Two if by Sea

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A joint newsletter from the **MIT** *and* **WHOI** *Sea Grant Programs*

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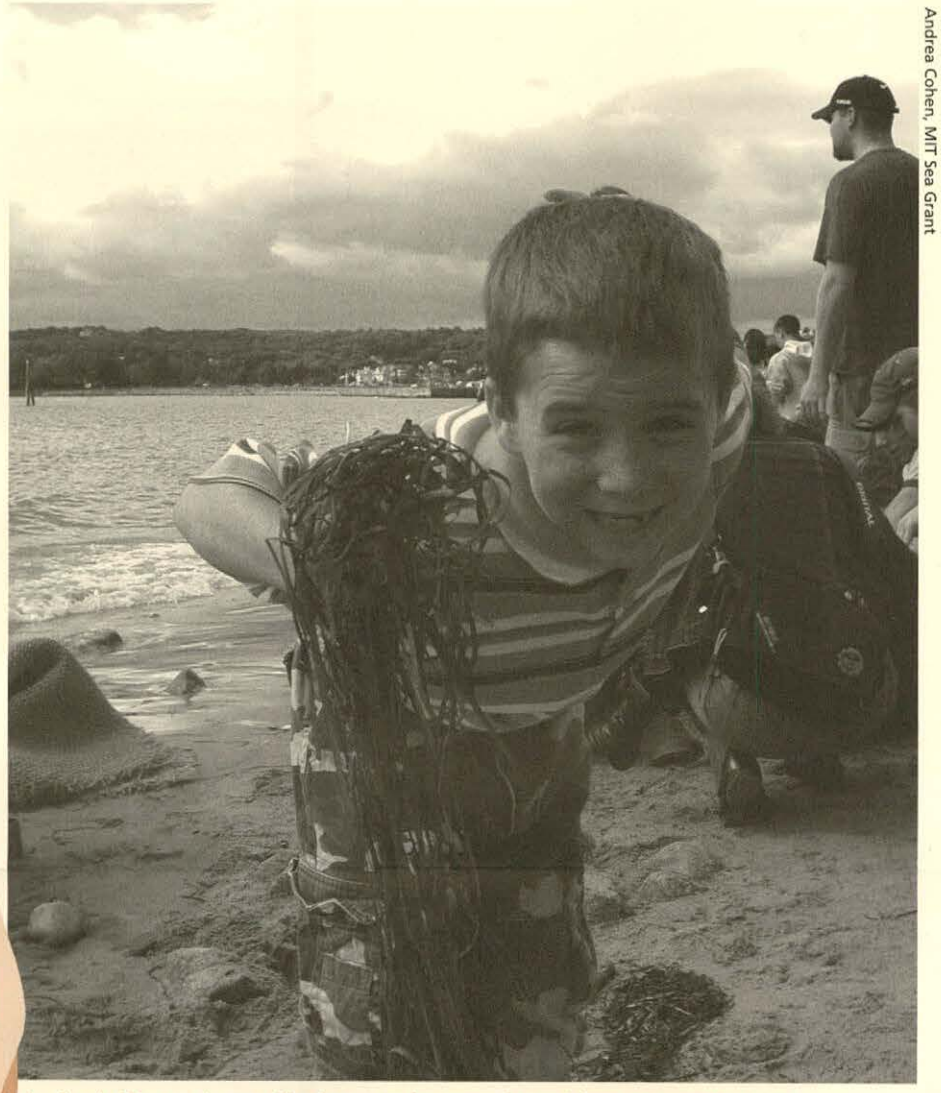
Eelgrass is extraordinarily useful in maintaining healthy ecosystems.

Bringing Eelgrass Back

by Andrea Cohen, MIT Sea Grant

On a sunny Monday morning in early autumn when most high school students would rather be at the beach instead of in class, roughly 50 kids were indeed camped out at Gloucester's Pavilion Beach. But these students were working—and learning—as they helped to collect and transplant eelgrass from a location slated for dredging to make way for Gloucester's new 550-foot stormwater outfall pipe. The eelgrass restoration project, spearheaded by MIT Sea Grant, is also supported by Massachusetts Coastal Zone Management (MCZM), the EPA, the Massachusetts Division of Marine Fisheries (DMF), and the City of Gloucester.

Eelgrass—a delicate, flowering marine plant—is a primary source of food for many plants and animals, as well as a critical nursery and shelter for shellfish and finfish. It also filters pollutants from the water column, is a key component of the nutrient cycle, and guards against shoreline erosion by quelling wave energy and storms. In short, eelgrass is extraordinarily useful in maintaining healthy marine ecosystems.



Andrea Cohen, MIT Sea Grant

▲ *Noah Meyers shows off eelgrass to be transplanted from Gloucester Harbor.*

Once abundant in New England waters, this species of plant was largely wiped out in the region in the 1930s due to a wasting disease. For decades, coastal development and pollution made the restoration of these grasses all but impossible. However, improved water quality in Massachusetts coastal waters is now giving a second chance for eelgrass and the many plants, invertebrates and waterfowl that depend on it. And this, in turn, has given middle and high school students the chance to get involved with bringing eelgrass back.

Since 2004, MIT Sea Grant has been engaging public school students in hands-on learning, with classes growing eelgrass in recirculating aquaculture systems. A collaboration with MCZM, the eelgrass curriculum teaches students not only about the history and importance of eelgrass, but also includes biology and ecology, graphing data, water quality testing, and system design.

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Two if by Sea

Two if by Sea reviews the coastal and marine-related research, advisory, education, and outreach activities of the MIT Sea Grant College Program and the Woods Hole Oceanographic Institution (WHOI) Sea Grant Program. The programs are part of the National Sea Grant College Program, a network of 30 core colleges and institutions established in 1966. Operating through partnerships between academia, government, and industry, Sea Grant works to achieve a sustainable economy and environment. Sea Grant is funded through the Department of Commerce's National Oceanic and Atmospheric Administration.

We welcome your feedback. To reach us, or to request a free subscription of *Two if by Sea*, send an e-mail to 2ifbysea@mit.edu, or contact either program:

MIT Sea Grant
Bldg. E38-300, 292 Main Street,
Cambridge, MA 02139
phone (617) 253-7041; fax (617) 252-1615
web.mit.edu/seagrant/

WHOI Sea Grant
MS #2, 193 Oyster Pond Road,
Woods Hole, MA 02543-1525
phone (508) 289-2398; fax (508) 457-2172
www.whoi.edu/seagrant/

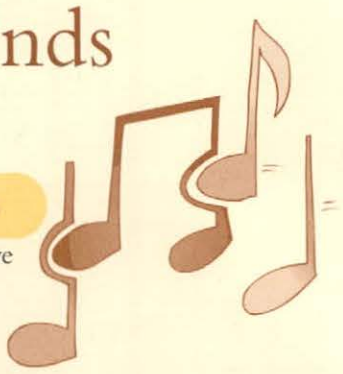
Editors
Andrea Cohen, MIT Sea Grant
Tracey Crago, WHOI Sea Grant

Graphic Design
Linda Walker Design, Falmouth, MA

Director, MIT Sea Grant
Chrys Chryssostomidis

Director, WHOI Sea Grant
Judy McDowell

Odds and Ends



Mussel Culture Meets Itunes

Mussel farmers and eider ducks have never gotten along. Flocks of the voracious ducks can find, dive on, and pick clean the young tender mussels growing on longline culture systems. The typical means of control is chasing them away with a speedboat and shotgun blasts. But this becomes impossible in stormy weather. MIT Sea Grant researchers have a solution—record the underwater sounds associated with these deterrent activities and re-broadcast them from a buoy moored in the middle of the longline array.

As an experiment, researchers recorded the sounds of mussel farmer Erick Swanson's chase boat in Mt. Desert, Maine. Swanson, the owner of Maine Cultured Mussels, was eager for a system to deter the ducks and spare him frigid chases during winter months. Cliff Goudey, who is leading the project, says the underwater sound system is working like a charm thus far. "We hooked up an MP3 player in a spar buoy, with the sound running during daylight hours when eider ducks like to feed." The twelve-foot-long cylindrical buoy delivers an underwater combination of engine and propeller roar and recorded shotgun blasts. The sounds are a little quieter than the real thing and can't be heard by coastal residents. The system will run all winter, says Goudey, who plans to follow up the preliminary effort with further research.

AUVs in Deepwater Oil, Gas Operations

MIT Sea Grant recently co-hosted a technology forum to discuss how autonomous underwater vehicles (AUVs) can offer low-cost solutions for deepwater oil and natural gas exploration and production. Current methods for servicing deepwater wells involve deploying remotely operated vehicles, small subs that are connected to a surface ship with a tether. This can cost roughly $100k per day. An AUV, which does not rely on a tether, should be able to monitor and service a well at a fraction of that cost.

The technical challenges for operating AUVs in such environments include improving underwater acoustic communications and supplying sufficient power to the AUV, says MITSG director Chrys Chryssostomidis. Other challenges include designing instruments to help the AUV carry out tasks three to four miles under water, and making sure that an AUV could dock and navigate properly at such depths. One incentive for carrying out the R&D needed to bring AUVs into deep water: the projection that 90 percent of undiscovered hydrocarbon resources will be found there.

Training Needs of Conservation Commissioners

The Massachusetts Coastal Training Program (CTP), a partnership between Woods Hole Sea Grant, Waquoit Bay NERR, and Massachusetts Coastal Zone Management, provides information, tools, and skills to coastal decision-makers. During the spring 2006, CTP partners conducted an audience needs assessment of conservation commissioners and agents from Massachusetts coastal communities. The purpose was to evaluate the training and information needs of these key local decision makers.

Asked to name the top coastal issues facing their town, commissioners cited: coastal development (47 percent), coastal flooding and erosion (44 percent), and water quality (24 percent).

The following areas were mentioned as possible topics for training: Understanding and Improving the Laws and Regulations; Compliance & Enforcement Options; Defining, Understanding, and Protecting Coastal Resources; Coastal Processes; Stormwater and Wastewater; Water Quality Issues; Estuaries; Structures; Public Access, Public Lands, and Aesthetics; [Dealing with] Difficult Cases; Conservation Commission Procedures; and Educating the Broader Public, among others.

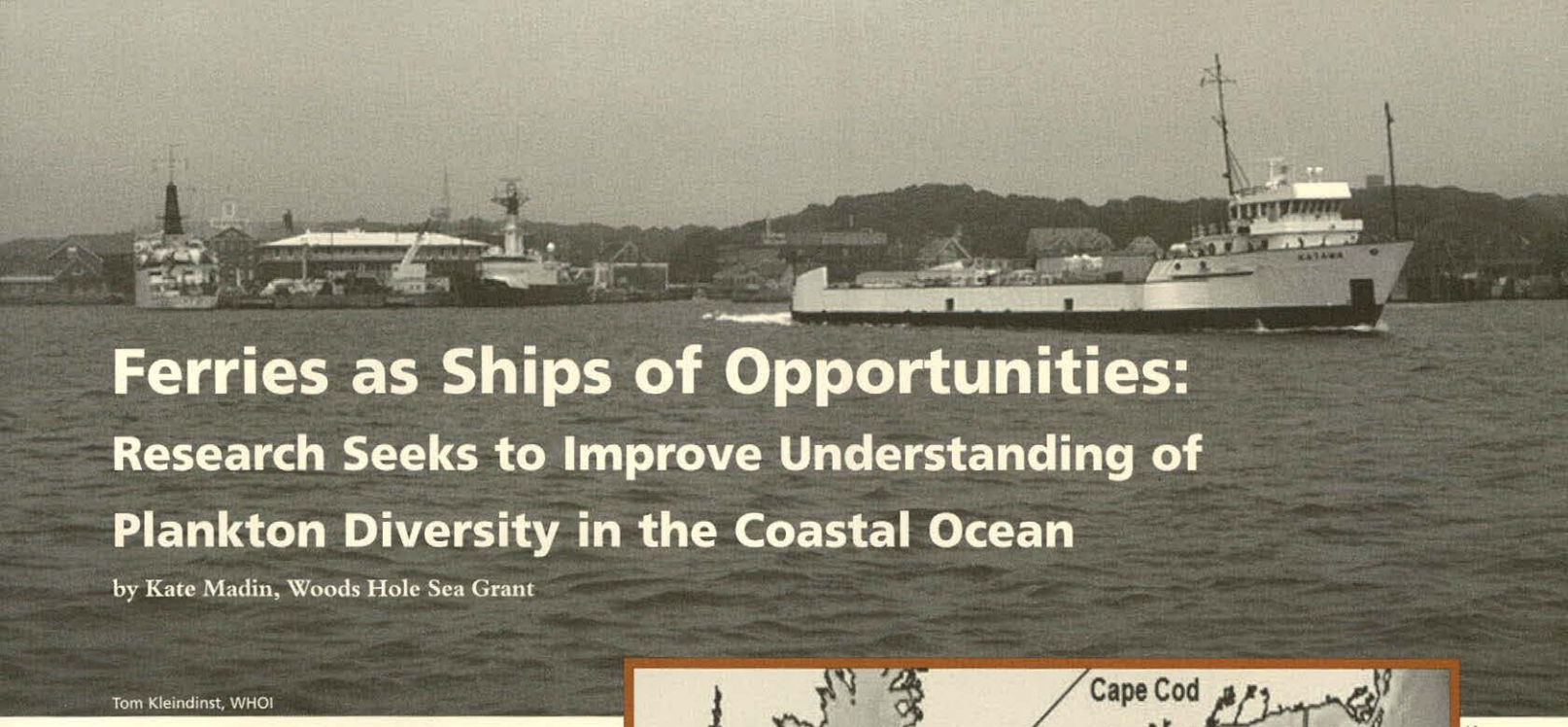
For more details, visit www.coastaltraining.org under the Training Needs section.

Massachusetts Coastal Hazards Commission

In February 2006, Massachusetts Governor Romney and the State Legislature asked the Executive Office of Environmental Affairs (EOEA), through the Massachusetts Office of Coastal Zone Management, to launch a Coastal Hazards Commission. The Commission was charged with reviewing existing coastal hazards practices and policies, identifying data and information gaps, and drafting recommendations for administrative, regulatory, and statutory changes, if deemed necessary. Five working groups of experts were assembled to assist the Commission with its recommendations: (1) coastal hazards data and tools, (2) policies, (3) planning and regulations, (4) structural measures to protect coastal development, and (5) public coastal infrastructure. Woods Hole Sea Grant's coastal processes specialist Jim O'Connell co-chaired the Commission's working group on protection, which was charged with identifying strategies that sought to minimize or eliminate imminent coastal hazards impacts. Draft recommendations and more information about the Commission can be found at www.mass.gov/czm/chc/index.htm.

Goodbye to Crago

Two if by Sea co-editor Tracey Crago left Woods Hole Sea Grant in December to assume the directorship of the Falmouth Volunteers in Public Schools (VIPS) program. "I learned so much in my 16 years at Sea Grant," said Crago. "My colleagues in Woods Hole are second to none and the talent within the entire Sea Grant network is enviable. I will always be a big fan and avid supporter of Sea Grant."



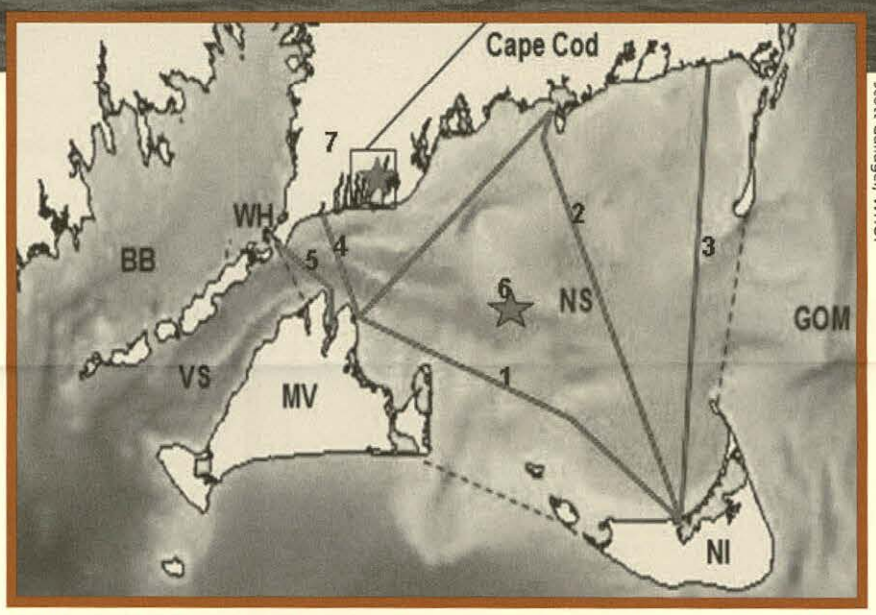
Tom Kleindinst, WHOI

Ferries as Ships of Opportunities:

Research Seeks to Improve Understanding of Plankton Diversity in the Coastal Ocean

by Kate Madin, Woods Hole Sea Grant

The islands of Nantucket and Martha's Vineyard, lying off the coast of Cape Cod, are well-known tourist destinations: their summer populations can soar to five and ten times those of winter levels. Residents and tourists alike travel there and back across the same body of water, Nantucket Sound. As they make the crossing to and from the ports of Woods Hole or Hyannis, most travelers have little understanding of what's happening in the water beneath them. But to Woods Hole Oceanographic Institution (WHOI) biologist and zooplankton ecologist Scott Gallager, gaining a clear picture of the complex physical, chemical, and biological factors operating in Nantucket Sound waters is critical. And he has forged an unusual partnership to help him get it.



Scott Gallager, WHOI

▲ *Nantucket Sound is the triangular section of ocean between Cape Cod and the islands, with Nantucket at the apex and Martha's Vineyard along one side. It's a busy place, with all types of craft making the crossing, from pleasure and fishing boats to shipping freighters and oil tankers.*

With Woods Hole Sea Grant support, Gallager and his WHOI colleagues have teamed up with The Steamship Authority, a provider of ferry service to the islands, to install instrumentation on two of its ferries. The goal is to collect high-resolution data about the Sound that will help scientists better understand the coastal Atlantic Ocean, its food webs, and its future. While the idea is not unique—ferries have been used to collect data throughout the world for over a decade—it has local appeal.

Gallager is interested in the smallest animals in the ocean—zooplankton—and the water conditions that affect how they live and grow. These tiny animals, near the base of the coastal ocean food chain, are the food source for the larger animals that people depend on and enjoy, from fish to whales. Gallager has good reasons to be interested. The availability of plankton determines whether there will be healthy populations of commercial fish and other animals. If human activity or climate changes drastically alter the types of plankton that flourish, the quantity and quality of food for fish and marine mammals—and for humans—would be affected.

So Gallager set about studying the physical, chemical, and biological factors that control how the many kinds of plankton coexist and form communities. The community changes over the year, based on environmental conditions, and on who eats how much of whom: "Seasonal changes in plankton diversity are a reflection of nutrient input, light, and temperature, coupled with biological processes including predator–prey interactions, growth, and reproduction," Gallager says. Zooplankton depend on plant plankton (phytoplankton), which depend on light, nutrients, and seasons. If we learn enough about how zooplankton will respond to changing conditions—including climate, and contaminants, and nitrogen loading—we may be able to predict what can happen to our fish stocks.

A warming climate and more human activity will inevitably affect coastal ocean conditions and the plankton that live there, Gallager knows. "Nantucket Sound is highly exploited by current uses," he says, "but future use of the area may be even more demanding, including [proposals for] the development of a wind farm system and dredging for sand recovery operations. There is a paucity of data on the physical and biological dynamics in the Sound."

With Woods Hole Sea Grant support, Gallager and WHOI colleagues Steve Lerner, Emily Miller, and Andrew Maffei have installed a package of sensors designed to measure water temperature, salinity, pressure, clarity, and oxygen, and to take digital images of the plankton on the ferry *Katama*. Now, as a "ship of opportunity," *Katama* tirelessly collects data on the Woods Hole-to-Martha's Vineyard run, building up a portrait of Nantucket Sound over time. The data travel over a wireless connection to shore, where Gallager makes them available in real time to scientists and the public on the project web site, http://sealion.whoi.edu/ferries.

Already, an interesting picture is forming of the western side of the triangle: he can match chlorophyll amounts—a measure of how much phytoplankton is in the water—with tidal flow and the salinity of the water. On a flood tide, when water flows into the Sound from the west, salinity is higher and chlorophyll lower. The situation reverses on an ebb tide, when water flows the other way. Gallager uses the data to construct 3-D diagrams of temperature, salinity, and chlorophyll. "We know that the phytoplankton is patchy," he says, but it will be neat to follow the diagram over time across the Sound, and *see* that it's patchy, and why."

Most recently, Gallager and co-workers have outfitted the ferry *Eagle*—which runs from Hyannis to Nantucket—with the same suite of sensors, essentially completing two legs of the triangle. He now can monitor changing seawater conditions and plankton assemblages on both sides of the Sound in real time.

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Kayaks Go High-Tech, Testing Marine Robotics

by Kathryn M. O'Neill, MIT News Office

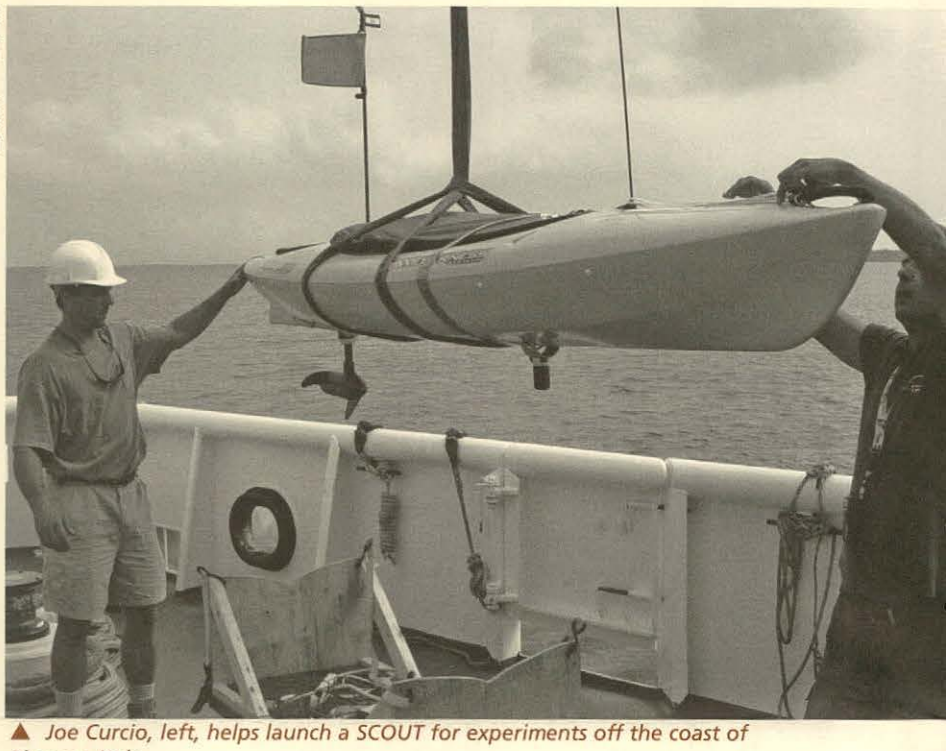
MIT researchers are working toward the day when a team of robots could be put into action like a team of Navy SEALs–doing such dangerous work as searching for survivors after devastating hurricanes or sweeping harbors for mines.

Working in labs that resemble machine shops, these engineers are taking small steps toward the holy grail of robotics–cooperative autonomy–making machines work together seamlessly to complete tasks with minimal human direction.

The tool they're using is the simple kayak.

The researchers are taking off-the-shelf, $500 plastic kayaks and fitting them with onboard computers, radio control, propulsion, steering, communications and more to create Surface Crafts for Oceanographic and Undersea Testing (SCOUTs). The research is funded by MIT Sea Grant and the Office of Naval Research, with hardware for acoustic communications provided by the Woods Hole Oceanographic Institution.

Matt Grund, WHOI



▲ *Joe Curcio, left, helps launch a SCOUT for experiments off the coast of Pianosa, Italy.*

Much of the technology being tested is ultimately intended for use in underwater robots, or autonomous underwater vehicles (AUVs), but testing software on AUVs can easily become a multimillion-dollar experiment.

"I want to have master's students and Ph.D. students that can come in, test algorithms and develop them on a shoestring budget," says John Leonard, associate professor in MIT's Department of Mechanical Engineering. Leonard, together with Joseph Curcio, a research engineer in Mechanical Engineering, and intern Andrew Patrikalakis unveiled SCOUT last fall in a paper for the IEEE Oceans Conference.

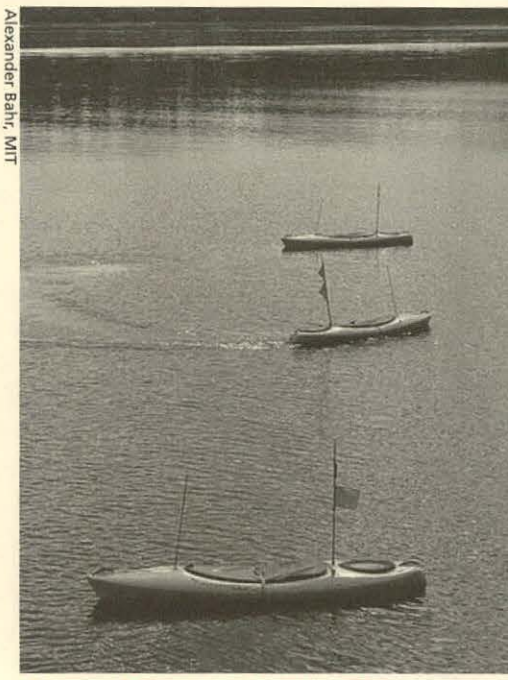
SCOUT is an inexpensive platform that eliminates the need for communication underwater–one of the more difficult problems posed by AUVs. "One of the biggest challenges underwater is that we can't transmit electromagnetic radiation a long distance," says Leonard.

Alexander Bahr, MIT

▲ *Joe Curcio readies SCOUTs at the Keyport Naval Base, near Seattle.*

Operating on the surface means that SCOUTs can take advantage of such technology as wireless Internet and global positioning systems (GPS), which don't work underwater. Researchers are thus free to focus on fine-tuning other necessary robot functions, such as navigation–all with the goal of creating a system that works so seamlessly that a lot of communication isn't necessary.

Alexander Bahr, MIT



▲ *Three SCOUTs in the waters off Pianosa.*

"In order to be effective with robots in the water, you'd best not have a plan that relies on a lot of communication," Curcio notes. "To be effective with a fleet of vehicles and have them do something intelligent, what you really need to do is have the software be so robust that communication between the vehicles can be kept to a minimum."

Curcio, Leonard and Patrikalakis have built 10 SCOUTs so far, four of which are owned by the Naval Underwater Warfare Center and in the care of Michael Benjamin, a visiting scientist in MIT's Department of Mechanical Engineering. Currently, the SCOUTs are being used in a variety of collaborative efforts at MIT. As Leonard and Curcio explain, SCOUT was designed to be a platform upon which others can build.

"The analogy was born that we should build it like the pickup truck. All we have to do is make it so that it drives with a known set of controls, or interfaces, and has a payload capability," says Curcio. "And the users, once they learn how to operate it—like a driver gets in and out of a car —should be able to easily get on board with another one, even though the payload may change."

Software developed on SCOUT may someday help AUVs search the sea bottom for plane wreckage or allow kayaks to find shipwreck survivors. And, adds Leonard, "We keep thinking of new applications."

Bringing Eelgrass Back, continued from page 1

In the Gloucester outing, students from four Massachusetts schools got their feet wet (literally), working with divers, biologists, engineers, and educators to gather eelgrass shoots from the harbor, at the site where the new outfall pipe will be installed. That pipe is part of a seven-year, $40 million project to separate the city's storm drains from its sewerage system. Because dredging for the pipe will disturb a half-acre bed of eelgrass, the city was mandated to follow a mitigation plan to help preserve the sea grass.

In the first day-long transplantation effort in August, divers gathered some 6,000 plants from about 18 feet down in the harbor, and volunteers separated these plants into individual shoots. Moving the eelgrass "is a lot like

Andrea Cohen, MIT Sea Grant

▲ *Volunteers sort eelgrass from Gloucester Harbor.*

transplanting perennials," says Alison Leschen, an aquatic biologist who is co-leading the DMF's Eelgrass Restoration Project. Shoots from Gloucester Harbor were planted in several locations in Boston Harbor, at a depth of roughly 15 feet. Their density and the size of the eelgrass beds are monitored twice a year.

In the second effort, another 6,000 shoots were gathered by divers and separated by students, including the 11th grade class from Minuteman Regional High. Their teacher, Christopher Whitaker, is leading the students in MITSG's eelgrass restoration program back in the classroom. But, he says, motioning to the harbor, "it's a lot better to get the students involved with living things than just telling them about it."

In an experiment to test different methods of storing and growing eelgrass, roughly half of the plants gathered in the fall are being housed in a 1,000-gallon tank at Gloucester's Maritime Heritage Center, where MITSG has its marine finfish hatchery. The tank is stocked with sea stars, crabs, lobsters, and fish, thereby recreating the plants' natural ecosystem and keeping algae in check. The other plants were woven into a floating raft made of coconut fibers, now wintering underwater on a pier near the hatchery. Essentially a mattress of eelgrass, this method of maintaining/growing eelgrass is a new one, says Brandy Wilbur, MITSG education coordinator and aquaculture specialist.

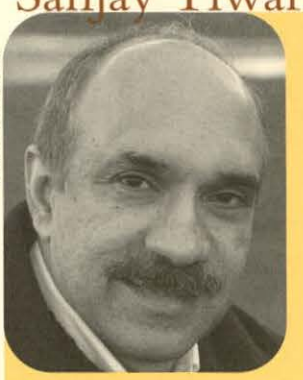
Tony Wilbur, a marine ecologist with MCZM (and husband of Brandy), has also played an integral role in the restoration effort. Along with donning a wet suit to gather eelgrass in both forays into the harbor, he has also been spending time underwater cleaning the plants and raft. Despite some initial algae on the raft, he notes that "the plants were resilient to the fouling algae and look very healthy and bright green . . . and the eelgrass in the tank seems to be stable." He adds that the researchers "will continue to collect data through the winter to document the survival and growth of the harvested eelgrass." In spring, the plan is to transplant the eelgrass back into the harbor and/or the Annisquam River.

For now, the eelgrass in transition offers visitors to the hatchery a chance to learn about the importance of healthy marine ecosystems. And along with students at Minuteman Regional High, classes at Essex Agriculture High School in Hawthorne, Rockport High School, Swampscott Middle School, Odyssey High School in South Boston, Wellesley's Dana Hall and Gordon School in East Providence are experimenting with different methods of raising eelgrass, which can then potentially be reseeded in local waters. And regardless of how many plants make it through the winter, says Brandy Wilbur, "this project has already been extremely successful because of all the collaboration and outreach."

For more information, or if your classroom is interested in participating, please see http://seagrantdev.mit.edu/eelgrass.

Profile
Sanjay Tiwari

Tom Kleindinst, WHOI



Sanjay Tiwari is studying the ocean floor and its features to identify commercially important species and their preferred habitats. Yet Tiwari, a research specialist in the WHOI biology department, is leading the Sea Grant-supported project from his desk, not a ship. Tiwari is a mathematician and he is using math to classify benthic habitats in a project that could play a significant role in fisheries management.

Over the years, a variety of techniques and tools have been developed to help with habitat identification: side-scan sonar, remotely operated vehicles, video imaging, and submersibles. Tiwari says that while each has important capabilities, collectively they share "an inability to characterize images [in a way that] describes substrate and habitat automatically and rapidly." What's needed, he feels, "is a set of automated image processing tools that can classify an infinite variety of habitats based on a scheme that we, as humans, consider important to benthic organisms." But first, he notes, those habitats must be defined and characterized.

NOAA's Northeast Region Essential Fish Habitat Steering Committee took on part of the task a few years ago, creating eight benthic habitat categories. Tiwari is working on another key step: looking at biological structures to determine what living organisms are attached to, buried in, or resting on each background. And he's using digital images—from video or fast still camera—to supply the data. The problem? Each image contains vast amounts of data that must be processed, analyzed, and characterized.

Enter Tiwari, with his array of mathematical approaches programmed to interpret the images. One, wavelet analysis, is a way of compressing an image using scale (resolution) and frequency (contrast) to represent the original image in a more efficient way. JPEG2000, a popular image format, is an example of using wavelets to store images.

Once images have been compressed, Tiwari creates and applies "learning machines," or algorithms, to distinguish patterns in the images. Learning machines differ in the ways in which they compute "similarity" among patterns. Tiwari can identify a scallop by assigning it a set of numbers that correspond to its characteristics or "feature sets," then using learning machines to distinguish it from other feature sets, say those of clams and sand dollars.

Tiwari is now working to increase the sophistication of the algorithms. And he's applying another mathematical approach called the hidden Markov model (HMM), commonly used in multiple DNA sequence alignment and gene finding.

Math and benthic species are just a couple examples of Tiwari's diverse interests. He was born in the foothills of the Himalayas. Tiwari's father was an economist, which may explain his affinity for numbers. His mother studied English literature, which likely led to Tiwari's being "hooked on Victorian and Edwardian literature." He collects first editions of Victorian and Edwardian children's books. And the hobby has led to a writing project of his own: Tiwari is now rewriting Wikipedia's Rudyard Kipling page. Oh, and he's also a runner and blues harp player—though he hasn't figured out a way to combine those interests...yet.

—Tracey Crago

Publications

The following publications are available from MIT Sea Grant and/or WHOI Sea Grant. For WHOI documents, write to WHOI Sea Grant, MS #2, 193 Oyster Pond Road, Woods Hole, MA 02543-1525; or call (508) 289-2398. For MIT documents, write to Publication Ordering, MIT Sea Grant, Bldg. E38-300, 292 Main Street, Cambridge, MA 02139. Requests should include your name and address and a check or money order for the amount listed, plus costs for shipping and handling ($1.50 for domestic, $3 for international postage). For a full listing of MITSG publications, see web.mit.edu/seagrant/publications; for a full listing of WHOI SG publications, see www.whoi.edu/seagrant/Publications/Publications.html

MITSG 07-1 24pp
$6.50

MIT Sea Grant 2007 Calendar

A. Cohen, MIT Sea Grant (editor)

Featuring photographs by Emily Hiestand, this calendar offers glimpses of seascapes, the urban harbor, fishing communities, and other vistas from the Commonwealth. Each month also highlights an area of MIT Sea Grant's research, education, and outreach activities.

MITSG 06-8 9pp
$4

Geographic Information Systems and Ocean Mapping in Support of Fisheries Management

T. Noji, NOAA's Northeast Fisheries Science Center; J. Pederson and C. Adams, MIT Sea Grant

This paper presents a summary of a conference held in April 2006 on how GIS systems and ocean mapping can support fisheries management. The focus was on regional mapping initiatives and highlighted sophisticated data management capabilities needed to realize important ocean mapping products and analysis.

MITSG 06-7 9pp
$4

Summary of Symposium on the *Alexandrium fundyense* Red Tide of 2005

C.C. Vakalopoulos, Mass. EPA; M.J. Mickelson, MWRA; and J. Pederson, MIT Sea Grant (editors)

This report presents a summary of a symposium held to discuss the 2005 outbreak of *Alexandrium fundyense*, which produces a toxin that can concentrate in shellfish and poison humans who eat the shellfish. The paper includes information about lessons learned, preparations for the future, economic costs, and monitoring.

WHOI-R-06-001 17pp
free

Effects of Watershed Land Use on Nitrogen Concentrations and δ^{15}Nitrogen in Groundwater

Marci L. Cole, Kevin D. Kroeger, J.W. McClelland, and I. Valiela, Boston University Marine Program

Eutrophication is a major agent of change affecting freshwater, estuarine, and marine systems. It is largely driven by transportation of nitrogen from natural and anthropogenic sources. In this paper, the authors report on their findings after measuring nitrogen concentrations and δ^{15}N values in seepage water entering three freshwater ponds and six estuaries on Cape Cod, Massachusetts, and assessing how they varied with different types of land use. Reprinted from *Biogeochemistry,* Vol. 77, pp. 199-215.

WHOI-R-06-002 8pp
free

Multiple Genetic Stocks of Longfin Squid *Loligo pealeii* in the NW Atlantic: Stocks Segregate Inshore in Summer, but Aggregate Offshore in Winter

K.C. Buresch, G. Gerlach, and R.T. Hanlon, Marine Biological Laboratory

The longfin squid *Loligo pealeii* is distributed widely in the NW Atlantic and is the target of a major fishery. A previous electrophoretic study of *L. pealeii* was unable to prove genetic differentiation, and the fishery has been managed as a single unit. The authors describe the results of their tests for population structure using 5 microsatellite loci.

WHOI-G-06-001
11" x 14" poster
free

These Dunes Aren't Made for Walking

Woods Hole Sea Grant

This 2-color poster describes the importance of dunes as a first line of defense against ocean waves and cautions beachgoers against trampling the dune plants when walking to the beach. The posters are printed on 100-lb. Yupo stock, a synthetic paper. When mounted properly, the posters will withstand a season of sun, salt, and wind. They can also be placed indoors at beach houses, changing areas, concession stands, and beach sticker sales areas.

WHOI-V-06-001
through 003
$10 to buy
($3 loan)

Oceans Alive Videos

Woods Hole Sea Grant

Videos from Woods Hole Sea Grant's popular lecture series "Oceans Alive: Plain Talk on Current Topics in Marine Science Presented for the General Public" are now available. Videos may be of interest to teachers seeking to broaden their own marine science knowledge and are useful for the classroom. The latest videos include The Changing Massachusetts Coastline: How it Affects Waterfront Property Owners—and You; Freeze Frame: A Photojournalist's Experience on an Arctic Expedition; and Young Scientists Present: Winning Science Fair Projects.

Treasure Chest
Photography by Emily Hiestand

Ship model and reflections of Boston's Financial District in the windows of Lannan's Gallery, Atlantic Avenue

Emily Hiestand is a writer and photographer, and the creative director of Elements Communications. She received a Brownie camera on her eighth birthday and has been making photographs ever since. These days, her photographs are collected and exhibited, and make themselves useful in homes, offices, civic spaces, and publications. Hiestand's books include *The Very Rich Hours* (travels to Greece, Orkney, the Everglades, and Belize), and *Angela The Upside Down Girl* (true stories about identity and place). Her awards include the Whiting Award, Pushcart Prize, Boston Art Directors Club Medal, and the National Magazine Award. For more information, visit Words + Images: www.ehiestand.

Note: This photograph and many more of Hiestand's can be found in the MIT Sea Grant 2007 calendar; for ordering information, see Publications.

Ferries of Opportunity, *continued from page 3*

Tom Kleindinst, WHOI

▲ *Plankton ecologist Scott Gallager analyzes samples in his lab at WHOI.*

Are plankton communities hurt by the increasing nitrogen outflow from the coast? Do warming water temperatures change plankton species or abundance? How do storms change the picture, and how quickly do conditions and plankton communities return to normal after a storm?

Soon, Gallager will have answers: "Instrumentation on the ferry transects across Great Round Shoals to the east, between Oak Bluffs and Nantucket to the south, and between Woods Hole and Vineyard Haven to the west, will allow us to have a complete description of the incoming and outgoing plankton communities in surface waters," he says. Such studies of plankton dynamics can provide evidence for what might happen to plankton in the future.

The goal is simple—and difficult: to build a complete picture of Nantucket Sound's coastal water, its movement, properties, and plankton. Gallager wants "to create a regional model to allow real time readings and forecasts of environmental perturbations, providing an understanding of what affects plankton diversity in the light of coming climate change." And via the website, the public is invited along for the trip.

Sea Grant
MIT / WHOI

Woods Hole Oceanographic Institution
193 Oyster Pond Road, MS #2
Woods Hole, MA 02543-1525

Two if by Sea

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A joint newsletter from the **MIT** *and* **WHOI** *Sea Grant Programs*

Netting

Check out these locales.

A New Look for Marine Careers

www.marinecareers.net

Sea Grant's popular web site devoted to marine science careers has been updated and completely redesigned. In addition to offering information on a wide range of career fields and to people working in those fields, the site features new salary information, slide shows that explore some of the different ways science is conducted, resources and links to other exciting opportunities in marine science, and much more!

Global Warming Q & A

www.whoi.edu/institutes/occi/viewTopic.do?o=read&id=521

Global warming continues to attract attention, with polls showing the American public believes the scientific community is in disagreement. Scientific observation has shown that the atmosphere near the Earth's surface is warming, and that this warming is just one of many kinds of climatic change that have occurred in the past and will continue into the future. A key question is: Have human activities altered the speed or intensity of climate change? Visit this site to learn more about a panel discussion held on the topic earlier this year at the Woods Hole Oceanographic Institution.

Sea Grant Library Enhances Website

http://nsgl.gso.uri.edu/

The National Sea Grant Library provides easy access to over 33,000 documents produced by the state Sea Grant programs. And now they're doing it with an updated, visually-enhanced and user-friendly site. Use the searchable database to find publications, all of which are available on a loan basis or, in some cases, can be downloaded free of charge. The site also offers an "Ask the Librarian" feature.

Picturing to Learn

http://web.mit.edu/i-m/picturing/

If a picture is worth a thousand words, perhaps drawing and visualizing can help science students enhance their potential for learning. Felice Frankel, a research scientist at the Massachusetts Institute of Technology (MIT) and a senior research fellow at Harvard University, is exploring this idea through Picturing to Learn, which actively engages students in creating visual explanations of the concepts they learn in the classroom. Examples on the website include very different ways of conceptualizing molecular bonding, as expressed by MIT chemistry students.

Calendar of Events

Ongoing

Coastal Decision Maker Workshops are specifically designed to inform coastal decision-makers about current science and management issues. Many of the workshops include practical information on addressing identified coastal management problems. For more information and the current schedule, visit www.coastaltraining.org/.

January 23-25 and February 27-March 1, 2007

In MIT Sea Grant's two Sea Perch Workshops, teachers will learn how to build a remotely operated vehicle (Sea Perch) and how to integrate ROVs and ocean exploration into the classroom. For more information, contact Brandy Wilbur at bmmoran@mit.edu or see http://web.mit.edu/seagrant/edu/seaperch/.

February 1, 2007

Woods Hole Sea Grant will issue a Request for Proposals (RFP) for the 2008-2010 funding cycle. To be added to the mailing list or for more information, including deadlines, contact Sea Grant at 508-289-2398 or seagrant@whoi.edu.

May 9-11, 2007

Working Waterways & Waterfront—A National Symposium on Water Access. Norfolk, Virginia. This conference will bring together experts in many fields to delve into issues that surround the rapid conversion of working waterfronts—marinas, boat repair yards, fish piers, and charter fishing docks—to other uses such as private residential developments and non-water dependent businesses. Sponsored by the Sport Fishing and Boating Partnership Council. Hosted by Virginia Sea Grant. Conference website: www.wateraccess2007.com/.

May 21-24, 2007

Fifth International Marine Bioinvasions Conference. Cambridge, MA. This gathering, hosted by MIT Sea Grant, will examine marine bioinvasion vectors, patterns, distribution, ecological and evolutionary consequences, economic impacts, biosecurity approaches, and natural and invasion impacts on biodiversity. For more information, see http://web.mit.edu/seagrant/bioinvasion2007/index.html.

July 22-26, 2007

Coastal Zone '07. Portland, Oregon. The biennial Coastal Zone conference, now in its fifteenth edition, is the largest international gathering of ocean and coastal management professionals in the world, representing federal, state, and local governments, academia, nonprofit organizations, and private industry. For information, see conference website: www.csc.noaa.gov/cz/.