HARBOR BRANCH
FLORIDA ATLANTIC UNIVERSITY®
Ocean Science for a Better World®
BULLETIN
Summer 2012

Ocean Energy Collaboration:

A Charge for Engineers

Beginning with famed inventor Edwin A. Link, Harbor Branch engineers have amassed a rich legacy of designing and fabricating innovative equipment that helps humans understand and wisely use marine resources. Today, in collaboration with FAU colleagues from the Southeast National Marine Renewable Energy Center (SNMREC) led by Executive Director Sue Skemp, they are helping to investigate and develop power extraction from particularly abundant marine energy resources, especially the Gulf Stream.

The project dates back to 2007, when the State of Florida provided $5 million to establish the Center for Ocean Energy Technology at FAU. In 2010, the U.S. Department of Energy designated the operation as SNMREC, the third national center dedicated to ocean energy research; the others are in Hawaii and the Pacific Northwest. Bill Baxley is the SNMREC Chief Engineer. *(story continues on next page)*

Photo: Rotors such as this will use ocean current to drive turbines

SNMREC Project Engineer Shirley Ravenna assembles turbine components

At present, the focus is to establish a small-scale ocean current test site approximately 12 miles offshore of Fort Lauderdale, the cornerstone of which is a moored boat-like buoy filled with instrumentation to help characterize the environment. Last year, Harbor Branch Senior Engineer Geoff Beiser oversaw a series of tow tests to assess how the buoy would perform in the current, which led to design changes documented by designer Kathy Russ and implemented by fabrication technicians including Jeff Smith and Dave Bourdette, all of Harbor Branch.

In parallel, an ocean current turbine is being constructed at Harbor Branch which allows researchers to investigate new technologies that commercial turbines will eventually use. Much of the work on the 20 kW turbine has been the responsibility of SNMREC Project Engineer Shirley Ravenna and Harbor Branch machinist technician Mike Young, who has created numerous components for the unit. The turbine eventually will be suspended in the water from a vessel tethered to the buoy offshore, and successful experiments are expected to attract commercial energy producers to conduct additional studies. If the concept proves economically and environmentally feasible, Harbor Branch and other FAU engineers may one day find their lives enriched by the energy extracted by technology they helped to develop.

On ladder (from top): Shirley Ravenna, Kathy Russ, Jeff Smith, Steve Black
On ground (L to R): Stewart Moreaux, Geoff Beiser, Craig Caddigan, Dave Bourdette, Bill Baxley

The laser transmitter prior to deployment

Laser System Passes First Field Tests

The promise of laser systems for improving the ability to see undersea lies in their potential for capturing images at farther distances and with better resolution than cameras or sonar, even in turbid (i.e., cloudy) water. This past May, members of the Ocean Visibility and Optics Lab (OVOL), led by Assistant Research Professor Fraser Dalgleish, Ph.D., took to the Indian River Lagoon for the first field tests of its prototype distributed laser imager and communications system, and they came back clearly pleased with the results.

With diver visibility of < 0.5 m in the test area, the team submerged the OVOL-conceived and -designed laser transmitter and the novel multiple photodetector receiver, and directed the transmitter toward a visual target bearing 50 mm diameter contrast standards at a water depth of 3 m (the depth of the Harbor Branch channel). At the surface, the receiver module for the system produced a high-resolution image of the target, and even when the receiver was retrained in the opposite direction, the system still managed to create a quality image using only the light reflected by particles suspended in the water (i.e., the turbidity). With the limited lagoon depth, the receiver system was at its lowest gain setting, and the team is looking forward to exercising the technique over greater ranges in the open ocean.

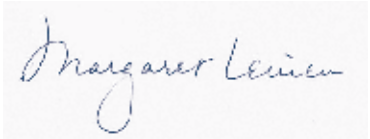
Dr. Dalgleish estimates that the system will produce quality images even at distances of 80 m. This real-time, detailed imagery will be an unprecedented benefit for researchers using wireless robotic vehicles to conduct benthic site surveys in applications such as coral reef research, as well as for undersea inspection missions conducted by the U.S. Navy, which is funding the work.

Executive Director's Report

While the notion of a researcher working alone and finding the answers to big questions is sometimes the case, the reality is that collaboration is the far more common model in research. And for many challenging projects, collaboration is an imperative. In recognition of this, funding agencies often require organizational partnerships for projects they support.

This past January, engineers from the FAU SeaTech research and technology development site traveled up to Harbor Branch for a day of information and idea exchange that produced potential avenues for collaboration. In April, faculty from the Charles E. Schmidt College of Medicine shared a similar day-long retreat with Harbor Branch researchers. The ocean energy collaboration between Harbor Branch engineering and fabrication personnel and the FAU Southeast National Marine Renewable Energy Center highlighted in this issue is a prime example of the opportunities that Harbor Branch encounters today as part of the University.

Fostering these internal relationships also makes Harbor Branch more attractive as a collaborative partner to other institutions, as the range of what we have to offer becomes greater and more compelling. These types of partnerships have been part of the Harbor Branch story from the very beginning, and they will continue to sustain us moving forward.



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(L-R) Dr. Paul Wills (IMTA principal investigator), Dr. Margaret Leinen (Harbor Branch Executive Director), Dr. Susan Laramore (IMTA shrimp component manager), Dr. Megan Davis (Harbor Branch Associate Executive Director), Kathy Russ (engineer), Geoff Beiser (engineer), Dr. John Scarpa (IMTA bivalve and urchin components manager) and Dr. Dennis Hanisak (IMTA macroalgae component manager) celebrate completion of system construction

Aquaculture Seeks Sustainability with New System Design

Integrated Multi-Trophic Aquaculture—or IMTA for short—is the technical term applied to an aquaculture strategy under investigation at Harbor Branch. The simple idea behind this not-so-simple name is to find ways to turn what is usually thought of as waste products of an aquaculture system from a liability into an asset.

To achieve rapid growth, farmed fish eat large amounts of food, but not all of that expensive feed is converted by the fish to biomass; a portion ends up as waste that must be removed from the aquaculture system before it becomes harmful to the farmed stocks. Land-based recirculating aquaculture systems typically rely on mechanical and biological filters to remove or detoxify waste. Although technically better than other aquaculture practices, this still includes the need to further treat the waste prior to discharge into retention areas or the environment, which can be difficult and expensive.

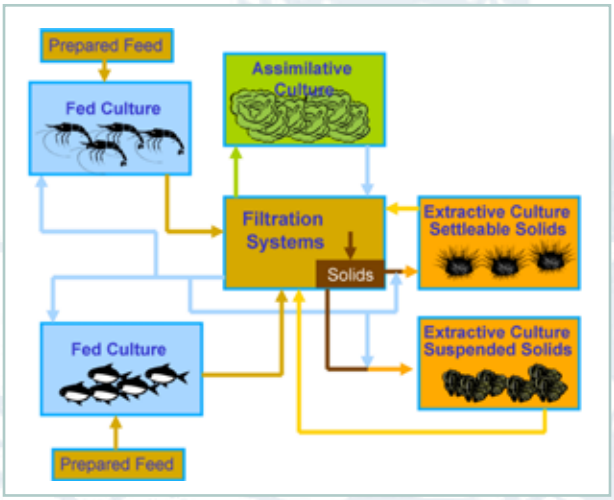
According to Associate Research Professor Paul Wills, Ph.D., it's wasteful as well. He notes that although these systems are designed for environmental sustainability, the discharge of water can be considered wasteful because the effluent contains a high nutrient load. "Instead of removing it and throwing it away," says Dr. Wills, "an IMTA system uses the waste products of one aquaculture stock as a nutrient resource to grow other cultured products, allowing for diversification and multiple revenue streams." For example, some of the solid wastes from fed culture stocks (fish; see diagram on next page) can be used to feed secondary crops such as sea urchins or sea cucumbers, which are known as "extractive culture" species because they extract solid waste from the culture system and grow to become harvestable biomass. Crops of plants or seaweed can be grown in IMTA systems as well, serving as "assimilative culture" species, because they absorb dissolved nutrients produced by the microbial biofiltration process.

In effect, an IMTA system brings together multiple species that feed at different levels of the food web, which scientists refer to as "trophic levels." The concept is similar to traditional polyculture systems that have been used in China for centuries to grow

multiple crops such as fish, ducks, shrimp and rice. Unlike the traditional model, however, Dr. Wills notes that the species in a land-based IMTA system do not need to share the same living space; rather, it is only the nutrients that need to be transported by water and shared between the fed and secondary stocks. This allows a modular approach to the system design whereby researchers can adopt a 'plug-and-play' strategy, swapping out various secondary culture species to find the best combinations for a particular farm or even region of the country.

The Harbor Branch IMTA project team includes not just aquaculture researchers and graduate students, but also marine ecosystem health scientists and engineers who collectively encompass the breadth of knowledge and expertise needed for a project of this scope.

The first year of the project, which began last summer, has been dedicated to designing and building a prototype IMTA system to characterize the waste streams produced by each of the components. Next, the team will use the prototype to conduct long-term studies that integrate the component trophic modules. Data gathered during these studies will allow development of predictive models for the flow of nutrients within the prototype system that will assist in the design of refined research systems and commercial scale IMTA systems. Initial project funding has come from revenues provided through the sale of Florida's Aquaculture specialty license plates, and the team is pursuing additional funding through NOAA, USDA and other sources to expand the project objectives.



Schematic representation of the various modular components of Harbor Branch's experimental IMTA system

Dr. Paul Wills, IMTA Project Manager, inspects a crop of sea lettuce grown in the prototype IMTA system's macroalgal culture module

Commercially important marine macroalgae, such as sea lettuce shown here, can uptake waste generated by other aquacultured crops and use it as a nutrient

Foundation News

DONATIONS IMMERSE STUDENTS IN OCEAN SCIENCE

FAU has offered the *Immersion in Ocean Science* and *Oceanographic Experience for Undergraduates* courses for the past three years through the Harbor Branch Semester by the Sea program. Although expensive, this high-quality programming – an at-sea experience accompanied by rigorous laboratory work – is critical, because it engages students by delivering the excitement of research and discovery at a critical decision-making stage of their careers.

We are grateful for a strong response to the *Immersion in Ocean Science* appeal of nearly $10,000, which will open these opportunities to an even wider range of students. We particularly wish to acknowledge the generous support from Mr. and Mrs. Carl Ruppert, Mr. and Mrs. Carl R. Belknap, Mr. John V. Gibson, Mr. and Mrs. Scott H. Buzby, Ms. Doris Saliwanchik, Dr. and Mrs. Robert P. Christopher, Mr. and Mrs. Frederick W. Bowers and so many others who made gifts to provide students with experiences that can truly be life-changing.

Your continued support is critical to enabling these educational experiences for the next generation of ocean scientists. Please make your gift online at http://fauf.fau.edu/GiveToHBOI or by contacting HBOI Foundation Executive Director Janet Alford at 772-466-9876 or jmalford@hboifoundation.org.

NEW MEMBERS ELECTED TO THE FOUNDATION BOARD

At the April 2012 board meeting, two new members were elected to the HBOI Foundation Board of Directors.

Michael O'Reilly of Vero Beach recently retired as Vice Chairman and Chief Financial Officer of The Chubb Corporation. He remains actively involved in the financial and insurance business as a Director and Deputy Chairman of Harbor Point, Ltd., and Chairman of the Board of Alterra Capital Holdings, Ltd. O'Reilly also serves as Vice Chairman of the Board of Trustees at Pace University and is a member of the Lake George Land Conservancy. He earned his B.S. and MBA degrees from New York University and Pace, respectively, and is a Financial Analyst Fellow.

Dr. Jerry R. Schubel (left) is President and CEO of the Aquarium of the Pacific and formerly held the same position at the New England Aquarium. He has an extensive background in

research and environmental affairs, having served as Dean and Director of the State University of New York at Stony Brook's Marine Sciences Center, and as a Research Scientist and Associate Director of the Johns Hopkins University's Chesapeake Bay Institute. Dr. Schubel earned his B.S. degree from Alma College, his master's degree from Harvard University and a Ph.D. in oceanography from the Johns Hopkins University. He received an honorary doctorate from the Massachusetts Maritime Academy in 1998. He is a member of the NOAA Science Advisory Board and has chaired the National Sea Grant Review Panel, the National Research Council's Marine Board and the Ocean Research and Resources Advisory Panel.

Dr. Charles W. Finkl Jr. was appointed to fill the vacancy created by the completion of Florida Atlantic University President Dr. Mary Jane Saunders' term. He is Professor Emeritus in the Department of Geosciences at FAU, President and Executive Director of Coastal Education and Research Foundation, Inc., and creator and Editor in Chief of the *Journal of Coastal Research*, which is the leading multidisciplinary journal linking coastal science, engineering and management. His expertise is in coastal research, beach preservation and dissemination of coastal information. He has published numerous articles focusing on a variety of subjects important to the preservation and protection of coastal areas.

THE POWER OF PLANNING

We are pleased to announce a very generous bequest of nearly $100,000 from the late Lillian Becky Brockmann of Hutchinson Island to the Harbor Branch dolphin research program. This thoughtful gift, a lasting legacy to Miss Brockmann's life, will support Indian River Lagoon dolphin care and research.

Bequests enable you to specify an organization or individual(s) to be among the beneficiaries of your estate after you die. Although most bequests can be accomplished through a simple addition to your will, it is best to discuss your intentions with your lawyer.

Generally, a bequest:

- costs nothing today,
- allows you to perpetuate your annual gift to Harbor Branch, while demonstrating to your loved ones what was important to you during your lifetime and
- if made charitably, may reduce your taxable estate.

Harbor Branch is working to extend the benefits of ocean science research on the Treasure Coast for generations to come. If you share the spirit of this goal, please consider Harbor Branch as you plan your estate.

Dr. Jim Masterson, Ocean Discovery Center Director, addresses Friends of Harbor Branch members during an orientation to Indian River Lagoon ecology

OTHER WAYS TO HELP

MAKE A RESTRICTED GIFT FOR RESEARCH: Restricted gifts to FAU-Harbor Branch have made it possible for scientists, engineers and students to:

- develop baselines used to monitor the health of the Indian River Lagoon,
- carry out the most comprehensive study of Indian River Lagoon dolphin health and population dynamics,
- discover, explore and preserve the unique deep coral reefs off Florida's coast,
- discover compounds from marine organisms that have the potential to fight human diseases and
- design, develop, build and test new technologies to facilitate ocean exploration.

HELP MAINTAIN THE CUTTING EDGE: Unrestricted gifts provide funds for priority projects and emerging opportunities. New technologies and scientific breakthroughs are enabled by the support of individuals who understand the value of investing in new ideas.

TRAIN THE NEXT GENERATION: Private support is essential to the development of graduate students and postdoctoral investigators who will help to unravel ocean science mysteries, restore damaged ecosystems and connect humans to medical treatments and other vital resources from the seas. Fruits of this investment include summer at-sea experiences that introduce students to a variety of marine science research techniques.

ENHANCE HARBOR BRANCH RESEARCH: The HBOI Foundation recently provided funding to broaden the Harbor Branch research portfolio through the recruitment of three senior researchers who are leaders in oceanography, biogeochemistry and ocean sensory engineering. Newly completed, state-of-the-art facilities stand ready to accommodate this expansion. Strategic charitable investments play a lead role in attracting outstanding scientists and engineers.

(story continues on next page)

Sunny Gardner interprets touch-tank residents for Ocean Discovery Center visitors

JOIN THE FRIENDS OF HARBOR BRANCH: Our annual donors make a difference to the global research conducted by Harbor Branch. Members learn about ocean science and technology first hand through events and behind-the-scenes tours that provide special access to Harbor Branch and its research faculty. Friends of Harbor Branch receive priority invitations to presentations such as the Ocean Science Lecture Series, as well as to trips, tours and other lectures.

PURCHASE A SPECIALTY LICENSE PLATE: Proudly display your support and feel good about the difference you're making in the health of our environment by purchasing one of the four Florida specialty license plates that benefit ocean exploration, research, conservation and education at Harbor Branch in the fields of marine ecosystem health, aquaculture and dolphin and whale research.

Dr. Amy Wright shows her Marine Biomedical and Biotechnology Research lab to tour participants

Guests of the Harbor Branch Foundation take a VIP tour around the campus

Volunteer Jeff Kirr pitches in on a clean-up of an Indian River Lagoon spoil island that's been adopted by the Friends of Harbor Branch (photo by Claudette Delanoeye)

SUMMER INTERNSHIPS

Intern: Wendy Arias
Mentor: Geoff Beiser
Project Summary: Ocean technology, with special emphasis on launch and recovery of a large-towed vehicle from a surface ship and analysis of research buoy design

Intern: Joseph Brooker
Mentors: Anni Dalgleish and Paul Wills
Project Summary: Comparison of three methods to characterize and quantify the waste solids generated in a recirculating aquaculture research system

Intern: Detelina Doncheva
Mentor: Esther Guzmán
Project Summary: Screening a library of compounds to evaluate their potential as inhibitors of CCL2 protein production.

Intern: Alexia Downs
Mentor: Peter McCarthy
Project Summary: Examination of the potential relationship between overuse of antibiotics and the prevalence of antibiotic resistance in Indian River Lagoon sediment bacteria

Intern: Hollianne Eckerd
Mentor: Shirley Pomponi
Project Summary: Development of sponge cell lines by immobilization in three-dimensional matrices

Intern: Erica Engelschall
Mentors: Floyd Russell and Amy Wright
Project Summary: Extraction, isolation, assay and characterization of sponge-derived natural products demonstrating activity against pancreatic cancer and tuberculosis cell lines

Intern: Kaitlin Gallagher
Mentor: Susan Laramore
Project Summary: Use of routine histological and *in situ* fluorescence techniques to study infection of Indian River Lagoon oysters by the protistan parasite *Bonamia*

Intern: Stacey Goldberg
Mentor: Esther Guzmán
Project Summary: Elucidation of the mode of action of the anti-cancer sponge natural product Iasonolide A: Is Interleukin-6 the link?

Intern: Ana Gonzalez-Angel
Mentor: Sara Edge
Project Summary: Effects of acute salinity stress on gene expression in larval *Porites* corals

Intern: Adam Greeley
Mentors: Jill Roberts and Amy Wright
Project Summary: Extraction, isolation and characterization of *Eudistoma olivaceum* (Ascidiacea) natural products capable of inhibiting synthesis of CCL2, a protein associated with increased incidence of some cancers

AT HARBOR BRANCH

Intern: Allison Jevitt
Mentor: Shirley Pomponi
Project Summary: Development of sponge hybridomas for optimization of sponge cells in culture

Intern: Krzysztof Latomski
Mentors: Fraser Dalgleish, Bing Ouyang and Anni Dalgleish
Project Summary: Artifact reduction in underwater imaging from mobile platforms

Intern: Stephanie Lear
Mentors: Nikki Dix and Dennis Hanisak
Project Summary: Laboratory examination of selective phytoplankton grazing by Indian River Lagoon zooplankton

Intern: Serena Parton
Mentor: Fraser Dalgleish
Project Summary: Optimizing the integration of optical and acoustic seabed mapping techniques

Intern: Matthew Russell
Mentor: John Scarpa
Project Summary: Evaluation of the particle-removing efficiency of oysters in an integrated multi-trophic aquaculture system

Intern: Christel Seegers
Mentor: Peter McCarthy
Project Summary: Determine the taxonomy of actinomycete strains in the Harbor Branch Marine Microbial Culture Collection and investigate the relationship between the diversity of sponge-associated actinomycetes and their source

Intern: Agnieszka Sobieraj
Mentors: Fraser Dalgleish, Bing Ouyang and Anni Dalgleish
Project Summary: Calibration of underwater serial imaging systems to improve seafloor visualization

Intern: Ashley Sproles
Mentor: Joshua Voss
Project Summary: Zooxanthellae and chlorophyll variation in the star coral *Montastrea cavernosa* as coral health indicators on St. Lucie Reef

Intern: Sarah Van Ostrand
Mentor: Adam Schaefer
Project Summary: Toxoplasmosis in Indian River Lagoon bottlenose dolphins and the possible role domestic cats play in transmission of the protistan parasite *Toxoplasma*

Intern: Yichao Yu
Mentors: Priscilla Winder and Amy Wright
Project Summary: Extraction, isolation and characterization of natural products from the ascidian *Tridedemnum* sp. showing inhibition activity against Interleukin-8 protein synthesis

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Florida Atlantic University, a member of Florida's State University System, was established by legislative act in 1961. in addition to its original 850-acre campus in Boca Raton, FAU has campuses in Fort Lauderdale, Davie, Dania Beach, Jupiter, Port St. Lucie and Fort Pierce. Fully accredited by the Southern Association of Colleges and Schools, FAU is currently servicing 28,000 regularly enrolled, degree-seeking students through its 10 colleges. FAU's Harbor Branch Oceanographic Institute is dedicated to exploring the world's oceans--integrating the science and technology of the sea with the needs of humankind. Harbor Branch is involved in research and education in the marine sciences; biological, chemical, and environmental sciences; marine biomedical sciences; marine mammal conservation; aquaculture; and ocean engineering.

FAU

Wild Dolphins APP for iPad

Visit the Harbor Branch Ocean Discovery Center!

Gift Shop and Friends of Harbor Branch program office located on site.
Hours: Monday-Friday, 10 a.m. to 5 p.m.; Saturday 10 a.m. to 2 p.m.
Phone: 772-242-2293 • For group tours, please call 772-242-2417 for scheduling.

Harbor Branch Florida specialty license plates support research, conservation, and education. Visit hboi.fau.edu for details.

SAVE THE DATE

September 29th is National Estuaries Day 2012

Explore ~ Learn ~ Enjoy!

Bring family and friends, spend the day with us and celebrate the natural treasure in our own backyard. . . the Indian River Lagoon!