

**HARBOR BRANCH**

FLORIDA ATLANTIC UNIVERSITY

2015

ANNUAL IMPACT REPORT

*Dive* into...

Ocean Science for a Better World®



## President's Message



The research and educational outreach taking place at Harbor Branch have never been more important than they are right now, as pollution endangers the Indian River Lagoon and sea-level rise threatens South Florida. Now more than ever, it is critically important that scientists understand the changes taking place, develop ways to cope with

them and transmit their knowledge to the public. Florida Atlantic University is committed to being part of the solution, with Harbor Branch playing a key role in the fulfillment of that mission.

The University's new 10-year strategic plan recently went into effect. Titled "The Race to Excellence," it is based upon four Pillars: healthy aging, neuroscience, ocean science and engineering/environmental sciences, and sensing and smart systems. As one of the world's most distinguished centers of marine-related research, Harbor Branch is leading the way in ocean science. Further development of its full range of activities is essential and will require both public and private support. We will continue to seek federal, state and private funding to advance the work of Harbor Branch's innovative researchers and maintain its long tradition as a center of community education. If you have not yet done so, I invite you to visit the family friendly Ocean Discovery Visitor's Center at Harbor Branch and the new Mission Ocean Discovery program, which offers tours, lectures and other public events.

Thank you for supporting Harbor Branch's efforts to increase knowledge of our oceans and find ways to protect and preserve them.

John Kelly  
President  
Florida Atlantic University

## Director's Message



*Ocean Science for a Better World*<sup>®</sup> - the mission driving FAU Harbor Branch faculty, staff, students and our supporters - is critical as clean water, healthy marine environments, food security and the need to understand the depths of our oceans remain among top global priorities. The 2015 Annual Impact Report provides the latest on our research

and discoveries, external funding, education and outreach efforts, and most importantly, stories of progress!

We are excited to share our financial snapshot, which shows a 20 percent increase in external research funding that gave our programs a great deal of momentum this year. The federal, state and private sources of funding make up more than half of our budget and are critical to the enterprise. Special thanks to the Harbor Branch Oceanographic Institute Foundation board of directors for their ongoing commitment to the Institute's goals.

Of equal importance to research is the need to share our knowledge and findings with the community. This year, we launched Mission: Ocean Discovery, an initiative that provides expanded programming about the oceans and important topics like global change, health of the Indian River Lagoon, coral reefs, drug discovery from the sea, growing seafood and more. Everyone should have an understanding of the ocean and how our marine environment is connected to our everyday lives.

I invite you to read about the work that makes FAU Harbor Branch a leader among the global marine science research community, and I encourage you to get involved! Together, we will make a positive impact on *Ocean Science for a Better World*<sup>®</sup>.

Megan Davis, PhD  
Interim Executive Director  
FAU Harbor Branch



# Harbor Branch... Did You Know?

**45**  
years of research

**24/7**  
rescue efforts for  
marine mammals

**19,000**  
microbes collected  
for drug  
discovery



Marine specimens collected  
for drug discovery:  
**30,000**



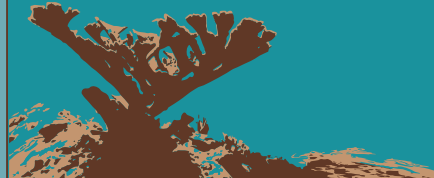
Interns since 1974:  
**500+**



Dolphin and  
whale stranding  
and responses in  
2015:  
**19**



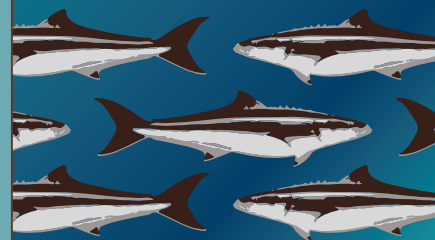
**632**  
sq. miles of deep  
water coral protected



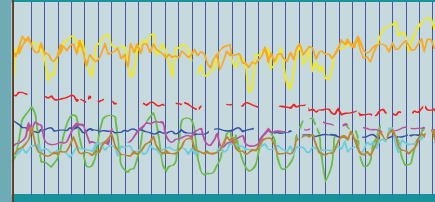
**1,700**  
Indian River Lagoon  
dolphins photo-identified



Number of eggs  
spawned by farm-raised  
cobia: **5 million**



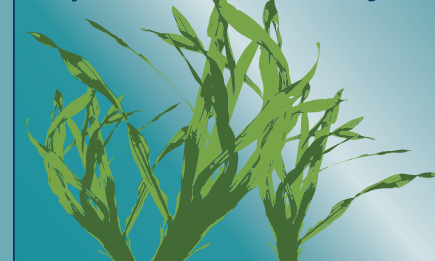
**90**  
miles of Indian River  
Lagoon monitoring



Volunteer hours:  
**3,571**



**10,400** lbs of  
seaweed grown by HBOI  
aquaculture annually



# Finding Solutions

## for the Indian River Lagoon

### The Indian River Lagoon at Your Fingertips – Harbor Branch’s LOBO Network

Gaining real-time information from the Indian River Lagoon has never been so easy. FAU Harbor Branch’s Indian River Lagoon Observatory Network of Environmental Sensors expanded over the past year. Harbor Branch scientists and engineers, led by Dennis Hanisak, Ph.D., installed five new Land Ocean Biogeochemical Observatory (LOBO) units in the St. Lucie Estuary, adding to the existing four LOBO units in the south and central IRL. The project in the St. Lucie Estuary was funded by \$2 million from the state legislature via Florida’s Department of Environmental Protection and the other LOBO units were funded by Harbor Branch Oceanographic Institute Foundation and FAU Harbor Branch.

The network sensors offer real-time data that is accessible online to anyone, anytime at [fau.loboviz.com](http://fau.loboviz.com). On an hourly basis, these sensors measure temperature, salinity, depth (for tidal fluctuations), turbidity (particles in the water), water color, dissolved oxygen, pH (to track ocean acidification), nitrate and phosphate (nutrients), and chlorophyll fluorescence (algal abundance).

### Harbor Branch Research Points to Sewage as Cause for Harmful Algal Blooms in IRL

In estuaries like the Indian River Lagoon, it is not uncommon for nutrient pollution to cause microscopic algae and seaweed blooms, creating major problems for the organisms in this fragile ecosystem. Harbor Branch research professor, Brian Lapointe, Ph.D., uses nitrogen isotopes in the algae to identify sewage nitrogen – most commonly caused by septic tanks – as the primary driver of algal blooms in the IRL. In a 2015 peer-reviewed paper, Lapointe’s work went against previous theories that fertilizers were the culprit behind the blooms. Policymakers along the lagoon can now use this science to make decisions on improving the health of the IRL. This project was funded by proceeds from Florida’s Save Our Seas specialty license plate, granted through HBOIF.

### Harbor Branch Conducts First-Ever Study of *Vibrio* Bacteria in the Indian River Lagoon

*Vibrio* bacteria causes an estimated 80,000 illnesses and 100 deaths in the US each year. Infections can be acquired by eating contaminated seafood or from aquatic injuries. *Vibrio* are naturally found in coastal waters; however, little is known about their distribution along the east coast of Florida.

Researchers at Harbor Branch conducted the first-ever study of *Vibrio vulnificus*, *V. parahaemolyticus* and *V. cholerae* in the Indian River Lagoon. They tested samples from recreational areas throughout the lagoon and found that these bacteria were most abundant during summer months, especially in low salinity areas. *Vibrio* were also found on the bodies of fish and bait species, posing a potential threat to local anglers.

The study is the subject of FAU graduate student Gabby Barbarite’s Ph.D. degree under the mentorship of research professor, Peter McCarthy, Ph.D. They share these results with health care professionals and lagoon users to promote awareness and improve recreational safety. Risk of infection can be reduced by properly disinfecting and avoiding exposure of wounds and using caution when handling and consuming seafood. To find out more about *Vibrio* visit: [www.fau.edu/hboi/mbbr/vibrio.php](http://www.fau.edu/hboi/mbbr/vibrio.php). This project was funded by proceeds from Florida’s Save Our Seas specialty license plate, granted through HBOIF, as well as the Harbor Branch Oceanographic Institute Foundation’s Indian River Lagoon Graduate Research Fellowship program.



FAU graduate student Gabby Barbarite and FAU undergraduate student Zack Nilles take samples from an IRL mangrove snapper for her *Vibrio* research project.

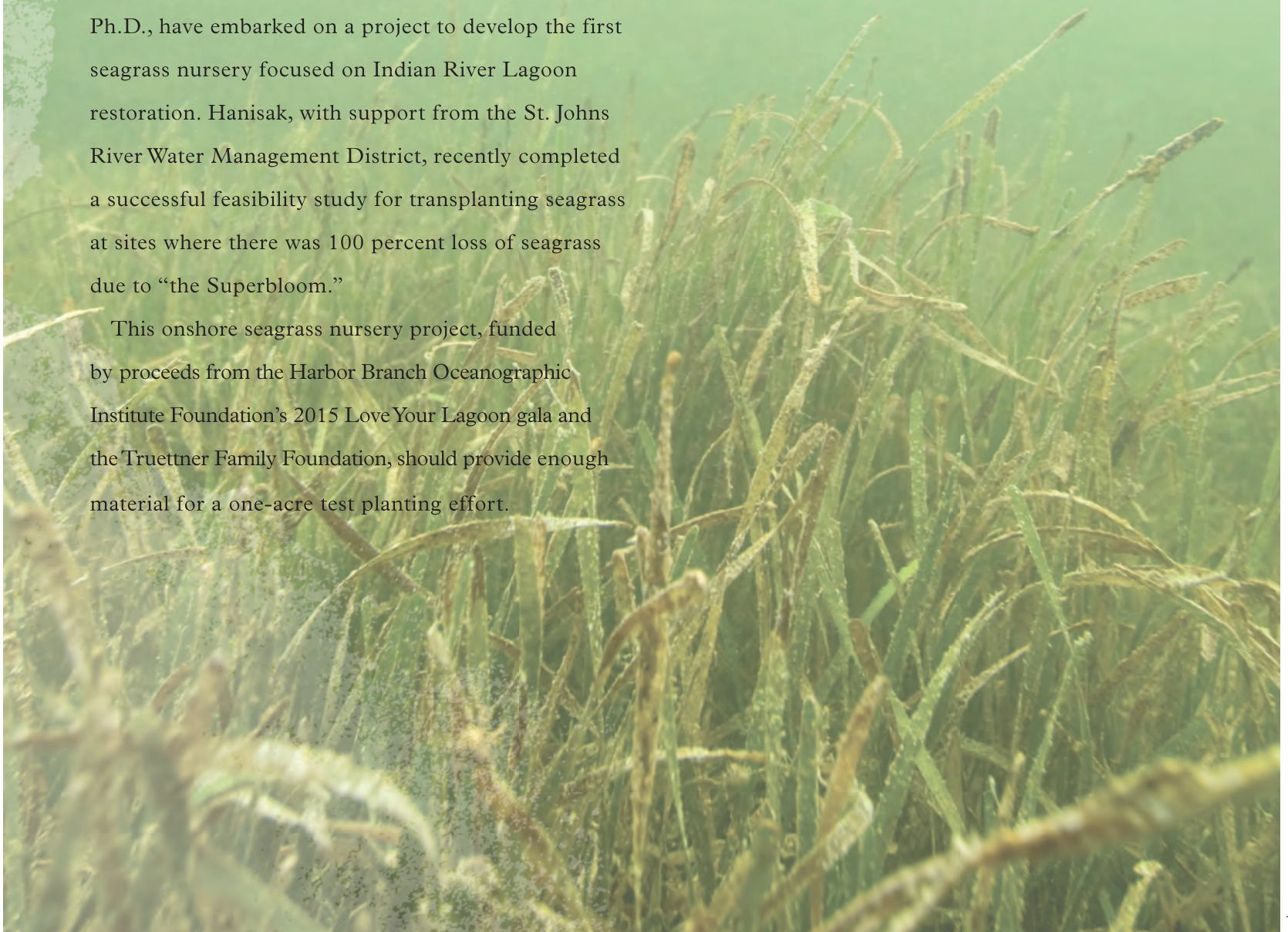


# Restoring Seagrass in the Indian River Lagoon

In 2011, the Indian River Lagoon suffered tremendous loss of seagrass, 60 percent lagoon-wide, due to light reduction from an unprecedented phytoplankton bloom – also known as “the Superbloom.” The loss of seagrass habitat has major biological and economic impacts, including a decline in fisheries. To date, recovery has been slow...only 10 percent of the lost seagrass has come back.

Scientists at FAU Harbor Branch, led by research professors Dennis Hanisak, Ph.D. and Paul Wills, Ph.D., have embarked on a project to develop the first seagrass nursery focused on Indian River Lagoon restoration. Hanisak, with support from the St. Johns River Water Management District, recently completed a successful feasibility study for transplanting seagrass at sites where there was 100 percent loss of seagrass due to “the Superbloom.”

This onshore seagrass nursery project, funded by proceeds from the Harbor Branch Oceanographic Institute Foundation’s 2015 Love Your Lagoon gala and the Truettner Family Foundation, should provide enough material for a one-acre test planting effort.





# Measuring the Lagoon's Breath

The Indian River Lagoon is a living, breathing ecosystem, with its health depending in part on the exchange of water through its inlets. High tides push in salty ocean water, and low tides draw out brackish estuarine water. Led by FAU Harbor Branch associate research professor Laurent Chérubin, Ph.D., the team is finding out how this process varies, both naturally and as a result of land-based water management decisions.

The initial focus of the study on IRL inlet ventilation rates, supported by the sales of the Save Our Seas specialty license plate, granted through HBOIF, is to analyze water exchange through the Fort Pierce Inlet. Over the course of a year, exchange rates are measured using a system of smart drifters equipped with sensor units, an acoustic Doppler current profiler moored at the bottom of the Inlet, an UAV equipped with a multi-spectral camera for aerial surveys and information from Harbor Branch's LOBO network. Once the methodology is proven, the plan is to begin characterizing tidal exchange at the other IRL inlets.





# Finding Solutions

## for the Indian River Lagoon

### Finding Freshwater Ciliates in Florida

Ciliates are a group of unicellular eukaryotic organisms that thrive in habitats ranging from freshwater to hyper saline. Consuming prey items from bacteria to large algae and other protists, these organisms are an essential part of the microbial loop and form the foundation to food webs. Some species are very large, even visible with the naked eye, and have traditionally been used as a proof of microbial endemism: the restriction of some species to a single geographic region. Hunter Hines, a Ph.D. candidate at Bournemouth University in the United Kingdom, is a visiting student working with research professor, Peter McCarthy, Ph.D., studying ciliate biodiversity and biogeography in subtropical Florida.

In the first weeks of his study, he found *Loxodes rex* - a giant flagship ciliate that had been originally described as endemic to tropical African countries- thriving in freshwater ponds in Fort Pierce, Florida. His studies, funded by the John Warner Memorial fund, expand the range of this organism into the Americas. Their published study includes the first description of the ecology of this organism and the first detailed images of the species.

### Studying Estuarine Impacts on Florida's Northernmost Coastal Coral Reef

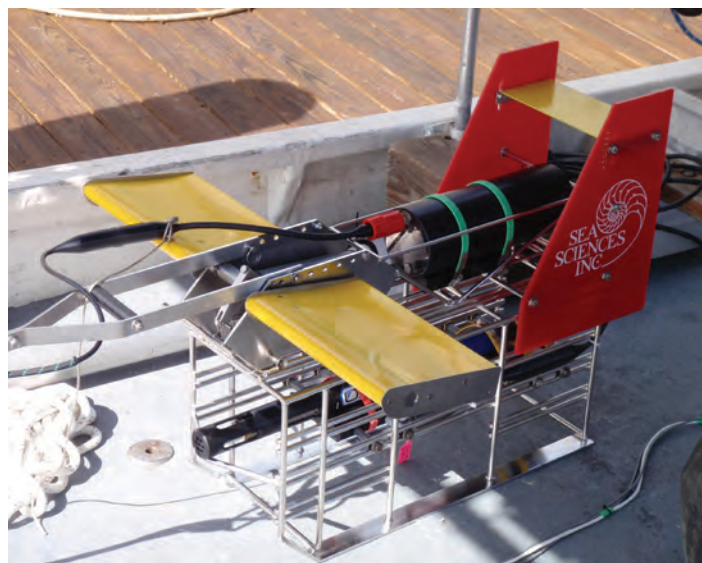
The St. Lucie Reef, located in Stuart, Florida, is the known northern limit of many tropical coral reef species. This fragile reef lies just beyond the St. Lucie Inlet, which is where freshwater discharges from Lake Okeechobee and the regional watershed pass through the St. Lucie Estuary and ultimately meet the ocean. Scientists and students at FAU Harbor Branch, led by assistant research professor Joshua Voss, Ph.D. and Jeff Beal from Florida Fish and Wildlife Conservation Commission, are working to determine how a reef can survive where salinity drastically varies depending on water management decisions.

The team's 2015 publication provides the first-ever molecular characterization of symbiotic algae in St. Lucie corals and indicated that the symbioses remain stable despite seasonal changes in estuarine discharges. Continuous temperature and salinity measurements in the St. Lucie Inlet and across the St. Lucie Reef characterized the timing and extent of freshwater discharge. Additionally, scientists constructed an ex situ mesocosm system at FAU Harbor Branch and completed experiments to assess the independent and combined impacts of thermal stress and estuarine discharge on South Florida corals.

The overarching goal of this work is to provide information to decision-makers for improved management in regional restoration and conservation efforts. This research is funded by Florida Sea Grant, match support from the River Branch Foundation and Robertson Coral Reef Program, and proceeds from sales of Florida's Save Our Seas specialty license plate, granted through HBOIF.

### Using Modeling to Understand the Indian River Lagoon

FAU Harbor Branch associate research professor Mingshun Jiang, Ph.D., is developing a water quality and carbon cycle model for the Indian River Lagoon and St. Lucie Estuary. The goals are to understand the mechanisms driving algal blooms and the impacts of nutrients and carbon inputs from the atmosphere and freshwater discharges on ecosystems like oysters and coral reefs. The prediction model includes: water movement, water quality, and carbon cycle. Collaborating with research professor Brian Lapointe, Ph.D., the team will measure key water quality and carbonate chemistry parameters in the St. Lucie Estuary and the reef area using state of the art instruments, including a light-weight tow vehicle, high resolution sensors, and traditional water sampling techniques. This project is funded by the Harbor Branch Oceanographic Institute Foundation, the NOAA Coral Reef Conservation Program and proceeds from sales of Florida's *Save Our Seas* specialty license plate, granted through HBOIF.



Acrobot LTV-50X for shallow water sampling.



# Finding Solutions

## for the Indian River Lagoon

### Harbor Branch Marine Mammal Team to the Rescue

The FAU Harbor Branch Marine Mammal Research and Conservation stranding and volunteer program, led by manager Steve Burton, plays a major role in rescue efforts for dolphins and whales that are in danger on the Treasure Coast. As a member of the Southeast National Marine Mammal Stranding Network, authorized by NOAA's National Marine Fisheries Service, team members are on call 24-hours-a-day, 7-days-a-week – ready to help when needed. From July 2014 – June 2015, Harbor Branch's marine mammal rescue team responded to 19 strandings – 6 dolphins and 13 whales – and participated in three multi-agency dolphin disentanglements. The program is funded by proceeds from Florida's Protect Wild Dolphins and Protect Florida Whales specialty license plates, granted through HBOIF.



Members of Harbor Branch's Marine Mammal Rescue team assist with a multi-agency dolphin intervention.

### What Dolphins are Telling us About Lagoon Health

Dolphins in the Indian River Lagoon swim in the same waters and eat some of the same fish as humans do, which makes them a sentinel species. For well over a decade, scientists have studied the health of IRL dolphins and use the findings as a barometer on the overall health of the lagoon. FAU Harbor Branch epidemiologist, Adam Schaefer, found high levels of mercury concentrations in dolphins that live in the northern region of the lagoon. The published study, funded by proceeds from the sales of Florida's Protect Wild Dolphins specialty

license, granted through HBOIF, was supported by other published research on fish species in the same area that also showed higher levels of mercury. Partners in the project included the Florida Fish and Wildlife Conservation Commission.

### Dolphins Have Social Networks, Just Like Humans

They may not be on Facebook or Twitter, but dolphins do, in fact, form highly complex and dynamic networks of friends, according to a recent study published by scientists at FAU Harbor Branch. Dolphins are known for being highly social animals, and a team of researchers, led by Harbor Branch research biologist, Elizabeth Murdoch Titcomb, took a closer look at the interactions between bottlenose dolphins in the Indian River Lagoon and discovered how they mingle and with whom they spend their time.

Using over six years of data from extensive photo-ID surveys conducted in the IRL, the researchers were able to learn about the association patterns as well as movement behavior and habitat preferences of some 200 individual dolphins. The work is funded by proceeds from Florida's Protect Wild Dolphins specialty license plate, granted through HBOIF.

The team found that individual dolphins exhibited both preference and avoidance behavior - so just like humans - they have dolphins they like and associate with and ones they avoid. The study also found that IRL dolphins clustered into groups of associated animals, or "communities," that tended to occupy discrete core areas along the north-south axis of the lagoon system.



Two of the dolphins that inhabit the Indian River Lagoon.





# Exploring Reefs and Testing New Technology Through NOAA-Funded Cruises

The Cooperative Institute for Ocean Exploration, Research and Technology (CIOERT), headquartered at FAU Harbor Branch, remained a leader in ocean exploration this year by participating in several National Oceanic and Atmospheric Administration (NOAA) funded projects. In May 2015, scientists and students, led by CIOERT executive director Shirley Pomponi, Ph.D., and chief scientist John Reed, explored and mapped uncharted deepwater coral reefs on the southwest Florida shelf. A new “tool sled,” designed and built by FAU’s Harbor Branch and College of Engineering and Computer Science and University of North Carolina Wilmington, was attached to a remotely operated vehicle (ROV) to collect sponges, coral and algae from the sea floor.

For the fourth and final year, the CIOERT team, led by chief scientist Dennis Hanisak, Ph.D., and research professor John Reed, conducted a cruise on the R/V Walton Smith to investigate the role that the mesophotic coral ecosystems of Pulley Ridge (off the southwest coast of Florida) may play in replenishing key fish species, such as grouper and snapper, and other organisms in the downstream reefs of the Florida Keys and Dry Tortugas. This project is a collaboration of over 35 scientists at 11 different universities pooling their expertise with state and federal agency scientists through NOAA’s Cooperative Institute for Marine and Atmospheric Studies at the University of Miami. The results will be provided to resource managers to enable development of more effective strategies to protect mesophotic reefs.



# Harbor Branch

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## at sea

### Protecting *Oculina* Reefs Based on Decades of Work by Harbor Branch Scientist

In summer 2015, NOAA announced the passage and publication of Amendment 8 of the Magnuson-Stevens Fishery Conservation and Management Act, based in part to the work of FAU Harbor Branch research professor John Reed and biological scientist Stephanie Farrington. This amendment protects the newly discovered *Oculina* coral reefs north of Cape Canaveral from bottom trawling and longlines, which damage this fragile coral habitat.

In 2011 during a NOAA-funded research expedition, Reed and Farrington discovered that these deepwater (250-300 ft) coral reefs extended nearly up to St. Augustine, Florida. Prior to that it was thought that they ended at Cape Canaveral. In 1984, 90 sq. miles of the *Oculina* reefs were made into a marine protected area, *Oculina* Habitat Area of Particular Concern- OHAPC, based on the research of Harbor Branch scientists John Reed and Grant Gilmore. This was the first marine protected area in the world to protect deepwater coral. The OHAPC was expanded to nearly 300 sq. miles up to Canaveral in 2000, and now this new discovery nearly doubles the size. The *Oculina* coral banks are essential habitat for coral and to various grouper and snapper species, which use the reefs as spawning grounds.

### Using Technology to Track Fish Spawning Aggregations

FAU Harbor Branch research faculty Fraser Dalglish, Ph.D., Laurent Chérubin, Ph.D., Bing Ouyang, Ph.D. and Anni Vuorenkoski Dalglish, Ph.D. are working on a project that utilizes the passive and active acoustic data collected from an autonomous vehicle, known as the Waveglider. This project, funded by Harbor Branch Oceanographic Institute Foundation, will estimate how many groupers are in spawning aggregations in certain areas of the Caribbean, Gulf of Mexico and the Florida Keys. The team began the first testing of the Waveglider with collaborators from Florida International University off the coast of Jupiter, Florida. In collaboration with the University of the Virgin Islands and the Caribbean Coral Reef Institute, the team was also awarded additional funding from NOAA to apply the new technology to study red hind spawning aggregations. These studies will assist agencies with protection of these important fisheries spawning grounds.

### Studying Record Amounts of Seaweed in the Caribbean and Atlantic

In 2015, mounds of seaweed that blanketed beaches from Florida to Texas and Barbados to Cancun wreaked havoc on tourism and ocean life. Looking for answers as to why there was so much of it, news agencies from across the globe including National Public Radio, the London Times, BBC and Travel Weekly reached out to Harbor Branch research professor Brian Lapointe, Ph.D. He has spent decades studying the ecology of *Sargassum*, the seaweed that accumulates in the Sargasso Sea in the middle of the North Atlantic. In a peer-reviewed paper published in 2014, Lapointe explained his theory of how the nitrogen content and growth rate of *Sargassum* increase as it circulates through relatively nutrient-rich coastal waters, like the Gulf of Mexico. This published research was very timely, as the Caribbean *Sargassum* problems occurred following the April 2010 Deep Water Horizon explosion in the Gulf of Mexico. His studies, which were funded by NASA and the National Science Foundation, showed that *Sargassum* offshore of the Florida Keys now has higher levels of nitrogen than in the past, making it grow at a more rapid pace. Currents carry the increasing amounts of *Sargassum* from the Keys to the Sargasso Sea and Caribbean region, where it washes ashore.



*Sargassum* seaweed overtakes the beaches of Martinique, Caribbean.



# Partnership Provides Access to Manned Submersibles

Scientists and students at FAU Harbor Branch had the unique opportunity to explore coral reefs in a manned submersible, thanks to a partnership with Global Underwater Explorers (GUE) and Brownies Global Logistics (BGL). With shared interests in ocean exploration and conservation, the partnership led to two collaborative expeditions aboard BGL's 146 foot Baseline Explorer. Harbor Branch scientists Joshua Voss, Ph.D. and Brian Lapointe, Ph.D. were able to utilize BGL's manned submersibles and GUE's advanced technical dive teams to investigate the status and health of coral reef ecosystems in the Florida Keys and Florida's Treasure Coast.





# Harbor Branch

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## at sea

### Ocean Exploration in the Caribbean and Hawaii via Telepresence

From the Exploration Command Center (ECC), scientists, students and the public experienced ocean exploration without ever leaving Harbor Branch. Funded by NOAA's Office of Ocean Exploration and Research through the Cooperative Institute for Ocean Exploration, Research and Technology (CIOERT), located at Harbor Branch, the ECC provides a means of viewing and participating in ocean exploration in real time. High-definition video is transmitted via satellite from NOAA's exploration flagship, the *Okeanos Explorer*, to the ECC, enabling scientists to view underwater habitats at depths as great as 6,000m and to communicate with the ship via chatrooms and satellite phone during the dives.

In April 2015, the CIOERT team, led by HBOI faculty Shirley Pomponi, Ph.D., Dennis Hanisak, Ph.D., Joshua Voss, Ph.D. and John Reed, along with William Clancey, Ph.D. from the Florida Institute for Human and Machine Cognition, participated via telepresence in an expedition by the *Okeanos Explorer*, using the Deep Discoverer remotely operated vehicle (ROV) to explore trenches and seamounts off Puerto Rico. The ship continued to Hawaii to begin mapping and exploration of deepwater habitats in the Pacific Ocean, and in August, scientists began again to use the Harbor Branch-CIOERT ECC to participate via telepresence. In August, Florida State University professor, Amy Baco-Taylor, Ph.D., and her graduate students joined the expedition, and in September, FAU graduate students enrolled in a semester-long graduate course, Ocean Exploration, participated in the last leg of the cruise. During each cruise, a variety of outreach engagements were led by James Masterson, Ph.D. to introduce the ECC telepresence-enabled ocean exploration to the public.

### Understanding the Impacts of Climate Change Through Modeling

Modeling is a research discipline that can be applied to understand a wide range of issues facing marine ecosystems. FAU Harbor Branch associate research professor Mingshun Jiang, Ph.D. is utilizing modeling to study eutrophication and phytoplankton blooms in the shallow Indian River Lagoon, carbon cycle and ocean acidification in the Florida continental shelf/slope, and iron cycle and phytoplankton blooms in deep oceans like the Scotia Sea in the Southern Ocean. One of his recent projects aims to understand the potential

impact on corals from ocean acidification – or the ongoing decrease in the pH of the oceans caused by the increase in carbon dioxide from human activities such as burning fossil fuel and deforestation. Collaborating with Harbor Branch research faculty Fraser Dalgleish, Ph.D., John Reed and Woods Hole Oceanographic Institute's Aleck Wang, Ph.D., the team is developing a physical-carbon model to understand the circulation and carbon cycle in the south Florida continental shelf and Florida Straits.

The team is also measuring key carbonate chemistry parameters over critical reef areas such as Pulley Ridge and *Oculina* Reefs using various platforms such as autonomous underwater vehicles (AUV) and remotely operated vehicles (ROV) combined with state of the art sensors and traditional techniques.

### Harbor Branch Team Tests New Underwater Vehicle Technology

A team of CIOERT researchers at FAU Harbor Branch, with project leads Fraser Dalgleish, Anni Dalgleish, Bing Ouyang and Mingshun Jiang, are working to adapt a new technology for benthic mapping capability: the Bluefin U-4000. The innovative ROV/AUV hybrid, once fully developed, will be able to operate both in a conventional fully autonomous mode and in a supervised autonomy mode using a fiber optic tether. The team, along with Chief Scientist for the cruise, John Reed, conducted dives with the new technology off Florida's east coast from near-shore to *Oculina* reefs offshore. They outfitted the U-4000 with an HD camera, a wide-angle piloting camera, and a number of biological and chemical sensors including high-resolution pCO<sub>2</sub> and pH sensors, allowing them to collect fine-scale environmental data and habitat information to understand the conditions associated with these marine ecosystems.

The long-term goals are to establish a southeast US autonomous vehicle sensing and imaging test and evaluation site, to develop an underwater autonomous platform and a sensing package that can effectively survey and monitor critical deep coral habitats, and to understand the health and ecosystem dynamics of deep corals in a warming and more acidic ocean. The project is sponsored by the National Oceanic and Atmospheric Agency, Ocean Exploration and Research Program, and the Pacific Marine Environmental Laboratory.



An underwater photograph showing a vibrant coral reef system. The water is clear and blue, with numerous fish of various species swimming throughout the scene. The coral structures are diverse, including branching and table corals. The lighting is bright, creating a sense of depth and clarity.

# Gulf of Mexico Reef Research Helps Inform Resource Managers

Research that was completed in 2015 through the Cooperative Institute for Ocean Exploration, Research and Technology, located at Harbor Branch, could play a major role in helping to protect coral reefs in the Gulf of Mexico. Led by FAU Harbor Branch assistant research professor Joshua Voss, Ph.D., two expeditions investigated three areas near the Flower Garden Banks National Marine Sanctuary, one of 14 federally designated underwater areas protected by NOAA's Office of National Marine Sanctuaries. To date, the sanctuary encompasses three banks, and the Sanctuary Advisory Council has proposed adding nine more. Dr. Voss and his team of students and interns conducted two scientific expeditions in collaboration with the University of North Carolina Wilmington and the Flower Garden Banks National Marine Sanctuary. The surveys and sampling conducted with a remotely operated underwater vehicle provided critical information and imagery for the Sanctuary Advisory Council's expansion plan. This project is funded by NOAA through CIOERT.



A photograph of a person in a red jacket and grey beanie looking out from a boat at a glacier. The person is in the foreground, looking towards a large glacier in the distance. The water is blue and there are ice floes. Another boat is visible in the distance. The text "Life on the Edge – Studying Beluga Whales to Polar Bears in the Arctic" is overlaid on the top left of the image.

# Life on the Edge – Studying Beluga Whales to Polar Bears in the Arctic

FAU Harbor Branch's Population Biology and Behavioral Ecology (PBBE) program team initiated, for the first time, studies on polar bears in Alaska as part of a grant from the North Slope Borough-Shell Baseline Studies Program. PBBE researchers use SNP genotyping to genetically track polar bears. By extracting DNA from small tufts of hair left behind by bears they are investigating the impacts of climate change on these iconic predators. PBBE scientists' recent peer reviewed papers include a study on a small, resident reproductive group of beluga whales, which was conducted over several years in collaboration with the local community of Yakutat. The study included the genetic ecology, population origins and traditional knowledge of this unusual, isolated group of whales. The program also launched the CetOMICS Initiative, a multi-year multi-disciplinary OMICS study of marine mammal health, fitness and viability. Other highlights included publishing research on colonization and mating systems in Steller sea lions and a book chapter on beluga whales, and co-publishing a paper on dolphin social organization using network analysis.



# Harbor Branch

## at sea

### Imaging Research for the Navy Supports National Security and Defense

Possible threats to coastal, port and harbor infrastructure and vessels come in many forms that require targeted approaches for effective security and defense. A critical tool in this defense mission is imaging, and FAU Harbor Branch research professor Michael Twardowski, Ph.D., is carrying out research for the Navy that is improving the performance of underwater camera systems by taking into account water quality in the surrounding environment. Imaging systems can often be ineffective because of water column turbidity, which can be highly variable in many coastal regions. Turbidity blurs object contrast in images and different types of suspended particles in coastal waters, such as phytoplankton, suspended sediment, and detrital “marine snow” have different effects on image quality. The Navy is using a model and sensor system developed by Twardowski that uses water quality information from the subsea environment to predict image quality and range for objects of different size and contrast. Knowing this information, imaging systems can be operationally deployed to optimize their performance. For example, longer viewing ranges have the benefit of expanding areal coverage in video images, and Twardowski’s performance model informs the Navy how far they can view without degrading image quality. The sensor system and model are currently being transitioned into the operational Navy to help make naval assets and our coasts more secure.

### Studying How Tiny Plants Make Big Impacts in the Ocean

Microscopic plants in water, or photosynthetic phytoplankton, are the base of the food web in marine ecosystems, forming a critical component of earth’s biogeochemical cycles. All phytoplankton cells have complex and unique shapes and structures called morphologies. FAU Harbor Branch research professors James Sullivan, Ph.D. and Michael Twardowski, Ph.D. believe that these morphologies have evolved to allow some phytoplankton to preferentially orient in fluid flows, perhaps to enhance light capture and growth rates. These morphological adaptations could confer species-specific competitive advantages, directly impacting phytoplankton community composition and rates of photosynthesis in the ocean.

This research may explain why phytoplankton exhibit such elaborate variations in shape, a question that puzzles evolutionary biologists to this day. Orientation of

phytoplankton also creates another practical issue: current models for underwater imaging, laser communications, and water clarity used by the U.S. Navy, as well as models of satellite remote sensing of ocean color by NASA, assume all particles in the water column are randomly oriented. Through a project sponsored by the Office of Naval Research, a team of Harbor Branch researchers, including Sullivan, Twardowski and Fraser Dalglish, Ph.D., are using an in-water holographic microscope and a remote laser scattering device called LiDAR to document orientation of phytoplankton and the effects on the ambient light field. The results of this project could be critical to interpreting and understanding bias in light signals in water, which is expected to improve the performance of imaging and laser communication systems. Results could also improve estimates of global phytoplankton productivity from space. Most importantly, a better understanding of phytoplankton orientation in specific flow regimes could provide a long sought after clue into the evolutionary drivers that have produced such a remarkable diversity in phytoplankton shapes found in the ocean.

### Taking Marine Science to the Sky

In 2015, FAU Harbor Branch assistant research professor Joshua Voss, Ph.D. and his team expanded their ocean observation research capabilities. With support from the sales of Florida’s Save Our Seas specialty license plate, granted through HBOIF, Voss acquired a DJI Inspire 1 aerial quadcopter capable of capturing georeferenced high definition still images, as well as ultra-high definition video footage. The team has used the new platform for imaging marine and estuarine habitats, assessing freshwater discharge events, and documentation of ocean exploration activities. The images taken by the drone can be combined into a mosaic to allow for broad scale, repeatable mapping that is particularly effective for assessing habitat restoration like the FWC salt marsh restoration project.



An aerial photo of the Indian River Lagoon taken from the Voss Lab’s quadcopter.



# Ensuring Safe, healthy seafood

## Solving Issues Surrounding Safe Shrimp Production

Shrimp is the most popular seafood consumed in the US, yet most of it is imported. A project at FAU Harbor Branch seeks to address two issues that can close the gap on shrimp demand and provide healthy seafood: growing season and feed costs.

Susan Laramore, Ph.D., is leading research on the shrimp culture component of Harbor Branch's land based integrated multi-trophic aquaculture (IMTA) system. The IMTA system allows for year-round production and operates with minimal feed costs by utilizing system by-products. Part of the studies have focused on producing novel feeds by turning fish waste into dried biofloc and adding fresh or dried *Ulva* seaweed that is also grown in the system. This project, which is funded by proceeds from Florida's Aquaculture specialty license plate, granted through HBOIF, seeks to show that IMTA can be an efficient and cost effective way to increase shrimp production while maintaining environmental sustainability.



## Partnership to Produce Healthy, Safe Fish for Consumers

The product of a partnership between FAU Harbor Branch, led by research professor Paul Wills, Ph.D., and Treasure Coast company, Amy's Island Seafood, could end up being your next healthy dinner choice. The two entities have designed and will be implementing a method of fish farming that produces safe, sustainable seafood for local consumers. The cultured fish, which is cobia, will be traceable from inception to plate, ensuring a high level of quality for customers. The researchers and company are in the first phase of the project, raising cobia from egg stage to market in a water reuse system that maintains a high quality environment for the fish to grow. The project continues to implement design changes that will move the system closer to a zero water discharge. This partnership is helping to address the need for more seafood as human population increases and take pressure off of wild fisheries.



## Successful Spawning of Sunray Venus Clams

The hard clam industry ranks number three for Florida's aquaculture. The sunray venus (SRV) clam has been targeted as a potential new clam species to add to the hard clam industry; however, hatchery producers continue to face challenges with the need for specialized spawning techniques. In 2015, a project between FAU Harbor Branch, led by assistant research professor Susan Laramore Ph.D, and the University of Florida, was initiated to determine optimal timing and dietary requirements needed for SRV spawning success.

The reproductive patterns and fatty acid profiles of wild and cultured SRV clams were compared during their six-month natural spawning cycles. This information was correlated with continuously collected water quality data from the clam sites. Cultured clams were successfully spawned three times and their resulting nutritional profile is being analyzed. Collected data will allow seed producers to predict the optimal time of the year to collect and spawn broodstock and to gauge whether SRV clams require additional nutrition during the farming process. This project is funded from Florida's Aquaculture specialty license plate, granted through HBOIF.





# Sea Sponge Compound Shows Promise in the Fight against Pancreatic Cancer

A recent publication by scientists at Harbor Branch's Marine Biomedical and Biotechnology Program, including associate research professor Esther Guzmán, Ph.D. and research professor Amy Wright, Ph.D. highlights an exciting new activity for the marine natural compound microsclerodermin A. Microsclerodermin A was isolated from a deep water sponge of the genus *Microscleroderma*. While this compound was known to have antifungal activity and cytotoxicity against a few cancer cell lines, its effects on pancreatic cancer cells were unknown. Their study found a novel activity for this compound – its inhibition of the nuclear factor kappa B (NFκB), an important regulator of inflammation and programmed cell death. NFκB is constitutively activated in pancreatic cancer cells where it leads to resistance to programmed cell death (apoptosis) and proliferation, which are characteristics of aggressive cancers. Resistance to apoptosis leads to resistance to most current chemotherapies. Microsclerodermin A induces significant apoptosis in three pancreatic cancer cells tested. As shown in one of those cell lines, treatment with microsclerodermin A induces significant apoptosis, while cells treated with methanol showed little effect. Funding for this project was provided by the Florida Biomedical Research Program Bankhead Coley New Investigator Award, awarded to Guzmán, and two National Institutes of Health awards, awarded to Wright. Their 2015 peer reviewed publication appears in *Invest New Drugs*.

[Using Marine Natural Products to](#)







# Finding New Ways to Battle Alzheimer's Disease

It is a crippling disease that affects over 5.4 million people in the U.S. Alzheimer's disease (AD) is especially prevalent in the state of Florida, where approximately 500,000 individuals are living with it. In 2015, researchers in Harbor Branch's Marine Biomedical and Biotechnology program made some exciting advances against the disease.

One of the hallmarks of AD is the cleavage of a protein called "amyloid precursor protein" by an enzyme complex called  $\gamma$ -secretase to yield amyloid beta (A $\beta$ ) peptides. A $\beta$ -42 is considered to be the most pathogenic of the A $\beta$  peptides and leads to plaque formation and neurodegeneration. A $\beta$ -40, another product of the cleavage, is considered to be neuroprotective. Early work in the field sought to completely inhibit the activity of  $\gamma$ -secretase, but the inhibitors were toxic as  $\gamma$ -secretase has other functions not related to AD. As an alternative to full inhibitors, compounds that selectively reduce production of A $\beta$ -42 (called  $\gamma$ -secretase modulators or GSMs) have been discovered and some are in advanced clinical studies. Such compounds, if given early in the disease, may prevent the progression of AD.

Harbor Branch researcher professor Amy Wright, Ph.D. has partnered with Todd Golde, Ph.D., and Kevin Felsenstein, Ph.D., along with Yong Ran, Ph.D. of the University of Florida (UF) Center for Translational Research in Neurodegenerative Disease to discover marine natural products that modulate the activity of  $\gamma$ -secretase. With a grant from UF and support for Wright from the Harbor Branch Oceanographic Institute Foundation, the team has discovered two classes of marine natural products with potent activity as  $\gamma$ -secretase modulators. Interestingly, some of these compounds increase the levels of A $\beta$ -40 and may be neuroprotective. One of the sponges that makes these compounds was successfully recollected on the May 2015 Cooperative Institute for Ocean Exploration, Research and Technology expedition to the Gulf of Mexico. Research is on-going to fully define the structures, explore their utility against AD and find additional compounds.



# Discovering Medicines,

---

from the sea

## Treat Tuberculosis

Tuberculosis (TB) is a devastating global health crisis, caused by the bacterium *Mycobacterium tuberculosis*, that claims over 1.5 million lives each year. Research professor Amy Wright, Ph.D., of FAU Harbor Branch's Marine Biomedical and Biotechnology Program in collaboration with Kyle Rohde, Ph.D. of the University of Central Florida (UCF), have discovered marine natural products that can selectively kill the latent form of *M. tuberculosis*. In 2013, they received an R21 grant from the National Institutes of Health (NIH) to conduct a pilot project which tested 4000 materials from the Harbor Branch natural products fraction library for activity in three assays related to TB. They have successfully identified two compounds that are selectively active to the intracellular form of TB while not showing activity in standard assays. These compounds likely work in new ways than existing medicines and are under further investigation at UCF. The screens also identified another 80 plus fractions with activity against *M. tuberculosis* in one or more tests. Based upon these early successes, in January the NIH awarded the team a three-year grant of over \$1 million, allowing work to continue on identifying additional compounds, and to study the details of how the compounds found to date kill *M. tuberculosis*.

Successful treatment of TB currently requires a multi-drug regimen administered for 6-9 months. After infection, the bacteria can survive as a "latent" or "dormant" form. The latent form of the bacteria is resistant to treatment and it has been estimated that 1/3 of the world's population has a latent TB infection. The emergence of multi-drug resistant strains has further complicated the already difficult task of treating TB.

## A New Weapon in the Fight Against Malaria

The Centers for Disease Control and Prevention (CDC) estimates that in 2010, over 216 million clinical episodes of malaria occurred worldwide, with over 665,000 ending in death and of those deaths 86% were children. FAU Harbor Branch research faculty Amy Wright, Ph.D. and Peter McCarthy, Ph.D., have partnered with Debopam Chakrabarti, Ph.D., of the University of Central Florida (UCF) on the discovery of marine natural products with activity against drug resistant forms of the malaria parasite *Plasmodium falciparum*.

Over 3.3 billion of the world's populations live in areas where malaria is transmitted, and although malaria is not currently a threat in the U.S., the transmission vector for the parasite, *Anopheles* mosquitoes, is widely prevalent and there remains a constant risk of reintroduction of malaria into the U.S. Emergence of drug-resistance has been an on-going problem in malaria treatment, with even the best treatments beginning to develop resistance.

Harbor Branch and UCF have jointly received three grants from the National Institutes of Health to study the Harbor Branch marine invertebrate peak library and marine microbial library for new anti-malarial agents. Studies to date have identified five classes of marine natural products with activity against drug-resistant forms of the parasite. A FAU Harbor Branch patent "Anti-malarial compounds from marine natural products" was allowed in July of 2015 that protects a series of four classes of marine natural products that show excellent activity and selectivity against the Dd2 strain of *Plasmodium falciparum*, a causative agent of malaria.



Specimens from Harbor Branch's natural products library.



# Educating

the next generation



The 2015 Semester by the Sea students and instructors aboard the R/V Bellows in the Gulf of Mexico.

## Students Spend a Semester By The Sea

It's what dreams are made of for students who love science and the ocean. The Semester By The Sea (SBTS) program, offered for the past 15 years by FAU's Harbor Branch and Charles E. Schmidt College of Science, Department of Biological Sciences, provides marine science students the opportunity to immerse themselves in hands-on learning alongside some of the most knowledgeable and respected scientists in their field.

Students enrolled in the 2015 SBTS "Ocean Exploration for Undergraduates" course spent five days at-sea taking part in a scientific cruise aboard Florida Institute of Oceanography's R/V Bellows in the Gulf of Mexico. Students developed team projects and were tasked with collecting appropriate data for projects that ranged from studies of fish and benthic invertebrate diversity to evaluating weather predictions. Through these activities, students learn a number of research methodologies in a team setting, and take a small project from inception at-sea through completion and scientific poster dissemination.

Harbor Branch's location facilitates activities in the other SBTS classes that include seining, sieving, snorkeling and boat trips. Students experience a variety of local and coastal habitats including: seagrass meadows, mangrove forests, salt marshes, intertidal mudflats, sandy shores, beach communities and nearshore reefs. Other habitats, including the Florida Everglades and the Florida Keys reef tract, are less than half a day's drive.

## Teaching Marine Science in the Keys

FAU Harbor Branch research faculty Dennis Hanisak, Ph.D., and Joshua Voss, Ph.D., spent a week teaching undergraduate students in the Florida Keys in summer 2015 as part of the Florida Institute of Oceanography's *Study Abroad in Florida: Field Studies in Marine Science* program. This is the third year that Voss and Hanisak have taught FAU's portion of the multi-university marine science course, working with students at the Keys Marine Lab. The five and a half week intensive summer field course is designed to educate students on the biodiversity, geochemistry and human impact of Florida's coastal and offshore ecosystems. Students who participate travel around the state, from the reefs of the Florida Keys to the western Everglades, and up into the estuarine and beach dunes of northeast Florida and the Florida Panhandle.



A student snorkels through a mangrove tunnel in the Florida Keys.





The 2015 Harbor Branch summer interns and sponsors.

## Over Four Decades of Summer Internships

Each summer, about 100 top ocean science and engineering students from prestigious universities all over the world apply to take part in Harbor Branch's highly competitive summer internship program. About 20 are selected to spend the summer studying alongside Harbor Branch faculty. This unique program, now in its 42nd year, provides undergraduate and graduate students with the opportunity to work with a mentor to develop and complete an independent research project. The 2015 summer intern projects were a reflection of the research being conducted at Harbor Branch, and encompassed a wide array of research areas including: Ocean Engineering and Technology, Aquaculture, Marine Mammals, Marine Biology, Microbiology and Marine Natural Products.

The Harbor Branch summer internship program was launched in 1974 with support from the Link Foundation. Support for the program also comes from the Gertrude E. Skelly Charitable Foundation, which funds students selected to work in the HBOI marine biomedical and biotechnology program.







# H2O To Go Program

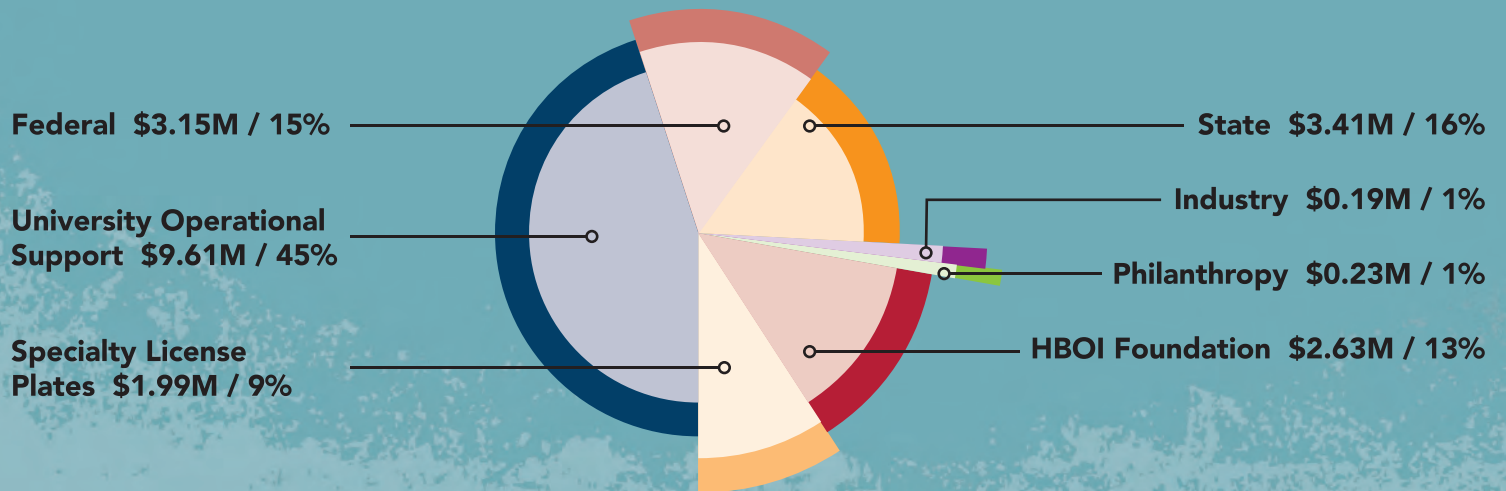
FAU Harbor Branch partnered for a second year with FAU's Pine Jog Center and Riverwoods Laboratory to host the H2O to Go program.

This week-long, residential research institute pairs high school students with scientists who are working in the field of environmental research. Over the course of June and July, three different groups of students participated in the program, with Harbor Branch providing activities like visiting seagrass beds to learn field sampling techniques and spending time in a laboratory learning about plankton and taxonomy.



# Fiscal Year 2015 (07.01.2014 - 06.30.15)

Funding by Source (\$21.20M)



## Competitively Awarded Grants & Contracts –

**\$ 6,754,162**

### FEDERAL –

**\$ 3,146,990**

National Oceanic & Atmospheric Administration	\$ 1,987,696
National Institutes of Health	\$ 406,733
U.S. Dept. of Defense	\$ 402,748
U.S. Army Corps of Engineers	\$ 262,002
U.S. Dept. of Energy	\$ 87,811

### STATE –

**\$ 3,413,981**

Florida Dept. of Environmental Protection	\$ 2,000,000
St. Johns River Water Management District	\$ 291,998
South Florida Water Management District	\$ 284,639
School Board of St. Lucie County	\$ 257,352
North Slope Borough (Alaska)	\$ 225,777
Florida Dept. of Agriculture & Consumer Services	
Aquaculture Review Council	\$ 147,481
Martin County	\$ 124,500
University of Florida	\$ 50,000
Indian River State College	\$ 32,234

### INDUSTRY –

**\$ 193,191**

Zeigler Brothers, Inc.	\$ 116,391
Amy's Island Seafood LLC	\$ 76,800

## Harbor Branch Oceanographic Institute Foundation Grants –

**\$ 2,627,657**

New faculty hiring plan	\$ 1,267,904
Research project grants	\$ 500,000
- New technology for drug discovery	
- Detection of fish spawning aggregations	
Faculty salary support	\$ 431,630
Faculty achievement awards	\$ 182,630
Enhancing institutional fundraising	\$ 96,129
Love Your Lagoon Gala proceeds:	\$ 94,567
- Seagrass nursery for IRL restoration	
- Indian River Lagoon Symposium	
Support of institutional operations	\$ 45,000
Gift shop inventory	\$ 9,797

## Specialty License Plate Awards –

**\$ 1,986,119**

*Granted through the Harbor Branch Oceanographic Institute Foundation*

Protect Wild Dolphins	\$ 1,011,415
Save Our Seas	\$ 381,552
Protect Florida Whales	\$ 323,252
Aquaculture	\$ 269,900



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FAU Harbor Branch acknowledges the generous support of the Harbor Branch Oceanographic Institute Foundation. The mission of Harbor Branch Foundation is to support Harbor Branch Oceanographic Institute, a research institute within Florida Atlantic University.

As a direct support organization of FAU, the Harbor Branch Foundation provides funding and support for research and education in marine sciences and ocean engineering. Its goal is to support FAU's Harbor Branch as it increases understanding of oceans and coastal areas through exploration and scientific investigation.

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FAU Harbor Branch appreciates the Love Your Lagoon 2015 sponsors for their support that made it possible to host the annual Indian River Lagoon Symposium and establish a seagrass nursery for restoration of seagrass habitats in the Indian River Lagoon (see story on page 5). The net proceeds from the Annual Love Your Lagoon Gala Dinner, sponsored by the Harbor Branch Oceanographic Institute Foundation, supports designated research and outreach activities to help improve the health of the Indian River Lagoon.

## Love Your Lagoon

**Mangrove:** Anonymous, Mr. Joseph Z. Duke, III & Mrs. Jennifer Johnson Duke, Mr. James & Mrs. Gretchen Johnson

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# Ways of Giving to Harbor Branch

FAU Harbor Branch Oceanographic Institute relies on private funding to further the important research being done by our highly-respected research teams and the students who work alongside them. All gifts, large and small, are investments in the success of Ocean Science for a Better World®. Following is a list of ways to make a gift in support of oceanographic research and exploration. We are happy to discuss these with you.

## Cash or Securities

Both cash and appreciated securities provide immediate financial support to FAU Harbor Branch Oceanographic Institute while offering tax benefits to you.

## Charitable Gift Annuities

In exchange for a gift of cash or securities, FAU Harbor Branch Oceanographic Institute can establish a Charitable Gift Annuity providing you income for life.

## Gifts from Wills and Estates

Naming FAU Harbor Branch Oceanographic Institute in your will or estate will allow your legacy of giving to live on after you have passed.

## Gifts of Life Insurance Policies

Life insurance plans no longer needed for their intended purposes can be donated to FAU Harbor Branch Oceanographic Institute for a tax benefit for the cash surrender value and the amount of any future premiums paid.

## Other Planned Gifts

Our gift planning team at FAU can advise with you and your financial planner on the many options we offer to create a planned giving strategy that best benefits your particular needs.

*For more information on giving, contact the Harbor Branch Development office at 772-242-2533.*

## Purchase a Plate

### Support Harbor Branch Research

*When you purchase one of these four plates, you are supporting research efforts at FAU Harbor Branch. The specialty license plate program, granted through the Harbor Branch Oceanographic Institute Foundation, provides funding for a variety of projects that bring solutions to needs expressed by Florida residents.*

### Aquaculture Plate

Did you know that half of the seafood we eat comes from aquaculture - also known as fish farming? Fish, clams, shrimp and plants are items grown for food and for restocking overfished areas. The Aquaculture license plate, designed by Guy Harvey, supports the research that Harbor Branch scientists do to advance the industry.



### Protect Wild Dolphins Plate

The Protect Wild Dolphins plate, designed by Steve Diossy, enables 24/7 emergency response for dolphins that become stranded or entangled in fishing gear. FAU Harbor Branch's marine mammal teams also conduct a variety of studies to help understand dolphin health, life history and the environment where they live.



### Protect Florida Whales Plate

Several whale species can be found in Florida waters, including the most endangered of all great whales: the North Atlantic right whale. Designed by marine life artist Wyland, the Protect Florida Whales plate supports protection of these endangered species through public education and conservation. Plate proceeds also fund FAU Harbor Branch's 24/7 emergency response for whales that become stranded.



### Save Our Seas Plate

The Guy Harvey-designed Save Our Seas license plate funds FAU Harbor Branch's research on Florida's waters and coral reefs. Harbor Branch scientists investigate the health of coastal waterways by utilizing a network of automated water quality measurement stations that allow researchers and the public to track conditions in popular boating and swimming spots.



*Buy a plate today at your local tax collector's office,  
or online at [fau.edu/hboi/license-plates](http://fau.edu/hboi/license-plates).*



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