

Sea Grant College Program

The National Sea Grant Program supports research, education, and outreach activities that address critical problems in human use of the sea. MIT Sea Grant focuses on developing scientific and technological systems that can provide ever-increasing accuracy and range in exploration, data gathering, analysis, and understanding of marine processes. Essential to this purpose is the transfer of knowledge to and within the program's broad constituency—industry, government agencies, public and private educational institutions, and the general public.

This reporting year saw several events that brought our program goals into sharper focus. Chief among these was the BP oil spill in the Gulf of Mexico, which has served to emphasize the importance of the ultra-deepwater exploratory and operations capability being developed by MIT Sea Grant's Autonomous Underwater Vehicle (AUV) Laboratory. On the administrative side, an emphasis on long-range strategic planning and increased reporting of measurable outcomes by the National Sea Grant Office has led to increased collaboration between research personnel and advisory staff.

Increased funding opportunities have led to a consistent increase in our efforts in the areas of naval architecture and systems. As a result, we have modified our organizational structure, grouping certain ongoing endeavors under the heading of the Design Laboratory.

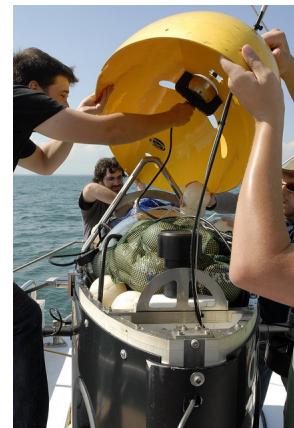
Going forward, our program will be organized into four areas:

- AUV Laboratory
- Design Laboratory
- Funded research projects
- Education and advisory services

Autonomous Underwater Vehicle Laboratory

The MIT Sea Grant College Program is historically credited with creating and developing AUVs—small, inexpensive, artificially intelligent, robotic submarines for undersea exploration. The lab has several vehicles, configured for different types of missions:

- Odyssey II class AUVs, which can carry a variety of payloads, such as a Nereus mass spectrometer or a camera combined with sidescan sonar
- Odyssey IV, a hovering/cruising AUV rated to 6,000 meters' depth
- Reef explorers (Rex II, III, and IV), small, inexpensive hovering AUVs tethered to a small surface-communication device
- Katrina, an autonomous surface vehicle



Preparing Odyssey IV for deployment off New Bedford, June 2010

Reef Explorers

This has been a particularly active year for the Rex class of vehicles, and there is great demand for them from the lab's research collaborators in the field. These full-size working vehicles are lightweight, adaptable, inexpensive, and easy to deploy and maneuver. A Rex is a hybrid AUV/ remotely operated vehicle (ROV) particularly well suited to shallow-water missions. Rex vehicles are used both by Sea Grant staff and outside investigators for environmental scouting, sensor and manipulator testing, and communications experiments. AUV Lab personnel use them to test sensors and other equipment for the Odyssey IV, which is currently committed to a deepwater project funded by Chevron.

The Rex II has operated in the field many times this past year, for a variety of purposes:

- Hull inspection
 - Around the Americas sailboat Ocean Watch
 - Troy Dwyer's fishing boat F/V Isabella and Ava
 - Mike Ryan's charter boat R/V R and R
 - Mike Ryan's charter boat R/V Discovery
- Observation
 - National Oceanic and Atmospheric Administration (NOAA) project—eelgrass
 - AUV Lab project—sunken thruster recovery
 - AUV Lab project—Sea Perch sensor data
 - AUV Lab project—observing descent characteristics of Odyssey IV
 - AUV Lab project—finding *Didemnum vexillum*
 - Hawai'i Institute of Marine Biology project—observing and telepresence viewing of coral reef
 - Sea Perch project—Sea Perch Institute videographer
 - Sea Perch project—Sea Perch Institute image relay vessel

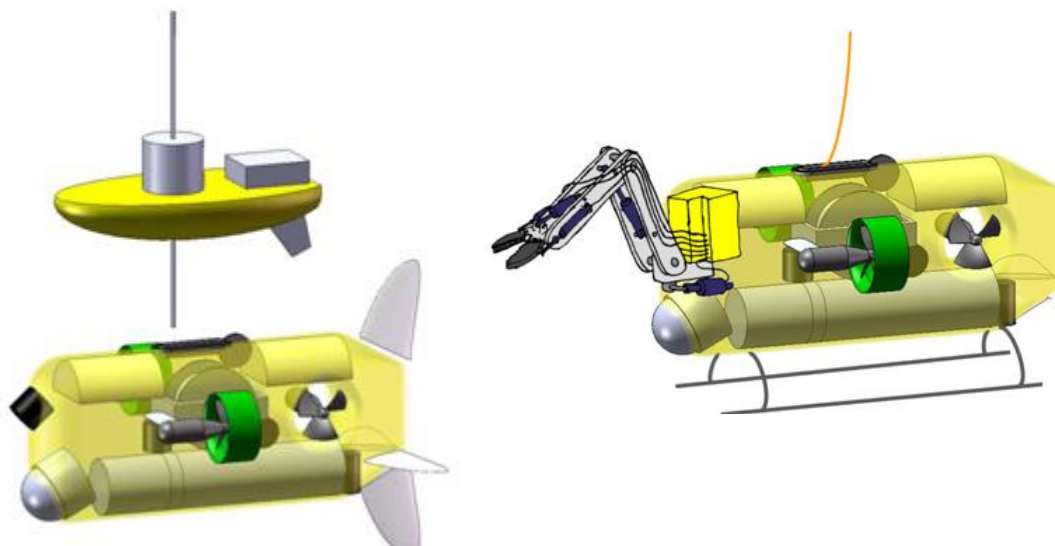
Other missions planned for the near future include coral observation in Hawaii for Sheila Frankel of the Department of Civil and Environmental Engineering (CEE); methane bubble observation in Mystic Lake for Harold Hemond (CEE); and eelgrass characterization and sunken vessel telepresence viewing in Virginia, both AUV Lab projects.

The eelgrass observation project exemplifies the utility of the Rex vehicle. Jesse Thornburg, a junior in the Department of Mechanical Engineering (MechE), received a NOAA internship to study damage from boat mooring chains to eelgrass beds along the Massachusetts coast. Eelgrass is a vital habitat for young lobsters, winter flounder, and other larvae and fry. Mooring chains pose a major threat to the grass by scouring circles on the sea floor as boats drift around with the wind and tide. Thornburg's project involves using Rex II to record color video and the GPS coordinates of the bed edges and the scar locations.

Results so far demonstrate that monitoring with the vehicle is more effective and efficient than the traditional method of sending down scuba divers. Image results compare favorably, and the overall cost in human effort is substantially less. At least two scuba divers plus a boat and driver are needed to measure mooring scars in eelgrass, but with Rex II the same patch can be monitored by a single operator working up to two miles away. Setup and operation of an AUV/ROV requires initial training, but is far less time consuming and expensive than scuba certification. Equipment cost is higher for the vehicle, but the researcher avoids the physical risks of diving.

Successful deployments for this study took place in June in the Charles River and more will be carried out in July at Nahant, Gloucester, and Swampscott. Thornburg will present his project and findings at the Sea Grant National Office in Washington, DC, in August 2010.

In the coming months the lab intends to develop a Rex III and IV. So far they have created a mechanical and electrical design in CAD software, redesigned the thrusters, and chosen materials for the new vehicles.



Drawings of Rex III and Rex IV, to be built this fall

Equipment Acquisition

This year, to help with design efforts, the lab team has been using an important new piece of equipment, a rapid-prototype 3D printer. The uPrint 3D Printer by Dimension allows us to prototype and even manufacture nearly any small shape in hard ABSplus plastic, including preassembled objects with moving parts. The uPrint machine has about the same desktop footprint as an office laser printer, but is a bit taller; it was purchased for just under \$15,000.

Underwater Communication

AUVs must network with other subsea devices to carry out any but the simplest of missions. Improving underwater signal processing capability for navigation, and the collection and transmission of data, is a major research focus for us. The communications group has recently focused on wireless underwater video transmission. Such a capability would constitute an important breakthrough in the field of oceanography.

Working with funding from the Chevron Corporation, our specific goal is to enable monitoring of deep-sea oil fields. Near-real-time video transmission over a deepwater wireless (acoustic) link would allow for image supervisory control of AUVs in oil field sites. AUV platforms have considerable operational cost savings over the tethered ROV systems currently used for inspections and intervention at deepwater sites. The recent oil well blowout in the Gulf of Mexico emphasizes the value of developing this capability to the utmost.

Data rates in typical underwater acoustic channels are currently limited and require compression techniques for real-time video transmission. During the year we developed a graphical user interface (GUI) for MPEG-4 and Wavelet CODEC and tested it using footage from our video collection, showing that MPEG-4 is suitable for underwater video transmission from an AUV at 10 kbp/s rates. A wavelet decompression algorithm is being optimized and tested with 10 and 64 kbp/s rates during June 2010, and AUV data rates for supervisory control will be analyzed in July.

The remainder of 2010 will be spent demonstrating our underwater communications system in a deepwater oil field environment. It has already been shown to work in shallow depths at a distance of 100 meters with high bit rates capable of supporting video transmission. The work planned for the rest of the year should allow for transfer of the technology to Chevron.

Ship Design

Electric Ship Research and Development Consortium

MIT Sea Grant director Chryssostomos Chryssostomidis is active in the nationwide Electric Ship Research and Development Consortium (ESRDC), whose mission is to design an all-electric vessel for the US Navy. The group is managed by the federal Office of Naval Research, with participation from leading electric power research institutions and senior naval officers. The MIT ESRDC team is led by Professor Chryssostomidis and includes professor Michael Triantafyllou and assistant professor Franz Hover of the Department of Mechanical Engineering; professors Steve Leeb and James Kirtley of the Department of Electrical Engineering and Computer Science (EECS); and professor George Karniadakis of Brown University and associate professor Richard Kimball of Maine Maritime Academy, who hold research scientist and visiting scientist appointments, respectively, at MIT. They are assisted by research scientists Julie Chalfant and Mirjana Milosevic Marden.

During this reporting period, the team worked on the simulation, validation, and analysis of the electric ship model. Work was especially focused on the gas turbine, propeller, and hydrodynamic elements, including linear and nonlinear wave forces, and nonlinear

maneuvering simulation models, to be coupled to high-order integrated power system models being developed elsewhere in the all-electric ship community. We continued to develop control protocols to simulate the response of the ship under transient maneuvering conditions. A detailed linear and nonlinear stability analysis shed further light into the behavior of the electric ship.

Testing was made possible by expanding the utility of the design tool to allow us to perform tradeoff studies on concepts such as AC vs. DC distribution, frequency and voltage level, inclusion of reduction gears, energy and power management options, and the effect of arrangements and topology. In cooperation with the US Coast Guard (USCG), especially the crews of the USCG cutters *Escanaba* and *Seneca*, we successfully conducted field experiments in power system monitoring and critical load diagnostics.

T-Craft, the US Navy's Transformable Craft

Professors Chryssostomidis and Karniadakis have received funding from the Office of Naval Research to design and model a propulsion system for a multihull vessel capable of ferrying heavy tanks from ships at sea through the surf and onto beachheads. Requirements for the T-craft are that it can travel at a speed of 40 knots, carry at least six tanks, survive 57-knot winds and 60-foot waves, and mitigate wave-induced rocking.

We have developed predictive simulation tools of the propulsion characteristics of the T-craft by using computational fluid dynamics algorithms. Our focus is on modeling and analysis of the dynamic aspects of this craft in two specific areas: waterjet and seakeeping. In a high sea, the T-craft's waterjet will roll up out of the water, ingesting air and causing propeller race, with a corresponding uploading of the propulsion power. Our model will enable us to test jet designs and power system configurations to mitigate the problem.

We are updating current modeling techniques to simulate the T-craft's seakeeping characteristics throughout the mission. We have created a modeling tool with a modified Navier-Stokes solver able to calculate the ship motions for arbitrary hull configurations without using empirical approximations for the roll damping coefficient often utilized in other strip theory codes. This work is ongoing.

OpenProp

OpenProp is a suite of propeller and turbine design codes written in MATLAB. It is intended as a GUI-based, user-friendly tool for both professionals and novices with some background in engineering. The open-source code is being published under the GNU public license protocol and is offered as a public resource to enhance the art of propeller and turbine design.

Basic work on this tool started in 2001 with the propeller code PVL, developed by professor Justin Kerwin as part of his propeller design course notes. This year, MechE doctoral student Brenden Epps improved upon the turbine optimizer and the validation testing of the designs. Work on OpenProp has progressed well, and its capabilities have caught the attention of US Navy personnel interested in unmanned vehicle design. Future additions to OpenProp are being planned in the following areas:

- Integration of the 2D foil code XFOIL for arbitrary foil geometries and inclusion of viscous boundary layer effects
- Integration of Christopher Peterson's (SM '08) cavitation bucket generator into the OpenProp code
- Addition of multiple blade row design capability
- Addition of blade strength analysis capability
- Extension of blade outputs to other CAD programs such as SolidWorks, and internal generation of 3D print files

Funded Research Projects

MIT Sea Grant conducts a yearly funding competition as mandated by NOAA through its National Sea Grant Office. Grants are available to researchers throughout Massachusetts. Selected proposals support the goals outlined in our strategic plan, and we are required to match every \$2 from our federal grant money with \$1 from nonfederal sources.

This year we have chosen to support six core research projects, and two regional projects in collaboration with other Sea Grant colleges; we will continue support for several larger, ongoing six-year focused research projects.

New Projects, Begun February 2010

Investigators submitted proposals for review by in-state stakeholders, peers from outside the state of Massachusetts, and finally by a panel of technical experts. The proposed projects described below were approved for funding.

We will be providing funds to support two regional proposals selected by the Northeast Sea Grant directors. Maine, New Hampshire, Rhode Island, Connecticut, and MIT Sea Grant programs will contribute \$25,000 each per year, for two years, in support of these projects. Woods Hole Oceanographic Institution (WHOI) Sea Grant will contribute \$44,165 the first year, and \$24,874 the next:

- Franz Hover, Robert Whitlatch of the University of Connecticut, and Emmanuel Boss of the University of Maine for their project, Using Technology to Assess the Invasive Sea Squirt, *Didemnum vexillum*, Impacts on Fisheries and Ecosystems. (Proposal reviewed by MIT.)
- Hauke Kite-Powell of WHOI, Christopher Brehme of the Institute for Broadening Participation, and Kerry Lagueux and Dr. Scott Kraus of the New England Aquarium for their project, Mitigating Risk to Whales from Lobster Fishing. (Proposal reviewed by WHOI.)

MIT Sea Grant itself will fund six research proposals by the following principal investigators (PIs):

- Bob Chen of the University of Massachusetts (UMass) Boston for his project, Consortium for Ocean Sensing in the Nearshore Environment

- John Stegeman and Jared Goldstone of WHOI for their project, Active Samplers: Development of Biomarkers for Coastal Pollution in the Blue Mussel, *Mytilus edulis*
- Rodney Rountree, Francis Juanes, and Stephen Frasier of UMass Amherst (and Clifford Goudey of MIT Sea Grant, recently withdrawn) for their project, DeepFSL—A Low Cost Bimodal Observation System for Deep Sea Ecosystem Research. This proposal was well reviewed, but concern was expressed by the panel and the management team regarding the effect of Goudey's departure. Ultimately, funding of \$75,000 was offered, as opposed to the requested \$79,304, for one year only. The PI can change the scope of the work to accommodate the change in personnel and reapply next year for support for the project's second phase.
- Scott Gallager, Mary Carman, and Amber York of WHOI for their project, Assessing the Distribution, Spreading Rate, and In Situ Growth of *Didemnum vexillum* and Other Invasive Species along the Northeast Continental Shelf

Changsheng Chen of UMass Dartmouth for his project, Development and Validation of the Water Quality Model System for Massachusetts Coastal Waters

- Associate professor Alexandra Techet of the Department of Mechanical Engineering for her project, Three-Dimensional Imaging System for In Situ Biological Sensing and Flow Velocimetry. The PI requested \$80,000 for the first year but her project ranked at the cutoff point for funding. Peer reviewers were divided in their response, while the technical panel felt there was a lack of clarity on the usefulness and application of the imaging device proposed. However, we wish to invest in this technology development as it is a good match with our strategic goals. Professor Techet has agreed to refocus the work and we will provide funding of \$50,000 per year for two years.

Continuing Projects, Begun February 2009

- Milica Stojanovic, Northeastern University: Wireless Underwater Video Transmission
- Harold Hemond: Enabling High- and Low-Molecular Weight AUV-based Chemical Analysis, Complementing Mass Spectrometry with Multichannel Time-Resolved Fluorometry aboard the NEREUS/Odyssey Vehicle
- Cabell Davis, WHOI: Incorporation of a Compact Digital Holographic Plankton Camera into Gliders and Drifters
- Geoffrey Cowles, UMass Dartmouth: An Assessment of the Tidal Kinetic Energy Resource off the Massachusetts Coast and Potential Impacts of Extraction

Continuing Six-Year Focused Research Projects

- Jeffrey Lang, EECS (started 2006): Touch-at-A-Distance, Pressure Microsensor Arrays for AUV Navigation

- Milica Stojanovic (started 2007): Acoustic Communication Networks for Distributed Autonomous Underwater Platform
- Franz Hover (started 2008): Autonomous Vehicle Exploration and Sampling of Deepwater Corals

Advisory and Outreach Program

MIT Sea Grant has an active Advisory, Education, and Outreach Program designed to address issues that are important to local, state, and regional government agencies, businesses, and citizens' organizations. Our staff members have strong links to the community and serve as conduits for the transfer of marine-related information, technological developments, and citizen interests and needs. They serve as an active link between scientists and our constituent groups.

A key advisory initiative is tracking and mapping the presence of invasive marine species. Advisory leader Dr. Judith Pederson will spearhead the fifth Rapid Assessment Survey of Marine Invasive Species in collaboration with the Massachusetts Office of Coastal Zone Management from July 24 to 31, 2010.



Advisory leader Judy Pederson examines the tidal zone for invasives

Education

A key component of our outreach efforts is a comprehensive and varied education program directed mainly at K–12 students. As part of this effort we maintain a Marine Education Center at the Gloucester Maritime Heritage Center, overlooking the harbor of this important fishing community on Massachusetts' North Shore.

The center previously specialized in exhibits and education programs on aquaculture for local schoolchildren. Activities were based in classrooms and in our aqualab facility at the center. This year we have decided to pursue an opportunity to create a new "green energy" facility to explore the process of making biodiesel fuel from marine algae. Led by marine educator Sarah Hammond, our education team is now building a system to grow algae in tanks, then process and convert it to create alternative fuel. Our existing finfish hatchery equipment has been modified to serve as growth chambers for the algae. The team began constructing a biodiesel reactor in June to process the algal product into biofuel.

Since the Gloucester site is now dedicated to the algae biofuel project, we are closing down the aquaculture program at that location. Effective July 2010, MIT Sea Grant will no longer hold finfish of any kind, and the small population of winter flounder housed in the Marine Education Center will be turned over to the Gloucester Maritime Heritage Center Aquarium for display in their tanks.

Sea Perch Program

The Sea Perch is a simple ROV made from inexpensive, easily available materials. Launched in 2003, the Sea Perch Program trains educators to build the Sea Perch, and use it on missions to observe underwater environments and collect near-shore water-quality data. Having trained teachers in over 200 schools (including schools in Cyprus and France), and having deployed a Sea Perch on the Around the Americas cruise, the program has ignited schoolchildren's enthusiasm for science, technology, and engineering on several continents.

This year we expanded the original Sea Perch Program beyond the construction of the original ROV design. These new offerings were developed to foster ongoing programs in schools where the Sea Perch is already part of the curriculum.

Sea Perch Institute

In 2009, MIT Sea Grant began to look at ways to support teachers in integrating the Sea Perch into their classroom on an ongoing basis. We decided to move away from the traditional "train the trainer" model, toward a new approach called the Sea Perch Institute (SPI). We expect this approach to have a lasting impact on the schools involved.



Participants in the June 2010 Sea Perch Institute Challenge

Schools apply to the institute and are selected based on past Sea Perch use and their goals for the following school year.

The program is geared toward veteran Sea Perch teachers, but new teachers are also eligible. Four professional development workshops per year are given, focusing on new technology, current research, and field sessions, providing teachers with a greater depth of knowledge and a plan for using Sea Perch in the classroom. Four schools are currently participating in these concentrated workshops and benefitting from regular classroom and campus visits by MIT Sea Grant personnel.

For an exciting finale to the SPI year, we held the first annual Sea Perch Institute Challenge on June 1, 2010, at MIT. Two hundred and fifty high school and middle school students from Massachusetts and Rhode Island participated. The challenge to students was to use their Sea Perches to map the site of a sunken cargo ship in Boston Harbor, test water quality to detect spills, and recover cargo, if indicated. To simulate conditions, a model ship with cargo was sunk in a swimming pool. The four schools worked progressively, cooperatively, and against the clock to complete the mission, which was highly enjoyed by all participants.

Future Educational Outreach—The Ocean Engineering Experience

Our education team is planning a week-long, hands-on summer program at MIT for eleventh- and twelfth-grade students. Scheduled for July 2010, the Ocean Engineering Experience (OEX) will be a residential camp aimed at introducing and possibly recruiting students to the field of ocean engineering. Their assignment is to design and build a fully functional floating wind turbine and ROV. The turbine will be moored on the Charles River and the ROV will be guided to “dock” at the turbine platform to simulate data transfer or battery charging.

Students will pay a \$1,200 tuition fee to participate in OEX, with some scholarships coming from the Blue Lobster Bowl funds. (The Blue Lobster Bowl, part of the National Ocean Sciences Bowl program, is a high school academic competition that offers talented students in the region a chance to test their knowledge of the marine sciences.) OEX is jointly sponsored by MIT Sea Grant and MIT’s Center for Ocean Engineering.

Students Supported by MIT Sea Grant

MIT Sea Grant promotes and administers a number of programs and awards that directly support aspiring scholars who are pursuing studies and careers in marine research.

The 2010 Dean A. Horn Award for Undergraduate Study in Marine Research was awarded to Joseph Conte, a sophomore in the Mechanical Engineering Department, for his research and design work and written report on “A Fast-Starting Robotic Fish.”

The Dean John A. Knauss Marine Policy Fellowship program places graduate students with host organizations in the legislative or executive branches of government, or appropriate institutions in Washington, DC, for a one-year, paid fellowship. Our nominee, Caitlin Frame, a PhD candidate in the MIT/WHOI Joint Program, was selected as an executive branch finalist and will be placed later this year.

We successfully nominated Dan Goethel of UMass Dartmouth for the three-year National Marine Fisheries Service/Sea Grant Fellowship in Population Dynamics. His project, A Spatially Explicit and Tag-Integrated Stock Assessment Model of Yellowtail Flounder, will be funded at \$38,000 per year.

Undergraduate Research Opportunities Program

During this reporting period, the following students carried out Undergraduate Research Opportunities Program (UROP) projects at MIT Sea Grant:

- Matthew L. Gildner, junior, MechE: Curriculum Development for the Ocean Engineering Experience (fall 2009, Independent Activities Period [IAP] 2001), Development for the Ocean Engineering Experience (spring 2010), and Development of an Inductive Charging System for an Autonomous Underwater Vehicle (summer 2010)
- Caine L. Jette, junior, EECS: Revolutionizing the National Ocean Sciences Bowl (fall 2009), and Electronic Ocean Sciences Bowl (spring 2010), and Continued Development of Electronic Ocean Sciences Bowl (summer 2010)

- Joann Lin, sophomore, CEE: Space-Use Conflict in the Development of Offshore Alternative Energy Sites (spring and summer 2010)
- Ari S. Umans, freshman: Super Sea Perch (IAP 2010)

The following students have initiated UROP projects with us for the 2010 summer term:

- Owusu Ansah Agyeman Badu, senior, MechE: Assessment of Salt Marsh Vulnerability to Climate Change
- Oscar A. Viquez Rojas, sophomore, MechE: Development of Numerical Codes for Design and Analysis of Marine Propellers and Wind Turbines

Internships

In partnership with our regional National Ocean Science Bowl, the Blue Lobster Bowl, MIT Sea Grant is offering a four-week, paid internship with Sea Perch. Two students have been selected to work with MIT Sea Grant and the Center for Ocean Engineering this summer.

Administrative Initiatives

Several changes and improvements were made in the administration of the MIT Sea Grant program this year, including work on an electronic project management and web support system, and an office move that reunites our staff under one roof.

Electronic Sea Grant

A fully automated web and database system, electronic Sea Grant (eSG), is nearing completion. It is a cradle-to-grave process for managing proposals, project reporting, information distribution, and for automatically creating and updating pages for our website. Every administrative process in the funding cycle, from the initial request for proposals through submission and review of pre-proposals and full proposals, through creation of the final omnibus document submitted to the Office of Sponsored Programs, will be handled in eSG. The system also allows us to collect reports from our PIs online and distribute their findings. The system can automatically assemble a page for each project on the fly so that vetted material is quickly made available to the public and the research community.

Faculty Committee

In October 2009, as part of its cost-cutting efforts, MIT minimized committee service requirements for faculty members and appointments to the MIT Sea Grant Committee were no longer recognized as service to the Institute. The director worked with vice president and associate provost for research Claude Canizares to design a lighter workload for the committee and encourage members to continue to act in their valuable advisory role. The response of committee members was most supportive, and they will continue to advise the director in funding and planning decisions.

Office Move

In June 2010, our advisory services section moved its offices from Building E34 to the seventh floor of Building E38, where our main office is located. The move was accomplished without incident and has brought the staff into closer contact. Administrative tasks are more easily carried out, and cooperation among personnel is expected to increase.

Vacation Tracker

Other departmental administrative tasks were simplified by MIT-wide initiatives such as the new vacation tracker application for sponsored research staff, which is now used—and much appreciated—by MIT Sea Grant staff.

2010 MIT Sea Grant Lecture

Each year we organize a lecture or symposium on an ocean-related topic. In 2010, we presented a lecture titled “Energy Technology and Policy—A Post-Copenhagen View: Marine Challenges and Opportunities,” by MIT professor Ernest J. Moniz. The event took place on Tuesday, May 4, in the top-floor lecture hall of the new MIT Media Lab complex and was followed by a reception.

Professor Moniz presented an overview of the challenges to the energy system from climate change and the necessary risk mitigation resulting from it. He discussed the technology, policy, and business innovations needed to address this challenge in the context of the Copenhagen Climate Conference of 2009. Specific examples of marine science and technology solutions for a low-carbon world were mentioned. Professor Moniz serves on President Obama’s Council of Advisors for Science and Technology and was named to the Department of Energy’s Blue Ribbon Commission on America’s Nuclear Future, effective January 2010.

Staffing and Oversight

MIT Sea Grant is overseen by a Joint Advisory Committee consisting of MIT faculty members and leaders in Massachusetts marine-related industry, colleges and universities, state government, and key nongovernmental organizations. Changes in the role of the committee followed on the changes in the faculty committee described above.

The MIT Sea Grant College Program’s management team consists of a director (Professor Chryssostomidis) and an associate director for research utilization (Dr. E. Eric Adams). Dr. Adams’s research portfolio is in coastal processes and Professor Chryssostomidis is responsible for overall program management. Our former associate director, Milica Stojanovic, has taken a faculty appointment at Northeastern University but retains a part-time position with MIT Sea Grant to work on underwater communications. The management team is jointly responsible for planning the research direction of the program.

Dr. Pederson leads the program’s advisory group. Her leadership reflects the program’s greater focus on the importance of a regional approach to research on the Northeast ecosystem, identifying and combating invasive species, and exploring more sophisticated methods of data collection.

MIT Sea Grant's administrative staff consists of assistant director Timothy Downes and program coordinator Kathy de Zengotita. The Advisory, Education, and Outreach Program has five professional staff members, whose activities include control of non-indigenous species, public education, anthropological research in fisheries, and communications. In addition to the advisory staff, MIT Sea Grant employed six research engineers in the AUV Laboratory and in support of our other externally funded research. Changes this year include the departure of our communications specialist; we are currently seeking a replacement. This spring we hired Juliet Simpson to lead our climate change outreach effort and to support our work in marine ecosystem health. Simpson received her PhD from the University of California, Santa Barbara, and was a postdoctoral research associate at Brown University, where she studied the effects of climate change and water quality degradation on the global spread of invasive aquatic plants.

Special Awards and Funding

Each year MIT Sea Grant awards the Doherty Career Development Chair for Ocean Utilization. It is a two-year appointment at \$25,000 per year for a young professor working on marine research. The 2010 winner is assistant professor Janelle Thompson of the Department of Civil and Environmental Engineering for her project, "Host-Associated Microbial Communities (Microbiome) in Corals, Their Activity in Response to Environmental Stress and to Lesions Caused by White Plague Disease."

During this reporting year, MIT Sea Grant again received funding from Eric Schmidt of the Google Corporation through the Schwab Fund for Charitable Giving. This \$100,000 grant will extend the current fellowship of \$80,000 that supports Brenden Epps's work on OpenProp, described above.

Chryssostomos Chryssostomidis

Director

Henry L. and Grace Doherty Professor in Ocean Science and Engineering

More information about the Sea Grant College Program can be found at <http://web.mit.edu/seagrant/>.