heritage State Park in Fall River (with the world's largest collection of 20th century U.S. Navy fighting vessels), the century-spanning heritage adds to the natural treasures found here.

In a canoe or kayak, you can see the river's natural and historic assets up close. Each fall, the Taunton River Watershed Alliance sponsors an archaeological canoe trip along the Nemasket River, a tributary of the Taunton in Middleborough and Lakeville. Along much of the river, paddlers can see large areas of intact flood plain forests inhabited by great blue herons, osprey, bald eagles, diamondback terrapins and other rare turtles. Fishing in the river presents the unusual prospect of catching both fresh and salt water fish, including striped bass, bluefish, and largemouth bass. Wild and Scenic designation will help us place signs and kiosks to teach the rich heritage of the Taunton.

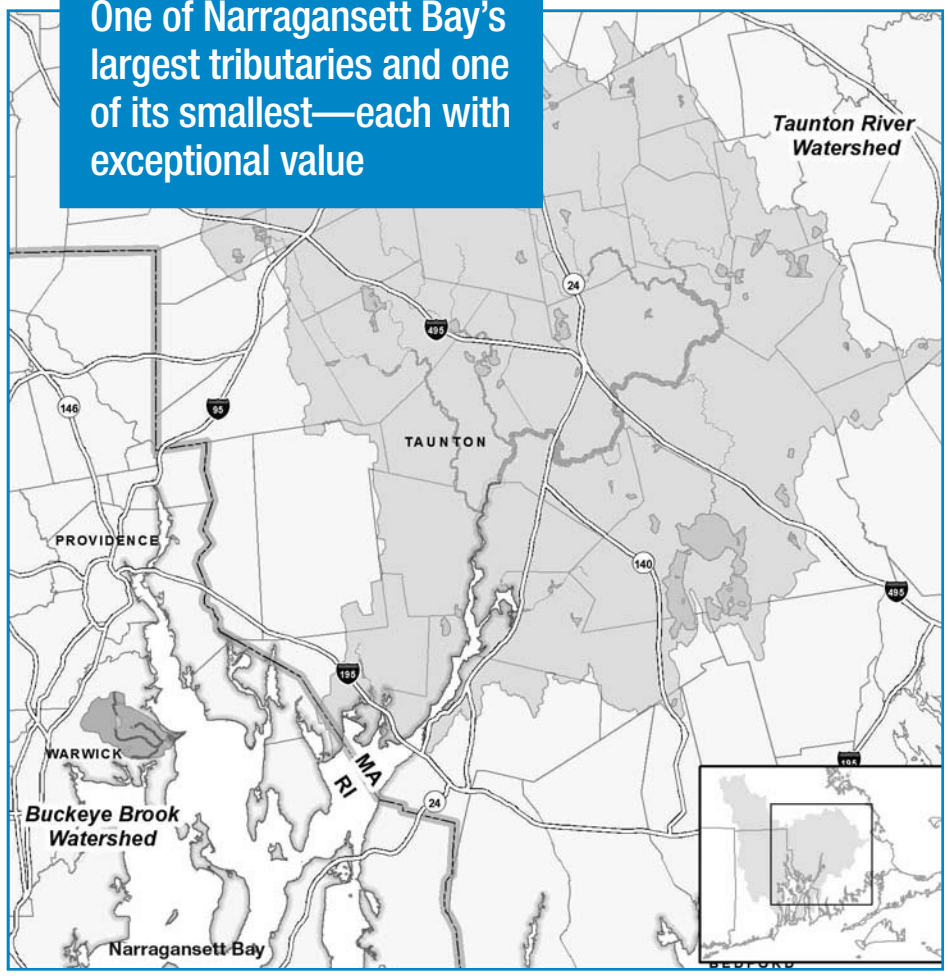
On July 16, 2008, a resolution designating the Taunton a Wild and Scenic river passed the U.S. House of Representatives by a vote of 242 to 175. It was a long, hard battle led by Reps. Barney Frank, Jim McGovern and Patrick Kennedy against arguments suggesting that the only thing scenic was the graffiti in Fall River and the only thing wild was the gangs that painted them. Opponents suggested that the designation was nothing more than a sham to prevent construction of the liquefied natural gas (LNG) terminal proposed for Weaver's Cove in Fall River.

Designation of the Taunton River as "Wild and Scenic" will not prevent development or give federal authorities control over private property. Rather, it is intended to balance protection of natural resources with economic development of the surrounding communities. The designation will be supported by a comprehensive river management plan that considers resource protection, land development and other measures to achieve specific goals. With designation will come federal assistance to help our communities affirm our natural heritage and bring back indigenous species. We know that preventing low flows, improving fish passage, removing dams and ensuring clean waters are key to the Taunton River's survival.

Fortunately, we are presented with the opportunity to preserve and restore the Taunton River through "Wild and Scenic" designation. Now on to the U.S. Senate for final approval!

*Carolyn LaMarre is executive director of the Taunton River Watershed Alliance in Taunton, Mass.*

**One of Narragansett Bay's largest tributaries and one of its smallest—each with exceptional value**




The Buckeye Brook and Taunton River watersheds. *Map by Paul Jordan.*

### Go Deeper!

For more on the Taunton River and TRWA, check out www.savethetaunton.org

For more on the National Wild and Scenic Rivers System, check out www.rivers.gov

## Buckeye Brook—Winding Through History

Thomas Ardito

The Allagash River in Maine. The Snake River in Idaho. Buckeye Brook in Warwick, R.I.?

If Steve Insana gets his way, one of Narragansett Bay's smallest tributaries will soon join the pantheon of America's greatest waterways as a national "wild and scenic river." The designation has been granted to more than 160 other rivers, usually through an act of Congress. There are "wild and scenic" rivers from Alaska to Florida—though none, yet, in Rhode Island.

Buckeye Brook winds five miles through suburban Warwick. It begins at Spring Green Pond, flows along the eastern edge of T.F. Green Airport and through Warwick Pond, then enters Narragansett Bay at Mill Cove, just south of Conimicut Point. Along the way, it passes through subdivisions, under roads, behind parking lots—and through some remarkably natural areas of forest and wetland.

The stream might seem an odd choice for "wild and scenic" status—yet to Insana and his supporters in the Buckeye Brook Coalition, it's every bit as valuable as the Allagash or the Snake. After spending a morning with Insana, poking into hidden corners of Warwick and seeing the brook through his eyes, one has to agree that it is, indeed, a very special place.

One scorching morning in July, Insana led a half-dozen government officials and local stakeholders on a trip along the brook, with the goal of convincing Jamie Fosburgh, rivers program

*—Buckeye Brook continues on page 10*

NARRAGANSETT BAY IN BRIEF

# River Restoration Efforts Pay Off

Thomas Ardito

## Fish Ladders and Dam Removals Under Way Around the Bay

Years of planning, engineering and fundraising to restore migratory fish runs to the rivers of Narragansett Bay are beginning to pay off.

In Rhode Island, four new fish ladders have been built over the past several years. On the Woonasquatucket River in Providence, for example, the Woonasquatucket River Watershed Council completed a fish ladder at Rising Sun Mills this spring; a few weeks later, native river herring were swimming upstream to spawn. Just upstream at Atlantic Mills, another fish ladder is under construction, and the watershed council is planning to remove two dams, at Paragon Mills and Dyerville.

Elsewhere in Rhode Island, major river restoration projects are planned for the Ten Mile, Blackstone, Pawtuxet and Pawcatuck Rivers. The Ten Mile River project, scheduled for next year, will construct three large fish ladders in East Providence, R.I., at Omega Pond, Hunts Mill and Turner Reservoir, providing migratory passage for river herring, American shad and eels. In Massachusetts, Save The Bay and partners completed construction this summer of a fish ladder in Rehoboth, on the Palmer River at Shad Factory Pond. The facility will provide access to spawning habitat for shad, herring, brown trout and eels. Two more river restoration projects are under way on tributaries of the Taunton River—one on the Three Mile River and another on the Mill River, both in Taunton, Mass.

Together, these projects are restoring populations of migratory fish which have been in decline for hundreds of years, when Europeans began building dams throughout the Bay watershed to power mills and factories. Fish run restoration provides broad ecosystem benefits—herring, shad and eels are important to Narragansett Bay's food web, serving as prey for salt water fish such as bluefish and striped bass, fresh water fish like largemouth bass and pickerel, and predatory birds such as herons, osprey and cormorants. For more information on fish passage restoration around the Bay, see our website, **www.nbep.org**.

## Rocky Point Shoreline Preserved

Generations of Rhode Islanders share fond memories of Rocky Point amusement park in Warwick, R.I. Since 1995, however, when the venerable park declared bankruptcy, the future of one of the largest parcels of coastal property on Narragansett Bay has been uncertain.

In August, the question was partially resolved when the city of Warwick finalized purchase of 41 acres along the shoreline of Narragansett Bay, which the city will manage as open space and for recreation. The acquisition was funded with $4.4 million in federal, state and local funds.

The fate of the interior of the property—about 82 acres—remains up for grabs. A plan to redevelop the property as high-end housing fell through, and the land, now held by the federal Small Business Administration, is again for sale. Open-space advocates are urging the state to acquire the land to create a coastal park, much like Colt State Park in Bristol, R.I. Other proposals for re-use of the property include redevelopment of the existing pier for ferries to Newport or Providence, and even the development of a wind farm to produce non-polluting electricity.

Andy Lipsky of the Natural Resources Conservation Service examines the new fish ladder at Rising Sun Mills in Providence. NBJ *photo.*

## NOAA Proposes Saltwater Angler Registration

In June, the National Oceanic and Atmospheric Administration proposed a national registry of saltwater anglers. Under the proposed rule, recreational fishers who fish in federal waters (generally, between three and 200 miles offshore) or who catch anadromous fish such as striped bass would be required to register, beginning January 1, 2009. There would be no fee for registration during the first two years of the program, but NOAA states that, beginning in 2011, there is likely to be an annual fee of $15 to $25.

The purpose of the measure is to improve NOAA's ability to collect information on recreational fishing catch, in order to improve fisheries management. States which already require salt water recreational fishing licenses may be exempted from the registry requirement if their licensing programs provide sufficient information for management. At present, states in the Southeast and West Coast generally require salt water recreational fishing licenses, while those in the Northeast do not.

Ultimately, the effect of the proposal may be to force Northeastern states to adopt saltwater fishing license programs. For more information, see **www.countmyfish.noaa.gov**.

## Hydrokinetic Energy Project Proposed for Sakonnet River

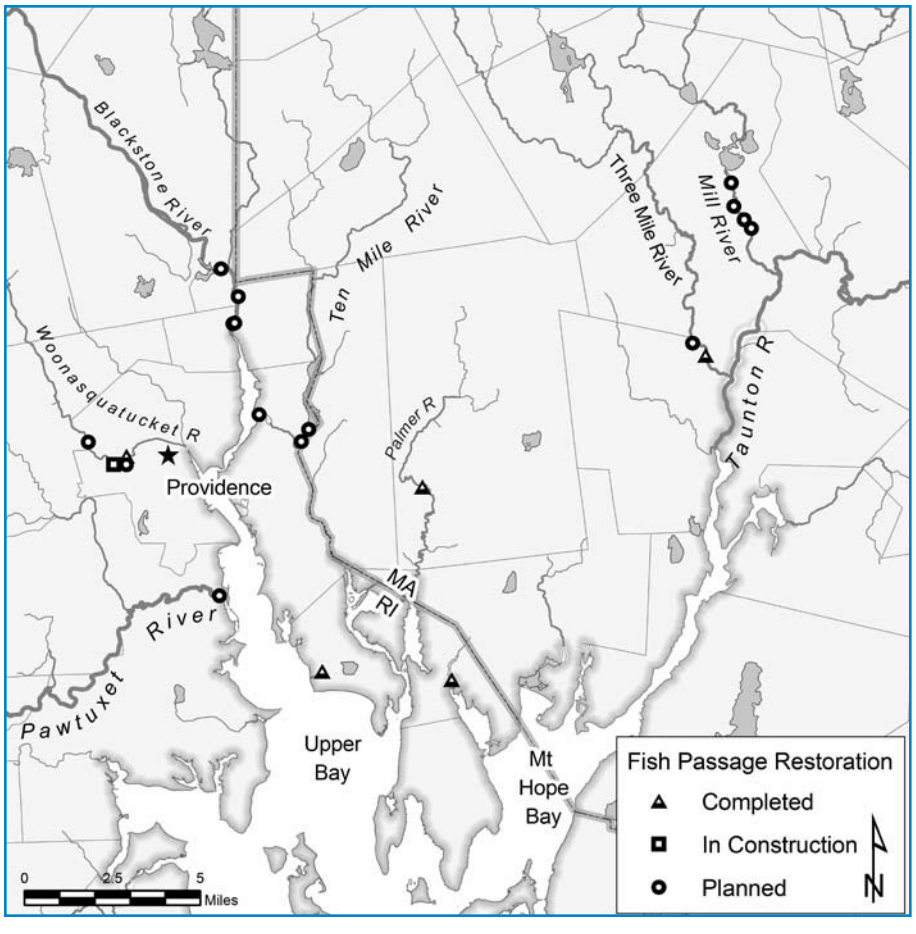
In August, the Federal Energy Regulatory Commission accepted an application from Rhode Island Energy Group, LLC, to develop a hydrokinetic generating station in the Sakonnet River, the easternmost arm of Narragansett Bay between Portsmouth and Tiverton, R.I. Hydrokinetic generators are in-stream turbines which produce electricity without use of a dam, as is necessary for conventional hydroelectric facilities.

If completed, the proposed facility will harness tidal energy with a turbine located in the Stone Bridge area, about a mile south of Route 24, where the Sakonnet River narrows, causing strong currents as the tide runs into and out of Mount Hope Bay. The company projects that the generator will produce about 2,000 megawatt-hours of electricity annually, enough to power about 200 homes. Cost of the project is estimated at $3 million. If approved, the permit will grant the company three years to develop and test the facility.

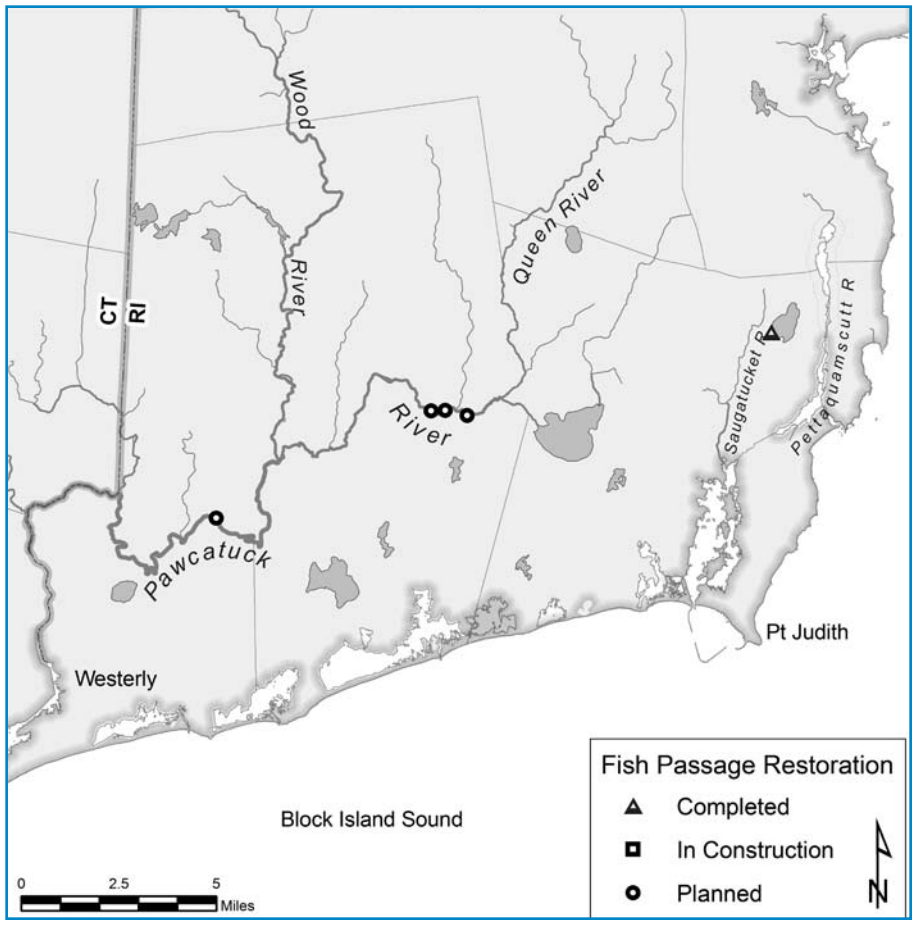
## Providence Hosts National Conference on Coastal Restoration

In October, a national organization dedicated to the restoration of coastal ecosystems, Restore America's Estuaries, will hold its biennial meeting in Providence. More than a thousand restoration practitioners—from technical experts to community advocates—are expected to participate in technical and policy discussions on topics ranging from shellfish restoration to sea-level rise.

Although the conference will feature presentations on restoration projects underway throughout the country and the world, its location will give participants the opportunity to see the work going on here on Narragansett Bay. Local organizations such as the Narragansett Bay Estuary Program and Save The Bay are hosting "field sessions" to show participants local river and wetland restoration projects and even let them get their hands dirty, helping Save The Bay plant native vegetation along the shoreline of its Explore the Bay Center at Field's Point, Providence. More information at **www.estuaries.org**.




River restoration projects in the Narragansett Bay watershed. *Map by Paul Jordan.*




River restoration projects in southern Rhode Island. *Map by Paul Jordan.*

## Get Out and Enjoy the Watershed with ExploreRI.org!

Meg Kerr

Fall is a great time to paddle the rivers, lakes and coastal waters of the Narragansett Bay watershed. The foliage is beautiful, the water is still warm and there are so many great places to explore! Before you go, check out our new web site, **ExploreRI.org**, to learn about the many places throughout Rhode Island where you can launch a canoe or kayak. The site's interactive map includes detailed information on over 200 boat ramps and launch sites throughout the state—with more sites added on a regular basis. If you don't own a boat or would like to participate in an outing led by an experienced professional, **ExploreRI.org** lists canoe and kayak outfitters throughout the area.

*Meg Kerr is watershed and community outreach coordinator with the Narragansett Bay Estuary Program.*

**Send your Bay in Brief tips to tom@nbep.org**

## R.I. Commission Develops New Bay Plan

### Goal is Integrated Management

Ames Colt

Rhode Island faces new challenges in protecting and restoring natural waters and watersheds, and managing common property resources such as marine fish and groundwater. Today, the key imperatives for the state include:

- Adapting to climate change;
- Coastal waterfront development and re-development;
- Maintaining public access;
- Dredging and dredged materials management;
- Maintaining the well-being of freshwater ecosystems and drinking water supplies;
- Developing ocean renewable energy resources;
- Sustaining commercial and recreational fisheries;
- Encouraging aquaculture;
- Protecting and restoring freshwater, estuarine, and marine habitats; and
- Preventing aquatic invasive species.

These issues entail multiple environmental, socio-economic, and cultural factors, and pose substantial risks and costs to the future well-being of Rhode Island. Their socio-economic impacts are multiplying and their solutions will demand significant public and private investment and commitments.

How, therefore, can we bring Rhode Island environmental and economic governance into the 21st century? Our governmental, non-profit, business, research, and educational networks incorporate an extraordinary array of interests. The resulting complexity of government and economic decision-making can stymie innovation, experimentation, and leadership. We must improve how we integrate, balance, and govern the priorities of resource users, environmentalists, business interests, seasonal residents, and local communities for Rhode Island's waters and watersheds. This "ecology of governance" requires a systems approach to aquatic environmental policy, organization, management and regulation. The current model for systems thinking and management is known as ecosystem-based management (EBM). EBM seeks to:

- Integrate ecological, social, and economic goals and recognize humans as key components of the ecosystem;
- Address the complexity of natural processes and social systems and use an adaptive management approach in the face of resulting uncertainties;
- Engage multiple stakeholders in a collaborative process to define problems and find solutions;
- Incorporate understanding of ecosystem processes and how ecosystems respond to environmental perturbations; and
- Be concerned with the ecological integrity of coastal and marine systems and the sustainability of both human and ecological systems.

To spearhead the adoption of EBM through expanded interagency (and intergovernmental) coordination, the Rhode Island General Assembly created in 2004 a state interagency commission called the Bays, Rivers, and Watersheds Coordination Team (BRWCT). The BRWCT's mission is to pursue EBM for Rhode Island's aquatic environments and water-reliant economy. It is comprised of the senior executive leaders of seven Rhode Island state agencies and programs:

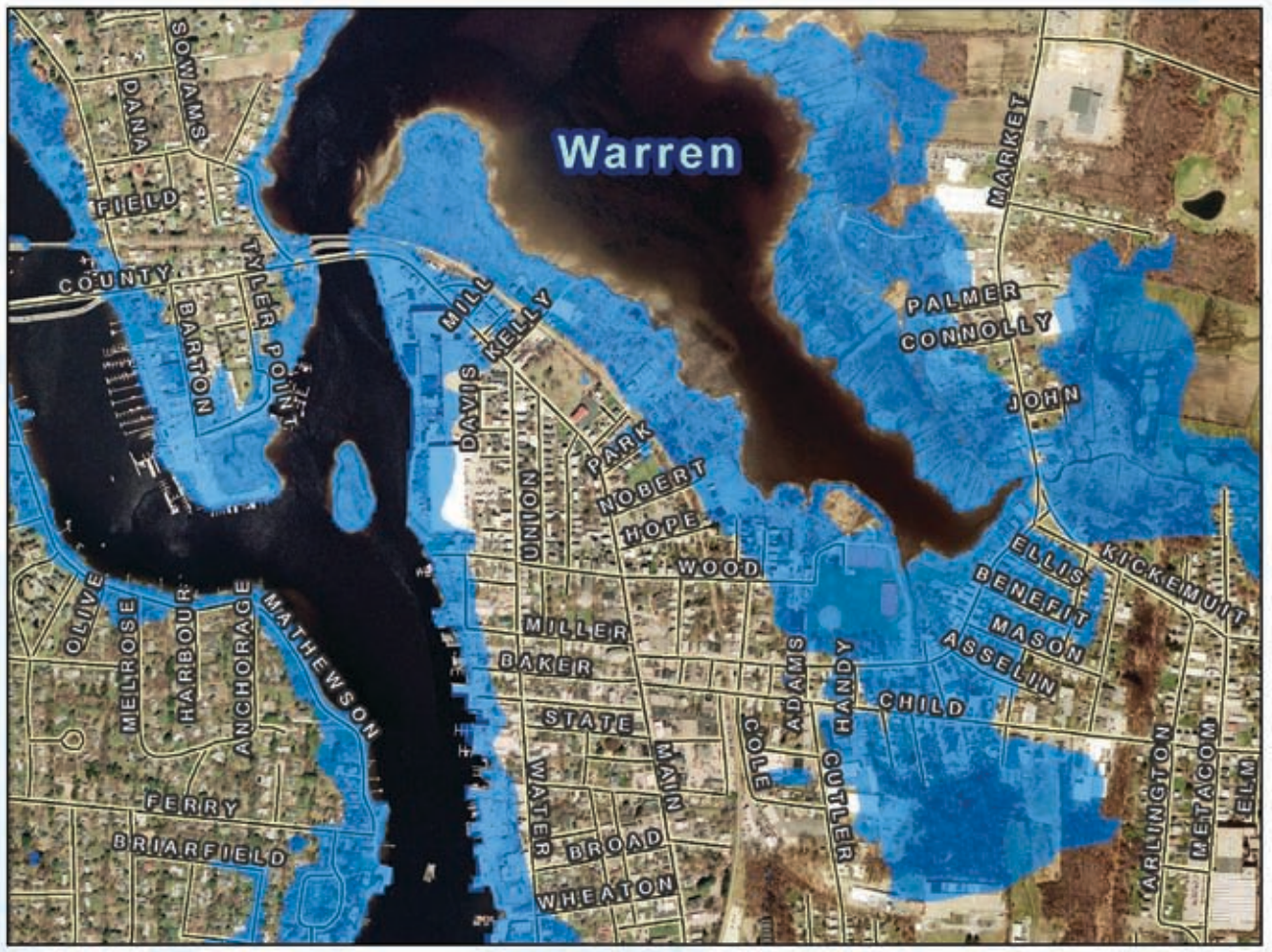
- Coastal Resources Management Council;
- Department of Environmental Management;
- Department of Administration's Division of Planning;
- Economic Development Corporation;
- Narragansett Bay Commission;
- Rivers Council; and
- Water Resources Board.

The BRWCT has been engaged in a strategic planning process known as systems-level planning. This summer, it issued a report, the Bays, Rivers, and Watersheds Systems-Level Plan for 2009-2013. The report is organized into eight major sections:

*—Bay Plan continues on page 11*

# Five Foot Impact

## Rising Seas Will Inundate Low-Lying Coasts



*Coastal Scientists anticipate that global warming will cause a local rise in sea-level of two to five feet by the end of this century. These maps show the impact on select coastal communities should such a change occur.*

*In Rhode Island, approximately 9000 residents in 1900 homes would be displaced. Two thirds of the state's salt marsh habitat would be inundated along with 1/4 of the beaches.*

Scale for detail Maps

0 0.25 0.5 Miles

0 0.25 0.5 Kilometers

N

NARRAGANSETT BAY ESTUARY PROGRAM

**Check out our interactive web feature on sea level rise at www.nbep.org !**

*Paul Jordan is a geographic information systems specialist with the R.I. Dept. of Environmental Management.*

—continued from page 1

# Global Climate Change

But the panelists noted that predictions made in 2000 by the Intergovernmental Panel on Climate Change, the world's leading body on this issue, are now considered extremely conservative based on current satellite observations. And, as Dr. Moran noted in her graphics, that doesn't even take into account the startling impact of increasing loss of ice sheets in Greenland or glaciers in the Antarctic, which aren't included in the already threatening equation. The audience was told that their worst fears today may actually be far less frightening than the reality they will encounter tomorrow.

Visual presentations on sea level rise drove home the point. It is already creeping up on us—no pun intended. At current rates, by 2100, Providence's Waterplace Park will be submerged. Well, at least the capital's famous "Waterfire" can be on the first floor of the Providence Place Mall—how convenient. Plus, the State House will have its own little riverside beach, as the lawn runs down to meet it.

The projected impacts of global warming—erosion, receding shorelines, the impact of storm surges and hurricanes, and sea level rise—are being taken very seriously by state and municipal planners and the business community around Narragansett Bay. Want to build a waterfront restaurant in Newport? Better put it on Spring Street, which runs parallel to Thames Street up the hill from the Newport Harbor, because that's where the water is heading (see "Bay Shorelines—2100?," map, pages 6-7). Planning upgrades to the wastewater treatment plant at Field's Point in Providence? We may not want to invest millions in an underwater sewage facility. And if you've been waiting to retire and buy a little cottage on a South County salt pond beach? Today's barrier beaches will be sandbars in a few decades. Surf's up!

The presenters' graphics drove home the conclusion that, while the problem is compelling, the message isn't getting to the general public. Scientists need to "talk about it like you're taking to your neighbor," said Dr. Moran. "Be clear and use emotion. Continue to point out what is clear, and what is uncertain."

Echoing those remarks were TNC's Dr. Shumway, who said, forcefully, that people "would react more strongly to climate change if it had a face, was considered immoral and was understood as a present danger with local impact."

Sen. Whitehouse concluded the hearing with a comment on the oft-heard objection to addressing climate change—that the cost would be prohibitive. "It would be nice to put a price tag on what happens if we do nothing," he observed. In a post-conference luncheon with the senator, that subject again came up among the panelists and guests. While there have been many studies, there is still a need to dig down and make that cost relevant to the average person, who worries about more mundane—but equally important—daily problems.

The day's number-one take home message: We need to answer the "So what?' question about all the data, maps, measurements and satellite images demonstrating the creep of global climate change. Show what it means in real terms to real people, so that citizens understand the enormity of the problems posed by global warming as it sits down right in our laps.

That is no longer a job just for Congress and scientists, but for everyone concerned with the future of Narragansett Bay. Everyone.

*Chip Young is a communications specialist with the University of Rhode Island's Coastal Institute in Narragansett, R.I.*

## Go Deeper!

**Check out NBJ's new interactive feature, "Rhode Island Shorelines 2100" at www.nbep.org. With it, you can download a KMZ file for use with Google Earth and zoom in anywhere in Rhode Island to see shoreline projections for 2100.**

**Our centerpiece map in this issue, "Bay Shorelines—2100?" by Paul Jordan, shows year 2100 shoreline projections for Wickford, Warren and Newport, R.I.**

**For lots more information on sea level rise in Rhode Island, as well as state policies and regulations, check out the website of the R.I. Coastal Resources Management Council at www.crmc.ri.gov**

# This OGRE is No Fairy Tale!

Lesley Lambert

For the past six years Roger Williams University in Bristol, R.I., has been perfecting the art of breeding shellfish, particularly oysters for use in shellfish restoration on Narragansett Bay. Oyster beds provide valuable bottom habitat for a multitude of marine species, and, while feeding, filter and clear up to 60 gallons of water per oyster per day. In 2006, Tim Scott, director of RWU's Center for Economic and Environmental Development, and Dale Leavitt, regional aquaculture extension specialist, started a program called Oyster Gardening for Restoration and Enhancement (OGRE). Steve Patterson was hired to oversee the program, while Karin Tammi runs the shellfish hatchery that breeds oysters for OGRE.

Oyster larvae float in the water column for about three weeks after birth, until they are ready to settle and attach themselves to a hard surface such as shells. Blount Seafood Co. in Warren, R.I., provides clam shells, also known as cultch, for the oysters to settle on at the RWU hatchery. OGRE staff and volunteers fill net bags with the newly settled oysters—still attached to their cultch—and then put them in floating cages, which are attached to private docks and mooring lines belonging to volunteers around the state. The oysters spend about six months during the summer and fall growing at these docks and moorings.

Once water temperatures have dropped sufficiently to reduce predation from crabs and starfish, the oysters are collected, counted, sorted by size and transported to designated sanctuary areas around Rhode Island. Here, they will spend the rest of their lives growing, filtering vast amounts of water, providing vital habitat for many commercial and noncommercial species, and, with luck, spawning to restore the native oyster population.

The OGRE program began in 2006 with just 18 volunteers and produced about 50,000 oysters. This year, OGRE has more than 70 grow-out sites and expects to harvest more than 500,000 juvenile oysters this fall. 125,000 of them will be "planted" at Town Pond, a recently restored tidal salt pond in Portsmouth, R.I., to improve marine habitat and biodiversity there. The OGRE program is preparing at least four other designated sanctuary sites for oyster distribution in the fall. These will be located at the mouth of the Potowomut River in Warwick, R.I.; Bristol Harbor; Prudence Island; and Congdon Cove in Point Judith Pond. Some other sanctuary sites include Ninigret Pond and Quonochontaug Pond.


Volunteers sort oysters at Roger Williams University. *Photo: Steve Patterson.*

An volunteer advisory board is being developed to help plan for the future of OGRE. The board will appoint regional coordinators throughout the state to oversee the cage culture, and will work to develop a business plan, secure long-term funding, expand the program and advocate the value of habitat and oyster restoration.

*Lesley Lambert is an environmental scientist with the Narragansett Bay Estuary Program.*

## Go Deeper!

**To learn more about OGRE or to get involved, contact Steve Patterson at oysters@rwu.org or call (401) 254-3707.**

# “StormSmart Coasts” Prepares Mass. Communities

Thomas Ardito

Since 1980, coastal storms and hurricanes have caused more than $15 billion in damage in the Northeast. During the same period, coastal population here has surged by eight million. Climate change, coupled with coastal development, will likely increase our vulnerability—global warming is expected to lead to more frequent and intense hurricanes and nor’easters, while rising sea level will create higher storm surges.

Massachusetts’ Office of Coastal Zone Management is helping coastal communities reduce the hazards associated with coastal storms through a new website, StormSmart Coasts. StormSmart Coasts is geared largely toward local officials, with points of entry for members of municipal boards and commissions as well as municipal staff. The site provides a wealth of technical resources on everything from coastal construction standards to flood mapping.

“We see ourselves as a support system for the communities. We’re there to help them in terms of planning, in terms of zoning, in terms of mitigating and adapting to climate change,” said Andrea Cooper, shoreline and floodplain manager for CZM. “We want to be proactive.”

StormSmart Coasts promotes an approach called “No Adverse Impact” (NAI), developed by the national Association of State Floodplain Managers. NAI calls for communities to regulate coastal development so as to 1) protect public safety; 2) prevent increases in flood or storm damage; and 3) avoid straining local budgets through increased storm-related costs. The NAI approach begins with accurate mapping of coastal hazards and vulnerabilities as a foundation for coastal land-use planning. Communities can then adopt development and siting standards for public and private property which reduce their vulnerability to coastal storms.

NAI encourages communities to create detailed emergency plans, as well. The smooth evacuation of New Orleans last month as Hurricane Gustav approached—by contrast with the disaster of Hurricane Katrina in 2005—demonstrated the value of effective storm preparedness planning.

The National Oceanic and Atmospheric Administration supported development of the StormSmart Coasts website through its Coastal Fellowship Program. Wes Shaw, the project manager, was a NOAA fellow during development and will now be working with NOAA’s Coastal Services Center in Charlestown, S.C., to help other states along the Gulf of Mexico in applying the StormSmart model.

Now that the website is up and running, the state will work with coastal communities to “test drive” the tools which it provides, according to Ms. Cooper. These include a variety of innovative land-use planning and management techniques such as “transfer of development rights” (TDR), “low impact development” or LID, and stormwater “best management practices” (BMPs). Using these approaches, communities can create economic incentives to protect shorelines, reduce flooding and erosion, and minimize the impacts of new housing on sensitive natural areas.

Though these kinds of measures are generally cost-effective over the long run, their initial cost—often considerable—may create a hurdle for cash-strapped Massachusetts municipalities. Ms. Cooper said that the state is committed to helping municipalities find funding to implement StormSmart Coasts, for example through federal and state grants. “In phase two of StormSmart Coasts, we’ll ask no money of these folks.” Noting that communities are often forced to choose between, say, land acquisition and school construction, she continued, “We have to take the environment and marry it with political and social systems in order to create real-world change. You may win the war, but you don’t always win every battle.”

StormSmart Coasts dovetails with a new statewide initiative to address climate change. The Global Warming Solutions Act, signed by Gov. Deval L. Patrick in August, requires Massachusetts to reduce greenhouse gas emissions 80 percent by from 1990 levels by 2050, and calls on other state agencies to join CZM in developing adaptation strategies.

The state’s goal is to begin creating a framework that will help communities adapt to changing climate and sea level rise over the next 20 to 50 years. “That’s the window everyone’s talking about now,” said Ms. Cooper. “You can’t just look ten years out—that isn’t enough.”

*Thomas Ardito is editor of the* Narragansett Bay Journal.

A photo-simulation of Waterplace Park in Providence with an increase in sea level of five feet, as projected for the year 2100 by many coastal scientists.

**Go Deeper!**

Check out MassCZM’s StormSmart Coasts website at www.mass.gov/czm/stormsmart

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# “Status and Trends”

Taunton—are all part of the Narragansett Bay Region, with a population of two million people in 100 cities and towns.

The Status and Trends report covers estuarine waters, fresh waters, living resources, watershed lands and Bay management. It was written by the staff of the Bay Program, drawing on scientific literature, agency reports and program studies, working with dozens of scientists representing state, federal, and non-governmental organizations throughout Rhode Island and Southeastern Massachusetts. Our goal is to establish a comprehensive baseline assessment of Narragansett Bay’s ecosystem—on land and water. In time, we intend to add environmental indicators—specific datasets such as dissolved oxygen or algae abundance—in order to track future changes in the ecosystem.

The public review draft of the report is available on NBEP’s website, **www.nbep.org**, where you can provide us with comments, download supporting documents, and check out interactive, web-only features. We’re planning a public workshop on the report early in 2009—sign up to receive information on attending. And while you’re there—don’t forget to subscribe to the *Narragansett Bay Journal*, if you haven’t already! *NBJ* is going electronic—send us your email, and you won’t miss a thing regarding Narragansett Bay.

**Go Deeper!**

To review and comment on the new Status & Trends report for Narragansett Bay and find complete information on the Narragansett Bay Estuary Program, check out our website at **www.nbep.org**

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# Buckeye Brook

manager for the National Park Service, that Buckeye Brook is worthy of wild and scenic status. We met in an empty parking lot behind a Knights of Columbus hall, next to a vacant meat market. Insana, president of the coalition, and Paul Earnshaw, vice-president, set up a large aerial photograph with the Buckeye Brook watershed delineated in yellow, and outlined their plan for the tour: begin at salt water and move upstream.

On the aerial, Buckeye Brook appeared as a natural corridor surrounded by a grid of streets—an irregular tear of trees and wetlands, rent through the woven fabric of Warwick. Urban rivers are often the only remnants of natural habitat on a developed landscape, serving as pathways for fish, birds, and other animals moving between Narragansett Bay and watershed lands. The brook is named for one such traveler: buckeye (pronounced "buckie") is local slang for alewife, the native river herring which migrates from salt water each spring to spawn in freshwater lakes and ponds.

Beginning in the 17th century, nearly every river and stream in Rhode Island was dammed to provide water power for sawmills, grist mills and, later, textile mills. Buckeye Brook, too, was dammed in Colonial times, but the large mills of the 19th century required more power than the little brook could provide. Today its old dams are breached, and Buckeye Brook is one of the few coastal streams in the state which supports an annual herring run unaided by fish ladders.

Herring runs have been spotty throughout the Northeast in recent years, but 2008 saw some good returns. On one of the best days this spring, the entire brook, from salt water to Warwick Pond, was filled with migrating herring. "There were three miles of fish in the brook, solid," recalled Insana. On the same day, Earnshaw estimated 1200 fish per hour passing one location.

By far the largest feature on the aerial photograph was T.F. Green Airport. Insana and his group have often been at odds with the airport corporation regarding its management of storm water and de-icing chemicals, which wash off the runways into the brook. According to Insana, the chemicals form a "toxic cocktail" that turns aquatic plants bright orange ("Even the snapping turtles are orange!" said Earnshaw) and causes low-oxygen conditions in the brook. The R.I. Dept. of Environmental Management lists Buckeye Brook as "not supporting" the state's goals for fish and wildlife habitat. Yet Insana acknowledges the economic importance of the airport. "I call it Mother Goose," he said. "She lays the golden egg."

We piled into several cars, forming a procession led by Insana's battered red Ford pickup—NASCAR stickers and an American flag on the back windshield—and began our tour of the brook at Mill Cove, where Buckeye Brook flows into the salt water of Narragansett Bay. Along the water's edge were broken foundations where beach houses once stood—silent reminders of storms, sea level rise and shoreline change on Narragansett Bay.

Insana and Earnshaw seem to know every inch of the watershed, including a number of historical sites which are, today, all but forgotten. Insana pointed out the old railroad bed where the trolley to Rocky Point Park once crossed the brook ("It was called the Union Electric Railroad—my grandfather was a conductor.") He led us through parking lots, behind dumpsters and into scrubby woodlots to show us 18th and 19th-century cemeteries—gray slate headstones adorned with angels, urns or willow trees—some as crisp and sharp as if they were carved yesterday, others eroded by time and weather into simple rough slabs. We stepped gingerly through acres of briar and poison ivy to see a freshwater spring which he said was the site of a Native American village.

At one point, Insana led us into a wooded area to show us a looted archaeological site. It wasn't far from a main road, but well hidden from view. The sight was shocking—a large, irregular, hand-dug pit, about fifty feet long, twenty feet wide and ten feet deep. Broken bottles, potshards and bricks stuck out of the ground. The digging was so extensive that several large trees had collapsed into the hole. The soil was exceptionally soft and sandy but, even so, it was a remarkable amount of digging, obviously the work of many days.

"Look what this guy did," grumbled Insana, crouching on the edge of the hole as he surveyed the damage. He said it was the former site of the John Warner house, and that it was important in the history of abolitionism. I later spoke with Charlotte Taylor of the state historical commission about the looting of archaeological sites—a problem throughout the U.S.—expressing astonishment that anyone would do so much digging to steal some old bottles. "People are just crazy," she sighed.

Small though it may be, it's not out of the question that Buckeye Brook could be designated a national "wild and scenic" river—if state officials can be convinced to support Insana's initiative. Fosburgh said the first step is for the park service to add the brook to a national rivers inventory; as a free-flowing (undammed) river with other important values, such as its historic resources and migratory fish runs, the brook is eligible for addition to the list. "The chances of going beyond that, to actually designating it a wild and scenic river—I don't know," said Fosburgh. "That seems an open question."

As established by the federal Wild and Scenic Rivers Act, passed in 1968, there are two ways in which a river can be designated "wild and scenic." One is through an act of Congress; the other is nomination by a governor, with approval by the Secretary of Interior. Fosburgh thought the first unlikely for Buckeye Brook—but saw the second as a possibility. In order to be designated through a governor's nomination, however, the law requires that a waterway must receive formal recognition, at the state level, of its exceptional value. Since Rhode Island doesn't have a state scenic rivers law or other designation for outstanding natural areas, this might best be achieved for Buckeye Brook through an act or resolution of the General Assembly.

One question is whether Insana's initiative will run afoul of the state's plans to expand T.F. Green Airport, which dominates the brook's watershed. A recent editorial in the *Wall Street Journal* railed on efforts to achieve a similar designation for the Taunton River as a ploy to prevent development (see "Taunton River," page 3). Business groups and others who favor airport expansion may be concerned that "wild and scenic" designation for Buckeye Brook will delay plans to extend Green's runway.

Governor Donald L. Carcieri, while advocating a balanced approach to airport expansion, has called Green Airport a "vital economic engine" for Rhode Island. To Insana, "wild and scenic" designation for Buckeye Brook would also provide statewide economic value. "This is huge," he said. "The first in Rhode Island, and the whole state's going to profit from it." Does he believe Carcieri will support "wild and scenic" status for the brook, given the governor's concerns for the airport? Insana is willing to make the case. "Let's see where Uncle Don's heart really is," he chuckled.

*Thomas Ardito is editor of the* Narragansett Bay Journal.

Paul Earnshaw examines an historic cemetery. NBJ *photo.*

## Go Deeper!

For more on Buckeye Brook and the Coalition, check out
**www.buckeyebrook.org**

For more on Warwick history, check out
**http://gaspee.com**

# Something Fishy on the Bay

## Disease May Be Killing Menhaden

Lesley Lambert and Thomas Ardito

Dragon boat races were held in Pawtucket on September 6th, amid hundreds of dead menhaden floating on the Seekonk River. *Photo:* NBJ.

August and September saw a slew of fish kills in Narragansett Bay, primarily in the upper Bay. Several such kills occurred in the Seekonk River, while isolated kills took place in Bullocks Cove, the Kickemuit River, the Providence River, and in Wickford and Warwick Coves. In each case, most of the fish affected were adult menhaden, locally known as "pogies."

Initially, many experts believed the cause to be low levels of dissolved oxygen (DO) in the water—a condition known as hypoxia. In August, 2003, an estimated two million juvenile menhaden, or "peanut bunker," were killed by hypoxia in Greenwich Bay. A survey by the Narragansett Bay Estuary Program (NBEP) and R.I. Dept. of Environmental Management on the following day documented levels of DO approaching zero throughout Greenwich Bay—lethal to most fish and many shellfish.

The extreme hypoxia of the Greenwich Bay kill was a fairly rare occurrence. This summer, by contrast, dissolved oxygen levels in Narragansett Bay have been "typical," according to NBEP's Dr. Christopher Deacutis, who conducts DO surveys throughout the upper Bay each summer.

"We had a few low-oxygen events, but it wasn't like 2003 or 2006," said Dr. Deacutis. "2006 was the worst we've seen." By late August, some Bay scientists began to suspect that the kills were not caused primarily by hypoxia.

Dr. Marta Gomez-Chiarri, a fish pathologist at the University of Rhode Island, examined a fish taken from Bullock's Cove in late August. She wrote in an email that the fish had lesions and hemorrhaging "consistent with infection by bacterial (such as *Vibrio* and *Aeromonas species*) or fungal (such as *Aphanomyces*) pathogens...These signs are not usually observed in fish that die due to...asphyxiation." Tightly schooling fish such as menhaden are highly vulnerable to contagious diseases and other toxic microorganisms.

It seems probable, then, that the fish kills on the Bay this year were caused not by low DO, but by some sort of pathogen. As noted by Dr. Gomez-Chiarri, an infectious disease seems likely. A less-likely suspect is a harmful algal bloom or HAB—rapidly reproducing toxic microorganisms that can kill fish and shellfish. Red tides are a type of HAB that have affected Maine and Massachusetts in recent years. NBEP scientists documented limited red tides in Narragansett Bay this summer, though lab tests suggested a non-toxic strain.

One of the most notorious HABs is *Pfiesteria*, nicknamed the "cell from Hell," a free-swimming microorganism which has caused large fish kills in the Southeast. *Pfiesteria* feeds on the flesh of fish, causing lesions and death, and produces toxins that can affect humans as well, causing asthma, memory loss and severe nausea. Nutrient pollution, such as that from waste water treatment plants and lawn fertilizers, is believed to increase the prevalence of *Pfiesteria*.

A concern is that these kinds of outbreaks may become more common with climate change and ecosystem shifts on Narragansett Bay. Many diseases thrive in warmer temperatures, and many are non-native species. West Nile Virus, for example, a mosquito-borne disease which affects humans, was introduced to the Northeast just a few years ago, and is expected to push northward with global warming. Diseases of marine organisms are likely to behave similarly.

The uncertainty surrounding the fish kills of 2008 points to one sure conclusion—that Bay scientists and managers need a better system for assessing these kinds of occurrences on Narragansett Bay. While several organizations routinely respond to problems on the Bay, there is no effective scientific framework in place to quickly analyze fish kills or HABs, and no formal program to document or track them.

Every fisherman knows that striped bass and bluefish follow the menhaden into the Bay. No menhaden—no stripers. To preserve these valuable fisheries—and the Bay ecosystem—we must develop a better understanding of the causes and consequences of fish kills on Narragansett Bay.

*Lesley Lambert is an environmental scientist with the Narragansett Bay Estuary Program.*
*Thomas Ardito is editor of the* Narragansett Bay Journal.

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## Bay Plan

- Waterfront and Coastal Development;
- Watersheds;
- Rhode Island's Water-Reliant Economy;
- Natural Hazards;
- Freshwater Supply;
- Water Quality;
- Fisheries and Aquaculture; and
- Aquatic Habitats and Invasive Species.

Each section summarizes key concerns and uncertainties, and establishes long-term objectives, strategies, and actions. The report identifies lead agencies and partners for each action. Detailed implementation guidance will be issued through annual work plans for the BRWCT and its members.

The strategic planning cycle for the Systems-Level Plan will continue through implementation, evaluation, and plan refinement. It will function as a collaborative learning process to help public, private, and independent sector leaders gain greater insight into the complex decision environments they operate within, as well as greater appreciation for what it will truly take to achieve our collective goals for aquatic environmental management and sustainable economic development.

If we don't invest in their quality and functional capacity, Rhode Island's aquatic environments and resources will decline, allocation and access disputes among multiple interests will intensify, and the capacity of our socio-economic and environmental systems to adapt to future change will erode. To simply maintain current levels of environmental quality (natural and built) and social well-being, Rhode Island must cultivate the resiliency of its aquatic (environmental, economic, and governmental) systems to adapt to unprecedented environmental change at multiple scales. The BRWCT dedicates itself to this essential obligation and welcomes the opportunity to work with partners in federal and local government, the private sector, the scientific and educational communities, and nonprofits.

*Ames Colt is chair of the R.I. Bays, Rivers and Watersheds Coordination Team.*

### Go Deeper!

**Download a copy of the Bays, Rivers and Watershed Strategic-Level Plan for 2009-2013 at www.coordinationteam.ri.gov**

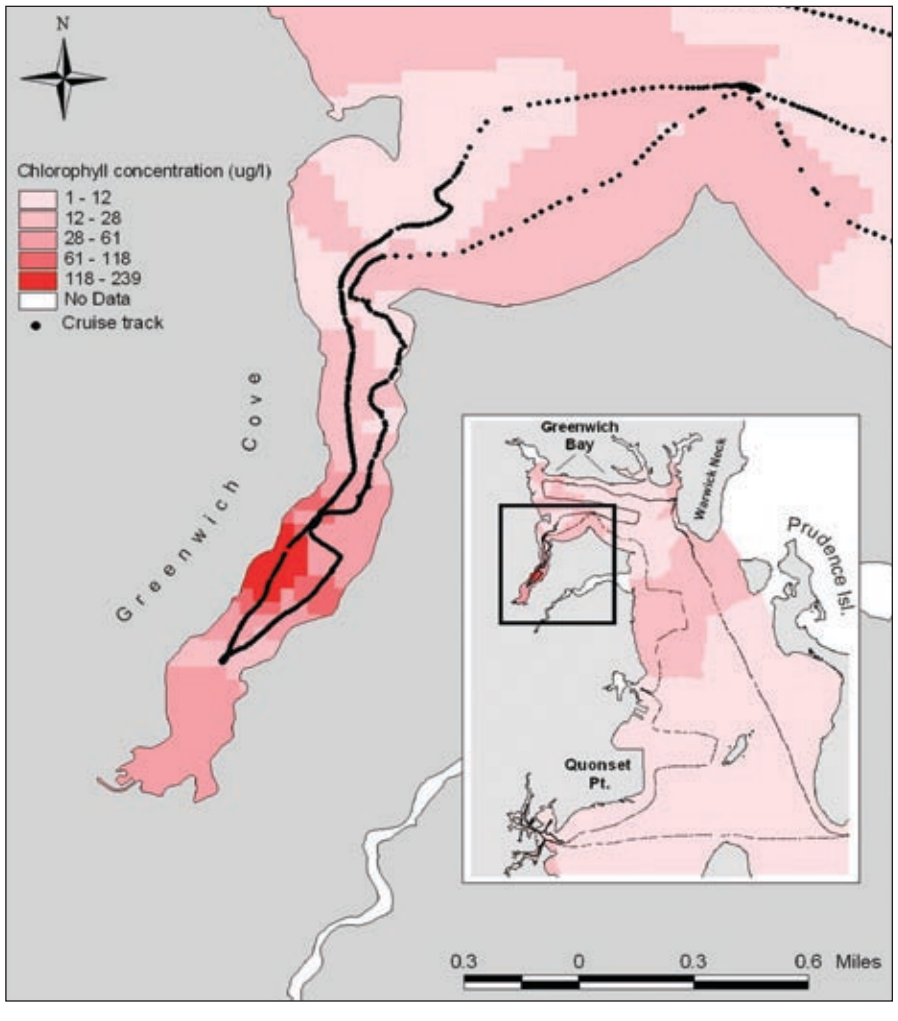
## Measuring Water Quality at 20 Knots

# Going with the Flow

Kenneth B. Raposa and Robert M. Stankelis

Water quality conditions in Narragansett Bay are currently monitored by an ambitious, multi-faceted effort collectively known as the Bay Window program. Bay Window monitoring includes water-quality instruments mounted on fixed buoys at stations throughout the upper Bay; instruments mounted on a "shuttle" or sled towed behind a small research vessel; and surveys from small boats which use hand-held instruments to measure dissolved oxygen. Although these techniques collect a great deal of useful information necessary for understanding Bay conditions, they do not provide sufficient data from the Bay's numerous shallow coves and embayments, to help us understand the causes of poor water quality often found in these areas. Recently, the Narragansett Bay National Estuarine Research Reserve began using an innovative new monitoring tool known as DATAFLOW to fill the gaps in our data.

DATAFLOW is a flow-through water quality monitoring system mounted on a small power boat used to measure and map surface water quality at speeds of up to 20 knots or more. The system is equipped with a global positioning system (GPS) to record position and a Yellow Spring Instruments (YSI) sonde—an instrument which automatically and continuously measures water quality. It's the same type of unit used on the Bay Window buoys, which ensures that data can easily be compared among the different Bay Window components. DATAFLOW data are useful for several reasons. They allow us to detect fine-scale variability in water quality that may not be detected with fixed-site monitoring, making it easier to understand water quality conditions as a whole. Second, since water quality data from DATAFLOW also have coordinates associated with them, it is easy to generate detailed, high-resolution water quality maps. Finally, DATAFLOW can operate in shallower water than fixed stations or towed shuttles, to give us a more complete picture of water quality in coves and embayments.




A map of Greenwich Cove, showing the track of a DATAFLOW cruise and levels of chlorophyll mapped. *Map by Kenneth B. Raposa.*

In September, NBNERR staff ran a boat equipped with DATAFLOW on Narragansett Bay. *Photo: Kristin Van Wagner.*

The Reserve began using DATAFLOW in 2007 to demonstrate the value of this technology in Greenwich Bay, a nutrient-rich sub-embayment of Narragansett Bay with chronic water quality problems—and site of a large fish kill in 2003. This year, we're again using DATAFLOW to map Greenwich Bay, as well as Greenwich Cove, portions of the West Passage, and Wickford Harbor. Each year, multiple cruises are undertaken (often coinciding with other components of Bay Window) in order to map water quality conditions at different times over the summer and fall when conditions in the Bay can be poor. Each cruise leaves in the morning from the T-wharf on Prudence Island and follows a pre-defined cruise track throughout the study area. During the entire cruise, water quality data and GPS positions are collected every 4 seconds using DATAFLOW. Data collected includes temperature, salinity, dissolved oxygen, pH, turbidity, chlorophyll, and latitude and longitude. The cruise also stops at a few calibration stations to collect supplemental water quality data to compare with readings from the DATAFLOW.

The overall strength of DATAFLOW is the ability to rapidly collect thousands of points of data from which highly detailed maps of water quality conditions can be easily produced. For example, chlorophyll (a measure of the amount of phytoplankton, or microscopic algae, in the water) data from a recent cruise in August 2008 in Greenwich Bay found high concentrations in Greenwich Cove, and lower concentrations in the rest of Greenwich Bay, the West Passage and in Wickford Harbor. Since the bloom was localized in Greenwich Cove, it would not necessarily have been detected using fixed-site monitoring alone. Since the amount of chlorophyll in the water can be an indicator of high nutrient levels, these preliminary data suggest that inputs of nutrients to Greenwich Cove may still be high.

Our experience with DATAFLOW suggests this technology is useful for rapidly mapping surface water quality conditions in shallow coves and should be an excellent complement to ongoing efforts to monitor water quality in Narragansett Bay. It can also be used to rapidly assess water quality conditions immediately after a fish kill occurs in any of Narragansett Bay's coves (such as those which occurred this year in Wickford Harbor, the Seekonk River and elsewhere) to help determine the cause and extent of the problem. In future years, we hope to use DATAFLOW to map water quality in targeted coves throughout Narragansett Bay on a rotating basis, to develop a more detailed picture of changing water quality conditions throughout Narragansett Bay over time.

*Kenneth B. Raposa is research coordinator, and Robert M. Stankelis is manager of the Narragansett Bay National Estuarine Research Reserve on Prudence Island.*

## Go Deeper!

For more on the Narragansett Bay National Estuarine Research Reserve, including information on visiting Prudence Island and access to real-time weather and water quality data for Narragansett Bay, check out their website at **www.nbnerr.org**