



Promoting Cooperation to Maintain and Enhance Environmental Quality in the Gulf of Maine



PHOTO: CENTER FOR WILDLIFE

Owls had a tough winter.

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PHOTO: © 2008 THE PRESIDENT AND FELLOWS OF HARVARD COLLEGE. USED WITH PERMISSION.

The Eastern yellowjacket (*Vespula maculifrons*), a frequent guest at picnics, is one of the more than 900 types of insects found on the Boston Harbor Islands.

## Boston Harbor insect census: Looking to tiny creatures to tell the big story on the environment

By Lori Valigra

THEY STING, CRAWL ON PICNIC FOOD and buzz around your ears when you hike. They also pollinate flowers, serve as food for other species and act as predators. Lowly insects may find themselves elevated to an even larger role in the future: as indicator species for changes in the environment.

Scientists at Harvard University and elsewhere are studying a relatively self-contained area in Massachusetts to create an All Taxa Biodiversity Inventory, or ATBI, of insects within the Boston Harbor Islands national recreation area. The researchers are developing a database at Harvard with high-resolution images and descriptions of insects—they already have more than 900 entries—present in the recreation area. The hope is that one day the insects can inform them of extinctions of plant or animal species, invasions of non-native species and even the impacts of changes in climate. But first, they have to find and identify which insects are present.

"More than 90 percent of life on earth is insects, and 98 percent of life is invertebrates," said Mary Raczko, partnership liaison with the Boston Harbor Islands national recreation area, whose park rangers and other staff are collaborating with Harvard's Museum of Comparative Zoology to conduct the ATBI. The five-year ATBI, now in its third year, started with insects, but the Boston Harbor Islands researchers aim eventually to create an inventory of a broad range of plants and animals on the 34 islands and peninsulas comprising the national recreation area and use

See *Insects* Page 12

## Profile: Heather Leslie Making a mission of resilience science

By Kirsten Weir

Heather Leslie is something of a split personality—in the very best way. One day you'll find the Brown University scientist on the rocky New England coast, studying tide pool tenants like barnacles and sea stars. The next day she'll have turned her attention to mathematical modeling and theoretical thinking as she immerses herself in the burgeoning field of resilience science.

Resilience science is the study of the ways ecosystems respond to disturbance. Can a damaged wetland absorb an ocean storm surge? Will an overfished swath of ocean collapse into a barren seascape? Finding answers to such big-picture questions can be dizzyingly complex. "The resilience work is a bit more conceptual than what a lot of people think of as 'science,'" Leslie said. Yet as the field matures,

See *Resilience* Page 10

## Hurricanes: Preparing for the next big one



IMAGE: JACQUES DESCLOITRES, MODIS, NASA/GSFC Hurricane Erin, Northeastern U.S., 2001.

By Susan Llewelyn Leach

It's a potentially dangerous combination: big hurricanes that rarely make landfall, untold damage when they do and a population largely blasé about the whole prospect. In the Gulf of Maine, where the last Category 3 hurricane (winds of 111-130 miles per hour or 96-113 knots) hit more than a half century ago, mobilizing public interest has been a slow sell. David Vallee knows. The National Weather Service meteorologist, who is located in


See *Hurricanes* Pages 6-7

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Rejuvenating the Penobscot River...



PHOTO: CHERYL DAIGLE  
...with repowered dams, sea-run fish.  
Story Page 11



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The Gulf of Maine Council on the Marine Environment was established in 1989 by the governments of Nova Scotia, New Brunswick, Maine, New Hampshire and Massachusetts to foster cooperative actions within the Gulf watershed. Its mission is to maintain and enhance environmental quality in the Gulf of Maine to allow for sustainable resource use by existing and future generations.

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**Letters to the Editor**

The *Gulf of Maine Times* welcomes readers' letters. However, we reserve the right to edit them for length and clarity. Please include your name, address and phone number. All submissions may be emailed, faxed, or mailed to the *Gulf of Maine Times*, c/o Editor. We will consider all letters for publication, but cannot guarantee that we will print and/or respond to every one.

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## Editor's Notes



PHOTO: JIM FENTON

A short-eared owl glides toward land from the ocean.

# Make your summer active

Summer is a time to get out and enjoy the environment. It's also a time of potentially turbulent storms and the dreaded red tides.

This issue of the *Gulf of Maine Times* contains a feature on the latest developments in hurricane technology and how the Gulf of Maine can prepare for the much-anticipated next great hurricane. One of the main challenges public officials and scientists face in both New England and Atlantic Canada is overcoming the nonchalance of the general population, which has not had to go without electricity for long periods of time or face the other impacts of a major hurricane.

The challenge of raising public awareness is perhaps more acute in the Canadian provinces. When Peter Bowyer, the program manager of the Canadian Hurricane Centre in Dartmouth, Nova Scotia, introduces himself to people, he says they look at him as though he just said, "I'm the coach of the Jamaican bobsled team." The unspoken question is always, "Why would Canada ever need a hurricane center?" The story by Susan Llewelyn Leach educates readers about the potential risks and impacts of the hurricane season, which started June 1.

Another story focuses on a census of insects being taken in the Boston Harbor Islands, where citizen and professional scientists are working hand-in-hand to collect and identify the species in that park area and put them into a database. Some of the species—on islands accessible by public transportation—are new or haven't been seen for more than 100 years. Knowing what insects are in the park could eventually tell us more about the impact of bigger issues, like climate change. An event to be held August 18 will allow the public to help collect samples of life on the islands. For dates and other activities check out the Boston Harbor Islands Web site at: <http://www.bostonislands.org/biodiversity> and <http://www.nps.gov/boha/naturescience/index.htm>.

Each season brings with it miracles of life, and stresses. Owls, for example, had a tough winter. A decline of red-backed vole in Canada forced many owls south for food, and unfortunately, for collisions with cars. Karen McElmurry, director of the Center for Wildlife in Maine, talks with the *Times* about creating a haven for hurt animals.

We hope these and other articles in the issue will inspire you to go outside and discover the nature in your own backyard.

On another note, we'd like to say thank you and goodbye to several people who have contributed significantly to the *Times* and who are going on to new opportunities. Peter Taylor has been writing the *Science Insights* column in the newspaper and has consulted for the Gulf of Maine Science Translation Project for five years. His last column appears in this issue. Karin Hansen, outreach coordinator for the Gulf of Maine Council on the Marine Environment for four-and-one-half years, also has managed the subscriber database and sent out the email notices about the availability of the *Times* online. This is her last issue of work on the paper. It also is my last issue as editor. I have enjoyed working on the newspaper in various capacities of editing, writing, design, layout and production for the past four years, and have had the privilege of interacting with many talented and generous writers, editorial staff, photographers, artists and designers. I've had the opportunity to update and improve the paper's print and online presence with input from readers, members of the Gulf of Maine Council and other supporters of the paper. I've also had the pleasure of interacting with wonderful stewards in the Gulf of Maine and with the energetic readers of the *Times*. Thank you for the chance to spend time with you.

Lori Valigra  
Editor

## Calendar

### June 29 - July 4

**Oceans & Human Health**, the Gordon Research Conference, runs June 29 – July 4 in Tilton, New Hampshire. The conference aims to provide a multidisciplinary platform for discussing the current state of knowledge of the rapidly evolving, interdisciplinary fields that comprise oceans and human health, to identify and debate unresolved questions, and to discuss new research directions. For more information visit: <http://www.grc.org/programs.aspx?year=2008&program=oceans>.

### September 15 - 18

**Ocean '08 MTS/IEEE Québec**, runs Sept. 15-18 in Québec City, Canada. The theme is *Oceans, Poles and Climate: Technological Challenges*. The Oceans '08 MTS/IEEE Québec topic areas include: an ice-free Arctic Ocean: navigational, legal, and policy issues; adapting technology and instrumentation to ice-covered seas; and long-term observation of polar oceans. The technical tracks include: sonar signal/image processing and communication; ocean observing platforms, systems and instrumentation; and air and space ocean remote sensing. For more information visit: <http://www.oceans08mtsieeequebec.org/>.

### September 17 - 19

**The 7th International Workshop on Unstructured Grid Numerical Modelling of Coastal, Shelf and Ocean Flows** runs Sept. 17-19 at the Bedford Institute of Oceanography in Nova Scotia. It will focus on theories, results and applications associated with unstructured grids. For more information visit: <http://wessex.eas.ualberta.ca/~myers/unstructgrid2008/>.

# SCIENCE INSIGHTS

## Report looks at ecosystem-based management 'on the ground'

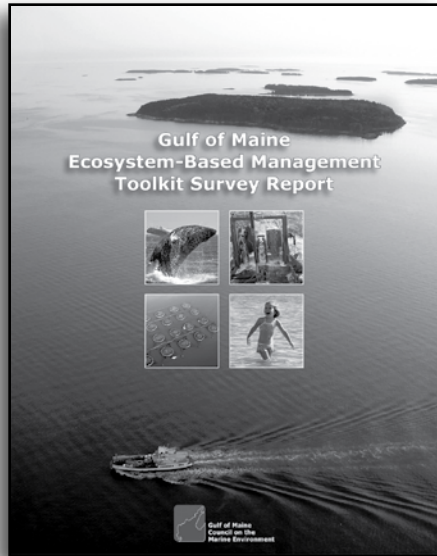
By Peter H. Taylor

Many government agencies and non-governmental organizations in the United States and Canada are collaborating to advance ecosystem-based management (EBM) in the Gulf of Maine.

The Gulf of Maine has a long tradition of fishing, marine transportation, coastal development and recreation. Because of the growing variety and intensity of human uses, effective management is essential for ecosystem health and economic prosperity in the region.

Among the many efforts under way to move EBM from concept to practice are the recently released Gulf of Maine EBM Toolkit Survey Report and a new guide called *Seascapes: Getting to Know the Sea Around Us*.

In September and October 2007, I conducted the Gulf of Maine EBM

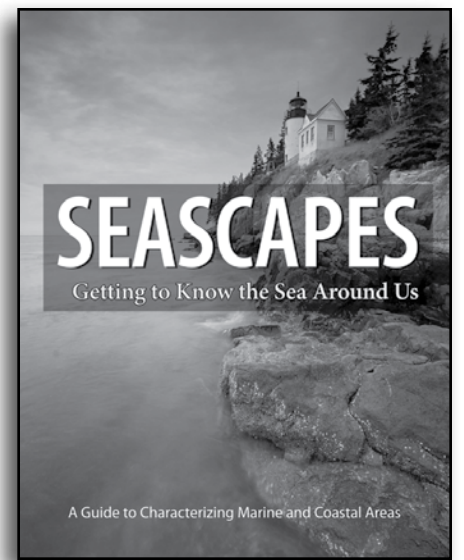


Toolkit Survey in collaboration with COMPASS (Communication Partnership for Science and the Sea) and the EBM Tools Network. We released the *Gulf of Maine Ecosystem-Based Management Toolkit Survey Report* on the findings in April 2008.

The survey provided insight into the on-the-ground realities of how people are trying to advance EBM in the region, challenges they are facing and potential ways to address the challenges. Survey participants were involved in ocean and coastal management in Nova Scotia, New Brunswick, Maine, New Hampshire, Massachusetts, and U.S. and Canadian federal waters.

Based on the survey, people engaged in ocean and coastal management around the Gulf of Maine appear to accept the broad concept of EBM. However, they are grappling with the specifics of how to advance EBM in their day-to-day work. For example, survey participants said they primarily need two types of information: practical information about how to do EBM in the Gulf of Maine, and information about the ecosystem context for management. The main findings of the survey are summarized in the box below. The complete findings are in the survey report, available at <http://www.gulfofmaine.org/ebm>.

Released in spring 2008, the 80-page *Seascapes* guide will help address the need for information about the Gulf of Maine ecosystem. Working with the Quebec-Labrador Foundation (QLF)/Atlantic Center for the Environment, I wrote *Seascapes* as a guide to characterizing marine areas. In recent years, people have sought to bring together information about the ocean and coast in a way that fosters



more holistic understanding of the ecosystem and improved management of human activities. Collectively, these information-gathering and sharing efforts can be referred to as marine area characterizations.

Generally, the goals of a marine area characterization are to gather and integrate information about a marine area, to communicate the information and to use the information to guide resource management decisions. The purpose of *Seascapes* is to enable people to learn about the ocean and coast through conducting marine area characterizations. These projects could provide very useful information for EBM.

How does one go about characterizing a marine area in a meaningful way? What information is needed? Where can the information be obtained? How can the findings be communicated so they are useful? The *Seascapes* guide answers these questions. QLF brought together experts in biology, oceanography, history and other fields from several organizations. They generated a slew of ideas that we shaped into *Seascapes*. The document can be downloaded from <http://www.waterviewconsulting.com>.

*After five years of consulting for the Gulf of Maine Science Translation Project, this is my final article for the Gulf of Maine Times. I've enjoyed being in contact with Times readers and hope that you will continue to contact me through my Web site and blog, <http://www.waterviewconsulting.com>, as I pursue exciting new projects.*

### Main findings: EBM Toolkit Survey

#### Obstacles to Implementing EBM

- Lack of money, time, or people to do EBM.
- Lack of established methods for implementing EBM.
- Lack of understanding or information on the ecosystem.

#### Important management issues

- Coastal habitats assessment and mitigation.
- Stakeholder and/or community engagement.
- Habitat restoration.
- Marine protected area management.
- Biodiversity conservation.

#### Management capacity needed

- Understanding how the ecosystem functions.
- Engaging stakeholders in decision-making.
- Communicating management processes to stakeholders.
- Visualizing possible development and resource use scenarios.

#### Types of information needed

- Case studies of present-day management situations in the Gulf of Maine region and how EBM could be or has been applied.
- Forward-looking assessments of how the Gulf of Maine ecosystem is likely to change and implications for management.
- Spatially explicit information about human activities affecting the Gulf of Maine and its watershed.
- Information about how the Gulf of Maine ecosystem functions.

#### Training needs

- Training to understand the conceptual framework of EBM and general approaches for putting EBM into practice.
- Training to better understand the ecosystem context in which management occurs and which management decisions affect.

## Reality-based regulations

By Dave Kellam

Planning board and conservation commission members in Kingston, New Hampshire, are "getting real" when it comes to protecting water quality. The municipal groups recently worked with the local planning commission and a consultant to rework the town's wetland buffer ordinance to replace an approach that relied on zoning to determine buffer widths, and instead use a more realistic process that prescribes differing levels of protection based on a variety of actual wetland functions.

Now, when a development proposal is presented to the town's planning board, a functional analysis of the wetlands on or adjacent to the property is included. Conducted by a wetland scientist, the analysis is part of a typical wetland's delineation report. The number of functions, such as groundwater recharge, that are conducted by the affected wetlands

determines the buffer width required for that parcel.

Functions considered in the ordinance include floodflow alteration, groundwater recharge, nutrient removal, product export, sediment/toxicant retention, shoreline/sediment stabilizations, wildlife habitat, fish/shellfish habitat, endangered species habitat and vernal pools. This is a much more justified approach than the previous one that set buffer widths solely based on commercial, residential or rural zoning.

The ordinance also outlines a variety of activities that are restricted in wetland buffers, including construction of swimming pools, storage of motor vehicles (including motorized boats and snowmobiles), dumping of waste, use of landscaping chemicals (including pesticides, herbicides or non-organic fertilizers), and landscaping with non-native plants.

Kingston's "one size does not fit all" approach is unique in the New

Hampshire Seacoast because most municipal buffer ordinances opt for one standard buffer width, regardless of the quality of the wetland it protects. But it is important to take a close look at each situation.

"Simply put, all wetlands are not created equal," said Glenn Greenwood, planner for the Rockingham Planning Commission. "Some wetlands are very critical to the protection of water quality or wildlife populations, while others don't function that well. Those poorly functioning wetlands don't need to have the same level of protection as highly functional ones."

Kingston's Planning Board Chairman Glenn Coppelman said he thinks this is the fairest way to balance natural resources protection and development needs. "This type of science-based ordinance gives developers options when looking at a parcel of land," noted Coppelman. "They can build closer to wetlands that are of lesser importance, but must maintain larger buffers next to critical ones. It exemplifies the common sense zon-

ing approach that Kingston is striving for. We simply want to make sure that natural resources that significantly benefit the greater community are not degraded by development."

The warrant establishing the new buffer ordinance was approved by a town vote in March 2008 by roughly a 2 to 1 margin. Kingston residents clearly indicated that they support protecting their most valuable natural resources while enabling development in appropriate locations.

*This project was funded by the Community Technical Assistance Program of the New Hampshire Estuaries Project, which provides assistance to communities on a wide range of regulatory and non-regulatory approaches to natural resources protection. For more information go to: <http://www.nhep.unh.edu>.*

*Dave Kellam is project coordinator for the New Hampshire Estuaries Project.*

## Book Review

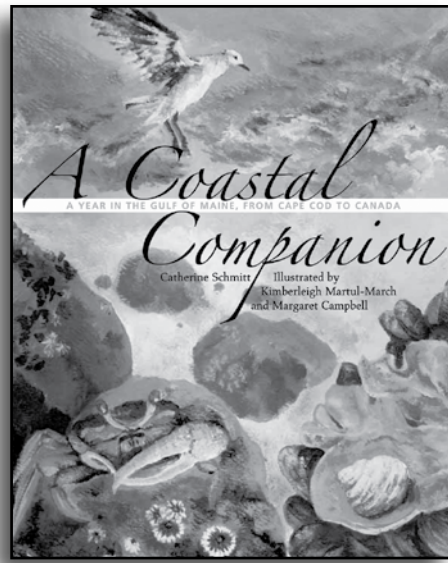
### *A Coastal Companion: A Year in the Gulf of Maine, from Cape Cod to Canada*

Reviewed by Lee Bumsted

There are many ways to learn about the Gulf of Maine and its inhabitants. Personal experience tops the list: paddling its bays, fishing its estuaries, watching birds in its marshes, walking its shores. Since things like work, weather or distance might get in the way though, reading a well-written book is a good alternative.

Catherine Schmitt created her book, *A Coastal Companion: A Year in the Gulf of Maine, from Cape Cod to Canada*, in the form of an almanac. There are entries for each day of the year. She selected topics based on seasonal activity, migratory patterns and event dates. Entries stand alone so they can be sampled at will, although there is value to enjoying this book from cover to cover in just a few sittings, as I did. In this way, the cycles of life in the Gulf over the course of a year can be better appreciated.

Schmitt's experience as a science writer shows here as she engages readers' interest in her subjects while gently educating them. She moves easily between field-guide-style descriptions of fish, invertebrates, plants and birds, clear explanations of migratory, tidal and other natural processes at work in the Gulf, and



### *A Coastal Companion: A Year in the Gulf of Maine, from Cape Cod to Canada*

By Catherine Schmitt

Illustrated by Kimberleigh Martul-March and Margaret Campbell

Tilbury House

250pp., \$20.00 paperback

thoughtful observations.

In entries for the second half of June alone, Schmitt describes the habits and behavior of periwinkles, horseshoe crabs, blackpoll warblers, fireflies, sweetgrass, bluefish, striped bass and pogies. She explains how the moon snail preys on periwinkles and how it forms the flexible collar that holds its eggs. She discusses how eelgrass is an "ecosystem engineer" because it creates the habitat needed for fish and shellfish nurseries.

## Book Review

### *The Naturalist's Guide to the Atlantic Seashore*

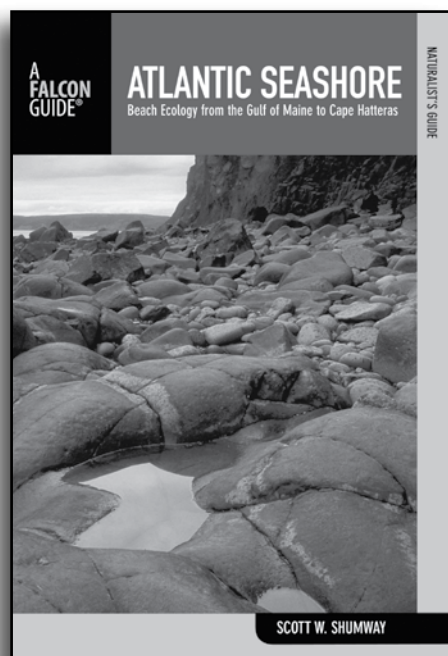
Reviewed by Lee Bumsted

Typical field guides have great depth but can lack breadth. There are comprehensive plant guides, bird guides, animal guides and shell guides that will help you identify whatever you find while out exploring the seashore. The subjects of such books may not be presented in the context of where they live and how they interact with their neighbors though, and you would need to carry three or four guidebooks along on one walk.

*The Naturalist's Guide to the Atlantic Seashore: Beach Ecology from the Gulf of Maine to Cape Hatteras* stands out because of its ecosystems approach to describing the plants and animals common to this region. Chapters are divided up by habitat. The typical denizens of rocky shores, sandy beaches, sand dunes, estuaries, salt marshes, tidal flats, seagrass meadows and the open ocean all get their own chapters. Some of the inter-relationships of plants and animals within a given habitat also are highlighted.

The book includes introductory chapters on the study of natural history, how the coast is formed and how food chains function. Terms are clearly defined and the text is written so that someone new to the study of beach ecology can follow along.

The author, Scott W. Shumway, a professor of biology at Wheaton College in Norton, Massachusetts, is also a good photographer. His photographs are among the more than 300 color images that illustrate this guide. Beautiful pictures of plankton,



### *The Naturalist's Guide to the Atlantic Seashore: Beach Ecology from the Gulf of Maine to Cape Hatteras*

By Scott W. Shumway

Falcon Guides, an imprint of

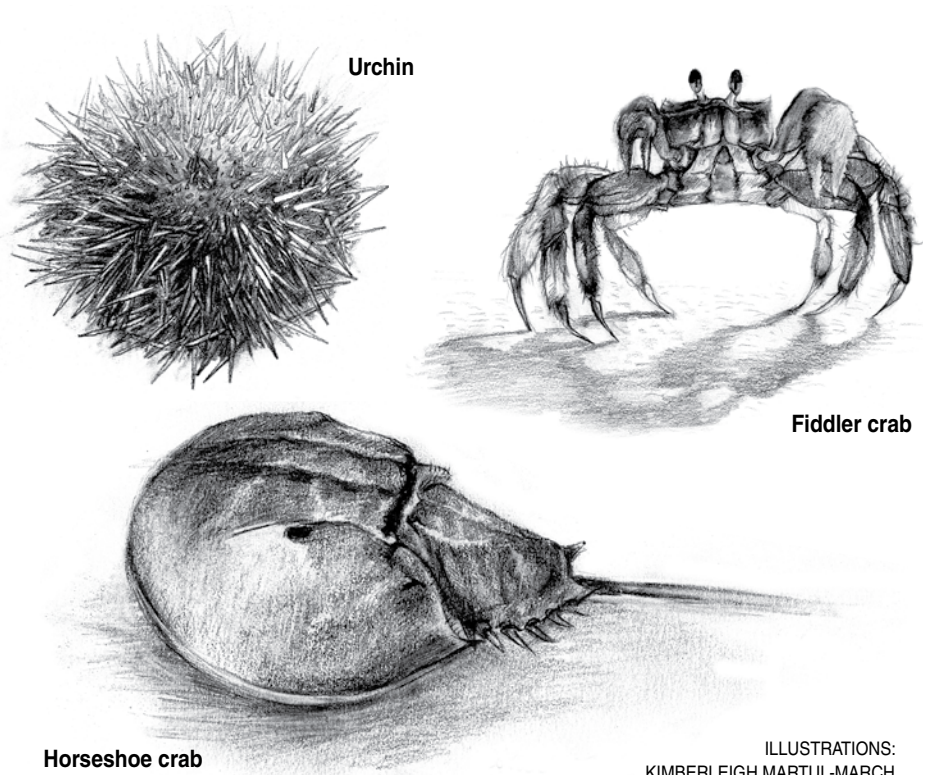
The Globe Pequot Press

232pp., \$24.95, paperback

worms, kelp, jellyfish, crabs, clams, salt marsh plants and shorebirds fill these pages.

*The Naturalist's Guide to the Atlantic Seashore* is printed on glossy paper, so the photographs pop off the page. It has a durable cover and binding to enhance its portability. An index with common and scientific names also makes it a useful resource while out and about.

Lee Bumsted writes on conservation and outdoor recreation topics from South Portland, Maine.



Horseshoe crab

ILLUSTRATIONS:  
KIMBERLEIGH MARTUL-MARCH

Schmitt defines the chemical process behind bioluminescence in the May 24 entry. She then takes it further: "The more scientists discover about bioluminescence, the more magical and incredible it seems. Some bioluminescent animals have personal dimmer switches, and adjust the intensity of their light to match the light from above, preventing a silhouette that might be visible to predators down below. Light-producing bacteria turn entire seas to a milky blue....To see this other kind of light, you must go to the sea at night and walk along the wet sand, watching where the waves recede. Or go out in a boat and dip your paddle into the waves, stir, and all the world will be illuminated."

Similarly, she describes both the science and art of sundogs, bright spots that appear to either side of the sun on clear, cold days, in the Nov. 11 entry. She writes: "Sometimes the sundogs look like patches of rainbow, adding the color of ice-shine to the ceiling of our shore."

The almanac format allows Schmitt to note birth dates of writers and scientists who have links to the Gulf of Maine. She selects pertinent excerpts from the work of writers such as Rachel Carson, Henry Wadsworth Longfellow and E.B. White, and tells a bit about their lives. In her biographical sketch of Henry Bryant Bigelow, the first director of the Woods Hole Oceanographic Institu-

tion, she describes his contributions to the practice of modern oceanography.

In *A Coastal Companion*, each month starts with a poem by a contemporary poet and a simple pen-and-ink drawing of a coastal scene by Margaret Campbell. Graphite pencil drawings of sea life and birds by Kimberleigh Martul-March are scattered throughout the text and enliven the 8-inch x 10-inch pages. Endnotes, a bibliography and an index round out the book.

While this is a book about the Gulf of Maine, most site-specific references are to the coast of northern New England, and Maine in particular. This is not surprising as the contributors are all Maine residents: the illustrators, the poets and the author. Schmitt is a staff member of Maine Sea Grant, a nonprofit federal-university partnership based in Orono and working to further marine science and education in the state of Maine.

Armed with a better appreciation of the natural history of the Gulf of Maine, readers can use the excuse of E.B. White's birthday on July 11 or Henry David Thoreau's on July 12 to head outdoors and experience the wonders of the Gulf firsthand.

Lee Bumsted writes on conservation and outdoor recreation topics from South Portland, Maine.

## Outside the Gulf



COURTESY: NICK WARREN

**Aquaculture in Haiti.** Scientists from the Marine Biological Laboratory in Woods Hole, Massachusetts, are helping Haitians to improve the talipia aquaculture yield using local plants. The fish could boost the protein-poor diet of the local residents. **For the full story visit the Times Web site at: <http://www.gulfmaine.org/times>.**

# Q&A: Karen McElmurry

## Creating a haven for hurt animals

By Catherine Coletti

Center for Wildlife Director Karen McElmurry became interested in working with wildlife during high school while volunteering at a humane society. She has helped care for injured wildlife ever since. As director of the Center in York, Maine, for 18 years, she has experienced firsthand the successes and challenges of taking in high volumes of injured wildlife. Each year, the Center cares for more than 1,500 animals, with the heaviest case load in the summer months. Throughout its history, it has never turned an animal away.



PHOTO: CENTER FOR WILDLIFE  
Karen McElmurry releases a barred owl.

Both Canada and the United States have licensed wildlife rehabilitators that treat sick, orphaned and injured wildlife, with the goal of returning them to the wild. Though there are numerous licensed wildlife rehabilitators in the Gulf of Maine region, the Center for Wildlife joins about two handfuls of other centers in the Gulf of Maine that can care for large numbers of injured animals. Other centers include The Hope for Wildlife Society and Spruce Cove Wildlife Rehabilitation Centre, both in Nova Scotia.

McElmurry of the Center for Wildlife spoke to the *Gulf of Maine Times* about the Center's work.

**Q: What species of animals does the Center for Wildlife (CFW) care for? What are the most common injuries? Are there similar organizations in the region?**

**A:** The CFW treats more than 150 different species of birds, small mammals and reptiles. We do not admit high rabies species like raccoons, fox or skunks. When we receive calls on these species we need to refer the caller to other licensed rehabilitators who handle them. The most common injuries we see are from animals being hit by cars, caught by cats and dogs, birds hitting windows, young mammals that still need care because the mother was live trapped and relocated, and young birds needing care due to habitat destruction or spring cleanup projects around homes.

Many animals that are hit by cars have fractured bones or have some head and eye trauma. Animals caught by cats usually have deep puncture wounds and need to be treated with antibiotics. The summer is our busiest time of year due to migratory birds returning to their nesting grounds, baby birds and mammals getting separated from parents, and

turtles being hit by cars as they travel to their egg-laying habitats. There are very few centers that handle a high volume of injured wildlife, but there are about 80 licensed wildlife rehabilitators in the state of Maine.

**Q: How far away do the animals come from? How are they transported to the Center?**

**A:** We receive animals from within a 100-mile (161-kilometer) radius. When someone calls the Center about an injured animal, we carefully give detailed instructions on the safest way for them to handle the animal and get it in a box or carrier for transport. Each call needs to be handled differently, as some animals can be quite dangerous for an inexperienced person to deal with. In those cases we would try to find a wildlife rehabilitator close by or a trained volunteer who has experience capturing an injured animal. It is always best for the finder to call before attempting to pick up an injured wild animal.

**Q: This past winter, there was an increase in owl injuries, especially among barred owls. What were some of the reasons why more owls needed care this past winter?**

**A:** We received 52 barred owls this winter due to a decline in the red-backed vole in Canada, which is an important prey species for the barred owl. This caused a southern movement of many owls seeking prey throughout the state. Unfortunately, winter is a tough time of year for all of our local owl species that struggle to find enough food and often collide with cars as they travel or hunt near the roads. The influx of the northern owls increased the number of birds being hit by cars and struggling to find enough food with the heavy snow cover and layer of ice on top of the snow. Barred owls may look big from the outside, but underneath all of those feathers is a bird that only weighs between 1 to 1.5 pounds (454 to 680 grams).



PHOTO: CENTER FOR WILDLIFE  
A barred owl with a fractured foot.

**Q: Why is it important to rehabilitate wildlife?**

**A:** I believe it is extremely important to rehabilitate wildlife, because natural resources and habitat are being destroyed or damaged at an alarming rate in Maine and across the country. With this depletion of



PHOTO: J. HESSION/CENTER FOR WILDLIFE

An eagle regains its freedom after rehabilitation.

habitat comes the necessity to assist species that are affected by the negative impacts that develop due to this destruction. As animals are forced to live in a closer proximity to humans, there is an increase in injuries and unfortunately deliberate removal or relocation of "unwanted" wildlife. The public is often misinformed about diseases, natural behavior and seasonal behavior of native wildlife. Human development leads to more road mortality, more window hits by birds and more wildlife caught by the roaming house cat. That is when wildlife rehabilitators are invaluable. Wildlife rehabilitators have the training, knowledge and expertise to work with a multitude of species that have very different and specific needs. It is not something that the general public should attempt. Our philosophy at the Center is that every animal, regardless of the species, deserves a second chance at life.

**Q: How many staff members do you have? What do volunteers do?**

**A:** There are seven year-round staff and two additional summer staff. Volunteers at the Center help the staff with animal care such as cleaning, preparing food, assisting with baby bird feedings, cage set-up, fundraising, building enclosures and other responsibilities.

**Q: What success stories are you especially proud of?**

**A:** There are so many successes at the Center, but I think one that stands out is a red-tailed hawk that had his leg caught in a leg-hold trap here in York [Maine]. The hawk was found in a ditch with the trap on its leg and was brought to the Center. Fortunately, the leg was not broken, but there was a lot of damage to the leg itself. Our veterinarian cleaned the leg and applied a dressing that needed to be changed every other day. It was obvious that the bird was in a lot of pain and discomfort, but he tolerated the daily handling and the bandage changes for three weeks.

After a re-evaluation by our veterinarian, he said the leg looked great and we could keep the bandage off and wait for the wound to completely close. After five weeks of being inside in a small cage the hawk was finally put outside in a large flight enclosure where he could once again spread his wings. After two more weeks outside, the hawk was taken back near where he was found and joyfully released back to the wild. After all of these years working with wildlife, I am still amazed at their resiliency and amazing healing abilities. Every animal that is released back to the wild is a success story. I am proud to say we have thousands of those.



PHOTO: CENTER FOR WILDLIFE  
A barred owlet found on the ground without its mother.

**Q: How can people help?**

**A:** The Center for Wildlife is a 501 (c) (3) [nonprofit] organization that relies heavily on donations and membership. Joining the CFW allows us to continue to help injured, ill and orphaned wildlife. The Center has an ongoing wish list on our Web site of frequently used items.

For more information, call the Center for Wildlife at (207) 361-1400 or visit its Web site at: <http://www.yorkcenterforwildlife.org>.

*Catherine Coletti is assistant editor of the Gulf of Maine Times.*

### Resources

For more information about wildlife rehabilitation in your area, visit your state's wildlife agency. For general information, visit the International Wildlife Rehabilitation Council at: <http://www.iwrc-online.org/> and the National Wildlife Rehabilitators Association at <http://www.nwrawildlife.org/home.asp>.

To find a wildlife rehabilitator, try the How To Locate a Wildlife Rehabilitator Web site, which has both U.S. and Canadian contacts at: <http://www.tc.umn.edu/~devo0028/contact.htm> or contact your local animal care center.

Hurricanes continued from Page 1

Taunton, Massachusetts, has been chipping away at that nonchalance for 10 years now. With another hurricane season set to begin June 1, he said, "We have a very inexperienced population that has not had to deal with the impact of a major hurricane. People haven't considered being without electricity for a week or two," he said.

The challenge of raising public awareness is perhaps even more acute in the Canadian provinces. When Peter Bowyer, the program manager of the Canadian Hurricane Centre (CHC) in Dartmouth, Nova Scotia, introduces himself to people, he says they look at him as though he just said, "I'm the coach of the Jamaican bobsled team." The unspoken question is always, "Why would Canada ever need a hur-

**Hurricanes – Saffir-Simpson Scale**

**Category 1** Winds 74-95 mph (64-82 kt or 119-153 km/hr)

**Category 2** Winds 96-110 mph (83-95 kt or 154-177 km/hr)

**Category 3** Winds 111-130 mph (96-113 kt or 178-209 km/hr)

**Category 4** Winds 131-155 mph (114-135 kt or 210-249 km/hr)

**Category 5** Winds greater than 155 mph (135 kt or 249 km/hr)

SOURCE: NATIONAL HURRICANE CENTER/NOAA  
 HTTP://WWW.NHC.NOAA.GOV/ABOUTSSHS.SHTML

ricane center?"

An Environment Canada study in 2004 answered that question. Called *A Climatology of Hurricanes for Canada: Improving Our Awareness of the Threat*, the study looked at the frequency of hurricanes in the Atlantic over the last 50 years of the century. The numbers near Nova Scotia were on par with Florida and Cuba. And the highest count in the entire Atlantic fell inside the CHC's Response Zone. The difference was in the strength. On the

coast of Nova Scotia there were no Category 3 to 5 hurricanes (see Saffir-Simpson hurricane scale box) during those 50 years, whereas Florida and Cuba saw many major storms.

But it's a different confluence of events that is making Bowyer's and Vallee's job of educating the public easier. In 1995, after a lull of two decades, hurricane activity in the North Atlantic showed a marked uptick that continues unabated; global warming and the environment are no longer the domain of scientists and tree huggers—the public has tuned in. And a couple of spectacular hurricane disasters in 2005—namely Katrina and Rita in the Gulf of Mexico, which almost fulfilled the worst-case scenarios of the regions they struck—brought the importance of preparedness into startling view.

In the two generations since the last huge hurricane hit the Gulf of Maine, meteorological science has made quantum leaps in forecasting with the aid of satellites and sophisticated software. But predicting the path of a hurricane and its landfall still comes down to the last 24 hours. That short timeline combined with a densely built-up coastline means the vulnerability of the Gulf's waterfront communities has grown significantly. Now even small storms can cause considerable damage.

For coastal zone managers, none of this is news. What is new is a unique Massachusetts program, which went live in May, called StormSmart Coasts. It is based on the premise that coastal resiliency and storm readiness rests largely in the hands of the 78 communities that dot the state's 1,500-mile (2,414-kilometer) shoreline. These towns, often with limited staff, lack the know-how and resources to prepare for storms and reduce their exposure to potential damage in the longer term.

StormSmart hopes to fill that gap. What it will offer municipal officials is an interactive Web site covering everything from "mitigation and shore protection" to "hazard identification and mapping" and "emergency services." All are backed up by access to technical



IMAGE: JACQUES

**Preparing for the next big one.** Hurricane Erin, pictured above, was not a major hurricane and up to Maine. Coastal areas saw large swells and rip tides, but Erin caused little damage. It's hour or 96-113 knots) hit the Gulf of Maine.

assistance, legal guidance and funding sources.

If successful, the program could become a national model for coastal states, said Andrea Cooper, the Shore-

line and Floodplain Management Coordinator for the Massachusetts Office of Coastal Zone Management (CZM). She explained that the concept for the Web site was disarmingly simple. Most

**Core samples: Examining history to predict the future**

By Susan Llewelyn Leach

**H**urricane activity in the Gulf of Maine is on the rise. But is it a temporary uptick or part of a decades-long, or even centuries-long, cycle? Scientists at Woods Hole Oceanographic Institution in Woods Hole, Massachusetts, are poking holes in the mud to try to find out.

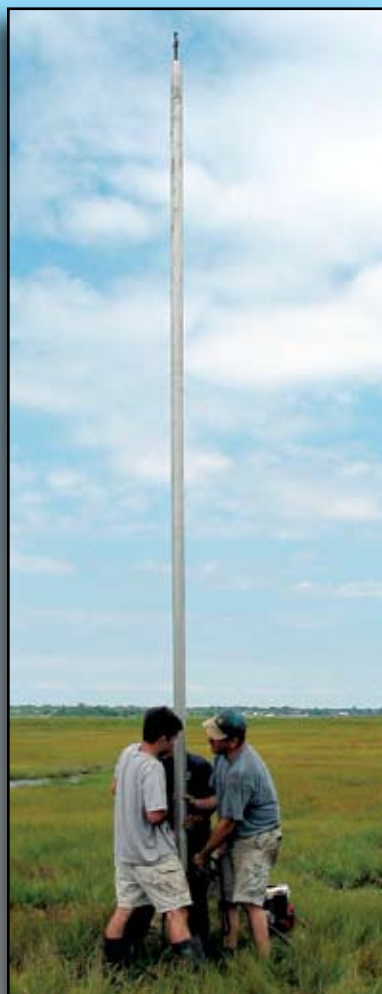
Using 20-foot (six-meter) long, vertical core samples from marshes and ponds, scientist Jeff Donnelly is piecing together a 2,000-year log of storm activity, which he hopes will offer clues to hurricane frequency in the future.

What's surprised him in his research, he said, is the strong correspondence between the core sample sites in New England, the Caribbean and the Gulf of Mexico. The whole Atlantic basin is pulsing with the same storm cycles, he said. The intervals of frequent storms and the intervals of low activity are largely in step.

As for huge storms—Category 3 and above—they appear in the historic record about every 80 to 100 years. But the climate has been changing, and the impact that will have is unknown, Donnelly said. It may make the probability of a big storm even greater. Either way, "the probabilities will catch up with us," he added.

In the meantime, the link between warmer seas and the present uptick is unconfirmed. Donnelly thinks a more critical factor in determining hurricane frequency in the Gulf of Maine will be the influence of global warming on El Nino and the West African monsoon.

His colleague Ilya Buynevich's storm research goes back 5,000 years. The Woods Hole scientist, who is working in tandem



COURTESY: JEFF DONNELLY, WHOI  
 Jeff Donnelly (right) and his colleagues balance a metal tube that is used to extract sediment cores from a marsh.

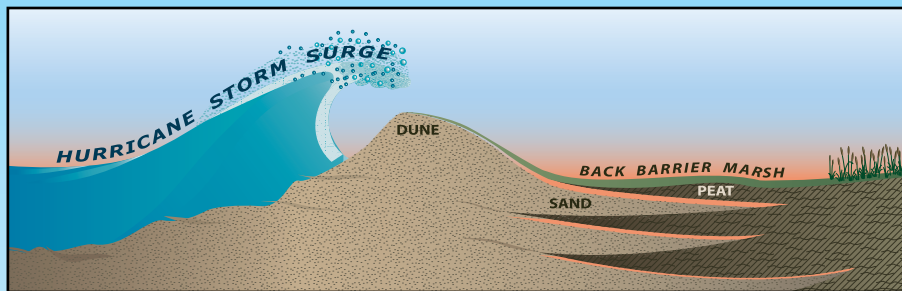
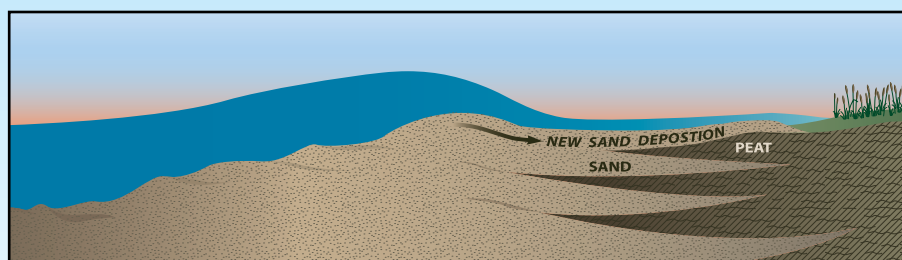


ILLUSTRATION: JAYNE DOUCE

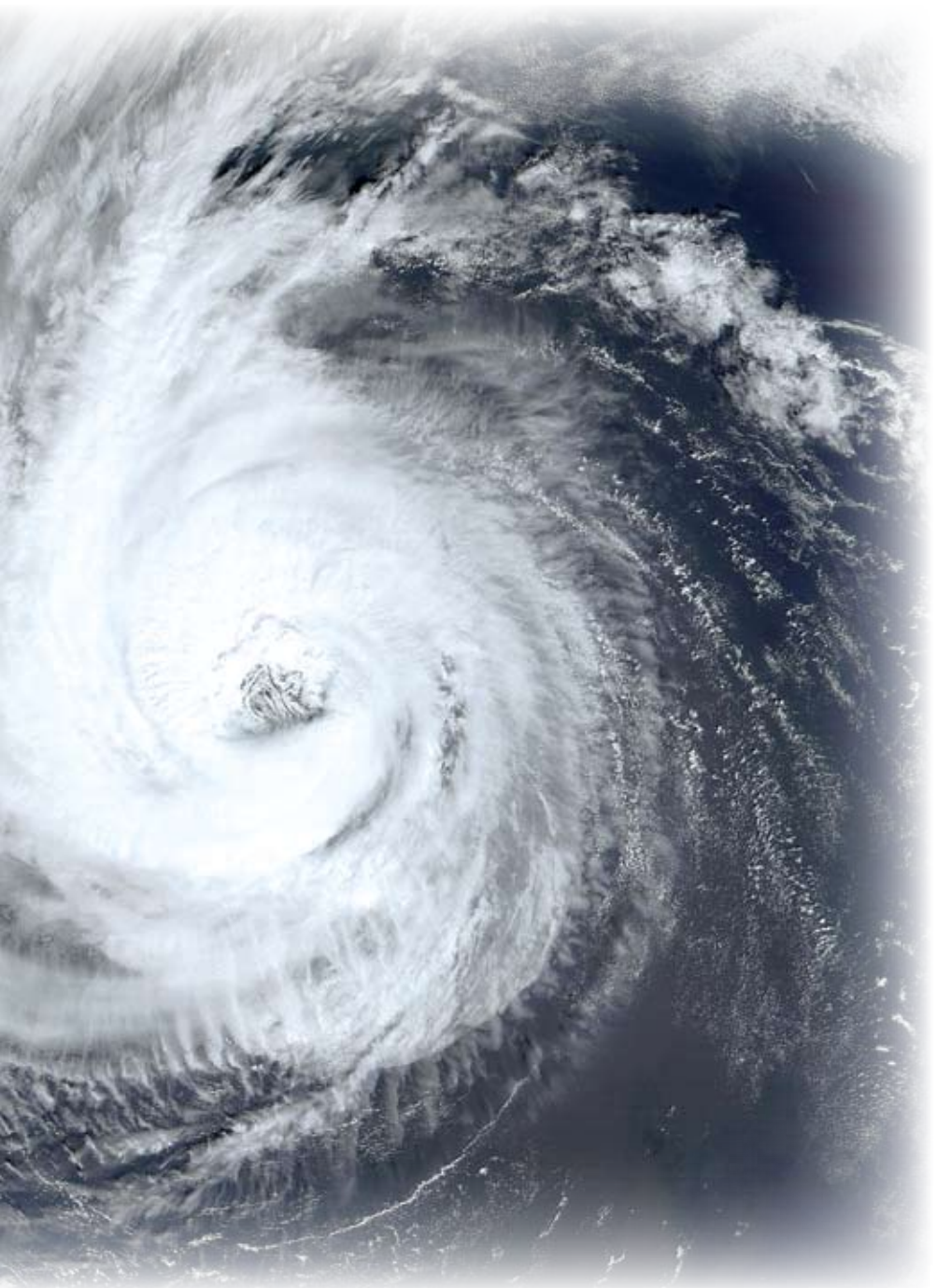
Water surging during an intense hurricane carries sand from the beach into the marsh (above). That sand and sediment becomes interspersed into layers between peat that forms naturally, just above the water line (below).



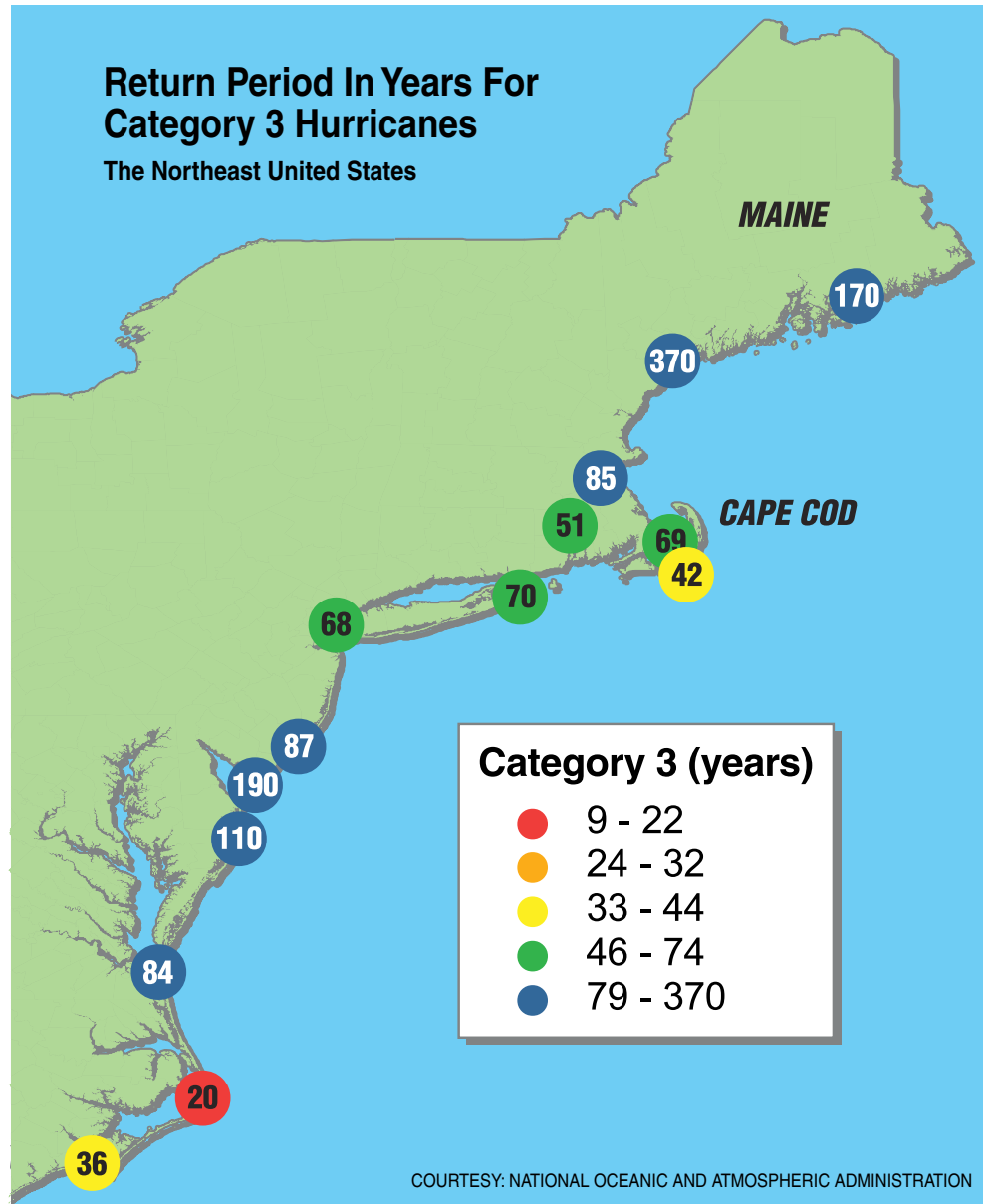
with Donnelly, uses ground-penetrating radar to track old shorelines and ancient beaches. The radar acts like an X-ray, picking up concentrations of heavy minerals and steep dropoffs, which are subsurface signatures of a big storm. Then, using optical dating of the sand grains to measure when they last saw sunlight, he can pin the event down to within a couple of decades.

For coastal zone managers, this offers an insight into why shorelines have shifted, pointing to marching dunes and natural features that could guide future development.

In a couple of years, when their research is further analyzed, Donnelly and Buynevich hope their data on how coastal ecosystems respond to huge landfalling hurricanes will guide coastal zone management and in turn limit damage, natural and human-made, from the next big one.



DESCLOITRES, MODIS LAND RAPID RESPONSE TEAM, NASA/GSFC [HTTP://VISIBLEEARTH.NASA.GOV/VIEW\\_REC.PHP?ID=2113](http://visibleearth.nasa.gov/view_rec.php?id=2113)  
 ne, but in September 2001 the storm made its way northward from Virginia, past Massachusetts  
 been more than half a century since the last Category 3 hurricane (winds of 111-130 miles per



of the information on the site was already available to the public either online or in hard copy, but rarely in a digestible form. In some cases, Cooper said, it would have required reading

through hundreds of pages of technical documents to find the relevant nugget. Over a two-year period, CZM pulled that data together into a user-friendly format, along with fact sheets that explain available tools and provide case studies of towns in Massachusetts that have implemented mitigation efforts.

Chatham's zoning law, for example, prevents development in the town's 100-year floodplain. When a local landowner legally challenged that bylaw, the case went as far as Massachusetts Supreme Judicial Court and ended in a landmark ruling in 2005 that affirmed the authority of towns to regulate flood-prone areas.

In Scituate, where the floodplain is already well developed, town planners in 2006 started informing owners of their property's flood history and showing them how to apply for Federal Emergency Management Agency (FEMA) funding to elevate their utilities, if not the homes themselves, above flood level.

With a highly developed coastline and little slowdown in demand for waterfront property, it might seem like the horse has already bolted from the barn. But much can be done, Cooper said, to retrofit houses, tighten building codes and mitigate a storm's impact, as well as conserve the natural environment. For example:

- Lawns in coastal floodplains act like asphalt in a storm, and can be re-landscaped with native vegetation to reduce flooding and stop erosion.

- Freeboarding a home by raising it two feet (0.6 meters) above flood level can cut home insurance so much that the owner ends up saving money, despite the initial upfront cost. Cost is key for people who might not be "big" on the

environment, Cooper said.

- Replacing paved surfaces with pervious ones like gravel, which lets excess water drain away naturally, also saves costs by reducing maintenance and the inevitable job of repairing potholes.

- Rain gardens that absorb runoff from roofs, driveways and walkways can help storm water percolate into the ground and reduce flooding. To illustrate their efficiency, Cooper recalled Mother's Day last year when parts of Massachusetts were hit by 13 inches (330 millimeters) of rain in 48 hours. The rain gardens, she said, absorbed all the excess water, while elsewhere sewers overflowed and rivers flooded.

Hurricanes produce three types of hazards: high winds, inland flooding and storm surge. Television footage of half-submerged houses is perhaps the most stark image of what a single storm surge can do. But even heavy rains can overwhelm storm drains and cause rivers and streams to overflow their banks and flood communities miles inland.

Besides costly property damage and the destruction of public infrastructure, storms also throw oil, sewage and other contaminants onto the shoreline and farther inland as storm surge washes into fresh water areas. Some species can't survive high concentrations of salt, and freshwater grasses sometimes die off. Dunes can take years to recover from erosion.

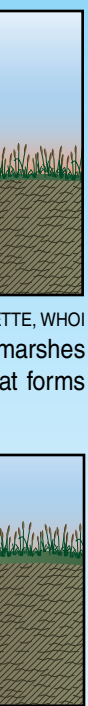
While scientists study prehistoric storm data and how the shoreline has shifted over the centuries (see sidebar,

"Core Samples") to gain clues about future hurricane activity, preparedness is still king. In the late 1990s, mitigation and retrofitting were in high gear. That changed after 9/11 with an unexpected twist. Homeland Security funds, designed to improve technology and tracking, lead to better hurricane emergency response, which depends heavily on communications, notification and monitoring, said meteorologist Vallee. For example, cross-border communications between utility providers in Canada's Atlantic provinces and New England's coastal states are now more sophisticated, and in the event of a huge hurricane, trucks would be pre-positioned to help if power got knocked out. Interstate communications are also more established.

In the end, however, nature has its own way of realigning the coast, in spite of human intervention. Whether the next big hurricane is around the corner or decades away, coastal communities' ability to use and adapt nature's own defenses, such as marshlands, dunes and rain gardens—along with building for the biggest storm in mind—should help contain its impact.

*Susan Llewelyn Leach is a freelance writer based in Cambridge, Massachusetts.*

**To read more about new hurricane technology visit the Times on the Web at:**  
[http://www.gulfmaine.org/times.](http://www.gulfmaine.org/times)



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PHOTO: JEFF DONNELLY, WHOI  
 A sediment core allows scientists to chronicle the landfall of historic hurricanes, such as the storms in 1635, 1938 and 1954 that struck New England.

**RESOURCES:**

<http://www.mass.gov/czm/stormsmart/index.htm>  
 Massachusetts Office of Coastal Zone Management – StormSmart Coasts

[http://www.atl.ec.gc.ca/weather/hurricane/climatology/preview\\_e.html](http://www.atl.ec.gc.ca/weather/hurricane/climatology/preview_e.html)  
 A Climatology of Hurricanes for Canada: Improving Our Awareness of the Threat

[http://www.atl.ec.gc.ca/weather/hurricane/index\\_e.html](http://www.atl.ec.gc.ca/weather/hurricane/index_e.html)  
 Canadian Hurricane Center

[http://www.nhc.noaa.gov/HAW2/english/storm\\_surge.shtml](http://www.nhc.noaa.gov/HAW2/english/storm_surge.shtml)  
 This is an animated graphic on the effects of storm surge and a list of safety precautions

<http://www.nhc.noaa.gov/pastprofile.shtml>  
 Tropical Cyclone Climatology

<http://www.nhc.noaa.gov/>  
 National Hurricane Center (USA)

# Travelogue

## Sandbar Social: Cape Cod's wet and wild residents

By Karen Finogle

A writhing mound of flesh filled both lenses of my binoculars as I trained them on a sandbar just off shore. Dozens of bodies lay in thick, uneven rows, occupying every last grain of earth and spilling into the cool, shallow water of the Atlantic. Some let their heads droop, resting them on the ground or on neighboring flesh. Others held their thick necks erect, their shoulders pulled up into a half-sitting stance to focus dark eyes in my direction.

I panned my binoculars left, then right, back again, following the borders of the small spit of land on which these beachgoers were settled. It was an island drained of any distinct color. A palette of mottled grays, browns and blacks blended in a massive sea of seal blubber that rose and fell with the shifting and settling of bodies.

We had heard the low, undulating rumble of their voices before we saw them. The summer air was thick, draped in a vaporous veil the sun, sequestered by rain clouds, had not yet lifted. My partner Pete and I had decided to walk South Beach, in Chatham, Massachusetts, anyway. There was only a slight breeze, and the undeveloped, often uncrowded Cape Cod beach, a spigot of sand and grassy knolls that ended only at the southern shores of Monomoy Island, was too alluring to pass up.

Kicking our shoes off at the bottom of the stairs to Chatham Light Beach, Pete and I sunk our feet into the cold sand and turned right, walking by Chatham Harbor towards South Beach and the open sea and passing only a few others who had ventured out on this overcast Sunday morning. As we walked, the din of the gray seals became audible: a crescendo of guttural barking and hooting as we crested a small slope of sand. I wondered at the origin of the sound, what could be drowning out the more melodic and familiar push and pull of the tide. I wondered until we rounded a bend where South Beach proper began.

On a sandbar unearthed by low tide and just a short wade from where we stood, a hundred or more gray seals had hauled out to rest, something, I learned later, these semi-aquatic animals do daily. It was a new phenomenon for me, a native New Hampshireite born among granite peaks whose state's diminutive coastline had never produced such a colossal gathering of pinnipeds.

Even Pete, who had spent summers since childhood visiting the Cape, seemed transfixed by the spectacle. We traded binoculars back and forth, watching the mammalian drama unfold. Most of the gray seals on the spit kept their front flippers tucked neatly against their stomachs, with eyes squinted shut against the daylight. Their splayed, torpedo-like bodies looked awkward and alien on land.

A few seals lounged in what looked like a yoga pose; their hind flippers held high in the air, heads lifted slightly off the ground. Were



PHOTO: PETE INGRAHAM

Gray seals lounge on a spit off of South Beach, near Chatham, Massachusetts.

they the smaller females or juvenile males wary of being rolled upon by one of the larger adult males, which might weigh in at 1,000 pounds (more than 453 kilograms) and measure eight feet long (almost 2.5 meters)?

A handful of the seals stayed in the water; their heads like fishing bobbers floating on the surface and always pointed in our direction—a deployed flotilla of Navy men, I imagined, ready to sound an alarm or mount a defense.

The last official count of gray seals in the Chatham area took place in 1999 when biologists estimated there were 5,600 animals; the number has likely increased to about 6,000. While most Chatham residents have become accustomed to their saltwater neighbors, seeing even one gray seal 30 years ago would have elicited a mouth-agape response, not unlike my own, from almost every other veteran seaside dweller and marine biologist alike.

Hunted for bounty until the 1960s, gray seals were considered extinct in the waters off New England until they received protection, first from Massachusetts in 1965 and then by the federal government in 1972 under the Marine Mammal Protection Act, which prohibits the killing or harassment of any marine mammals. Over time, seals from a large refuge colony on Sable Island, off Nova Scotia, migrated and re-colonized Massachusetts. With the Cape's abundance of sand eel, a favorite staple, and fish, skates and squid, breeding and pupping on Muskeget Island in Nantucket Sound began. In the late 1970s, less than 20 seals were counted in those waters, but by 1994, because of migration and successful pupping, 2,010 seals were reported.

As sunlight began to burn through the cloud-ceiling overhead, Pete and I broke from our vigil and continued down South Beach. I was reluctant to leave the sovereign island nation of *Halichoerus grypus*, the "hook-nosed sea pigs," but the firm sand at the water's edge and the skipping rocks, worn thin and smooth, puckering in that wet ce-

ment surface lured us away. So too did the wide expanse of nothingness—the light surf breaking on an empty beach that extended towards the horizon, populated only by busybody terns, gulls and plovers.

We wandered aimlessly; the seal raucous faded on the breeze that whispered by us. For awhile, Pete and I beach combed for shells, stopping to pick different ones up and studying the rich purple, green and blue hues before dropping them back on the sand. I like to imagine the beach as an art gallery. Exhibits change twice daily by tidal curators, where everything is on loan from the sea.

We were a mile, maybe two, past the seal colony when, looking back out at the ocean, I spotted one, then another dark gray head bobbing in the breakers near a smaller sandbar. Our aquatic equivalents didn't haul out but dove and surfaced in the shallow waters, close enough that without binoculars I could study their antics, which always suggested fun.

It seemed that these two clowns were intent to locate and study us as well. Their heads always pivoted towards shore, like periscopes, when they sought a breath of air, as if tracking our movements. Were they curious about their distant cousins who had, for unfathomable reasons, abandoned water for a life on land? Did they puzzle at our awkward, erect appearance? Or, as fishermen, did they view us merely as competition for the slippery morsels they chased beneath the water's surface?

In recent years, some of Cape Cod's fishermen have recast the gray seal in the role of unsavory competitor, one that gorges itself on commercial fish stock like cod, haddock and flounder. No conclusive proof exists yet to indicate the robust seal population has a negative effect on the industry. Surely overfishing and environmental conditions are also at play, argue marine biologists. Probably so, but stories of empty fishing weirs and below-average catches still permeate the region. No one has advocated harming the

seals, but their sandbar socials must be an eyesore for those whose nets ply the same waters.

But not, it turns out, for the small crowd that had gathered near the island colony by the time Pete and I walked back up South Beach. The sun had emerged, a luminescent piper calling forth the masses. And the tide had slipped farther out, narrowing the channel of water between shore and sandbar. A group of 15, maybe 20, people had gathered near the seals, and some had waded out in the shallow water, cameras in hand, not more than 20 or 30 feet (six to nine meters) from the bobbing sentinels.

"They're going to get bitten," I whispered to Pete. He nodded. I wanted to usher these well-intentioned people back. To penetrate the seals' world in such a manner, without invitation, seemed wrong, even to this pinniped neophyte. Later, after reading a brochure from the Cape Cod Stranding Network on seal watching guidelines, I learned that the crowd should have stood at least 150 feet (almost 46 meters) from the resting seals. And that the intent gaze that more and more seals drew upon us, the greater number of heads that had lifted from the sand and were cocked in our direction, had not been signs of mutual curiosity but ones of harassment. We bipeds, especially the ones who wandered too close, had impeded on the seals' much needed cycle of rest.

Pete and I didn't stay long. There is always a little magic lost when your discoveries become everybody else's. It's as if the wildness of the moment became diluted as more feet waded closer and closer to the seal colony. That is nature's hold on us. In revealing herself, she draws us to her—pulling at our primitive core until we are compelled to become part of her. Many feet in the water, unsure of how far to wade.

Karen Finogle, a free-lance writer and senior editor at AMC Outdoors, lives in Durham, New Hampshire.



## Blue mussel farming as supplemental income

By Rebecca Zeiber

Andy Lang has a simple Darwinian outlook to his career: "Adapt or perish."

He's been relatively successful at adapting over the years, maintaining the family tradition of fishing in conjunction with his landscaping business in Greenland, New Hampshire. But Lang's recent efforts to diversify as a fisherman have brought about a new type of work for him—blue mussel farming.

Lang's efforts to raise and harvest blue mussels in a submerged offshore farm are thought to be the first such activity in the United States. The mussel farm, located a few miles off the coast of New Hampshire near the Isles of Shoals, raises the shellfish on a set of longlines submerged 30 feet (9 meters) under the water.

Lang was recently awarded an \$80,000 grant from the U.S. Department of Agriculture's Small Business Innovation Research (SBIR) program. The SBIR grant will help enable Lang and researchers at the University of New Hampshire to increase the operation's efficiency and ensure it is economically viable for other fishermen.

"When you're the guinea pig, it's both scary and exciting," Lang said. "You don't know if you're going to go broke or be successful. But I'm in it for the long haul."

His persistence and ability to adapt has allowed Lang to continue fishing, an interest that came about when he lived in North Weymouth, Massachusetts, as a child.

"I fished for rock cod and codfish right off the beach when I was a kid," Lang recalled. "I used to ice down about half a dozen fillets and put them in my little red wagon and walk up and down the streets selling them to folks," he chuckled.

Since that time, Lang has experienced some of the hardships of being a commercial fisherman in New Eng-

land. He still uses his 61-foot (more than 18-meter) aluminum trawler to fish for scallops and shrimp in the winter, but with rising costs for boat fuel, maintenance and seafood transportation, he has had to think outside the box.

"I had to diversify to make ends meet," Lang said. That's when he heard about the effort by the University of New Hampshire (UNH) Open Ocean Aquaculture (OOA) program—now known as the Atlantic Marine Aquaculture Center—to encourage local fishermen to begin mussel farming for supplemental income. In 2005, he received the country's first permits to farm mussels in the open ocean.

Persistence, innovation and technical help from UNH have kept the mussel farm going thus far. The SBIR grant will enable Lang and researchers like Ken La Valley, New Hampshire Sea Grant commercial fisheries specialist, to try different strategies to maximize efficiency over the next two years.

It doesn't take long to discover that Lang is brimming with new ideas on how to make mussel farming an alternative for struggling New England fishermen.

Traditionally, the mussel seed is collected on a longline rope during the winter and spring spawning periods. This means sacrificing the number of lines used to grow out the adult mussels, La Valley explained. He and Lang are designing different line configurations, such as those that float above the grow-out lines, to make sure the space is used efficiently. Different types of rope material used for seed collection will be tested as well, but new techniques require money.

"This grant gives us some help," Lang said. "We don't have deep pockets, but there are so many different things I want to try to do, such as tie the lines differently and use different materials. We want this to be a complete farm for mussels, one-stop



PHOTO: REBECCA ZEIBER, NH SEA GRANT

Commercial fishermen Andy Lang (left) and Robert Bryant (right) inspect the lines in their mussel farm to see the progress of the organisms' growth.

La Valley added that the SBIR grant will allow funds to be used for optimizing harvesting yields and improving storage and handling techniques to extend the shelf life of the mussels.

"We want to build upon the groundwork laid by the OOA program and take it to the next level," La Valley said. "The grant is geared to make small business work, and Andy has the best shot of anyone to make this work."

But for Lang, the work isn't about any one individual. "This isn't about me or about money. But when you're the first guy to try something new you need a little help," he said. "This grant isn't a donation. It's a way to learn information that we'll give back to the government and to other fishermen about making this a feasible business."

"It takes time to produce a quality product," Lang added. "You reap

shopping."

Lang discusses another challenge they have faced: many of the mussel shells break during processing. The relatively thin shells of the open ocean mussels are easily broken by the rough brushes meant to separate the individuals and remove grit and sand, and those with broken shells cannot be sold to local restaurants.

However, Lang has some ideas for meeting that challenge. The blue mussels raised in the open ocean do not take in much sand or grit the way traditionally farmed mussels do, he explained. They don't need much scrubbing, so he wants to experiment with changing the brushes to barrel rollers or simply rinsing the shells as an alternative.

what you sow. You hear that all the time in so many different ways, but it's really true. If you want something nice, you need to put good effort into cultivating it."

For more information see the Summer 2007 issue of the *Gulf of Maine Times* at: <http://www.gulfmaine.org/times/summer2007/barnaby.html>.

Rebecca Zeiber writes for *New Hampshire Sea Grant in Durham, New Hampshire*.

To read about the debate over a male dogfish shark fishery visit the Web edition of the *Times* at: <http://www.gulfmaine.org/times>.

The *Gulf of Maine Times* is made possible in part by a grant from:



For general information about the Gulf of Maine Council, please call:

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Gulf of Maine Council Coordinator  
(603) 796-2615

To speak with someone in your jurisdiction about the Gulf of Maine Council and related activities, please call:

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Elizabeth Hertz  
State Planning Office  
(207) 287-8935

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Julia Knisel  
Office of Coastal Zone Management  
(617) 626-1191

#### New Brunswick

Jane Spavold Tims  
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(506) 457-4846

#### New Hampshire

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New Hampshire Department of Environmental Services  
Concord, New Hampshire

Ron Chisholm, Minister  
Nova Scotia Fisheries and Aquaculture  
Halifax, Nova Scotia

Rick Doucet, Minister  
New Brunswick Department of Fisheries  
Fredericton, New Brunswick

Martha Freeman, Director  
Maine State Planning Office  
Augusta, Maine

Carolyn Gravel, Manager  
Environmental Affairs  
Shipping Federation of Canada  
Montréal, Quebec

Roland Haché, Minister  
New Brunswick Department of Environment  
Fredericton, New Brunswick

W. Donald Hudson, President  
The Chewonki Foundation  
Wiscasset, Maine

Byron James, Deputy Minister  
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Fredericton, New Brunswick

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National Oceanic and Atmospheric Administration/ National Marine Fisheries Service  
Gloucester, Massachusetts

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Augusta, Maine

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Energy Delivery & Generation  
Manchester, New Hampshire

Claribel McBane  
Marine Fisheries  
New Hampshire Fish and Game Department  
Durham, New Hampshire

Leslie-Ann McGee, Director  
Massachusetts Office of Coastal Zone Management  
Boston, Massachusetts

Marvin Moriarty, Regional Director  
U.S. Fish and Wildlife Service  
Hadley, Massachusetts

Michael Murphy  
Acting Regional Director  
Oceans and Habitat Branch  
Department of Fisheries and Oceans  
Bedford Institute of Oceanography  
Dartmouth, Nova Scotia

Mark Parent, Minister  
Nova Scotia Department of Environment and Labour  
Halifax, Nova Scotia

Stephen Perkins, Director  
Office of Ecosystem Protection  
U.S. Environmental Protection Agency  
Boston, Massachusetts

Jennifer Smith, Manager  
GIS/Conservation Planning  
WWF-Canada Atlantic Program  
Halifax, Nova Scotia

Lee Sochasky, Executive Director  
St. Croix International Waterway Commission  
Calais, Maine

Robert L. Stephenson, Director  
DFO St. Andrews Biological Station  
St. Andrews, New Brunswick

Greg Thompson  
Fundy North Fishermen's Association  
Dipper Harbour, New Brunswick

## Resources

...for and about the Gulf of Maine

The first version of the **Indicator Reporting Tool** is available. It uses novel technologies to bring together data from Gulfwatch, the Gulf of Maine Ocean Observing System (GoMOOS) and Mussel Watch. Point-source data and eelgrass extent also are available. The tool effort was started in 2006 by The Gulf of Maine Council's Ecosystem Indicator Partnership (ESIP) to provide up-to-date contaminant and nutrient data for the Gulf of Maine. The project is funded through a grant from GeoConnections, a Canadian initiative to use technology to deliver scientific information to resource managers, community leaders and citizens. ESIP is involved in follow-up projects to bring in more indicator data and improve graphing and data functions. The new tool and ESIP's current Monitoring Map are at: <http://www.gulfmaine.org/esip>.

The assessment report entitled **From Impacts to Adaptation: Canada in a Changing Climate 2007** discusses current and future risks and opportunities that climate change presents to Canada, with a focus on human and managed systems. The current state of understanding is presented, and key knowledge gaps are identified. Visit [http://adaptation.nrcan.gc.ca/assess/2007/index\\_e.php](http://adaptation.nrcan.gc.ca/assess/2007/index_e.php).

The New Hampshire Department of Environmental Services has a new newsletter, **The Critical Edge**, available to its Enews subscribers. An offering of the department's Shoreland Protection Program, the newsletter will give monthly updates on the status of changes to the Comprehensive Shoreland Protection Act during the summer of 2008. It then will become a quarterly newsletter. Visit [http://des.nh.gov/news/edge/2008may\\_ce.pdf](http://des.nh.gov/news/edge/2008may_ce.pdf).

*Resilience continued from Page 1*

resilience thinking is becoming an increasingly important tool for managing our fragile coasts.

Leslie grew up in Plymouth, Massachusetts, and spent much of her childhood close to the water. "That certainly sparked an early love of the ocean in me," she said. She studied science at Harvard and earned her Ph.D. at Oregon State University, investigating how marine invertebrates respond to varying conditions up and down the Oregon coast. Last summer, she returned to her New England roots when she accepted a position as assistant professor of environmental studies and biology at Brown in Rhode Island.

Resilience doesn't imply that an ecosystem will remain static, Leslie explained. Rather, resilient places are those that can adapt to disturbances. When winter arrives on New England's barrier beaches, for instance, sea birds take leave, and the topography of the dunes changes as they are slammed by winter storms. "Their appearance changes through time, but the same ecosystem remains," she said. "The functioning barrier beach is still there."

Every ecosystem is different, of course, but Leslie pointed to certain characteristics that resilient places tend to share. Among the most important, she said, is diversity. "More species-rich ecosystems, as a rule, tend to be more resistant to disturbance—whether invasions by invasive species, or a change in environmental conditions."

Also key, she said, is that important interactions remain intact. The delicate dances between predator and prey, for example, are crucial to a healthy environment. Even diverse ecosystems with healthy interactions can suffer, however, if the nature of the disturbance changes. Consider again the barrier beaches. If storms



PHOTO: KERYN BROMBERG

Heather Leslie (left), in the field on Prudence Island, Rhode Island, with Christine Holdredge, a Brown University graduate and research technician.

suddenly become more frequent or more severe as a result of climate change, Leslie noted, the once-resilient beaches may no longer be able to shoulder the blows.

Predicting whether or not an ecosystem is resilient is still a daunting task, said Leslie. But she's optimistic. In the last several years, she said, resilience science "has moved beyond intellectual curiosity, toward actually trying to apply this knowledge to inform environmental decision making."

In many ways, resilience science is closely coupled with ecosystem-based management (EBM), a popular new

management strategy that factors in all ecosystem components, including humans, rather than managing each resource in isolation. Keeping people in the picture is also a key element of resilience science, Leslie said. "In the Gulf of Maine, there has been a decline in the abundance of groundfish, a rise in crabs and lobsters, and that has affected human communities that rely on those resources," she said. Social, economic and environmental factors all feed into the Gulf of Maine's resilience to future upsets.

Going forward, Leslie sees great promise for EBM and resilience sci-

ence in the Gulf of Maine. "Even though the abundance of cod and other groundfish has been quite altered, they are still in the system. All of the pieces are still available to us. There's hope of restoring them," she said.

Of course, cod aren't everything, even in the northwest Atlantic. "Perhaps we've been overly focused on [fishing] because of its clear economic importance," Leslie said. "In my opinion, we should be paying equal attention to barrier beaches and salt marshes, and what contributes to their resilience."

She suggested that the next step may be to perform a formal resilience assessment in the Gulf. Other communities have undertaken such projects, and a group called the Resilience Alliance has developed a pair of workbooks (available at <http://www.resalliance.org/3871.php>) to help guide the process. While she'd love to be involved in such a project, she said, she doesn't feel right leading the charge. "In my opinion, it's not something that should be led by a small group of academics. It would be more beneficial as a community-driven effort."

What's clear, Leslie said, is that resilience thinking comes at a crucial time. "We are facing a rapidly changing world, perhaps more so than ever before," she said. "We need to understand how ecosystems are changing, how we might mitigate those changes and how people are likely to be connected. There is a lot of opportunity for resilience thinking to contribute to resolving those questions."

*Leslie is the co-editor, with Karen McCleod, of the book "Ecosystem-Based Management for the Oceans," which will be published by Island Press later this year.*

*Kirsten Weir is a free-lance writer in Saco, Maine, who focuses on science, health and the environment.*

## From the Scientific Literature

### Eel declines linked to changes in Sargasso Sea

American eels are quickly disappearing from restaurant menus as stocks have declined sharply across the North Atlantic. The reasons for the eel decline remain as mysterious as its long migrations. A recent study by a National Oceanic and Atmospheric Administration (NOAA) scientist and colleagues in Japan and the United Kingdom says shifts in ocean-atmosphere conditions may be a primary factor in declining reproduction and survival rates.

"Although many aspects of spawning and early life history of this species are poorly understood, they are clearly adapted to grow in the low productivity waters of the Sargasso Sea south of Bermuda," NOAA biologist Kevin Friedland said in a statement. "They spend up to a year or more as larvae and tend to live in the upper 100 meters (about 330 feet) of the water column, so any changes in the surface waters will have a big impact during critical stages in their development."

Friedland and colleagues have found a significant correlation between the North Atlantic Oscillation (NAO), a decadal long ocean-atmosphere circulation pattern, and long-term variations in the catches of juvenile stages of the eels, commonly called glass eels. The harvest of glass eels, considered a delicacy, remains controversial due to concerns about stocks that some say may be close to collapse.

Their study was published recently in the *ICES Journal of Marine Research*.

For more information see: <http://search.eurekalert.org/e3/query.html?q=t=eel+declines&col=ev3rel&qc=ev3rel>.

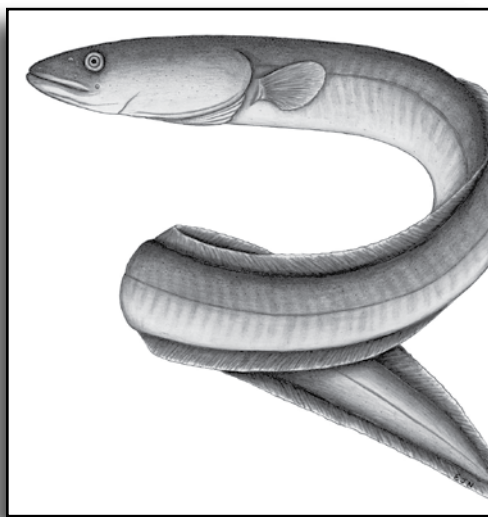


ILLUSTRATION: ETHAN NEDEAU

American eel.

## In the News

### Mapping communication flow for coastal managers

A University of New Hampshire (UNH) researcher is studying the patterns of communication within and between local and regional organizations.

Troy Hartley, a UNH research assistant professor, was motivated by the U.S. Commission on Ocean Policy report that indicated effective coastal and ocean management is inhibited by a lack of communication, coordination and a sense of partnership. Hartley is looking at the communication networks for projects undertaken by the Atlantic Marine Fisheries Commission, the New England Fisheries Management Council, the NH Coastal Program and Cape Breton Island in Nova Scotia.

Hartley used interviews and surveys to measure communication patterns among individuals within these entities and projects. The frequency and directional flow of information within and between the key individuals, such as project coordinators, scientists and decision-makers, were then "mapped" using the computer program Inflow.

"Communication 'maps' make sense to people," Hartley said in a statement. "But we will struggle finding the best ways that people can work together, communicate and coordinate effectively on a regional scale. We need to get better at that for regional integrated coastal and ocean management to become a reality."



PHOTO: REBECCA ZEIBER, NH SEA GRANT

Troy Hartley shows a computer-generated "map" of communication networks for coastal and ocean management organizations.

**To read more articles from In the News and From the Scientific Literature, please visit the *Gulf of Maine Times* online at: <http://www.gulfofmaine.org/times>.**

# Rejuvenating the Penobscot to make way for salmon, other sea-run fish

By Elizabeth McGowan

Bob Croce began trying to tease Atlantic Salmon from Maine's Penobscot River in his early 20s. He didn't land what he's christened a noble fish until almost a decade had passed and he'd clocked 76 solo hours combing the waters of New England's second-largest river.

It was Father's Day 1976 when a friend helped him net that unforgettable 15.5-pound (7-kilogram) fish at the famed Bangor Salmon Pool.

"You cast over the same spot for hours and hours, then for some mysterious reason a fish will take a fly," Croce recalled more than 30 years later. "It's a cognitive experience. Your mind can't roam. You can't ask for any more of a challenge than Atlantic salmon fishing."

Impacts of the usual industrial era suspects—pollution, overfishing and barriers such as an insurmountable gauntlet of dams—have contributed to depleting today's endangered salmon population to a pitifully unsustainable 1,000 statewide. Maine is the last stronghold for a swimmer that once graced New England's freshwaters south to Connecticut's Housatonic River.



PHOTO: BILL CURTSINGER

Atlantic salmon in the fish trap at the Veazie Dam.

With salmon fishing mostly off limits in Maine since 1999, those in need of a fix have to shuttle off to Canada. Still, Croce, a Massachusetts native, is confident that salmon fishing in his adopted state doesn't have to remain a memory.

That core belief spurs his championship of an unprecedented undertaking to balance the environment and the economy in Maine's largest watershed. Conservation organizations are collaborating with state and federal officials, the Penobscot Indian Nation and a hydropower company to spur the recovery of Atlantic salmon and 10 other native sea-run fish species by rejuvenating 1,000 miles (about 1,609 kilometers) of Penobscot habitat.

It's a complicated, expensive, multi-layered project coordinated by an Augusta-based, not-for-profit corporation named the Penobscot River Restoration Trust. The \$55 million blueprint calls for removing two of the southernmost dams, installing a state-of-the-art fish passage at another and improving fish passage at four others.

The Penobscot, which drains a third of Maine, traces its humble beginnings to Mount Katahdin. A final agreement signed in June 2004 allows the Trust to shut down three of the southernmost dams it buys from PPL Corp., formerly known as Pennsylvania Power and Light. To keep its river-dependent energy supply flowing, PPL has the option of upping its power production at half a dozen less-restrictive dams in the watershed.

If permitting, licensing and contractor selection proceeds on schedule, the restoration project could optimistically be completed by 2015. Though the National Oceanic and Atmospheric Administration (NOAA) is pursuing funding for the project, private fundraising continues because that federal allotment isn't guaranteed.

"This Penobscot project is a linchpin, because it could really make a difference on a watershed level, and has the potential to be a model," said NOAA spokeswoman Robin Bruckner, based near Washington, D.C. "We're ready, willing and able. If it fails for lack of funding from Congress, that could be a showstopper."

Perhaps taking a cue from two federally funded U.S. initiatives that remove blockages and right cockeyed culverts—the Open Rivers Initiative and the Fish Passage Program—the Canadian government dedicated a \$30 million trust fund in late 2006. This year the newly minted, non-profit Atlantic Salmon Conservation Foundation began awarding grants for projects that conserve, restore and rebuild salmon habitat in Atlantic Canada and Quebec.

Two of the Penobscot dams, the Veazie, closest to Bangor, and the Great Works, near Old Town, will be taken out. On paper, opening those 12 miles (about 19 kilometers) of river would restore 100 percent of the historic habitat for lower river species that shy away from steep rapids or waterfalls: striped bass, rainbow smelt, tomcod and Atlantic and endangered shortnose sturgeon.

Northward near Howland, a dam at the juncture of the Piscataquis and Penobscot will be decommissioned, but left standing to honor townspeople's requests. It's here, along waters almost the length of two football fields, where experts are tasked with crafting a nature-mimicking passage that fish can find and navigate.

"The design is rocket science, because certain species of fish are so finicky with the way they move upstream," NOAA fishery biologist John Catena said about the mini-stream. "There are very few examples of this in the Northeast."

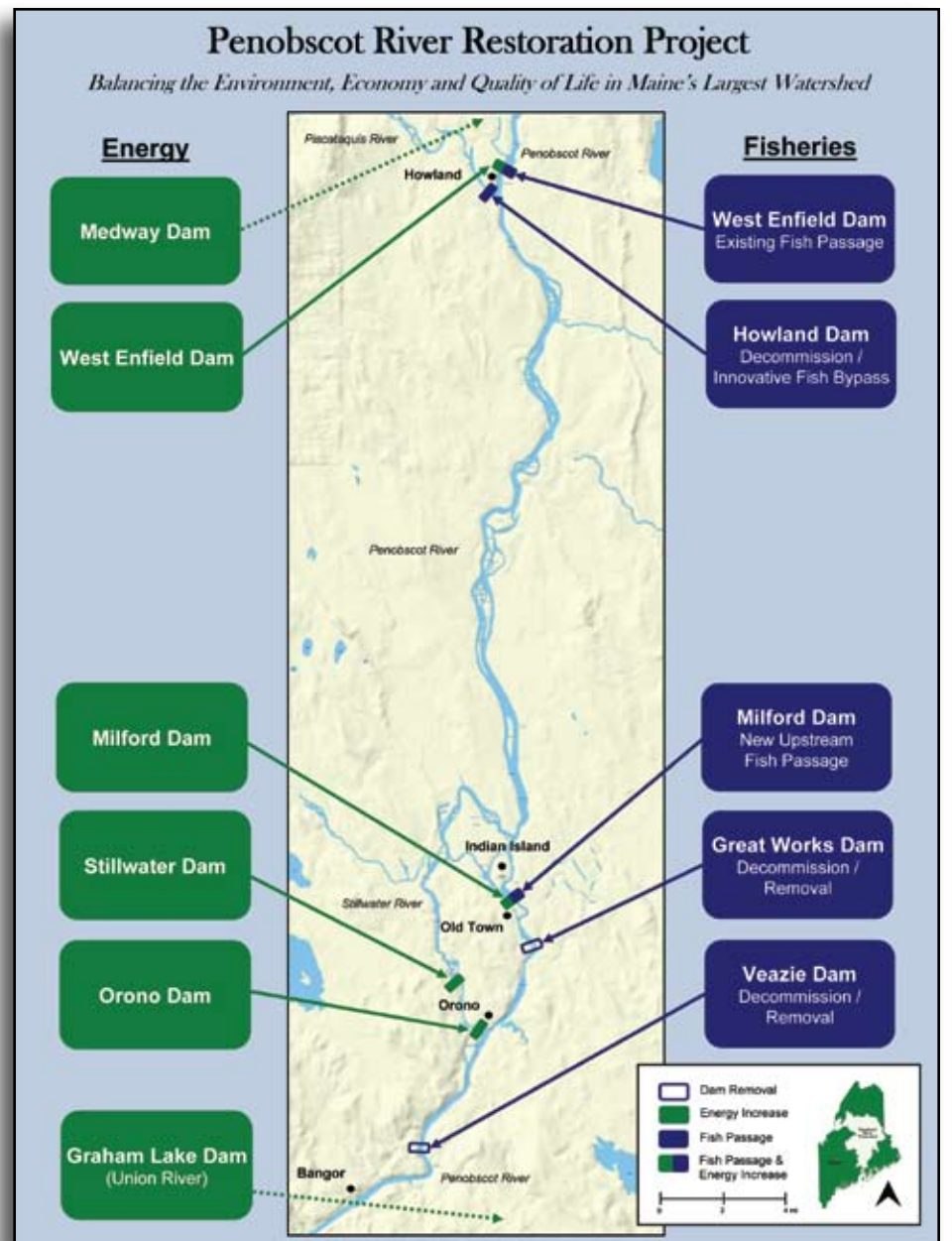
That engineering genius will al-



PHOTO: CHERYL DAIGLE

Department of Marine Resources staff member transports an Atlantic salmon caught in the Veazie fish trap. This salmon will be brought to the Craig Brook Fish Hatchery in East Orland.

low the more "athletic" species—Atlantic salmon, American eel, American shad, alewife, blueback herring and sea lamprey—to reclaim their traditional digs in the Penobscot's northern reaches. Those same bold and hardy half-dozen also shouldn't be intimidated by a lift to be installed farther south to "ferry" them across the Milford Dam, once the site of daunting rapids.



COURTESY: PENOBSCOT RIVER RESTORATION PROJECT

Jeff Reardon, Trout Unlimited's full-time liaison to the Trust, likes to joke that if he were God, all dams would be removed so fish could flex their former freedoms and the Trust would reach its promised goal of restoring free-flowing habitat. But lacking deity status, he instead bellies up to the bargaining table to seek common ground.

"I'm not going to get anywhere arguing with people about their values," he said. "We think we are better off making a decision that local communities embrace."

He's referring to the situation in Howland, where citizens have lobbied to preserve their impoundment, a cultural icon they cherish as their town common. It's near this 570-foot (more than 152-meter) spillway that inventors are being asked to configure, a highly engineered, stream-like channel that beckons fish during low and high water flows. Slope, depth and water velocity are integral to the complex equation.

It's imperative to get it exactly right, Reardon warned, so it doesn't end up as yet another well-intentioned but useless "New England monument to our failure to understand how fish move through rivers."

Dam removal isn't yet off the table in Howland, he said. That option could still come to fruition if the bypass proves to be untenable after a 15-year trial period.

A river long abused and reshaped by timber company log drives, soil runoff from road construction and paper mill pollution doesn't magically recover to its ancient flourishing self just because human beings decide to obliterate a few impediments.

"With this project, there are hurdles and challenges, and we need to go in with our eyes open," said NOAA fishery biologist Rory Saunders. "It's not a silver bullet, but it's a great first step."

After feeding in the Davis Strait between Labrador and Greenland,

salmon swim 2,400 miles (more than 3,862 kilometers) to their natal Maine rivers. To spawn and survive, they need cool, super-oxygenated, flowing water; clean gravel (suspended sediments suffocate eggs); and an abundance of refuges for overwintering.

While Saunders is aware that the salmon is the "poster fish" of this effort, his studies are helping to uncover the intricate relationships that unfolded as these 11 sea-run species co-evolved for thousands of years. Not only can some of these other fish serve as meals for juvenile and adult salmon, but they also play significant roles in the salmon's life cycle.

For example, it's likely native predators such as double-crested cormorants, river otters and ospreys didn't decimate salmon smolt populations because they could feed on more plentiful alewives.

"To a large degree, a lot of these are untested hypotheses," Saunders said about trying to predict if natural cycles will reign again. "That's why we have to keep monitoring."

Saunders and other specialists will be eagle-eyeing predator-prey interplay and any number of concerns as they monitor this river re-evolution. Like democracy, it seems, this enterprise will require eternal vigilance.

*New England native Elizabeth McGowan writes about energy and environmental issues from her adopted home, Washington, D.C.*

*A version of this article appeared in "Outdoor America," a publication of The Izaak Walton League of America at <http://www.iwla.org>.*

**A related story, "Envisioning Success," can be read on the Times Web site at:**  
<http://www.gulfmaine.org/times>.

**Insects continued from Page 1**

biodiversity data to help manage its resources.

Ultimately, similar ATBI studies conducted across the United States and the rest of the world could be used for broad comparisons, such as looking at the impact of weather and climate changes on species like insects. But that may be decades away. For now, it's not possible to talk about the impacts of global warming until researchers identify what species exist in a certain location, and then compare them over time, said Brian Farrell, principal investigator at Harvard and a key participant in the Boston Harbor Islands project.

"We're establishing a baseline snapshot of what is on the islands today," Farrell said. "There's no single reference source to find out what some of these species are. These kinds of databases [ATBI], if they're replicated across the country, will be nerve centers to identify species locally."



PHOTO: CARMEN CHAVEZ

Harvard postdoc Jessica Rykken sets up an ultraviolet light trap for moths and other nocturnal flying insects on Thompson Island.

The Boston Harbor Islands/Harvard ATBI is modeled to a large degree on similar work at the Great Smoky Mountains National Park in Tennessee. Both of those, and others including the Nantucket Biodiversity Initiative and Acadia National Park in Maine, are members of the ATBI Alliance, a group of U.S. national and state parks and preserves looking to identify living organisms within their boundaries.

"The Boston Harbor Islands are small enough and conspicuous enough to finish a project like this within a reasonable amount of time and do comparisons along the way," said Farrell.

Another unique aspect of the Boston Harbor Islands/Harvard ATBI

**Get your bugs straight**



Jagged ambush bug (*Phymata pennsylvanica*)

The word "bug" is a vernacular term that generally means some insect. But to entomologists "bug" is a scientific term referring to a particular type of insect with a sucking mouth part that is a member of the order Hemiptera. Such "true" bugs include aphids and cicadas.

MAP: BOSTON HARBOR ISLANDS NATIONAL PARK AREA. ALL INSECT IMAGES © 2008 THE PRESIDENT AND FELLOWS OF HARVARD COLLEGE. USED WITH PERMISSION.

is the high-quality images of the insects in the database. It is difficult to see tiny insects under a traditional white light microscope, Farrell said. So his group adopted commercial computer and software technology used to image cells in biology. That technology allows pictures of an insect to be taken at 10 to 30 different focal planes, or angles to the insect, and then stitched together into one very high-resolution, focused image. Farrell claimed that kind of detailed, fully focused image of an insect is unprecedented, and it is the heart of the ATBI project.

When more parks conduct ATBI projects and there are regional databases all over the country, it will be easier to start talking more knowledgeably about large issues like the impact of global warming. "It will be great data to compare over time and see how distributions of insects change with time in a region. So I think it will be very valuable long term, over the next 10 to 100 years," added Jessica Rykken, a postdoctoral fellow at Harvard's Museum of Comparative Zoology who is coordinating the ATBI with the Boston Harbor Islands.

Shorter term, Rykken said the insect data can help answer what happens when vegetation changes on the islands. The Boston Harbor Islands have a lot of non-native plant species, and more and more the invasive species are being removed and replaced with native species. "So by looking at species of bees and other pollinators, we can do before and after studies of what happens to them when the plants are changed," she said.

Although Rykken and Farrell say one might not expect to find too many new species on such established islands, there is quite a bit of biodiversity. One ground beetle (*Bembidion puritanum*) they found on Thompson Island hadn't been seen in the United States for more than 100 years. Another tiny wasp was found on Thompson Island as well, and the only other species found in that

genus is in the southwestern United States, so the wasp on Thompson might be a new species, Farrell said. In addition, Rykken and her helpers found five species of sow (potato) bugs throughout the islands, but on Spectacle Island they found three additional species that they hadn't seen anywhere else. "My hypothesis is that they came in with the soil from the Big Dig," she said, referring to Boston's large Central Artery project.



PHOTO: BARB BRYANT

Children use a chart to sort and identify insects during a visit to Georges Island.

"You can make new discoveries in Boston's back yard, because this level of discovery hasn't been done in many places," said Farrell.

A large part of the insect ATBI is education: the Web site, posters, maps and activities for citizen and professional scientists. There's even a card game that is being sold at the

Harvard Museum of Natural History, of which the Museum of Comparative Zoology is a part, and at various Boston Harbor islands. Players have to match insect predators pictured on the cards with their insect prey on other cards. Both the museum and Spectacle Island also are planning ATBI exhibits this summer.

A recent trend has been the "bioblitz," typically a 24-hour event where scientists and citizens are invited to catch as many insects as possible. So far, several "beetle blitzes" have revealed 80 types of ground beetles on the islands. Farrell said the islands have greater-than-expected biodiversity, including 40 ant species and 80 bee species.

The Boston Harbor Islands is planning an "intertidal bioblitz" on August 18 (see the Boston Harbor Islands Web site in the "Resources" section). There are at least 12-16 species of crabs, snails, burrowing worms and insects, said Raczko of the Boston Harbor Islands.

"Bioblitzes are spreading worldwide and nationwide. They're analogous to the Christmas bird count," added Farrell. "It's a way for everyday people to do citizen science."

Lori Valigra is editor of the Gulf of Maine Times. She also writes about science, technology, business and other topics from Cambridge, Massachusetts.

**Resources:**

**All Taxa Biodiversity Inventory**  
<http://www.mcz.harvard.edu/Departments/Entomology/>

**Boston Harbor Islands** <http://www.bostonislands.org/biodiversity>  
 and <http://www.nps.gov/boha/naturescience/index.htm>

**Predator/Prey cards and other educational information**  
 contact: [Mary\\_Raczko@nps.gov](mailto:Mary_Raczko@nps.gov)

**Nantucket Biodiversity Initiative** <http://www.nantucketbiodiversityinitiative.org/>

**All Taxa Biodiversity Inventory Alliance** <http://www.atbiallyance.org/>

**Insect imaging**  
<http://insectdatabases.oeb.harvard.edu/Caribbean/databasing&imaging.htm>