FIO Report

FLORIDA INSTITUTE OF OCEANOGRAPHY

2015–2016

A Special Thanks to All of Our Members

Full Members

Eckerd College
Florida Atlantic University
Florida Department of Environmental Protection
Florida Agricultural and Mechanical University
Florida Fish and Wildlife Conservation Commission
Florida Fish and Wildlife Research Institute
Florida Gulf Coast University
Florida Institute of Technology
Florida International University
Florida Polytechnic University
Florida Sea Grant
Florida State University
Jacksonville University
Mote Marine Laboratory
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Nova Southeastern University
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University of Miami
University of Central Florida
University of North Florida
University of South Florida
University of West Florida

Associate Members

Clearwater Marine Aquarium
The Florida Aquarium
Hubbs-Seaworld Research Institute
Sanibel-Captiva Conservation Foundation
SRI International
St. Petersburg College
University of South Florida St. Petersburg

Affiliate Members

ROFFS Roffers Ocean Fishing Forecasting Service

Notes from FIO Director Dr. William T. Hogarth

As one of the two State of Florida Academic Infrastructure Support Organization (AISO), the Florida Institute of Oceanography (FIO) is committed to providing the highest quality support for member institutions, student success, research, and education with the necessary research vessels and marine laboratory enabling Florida to be one of the leading states in oceanographic research and education.

With strong financial support from Florida Legislature, FIO has a clear plan to continue to achieve these efforts. The support FIO has received over the years has made it possible to upgrade our research platforms with state-of-the-art instrumentation, increase opportunities for students to utilize vessels through FIO's Subsidized Days program, and initiate a multi-institutional five-week field intensive course designed to expand undergraduates knowledge of Florida's various ecosystems. In addition, we continue to support the vessel needs for our faculty that receive research funds to conduct coastal and ocean research.

Five years after the Deepwater Horizon oil spill, settlements are funding recovery and efforts to build a stronger Gulf of Mexico environment and economy. FIO will be funded to host the Florida RESTORE Act Centers of Excellence Program. The program will support research and technology developments that promote innovative restoration science. Initial grants to begin this year will focus on fisheries and wildlife research and monitoring projects from the Everglades to the deep sea around the DWH blowout site. Outcomes include new data and approaches to help managers sustain and grow the natural resources that are the foundation of Florida's economy and heritage.

Also, in 2015, FIO assumed the lease for the Keys Marine Laboratory (KML) located in Layton, Florida. This laboratory has a state-of-the-art salt water system that will allow our users to expand research activities in such areas as ocean acidification and toxicity status. We continue to operate with input from FWRI, to ensure a seamless transition and to meet the long-term commitments of the KML.

This magazine is the first publication FIO has undertaken to highlight our member institutions and research, education and outreach activities. We have endeavored to demonstrate the support FIO provides, as well as highlight some of FIO capabilities. I would like to thank Guy Harvey and Fred Garth of *Guy Harvey Magazine* for their support and assistance with this publication.

We encourage you to go to our website http://www.fio.usf.edu for further information and follow the great work our institutions provide for the citizens of the State of Florida.

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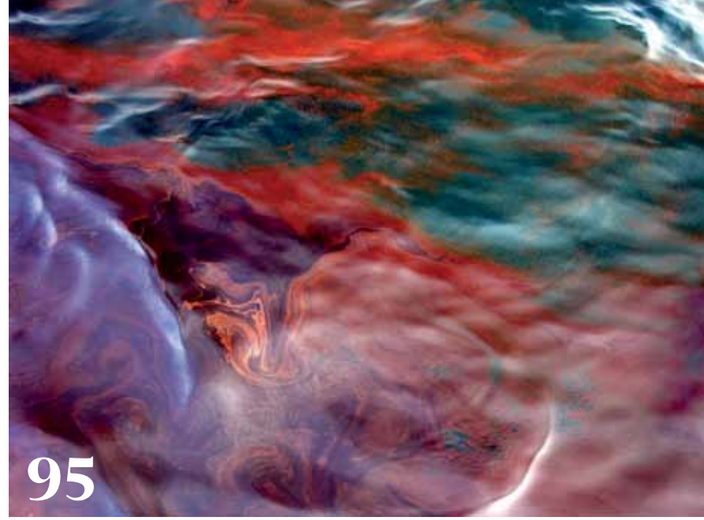


FIO Online

Find out more about the Florida Institute of Oceanography at http://www.fio.usf.edu/

VESSEL TRACKER

Track the *R/V Weatherbird*, *R/V Bellows* and other vessels and see real time water temperature and salinity during transects.

FACEBOOK

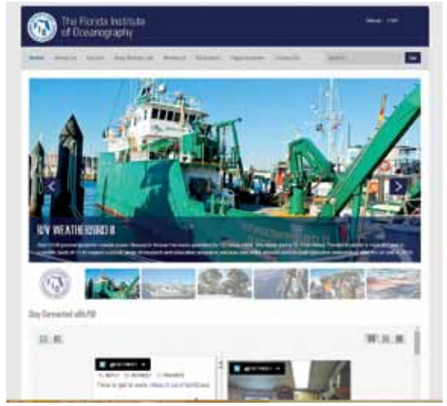
Interact with FIO and keep up to date with happenings around FIO.

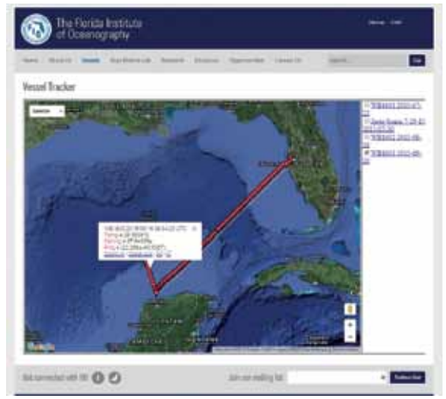
YOUTUBE

Discover FIO's YouTube Channel where you can take a ride aboard some of the vessels or dive underwater on a research trip.

BLOG

Read about student learning and experiences in a blog dedicated to FIO's Summer Marine Field Studies class. Follow the class around Florida and see pictures they post of various ecosystems from the Keys to the Panhandle.





A message from the chancellor of the State University System of Florida, Marshall Criser III.

In Florida, we have the unique opportunity to provide our researchers and students with the tools to expand our knowledge of marine science. The Florida Institute of Oceanography, a system resource housed at the University of South Florida's College of Marine Sciences, allows our students to connect first-hand with the scientific research conducted along Florida's coast. During a recent visit to USF, I had the opportunity to talk to enthusiastic students who said the Florida Institute of Oceanography enabled them to discover their own talents and interests and gave them the skills to be competitive in their field. It was a pleasure to visit with our students, and it was especially rewarding to learn how the Florida Institute of Oceanography contributed to their university experience and prepared them for the workforce.

Marshall Criser
Chancellor, State University System of Florida

FIO council member Dr. Shirley Pomponi and scientists at Florida Atlantic University are studying sponges as a way to cure cancer. They invented a sponge tracking ROV that vacuums up sponges form the seafloor. Chemicals in the sponges may be used to combat pancreatic cancer and treat breast cancer. Support from the State University System of Florida provides a good return on taxpayers investment.

STATE UNIVERSITY SYSTEM of FLORIDA
Board of Governors

Guy Harvey Fishery Symposium Draws All-Star Cast

BY FRED GARTH

Two years after the Deepwater Horizon oil well was finally capped, scientists, fishermen and fishery experts gathered in St. Pete Beach, Florida to discuss the current and future condition of the Gulf of Mexico's fishery. The inaugural Gulf of Mexico Fisheries Symposium, organized by *Guy Harvey Magazine* and the FIO (Florida Institute of Oceanography), was held on September 14-15, 2012, and was the first event of its kind, in that, representatives from all sectors of the marine world attended. Both recreational and commercial fishermen, non-governmental and governmental agencies, politicians, fishing authorities and marine scientists came together to explore the vital issues facing the Gulf.

The first symposium featured notable scientists, such as Dr. Bill Hogarth, the director at the FIO and the Symposium's chief science advisor. Others from the scientific community included Dr. Dean Grubbs from Florida State University, Eric Schwaab, acting assistant secretary for Conservation and Management, Gil McRae, director, Fish and Wildlife Research Institute (FWRI), Donald Kent, president of the Hubbs-Seaworld Institute and Dr. Bob Hueter from Mote Marine Laboratory.

The Guy Harvey Research Institute was represented by Dr. Guy Harvey and Dr. Mahmood Shivji, who is the director of the GHRI. From the governmental realm, Senator Jack Latvala presented the state of Florida's point of view. NGO's such as the Ocean Conservancy and Shareholder's Alliance also attended and presented. The mission of the symposium was to provide a platform where all stakeholder groups could share knowledge and move forward with a unified mission toward a sustainable and healthy fishery in the Gulf of Mexico.

Because of the overwhelming positive response of the first symposium, a second Gulf Fisheries Symposium was held on November 13-14, 2014. One of the major topics was red snapper management with a panel that included president of Florida's Coastal Conservation Association, Jeff Miller, and long-time commercial fisherman Jason De La Cruz. It was rounded out by Dr. Roy Crabtree of the National Marine Fisheries Service, Dr. Greg Stunz of Texas A&M University, Dr. Will Patterson of the University of South Alabama and Dr. Bob Shipp, who was director of the Dauphin Island Sea Lab in Mobile, Alabama, for more than 30 years.

A third symposium is set for October 2016. Both Dr. Hogarth and Dr. Harvey will again headline the event with other leaders from state and federal governments, NGOs, commercial and recreational fishermen and fishery scientists trying to work together for a healthy ocean.

"Ultimately, we all share the same ocean, so we have to ensure sustainable use of our marine resources," Dr. Harvey said. "By bringing everyone together, we can better understand each other's point of view and find solutions we can all live with."

For more information go to: www.gulffisheriessymposium.com.

Dr. Bill Hogarth, Guy Harvey, PhD, Senator Jack Latvala. Photo: Jim Tizzano. The symposium drew a large crowd of students, scientists, teachers, fishermen, NGOs and government regulators.

Scientist Spotlight

BY DR. VALERIE HARWOOD

Brad Gemmell, a marine biologist, will join the Department of Integrative Biology at USF Tampa as an assistant professor in Fall 2015. His highly interdisciplinary research focuses on the behavior of marine organisms and their interactions with the surrounding physical fluid environment. He studies how these interactions govern predator-prey relationships, as well as large-scale ecosystem and evolutionary processes. He uses a mechanistic approach to investigate the function of organisms in fluid environments, including sublethal effects of environmental pollutants (e.g. oil spills). He has performed field-based research in the Gulf of Mexico, North Atlantic, Arabian Sea/Indian Ocean, Caribbean, the Equatorial Pacific and the North Pacific.

Brad uses state-of-the-art, high speed imaging techniques such as particle image velocimetry (2D) and holographic cinematography (3D) to image animals as they feed, mate, swim, and migrate, providing new insights into the effects of fluid dynamics and turbulence on their activities. He also has a general interest in the "evolutionary arms race" between predators and prey, convergent evolution in propulsive mechanisms and understanding biological propulsion for use in bio-inspired design.

Aquatic predator-prey interactions are a focal point of Brad's research because predation is an important driver of ecosystem structure. For example, predation on zooplankton (i.e. copepods) provides a major pathway for the transfer of energy to higher trophic levels. On a global scale, predation on copepods transfers gigatons of carbon from primary producers like phytoplankton to fish. In response to high predation pressure, copepods have developed high sensitivity to hydromechanical disturbances produced by approaching predators and respond with rapid, powerful escapes. The trophic position and abundance of zooplankton mean that factors such as fluid signals (e.g. turbulence), environmental change or pollutants which influence success of planktivorous predators may have a disproportionally large impact on ecosystem-level processes.

One key problem is that these types of predator-prey interactions are commonly described in isolation from the fluid environment in which the behavior occurs. Thus, understanding fluid signals generated and detected by aquatic organisms is paramount in advancing our understanding of ecologically important, large-scale processes. However, data that resolves fluid motion and animal behavior simultaneously at small-scales and high speed is virtually non-existent given current logistical and technological impedances. Brad's research program addresses the major challenge of quantifying these small-scale fluid signals using 2-dimensional and 3-dimensional tools for visualizing animal behavior and fluid signals simultaneously, as well as inventing unique tools. The knowledge gained from his studies is placed in the context of ecologically important behaviors, providing a better understanding of how animals live in aquatic environments.

News & Notes from Across the State

The Florida Department of Environmental Protection's (DEP) Florida Coastal Management Program offers an easy tool to help both residents and visitors maximize their quest for fun in the sun! The Florida Beach Access Guide is an interactive web-based map and mobile application that helps users locate every public beach access point in the state and acquire additional information on available amenities such as restrooms and lifeguard availability. The guide also provides driving directions to each access point and locates fishing piers and coastal accesses found within state parks.

"Florida's coast is lined with beautiful beaches, said Rebecca Prado, program administrator of the Florida Coastal Management Program. "We hope that this new map and mobile app will allow the public greater knowledge of Florida's beach access points so they can explore and enjoy more of the coast."

More than 2,000 public coastal access sites are included in The Florida Beach Access Guide, which is are divided into three regions—the Panhandle, Atlantic coast, and southwest Florida coast. Each section features an overview of each of the region's coastal counties and includes detailed information about each access point, such as parking, accessibility, facilities, shelters, picnic areas, boardwalks, camping, boat ramps, food options nearby or on site, and any fees that may be associated with the access point. The Florida Beach Access Guide can be found online, here: http://fdep.maps.arcgis.com.

For smartphone users, the process is even easier! The Florida Beach Access Guide is hosted on the free Explorer for ArcGIS mobile application, available for download on both iTunes and Android Market. Once the Explorer for ArcGIS app is downloaded, users can search for "Florida Beach Access Guide" and have the option to save it to their app favorites section for ease of use.

BY AMBER NABORS

Congressman David Jolly came to the Florida Institute of Oceanography to get a briefing on the state's fisheries and saw highlights about ongoing research in the Gulf of Mexico. He took great interest in FIO Director Bill Hogarth's overview of our operations and the economic importance the marine industry has on Florida's economy. One topic of discussion was how much better commercial fishery track data is documented compared to recreational fishery dependent information.

Above: David Jolly's experience boating in the Gulf extends back to his childhood, and after listening to Capt. Brendon Baumeister's stories at sea on the the R/V Weatherbird II, *Jolly may be ready to head out on the next trip.*

FIO hosted a media event to mark the 5th anniversary of the Deepwater Horizon oil spill. U.S. Representative Kathy Castor spoke about the quick response FIO played in acquiring data during the disaster. Dozens of media representatives attended from print and television networks with coverage getting picked up nationally.

Sea turtles, even at a tender 6-18 months of age, are very active swimmers. They don't just passively drift in ocean currents as researchers once thought. NOAA and University of Central Florida researchers say it's an important new clue in the sea turtle "lost years" mystery. Where exactly turtles travel in their first years of life, before returning to coastal areas as adults to forage and reproduce, has puzzled scientists for decades.

"All species of sea turtles are endangered or threatened under the Endangered Species Act; knowing their distribution is an essential part of protecting them. With a better understanding of swimming behavior in these yearlings, we can make better predictions about where they go and what risks they might encounter," said Dr. Nathan Putman, lead author of this new study and sea turtle biologist with NOAA's Southeast Fisheries Science Center in Miami.

Upon hatching, young sea turtles swim offshore and disperse with the help of ocean currents. The turtles are rarely observed during the next two to ten years or so, but prior studies suggest that at least some reside among mats of seaweed, such as Sargassum, that provide shelter and habitat in the open sea. Not much is known about these juveniles' movements during this time (researchers dub it the "lost years"), but it has been widely assumed that turtles simply drift with ocean currents.

Putman worked with Dr. Kate Mansfield, director of the University of Central Florida's Marine Turtle Research Group, to challenge this long-existing hypothesis. Mansfield placed specially designed solar-powered tags on 24 green & 20 Kemp's ridley wild-caught sea turtle toddlers in the Gulf of Mexico. The tags were tracked by satellite for a short period of time before shedding cleanly from the turtle shells (max. 2-3 months). Next to the turtles, Mansfield deployed small, carefully-weighted/passively-drifting surface buoys that were also tracked by satellite.

When the drifter tracks were compared to the sea turtles' movements, the researchers found that the turtles' paths differed significantly from the passive drifters. Using observed and modeled ocean current conditions, they found a difference of distance between the turtles and drifters to be as much as 125 miles in the first few days. In nearly every instance, the toddlers' swimming behavior appears to have helped them reach or remain in favorable ocean habitats.

"The results of our study have huge implications for better understanding early sea turtle survival and behavior, which may ultimately lead to new and innovative ways to further protect these imperiled animals," said Mansfield.

BY ZENAIDA KOTALA

Photo: Captain Kimo, Mosquito Lagoon.

Florida leads the nation in deaths due to Vibrio bacteria found in the marine environment. People who eat raw seafood or have open wounds are at most risk for infection. "Flesh eating bacteria" is a misleading name given by the media. Vibrio can enter through cuts or punctures but it will not break down healthy tissue.

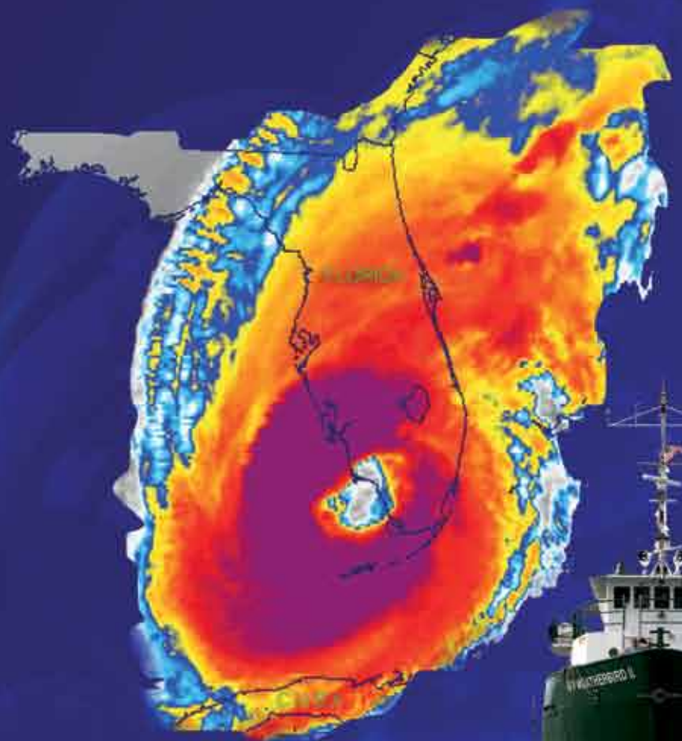
The bacteria occurs naturally and no evidence points to increasing populations, but reported infections have increased over the years. In the past decade Florida reported an average of 133 cases annually. In 2014, there were a total of 167 reports of vibriosis. Half of the infections are foodborne and most are caused by V. parahaemolyticus. It alone caused 30 infections and one death and V. vulnificus was responsible for 32 infections and seven deaths.

Brackish water like the Indian River Lagoon are hotspots for vibriosis since the species prefer inshore stagnant locations. They help break down organic matter in the ecosystem and are not the result of pollution. Florida Atlantic University does extensive research on the threat to humans and you can read more at http://goo.gl/fRCQEg.

U.S. Sen. Bill Nelson announced at FIO the more than $4 million from fines paid for the 2010 Deepwater Horizon disaster. He spoke about the resources in place to help scientists and students across Florida study the impact of the spill and Gulf restoration efforts.

FIO's History

In 1967, the then Florida Board of Regents formed the FIO as a way to unite scientists with a common interest in the coastal oceans who could share in the limited lab and vessel capabilities. FIO's has grown over the decades making discoveries and responding to crises. Weatherbird was a quick responder to the 2010 Deepwater Horizon oil spill. The new KML saltwater system will address concerns on ocean acidification for the future.



1967 FIO established

1978 Vice Adm. Bill Behrens Jr. becomes FIO Director

1980 MV Brandy renamed RV Suncoaster

1983 John Ogden becomes FIO Director

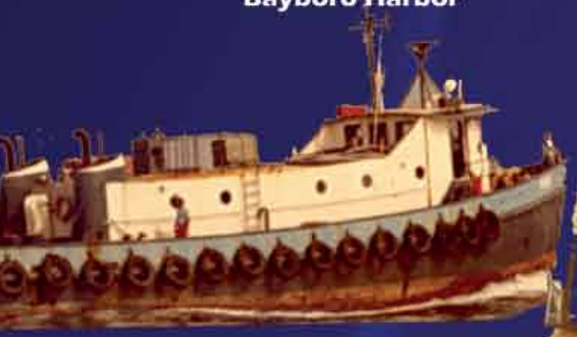
1988 5' surge floods KML from Hurricane Wilma rebuild takes 4 years

1990 FIO aquires R/V Weatherbird

2005 Deepwater Horizon spill

2009 FIO designated as Gulf coast state entity responsible for administering the Florida RESTORE Act Centers of Excellence Program (FLRACEP)

1967 FIO moves to Bayboro Harbor



1978 FIO takes over KML operations from Sea World

1980 State of Florida Buys KML

1983 Bellows maps Pulley Ridge Reef

1988 FL BOG designates FIO as an AISO and USF to host FIO

1990 Bill Hogarth becomes FIO Director

2005 New KML saltwater system will address concerns on ocean acidification for the future.

FLORIDA INSTITUTE OF OCEANOGRAPHY:

BY MARK COLLINS

The Florida Institute of Oceanography supports excellence in marine science, technology and education through infrastructure, information, programs and people. The research institute is at the front line contributing to research advancements with natural and man-made hazards.

Its members are the heart of the organization providing expertise and a network to enhance the consortiums endeavors. Tied to the State University system, we partner together with our member state agencies, public and private educational institutions, and research groups to enable timely identification of oceanographic research opportunities and plan for future infrastructure.

FIO's collaborates and leverages intellectual resources in the State University System with a strong return on investment. FIO's subsidized Ship-time Program provides money for research and teaching opportunities on the vessels. The program gives students valuable experience working at sea. We provide a cost effective strategy integrating platforms that cost millions of dollars through shared technology. This provides university students a lifetime opportunity to gain hands-on experience for entering STEM careers.

Florida was unique having FIO's organization and resources in place to respond immediately to the Deepwater Horizon spill before many federal vessels reached the Gulf. The Flagship in the FIO fleet is the *R/V Weatherbird II*. It made repeated journeys to the spill zone, allowing scientists to quickly gather data. An exclusive Memorandum of Understanding with the Coast Guard gives them needed data and scientific insight, and FIO members get access to disaster zones as events unfold.

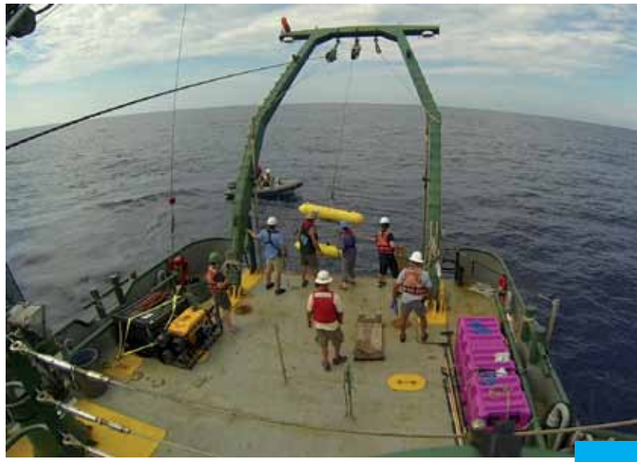
The *R/V Bellows* is another floating laboratory in the FIO fleet. It has gathered red tide information and helped scientists offshore since the 1970s. Through the years, over 5,000 Florida students have experienced working at sea and operating scientific equipment at FIO.

An example how FIO brings state colleges and universities together is through its intensive field marine class. Students earn credit traveling around the state looking at ecosystems from the Florida Keys to Panhandle beach dunes. The five-week university level biology class includes work under the water, on research vessels, and across land including the Everglades in South Florida and the St. Johns River in North Florida.

Educational outreach at FIO helps people of all ages understand, appreciate and support scientific endeavors. Thousands of visitors come to the Science Festival in St. Petersburg and see FIO instruments and tour the vessels. Our teacher at sea and Girls Oceanography Camp support brings the ocean to the classroom.

The fisheries' economic impact around Florida's nearly 2,300-mile-long coast is significant totaling nearly $30 billion dollars each year, which doubles the combined industries of citrus, cattle, ranching and the space industry. FIO supports research into all aspects of fisheries to ensure its success. Jobs depend on accurate fish habitat data and stock assessments.

U.S. Congress designated FIO as the Florida Gulf Coast Entity to receive funds from the RESTORE Act to administer the Florida's Centers of Excellence Research Grants Program. Developing better observations in the Gulf is key to successful oil spill restoration. Future funds will keep Florida competitive in marine science and help drive the economy in the future.



2014 Red Tide Event Response

Contributors: Alina Corcoran, Matt Garrett, Karen Atwood & Bradley Walter

The Harmful Algal Blooms (HAB) group at FWRI will be the first to tell you that it takes a team to track and study red tides in Florida waters. A red tide, or harmful algal bloom, is a higher-than-normal concentration of a microscopic alga (plant-like organism). In Florida and the Gulf of Mexico, the species that causes most red tides is Karenia brevis, often abbreviated as K. brevis. HAB researchers combine field sampling, satellite imagery, and modeling to obtain a comprehensive picture of bloom progression, as well as mitigate the negative effects of blooms by providing timely information to stakeholders and the public.

Researchers in the HAB group, working closely with numerous partners, use a diverse set of tools and technologies to understand the factors that contribute to bloom development and demise. One key partner in red tide monitoring is Mote Marine Laboratory; joint FWRI-Mote field operations allow for comprehensive sampling that includes both ship-based efforts and remote data collection via gliders. Another partner that plays a vital role in monitoring is the University of South Florida (USF). USF's Optical Oceanography Laboratory processes data collected by NOAA and NASA satellites through mathematical algorithms to generate images of blooms, which allow FWRI researchers to detect offshore blooms, assess the spatial extent of inshore blooms, and better focus response efforts in the field. USF's Coastal Ocean Monitoring and Prediction program also provides valuable information on subsurface blooms through glider deployments. Finally, the Collaboration for Prediction of Red Tides—a collaboration between FWRI scientists and USF scientists—provides three-day bloom forecasts researchers use to track and predict where ongoing blooms are heading.

During the summer of 2014, one particular red tide called FWRI and its partners into action. It was a large bloom, approximately 80 miles long and 50 miles wide located 40 to 90 miles offshore between Dixie and Pasco counties. On July 9, the FWC's Fish Kill Hotline received reports from recreational anglers of dead benthic reef fish species. These reports were the first indication of an offshore HAB. With the help of FWC's Law Enforcement Division and Fish and Wildlife Health scientists, the HAB group confirmed the bloom was caused by Karenia brevis, the Florida red tide organism. The team led subsequent event response efforts to track and study the bloom. In addition to leading day trips to sample bloom patches, the group orchestrated and crewed three major research cruises aboard FIO's *R/V Bellows*: one in early August, one in late August and one in

A view of FWC researchers Eric Muhlbach, Kate Hubbard and Sheila O' Dea collecting water samples. Photo: FWC.

mid-September of 2014. Each cruise lasted approximately three days and tracked the development of the bloom and associated physical, chemical, and biological factors through space and time. This sampling was particularly important because it provided subsurface data on HAB species. Satellite data and surface sampling only provides information on the surface expression of the bloom, which for Karenia brevis is just the tip of the iceberg.

Through the research cruises, scientists documented an inshore-offshore gradient in the HAB populations, with potentially toxic diatoms in the genus Pseudo-nitzschia inshore. Researchers also found an overall shift to Pseudo-nitzschia through time. This shift, as well as the inshore-offshore gradient, was attributed to a change in the upwelling regime, which highlights the importance of physical factors like upwelling in dictating where and when red tides will occur. The comprehensive sampling led by FWRI resulted in 3D pictures of both HAB taxa, as well as the physical and chemical environments. This information is being used to address specific hypotheses related to bloom drivers.

Throughout last year's event, the HAB group at FWRI disseminated bloom information quickly to many stakeholders, including local county and state agencies, visitor bureaus, the Florida Department of Health, Florida Department of Agriculture and Consumer Services, the media and the public. These outreach components, including FWRI's weekly Red Tide Status Reports, public outreach and education, and the joint FWRI-Mote Marine Lab Facebook page, ensured timely and effective messaging was circulated to key stakeholders to mitigate the negative effects of blooms. A good example of that mitigation last year was the use of CPR's three-day forecasts to inform water and shellfish sampling by the Florida Department of Agriculture and Consumer Services, the agency responsible for management of shellfish harvesting beds in Florida to protect public health. The collaboration between FWRI and its partners has increased over the years, resulting in a tightly coordinated framework of fieldwork, research and outreach efforts. To learn more about the FWRI HAB group and the work they do, visit MyFWC.com/RedTide.

Above: Each sampling bottle traps water at a specific depth in the water column. Here, Research Scientist Kate Hubbard and Technician Eric Muhlbach are filling smaller bottles with water from deep in the Gulf.
Opposite, top: Either collecting data on the way out or processing it coming back, passing the Skyway on the R/V Bellows *always means more work ahead. Opposite, bottom: HAB researchers smile. Photos: FWC.*

Shark Lady

Dr. Eugenie Clark passes away after nearly 75 years of marine research

by Hayley Rutger

Dr. Eugenie Clark and shark jaws. Photo: Mote Marine Laboratory. Right: Portrait of Dr. Eugenie Clark, founding director of Mote Marine Laboratory in 2005. Photo: Tak Konstantinou.

Blazing trails for women in science; inspiring generations of people from ocean experts to school children; swimming with sharks to learn about them; and founding a world-class marine laboratory that turned 60 in 2015—this is a snapshot of the life and legacy of Dr. Eugenie Clark.

"Genie" Clark—the famous "Shark Lady" who founded Mote Marine Laboratory in Southwest Florida—died at age 92 on Feb. 25, in the company of family at her home in Sarasota, due to complications from battling lung cancer for years. She undertook her last ocean dive in 2014, and her latest research was in review for publication when she passed away.

Clark, an ichthyologist, was a world authority on fishes—particularly sharks and tropical sand fishes. A courageous diver and explorer, Clark conducted 71 submersible dives as deep as 12,000 feet and led over 200 field research expeditions to the Red Sea, Gulf of Aqaba, Caribbean, Mexico, Japan, Palau, Papua New Guinea, the Solomon Islands, Thailand, Indonesia and Borneo to study sand fishes, whale sharks, deep sea sharks and spotted oceanic triggerfish. She wrote three popular books and more than 175 articles, including research publications in leading peer-reviewed journals such as *Science* and a dozen popular stories in *National Geographic* magazine.

In 1955, Clark and her fisherman assistant started the one-room Cape Haze Marine Laboratory in Placida, Fla., with philanthropic support and hearty encouragement from the Vanderbilt family. The Lab thrived in partnership with its community and became Mote Marine Laboratory in 1967 to honor major benefactor William R. Mote. Today, the Lab is based on City Island, Sarasota, and it hosts 25 diverse marine research and conservation programs, education programs for all ages and a major public aquarium. The Lab has multiple campuses stretching from Sarasota to the Florida Keys and more than 200 staff, including scientists who work in the oceans surrounding all seven continents.

Clark joined the zoology faculty at the University of Maryland in 1968, and she officially retired in 1992. She returned to Mote in 2000 as senior scientist and director emerita and later became a trustee. There, she continued to build upon and champion the groundbreaking research that she started 60 years ago.

Clark spent her final days among family, friends and colleagues from the Lab. Her scientific discoveries and her amazing story will continue to inform and inspire people around the globe.

"There was absolutely no one like Genie Clark," said Dr. Michael P. Crosby, president and CEO of Mote. "Her fascination with fishes and [her] dedication to research changed marine science forever; her life story set an example for women in science and countless others who are striving to make a positive impact; her graciousness and warmth opened hearts and made ocean knowledge more accessible to many; and above all, her leadership and legacy sparked a tradition of world-class marine research and education that will continue for generations. Her passion for science and her freedom to pursue that science at Mote continues to inspire us all."

"Genie was an amazing woman—her initiative, intelligence and enthusiasm have always been the heart of Mote," said Dr. Kumar Mahadevan, the longest serving president in Mote's history. "As a graduate student in India in 1970, I knew about the reputation of Mote Marine Laboratory as the 'leading institution in ichthyology and shark research' from the great scientific publications by Genie and other scientists at the Lab. When I moved to nearby Anna Maria Island in 1975, I aspired to, and was fortunate enough to become, part of the Mote family. To me, Genie has been a great mentor, friend and a true inspiration." Mahadevan served as senior scientist starting in 1978

Dr. Eugenie Clark during a research expedition in the early days of her career. Right: Mote President & CEO Dr. Michael P. Crosby, Mote founding Director Dr. Eugenie Clark, Mote President Emeritus Dr. Kumar Mahadevan. Photos: Mote Marine Laboratory.

and became the Lab's CEO from 1986 to 2013.

"Genie was affectionately known and respected as the 'Shark Lady' because her shark research was so innovative and she was dedicated to teaching the truth about sharks," said Dr. Robert Hueter, director of the Center for Shark Research at Mote. "In the early days of Mote Marine Laboratory, Genie discovered that sharks could be trained to learn visual tasks as fast as some mammals. This was groundbreaking knowledge, which Genie published in the top scientific journal *Science*. Through her singular efforts, Genie established Mote's 60-year legacy in shark research, ultimately leading to Mote's designation by the U.S. Congress as the site of the nation's only Center for Shark Research. We are all extremely grateful to her and will miss her inquisitive, energetic and loving spirit forever."

Clark is also widely known for studying sand fishes, particularly in the Red Sea. For example, she found that a Red Sea fish called the Moses sole secretes a natural shark repellent substance.

Over dozens of expeditions in the Red Sea and Gulf of Aqaba, Clark became a champion of conservation there. She advocated to preserve the Ras Mohammad area of the Red Sea, a place of stunning coral reefs. Her voice provided crucial support and the area became Egypt's first national park in 1983. Today, the Red Sea and Gulf of Aqaba remain critical areas of focus for Mote.

Clark is the recipient of three honorary degrees and numerous awards including The Explorers Club Medal; the Medal of Excellence from the American Society of Oceanographers; the NOGI award in Arts from Underwater Society of America; the Dugan Award in Aquatic Sciences from the American Littoral Society; a gold medal from the Society of Women Geographers; the Distinguished Fellow Award from the American Elasmobranch Society; and the Franklin L. Burr Award from the National Geographic Society. Several fish species have been named in her honor: *Callogobius clarki* (Goren), *Sticharium clarkae* (George and Springer), *Enneapterygius clarkae* (Holleman), and *Atrobucca geniae* (Ben-Tuvia and Trewavas).

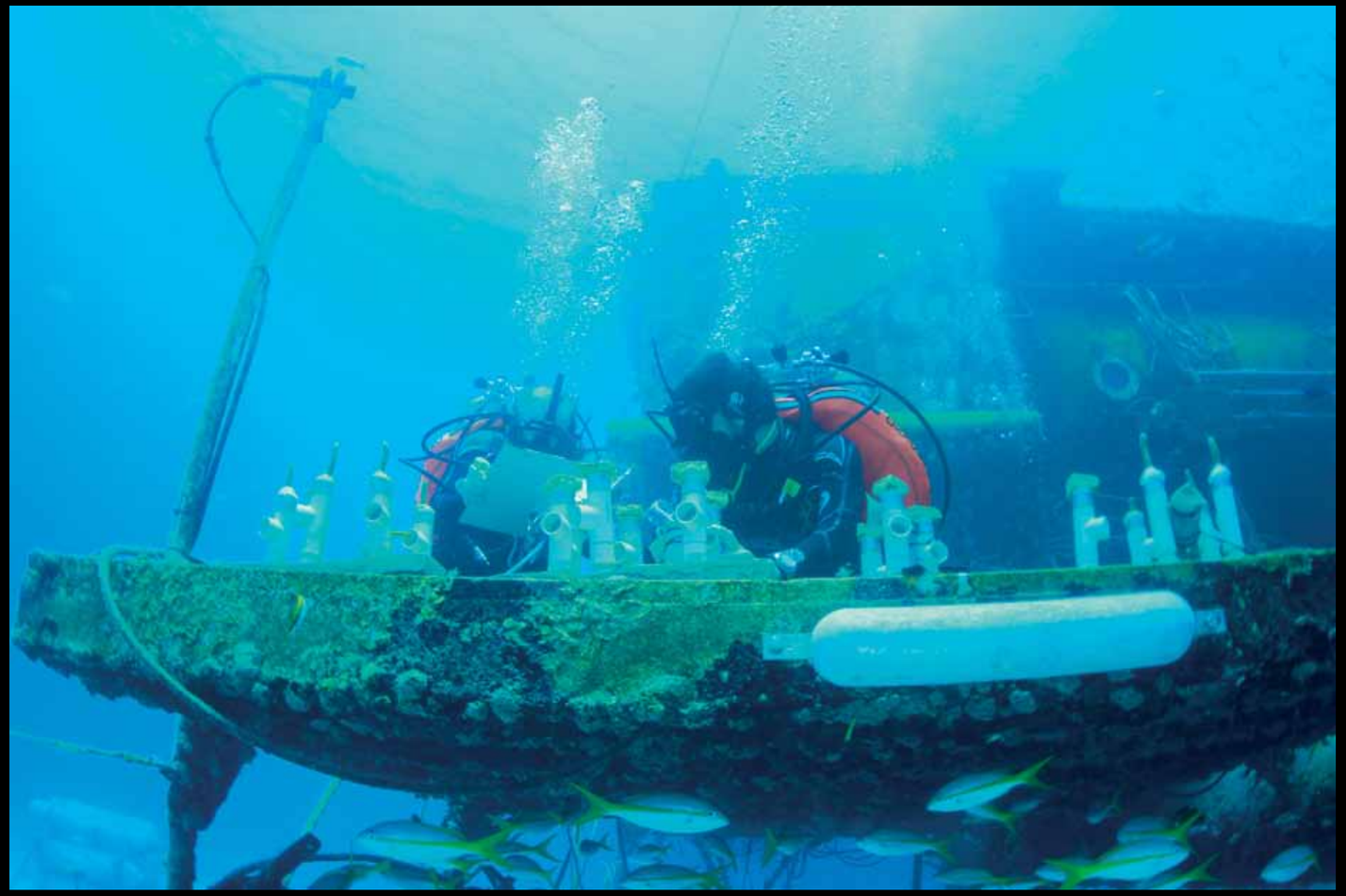
In 2015, the American Elasmobranch Society, together with Save Our Seas Foundation and Mote, established the Eugenie Clark Award in her honor. The award recognizes female, early-career scientists who demonstrate uncommon perseverance, dedication and innovation in biological research and public outreach on elasmobranch fishes, just as Clark did.

She has written three popular books: *Lady with a Spear* (1951), describing her adventures in Micronesia and the Red Sea; The *Lady and the Sharks* (1969), which chronicles starting the Cape Haze Marine Laboratory; and *The Desert Beneath the Sea* (1991), a children's book written with Ann McGovern describing a scientist researching the sandy bottom of the sea.

After carrying out a distinguished career spanning almost 75 years, raising four children and inspiring countless scientists, students and others, Clark will be remembered for her legacy of amazing discoveries and their ripple effects around the world.

Clark is survived by her four children, Hera, Aya, Tak and Niki Konstantinou, and by her grandson Eli Weiss.

You can honor Clark's life by supporting her Lab through the Dr. Eugenie Clark Memorial Research Endowment Fund: www.mote.org/geniememorialfund.



Photos this page: Kip Evans.

AQUARIUS

BY TOM POTTS & AILEEN SOTO

The Medina Aquarius Program is dedicated to the study and preservation of marine ecosystems worldwide. As part of Florida International University's Marine Education and Research Center, the Medina Aquarius Program is enhancing the scope and impact of FIU on teaching, research, educational outreach, technology development and professional training. At the heart of the program is the one-of-a-kind Aquarius Reef Base, the world's only undersea research laboratory dedicated to science and education.

Deployed 60 feet beneath the surface in the Florida Keys National Marine Sanctuary, Aquarius is a globally significant asset that provides unparalleled means to study the ocean, test and develop state-of-the-art undersea technology, train specialized divers and engage the imaginations of people all across the world. At Aquarius, scientists are at the cutting edge of research on coral reefs, ocean acidification, climate change, fisheries and the overall health of the oceans.

Since its deployment in 1993, aquanauts and their support teams have used Aquarius to answer critical challenges facing scientists and policy makers. Universities, researchers, government agencies and private industry have conducted 127 missions to discover, preserve, train and innovate. Over 600 scientific research papers have been published based on Aquarius science.

Aquarius is a complex system that features the undersea habitat located in a sand patch on Conch Reef; a life support buoy on the surface that contains power generators, air compressors and telecommunications equipment; and a mission control center in Islamorada, Florida. Because the habitat provides divers with the ability to live undersea for weeks at a time, Aquarius enables research that cannot be done anywhere else on the planet. Unlike traditional surface-based scuba diving, which limits the amount of time divers can spend on the bottom, Aquarius aquanauts are saturation divers. This capability means researchers can spend up to nine hours of bottom time per day at 95 feet and an unlimited amount of time in the water at 50 feet.

Most importantly, Aquarius is a platform for everyone. In keeping with the mission of FIU's School of Environment, Arts and Society (SEAS) to, in part, ensure a sustainable future, the Medina Aquarius Program includes extensive educational outreach programming to give access to its marine ecosystem, share its science, and inspire countless minds young and old. Its potential is boundless.

Marine Ecosystem Science and Long-Term Monitoring

Aquarius provides scientists with the opportunity to conduct crucial research covering a variety of areas including water quality, coral reef biology, ecology, and physiology, long-term ocean monitoring, restoration science, ocean acidification and global climate change.

Undersea Equipment Testing

Aquarius provides extended presence in a real underwater environment, which exceeds the capabilities of scuba diving or shore-based facilities for equipment testing. In this capacity, Aquarius can evaluate the latest technologies in ocean observing, forecasting and modeling, reef monitoring and extreme environment equipment.

Training and Procedure Development

Through partnerships with NASA, the United States Navy, and others, Aquarius serves as a space analog, training platform and remote telemedicine testing facility. Studies include human physiological responses to extreme environments, spacewalk and lunar excursion procedures. Robotic geological sample retrieval and remote tele-robotic surgical procedures have also been tested during Aquarius saturation missions.

Outreach and Engagement

With each mission, Aquarius is inspiring the next generation of researchers and explorers through innovative education and outreach programs that reach millions of students globally. Leveraging onboard video conferencing capabilities, scientists taking up residence in Aquarius are able to engage audiences worldwide through interactive classes and live chats. Researchers are able to teach classes from the depths of the ocean and visit with schoolchildren by offering virtual fieldtrips of the undersea research lab. Aquarius also features the Teacher Under the Sea program, which provides unique experiential learning opportunities to engage today's explorers and tomorrow's problem solvers.

Links to check out

http://aquarius.fiu.edu
http://www.facebook.com/AquariusReefBase
https://www.flickr.com/photos/aquariusreefbase/sets/
https://www.youtube.com/user/AquariusReefBase

Interactive:
Catlin Seaview 360: http://bit.ly/1MQcNoD
Northeastern U. Aquarius 360: http://bit.ly/1Uf1Iqw
Northeastern U. Aquarius 360 (2): http://bit.ly/1EZjwPr
Time Magazine: http://time.com/cousteau/

From the Host Provost

The University of South Florida (USF) is proud to be the host institution for the Florida Institute of Oceanography (FIO), an Academic Infrastructure Support Organization (AISO) for the State of Florida. Located in St. Petersburg and housed at the USF College of Marine Science, FIO facilitates and supports the work of Florida's faculty, researchers and students.

Florida has more than 2,200 miles of tidal shoreline, more than 11,000 miles of waterways and year-round weather ideal for outdoor activities. FIO's infrastructure has supported more than 5,000 undergraduate and graduate students statewide and over $110 million in grants received from state, federal and private entities to study Florida's marine resources.

FIO's infrastructures include operating two research vessels and the Keys Marine Laboratory, located in Layton, Florida, that are utilized by member institutions and the wider scientific community. The research vessels connect our students to hands-on research opportunities along Florida's coast while in the Keys, FIO's laboratory is a true gem that provides easy access to one of the most unique and beautiful marine habitats anywhere in the world.

FIO and its member institutions played a critical role in the scientific response to the 2010 Deepwater Horizon (DWH) well explosion, which was the largest marine oil spill in U.S. history. FIO's *R/V Weatherbird II* was a first responder and transported Florida's faculty and researchers to the scene. The USF Research Foundation contributed $500,000 in research dollars to FIO for its members to conduct the initial critical sampling of the DWH oil spill. The USF Office of Research and Innovation and the Office of the Provost also provided the initial support to establish the Gulf of Mexico University Research Collaborative (GOMURC) initiative with Texas, Louisiana, Mississippi and Alabama to address current and future Gulf issues. Today, GOMURC consists of more than 90 research institutions across the five Gulf States. FIO and its members are at the forefront of advancing science through collaboration and, as a result, the public has a greater understanding of the fragile Gulf environment than ever before.

In 2012, FIO was designated by Congress to be Florida's Gulf State Entity to receive, administer and coordinate the Centers of Excellence Program under the RESTORE Act. FIO has received over $4 million resulting from the first phase of the civil settlement under the RESTORE Act to operate a program with funds awarded in September 2015. An additional $22 million is expected to flow to FIO in the next 10-15 years resulting from the BP civil settlements.

As host institution, USF is committed to providing the highest quality service to FIO and its member institutions, to empowering student success, and to advancing the scientific capabilities and education necessary to protect Florida's treasured marine resources while continuing to elevate the SUS on a global scale.

Dr. Ralph Wilcox, USF Provost

Deepwater Horizon

From disaster FIO orders restoration

DwH Explosion
April 20, *2010*

RV Weatherbird II responds

STATE OF FLORIDA INSTITUTE OF OCEANOGRAPHY FIO

$10 Mil. BP Block Grant to FIO

26 PROPOSALS

FIO Awards $9.6 Mil.

USF UNIVERSITY OF SOUTH FLORIDA

USF Research Foundation jump-starts DwH research with $500K

GULF OF MEXICO RESEARCH INITIATIVE

BP forms GoMRI $500 Mil./10 yrs funding

May 2010

3 Florida Consortia

C-IMAGE - I

C A R T H E

Deep-C

GOMRI funds consortia

August 2011

PI Selected

- Dr. Steven Murawski
- Dr.Tamay Özgökmen
- Dr. Eric Chassignet

THE DEPARTMENT OF THE TREASURY 1789

RESTORE Act passed

July 2012

4 Florida Consortia

RECOVER

DEEPEND

DEEP PELAGIC NEKTON DYNAMICS OF THE GULF OF MEXICO

C-IMAGE - II

Center for the Integrated Modeling and Analysis of Gulf Ecosystems

C A R T H E

GoMRI funds 12 consortia $140 Mil

November 2014

PI Selected

- Dr. Martin Grosell
- Dr. Steven Murawski
- Dr. Tracey Sutton
- Dr.Tamay Özgökmen

STATE OF FLORIDA INSTITUTE OF OCEANOGRAPHY FIO

FIO designated Gulf coast entity to receive funds to create Centers of Excellence

10 PROJECTS

Centers of Excellence awards projects

August 2015

WORKHORSE of the SEA

By Mark Collins

Demand for a vessel that "handles it all" keeps the *R/V Bellows* at sea quite often. Missions change, but over the decades, students and scientists have repeated journeys on a vessel that's become a familiar home. The 45-year-old "workhorse of the sea" is capable of switching science objectives to suit the research community in marine chemistry, biological and physical science.

Cutting through the waves, the *R/V Bellows* zigs and zags over unexplored paleoshoreline structures in the southeastern Gulf mapping the hard bottom with sidescan sonar. It is one of the few specialized vessels equipped for this type of scientific work and the first vessel to discover the deepest reef powered by sunlight in the United States. Pulley Ridge was found 100 miles west of Key West in water about 60 to 90 meters below the surface. The data from mapping, along with collecting sediment and algae samples, helped scientists trace the reef's origins to ancient submerged barrier islands.

The *Bellows* transected the Gulf, the Florida Keys and Bahamas providing answers to questions about ocean geology, red tide movement and it sprang into action collecting contaminated water and sediment

Right: R/V Bellows *crew from right to left, Patrick Foster, David Kennedy, Asst. Capt. Billy Coker, Capt. Dave Coy. Below:* R/V Bellows *docked.*

samples from the Deepwater Horizon spill oil.

Thousands of university students have used the floating lab to fulfill degree requirements over the years. The FIO subsidized shiptime program provides time on the vessels where students are exposed to life on the sea through a hands-on introduction to ocean sampling techniques.

FIO offers 8th grade students immersive oceanography camps where a day at sea on the *Bellows* feeds curiosity and stears young minds toward STEM studies. Real research world experiences carry on to older students shaping a high retention rate for future marine scientists. It's estimated a program like the *Bellows* provides a fruitful return on investment amounting to 800 undergraduate and graduate students yearly obtaining the hands-on-training to become future workforce marine scientists.

The *R/V Bellows* experience leaves an impression on students persuading many toward oceanography careers. The ship's long track record was formative in Dr. Wade Jeffrey's success as an oceanographer. He spent time on the vessel in the 1980s as a graduate student. Today, he's one of the ship's primary users teaching research techniques to his students at the University of West Florida.

The story is similar for Florida Gulf Coast University's Dr. Darren Rumbold. In the 80s, he pulled plankton nets and measured water quality with the CTD, and now his students follow in his footsteps in a classroom at sea.

A dedicated crew of four can accommodate 10 scientists for about eight days. The boat is equipped with water samplers, a current profiler, and an echo-sounder which is used by scientists to conduct seafloor surveys. *Bellows's* winches include electrical wires to collect real-time data from towed underwater instruments. Equipment can be deployed using the U-frame on the stern or by a starboard A-frame.

Maintaining this equipment on a ship at the end of its life is increasingly costly. The steel hull is corroding and problematic plumbing issues have shorten trips. Navigating the roughest seas has been a smoother ride compared to the struggles in replacing the ship. Funding for a new vessel was strongly supported by the SUS Board of Governors, however, the governor vetoed the request citing the schools should shoulder some of the cost. As a result, President Genshaft of USF reached out to the primary *Bellows* users from the past five years and received pledges for $3.1 million. That's just half the cost needed for design and construction of the new $6.2 million vessel.

FIO Director Dr. Bill Hogarth has worked tirelessly for solutions and is optimistic. "Each member will write the governor and legislature for the three million needed to construct the vessel. The naval architect has plans, and it's just a matter of time for financing."

In the meantime, FIO is testing the hull twice a year and making sure the vessel is seaworthy. Hogarth said. "We don't want to take people out into the ocean and not feel comfortable. We have a safe vessel to do it."

The *Bellows* is unique in its capability to handle vast projects in shallow coastal waters. Losing it would be a hit to the state's economy as it brings in up to a million dollars a year from researchers who pay to charter the boat. A large chunk of Florida's marine economy is driven by these SUS researchers, faculty and students who study the ocean ecosystems, which support one of Florida's largest industries behind tourism; collectively, over 500,000 jobs and over $13 billion in wages are directly related to the Florida marine industry.

The *Bellows* waits for that saving life ring and, should the check arrive, the payoff will hopefully be another half century of student education and research.

Top right: Scientists explore Pulley Ridge reef looking for new insight of how reefs function in order to better preserve other reefs. Right: Hundreds of students get hands-on experience with oceanographical tools like this CTD, which is routinely used in marine science research.

THE R/V WEATHERBIRD II

BY MARK COLLINS

Far offshore, reference points disappear and the bottom drops down to thousands of meters deep. In these remote areas, the *R/V Weatherbird II* provides discoveries and offers access to questions obscured by the fathoms. At sea, time becomes more elusive, yet the sense of urgency for information keeps work going around the clock.

Over the past 33 years, the *R/V Weatherbird* has sailed far from its early beginnings as an oil rig supply vessel. The Deepwater Horizon oil spill thrusted the 115-foot ship into the frontlines of marine science and the headlines of news outlets around the world.

As the crisis unfolded center stage to the world, the *Weatherbird* had backstage access granted by the United States Coast Guard. FIO's scientific expertise assisted the USCG response and the exchange provided FIO researchers data on a spill that grew to a size larger than Florida. The partnership signed a Memorandum of Understanding positioning FIO at the frontline to improve emergency response.

With the *Weatherbird* at the spill epicenter, scientists aboard provided eyewitness details of an underwater plume of hydrocarbons gushing for miles, 1,300 feet deep in the northern Gulf. The crew watched dolphins swim through the ooze and oil-soaked birds gathered on the deck. Now, five years later, scientists estimate about 10 percent of the oil is probably on the seabed and many questions remain about the long-term impacts on the Gulf.

Research trips across the Caribbean, Bahamas and recently to the southern Gulf have all accomplished unique goals. Mexico is one place offering clues to how an oiled ecosystem recovers. In September, a team from C-IMAGE sailed throughout Campeche Bay at a site where oil flowed from a blown-out rig for nearly 10 months. The Ixtoc-I spill disaster happened 35 years ago, spewing 10,000 to 30,000 barrels a day. The Mexican government granted the *Weatherbird* special access to conduct scientific fishing within the blocked off spill zone. Samples collected during the cruise measured fish toxicity (PAH), plastics, sediments, and plankton providing baseline exposure levels and, in turn, will help predict how the northern Gulf may recover in the wake of DwH.

A critical component to the health of the Gulf is its circulation driven by the Loop and its influence along the West Florida Shelf. The *Weatherbird* is helping to unlock the mysteries of how water moves in the Gulf of Mexico. It carries heavy buoys and underwater current detectors offshore where a network provides continuous surveillance of water movement. This data is fed into models run by the Ocean Circulation Group at USF and its output reveals predictions about currents, oil movement, red tide and gag grouper recruitment success.

FIO Sponsors *Guy Harvey Magazine*'s Education Issue

BY FRED GARTH

There are more than 6,000 schools in the state of Florida—from elementary to university and both public and private. Each year, all of those schools receive a special edition of *Guy Harvey Magazine*'s annual Education Issue. Published each Fall, the Education Issue covers the amazing marine science projects that students around the state are accomplishing. Such as the Navarre Beach Marine Science station where students are building their own underwater ROVs (Remote Operated Vehicles) to study reef habitats. Or, Nature's Academy near Tampa that operates its school completely in the outdoors. Nature is their classroom.

Because there is no higher calling for the FIO than education, the 2015 edition of *GHM*'s Education Issue was sponsored by the organization.

"The charter of FIO is a collection of state schools, so education is foundational for us. That's why it made sense to join with Guy Harvey to help education of youth about marine sciences," said Bill Hogarth, director of FIO.

While most people think of Guy Harvey as marine artist and a man with a ubiquitous T-shirt collection, many don't know that Harvey is actually Dr. Guy Harvey, marine biologist. Before his art gained him fame, Harvey was a science teacher at the University of the West Indies in Jamaica. So, even though art is dear to his heart, teaching is his first love.

"Educating our youth to the challenges facing the marine environment is something that is critically important to me," Harvey said. "In fact, many of my films are based in science and education."

The collaboration between the Guy Harvey organization and FIO—two entities that have education at the top of their agenda—is once again providing students in Florida with the tools they need to learn about the marine environments we all enjoy.

Department of Environmental Protection

By Heather Thomas

Funds from the Deepwater Horizon oil spill aid in the restoration of Florida's Gulf Coast

In has been over five years since the Deepwater Horizon explosion and oil spill occurred in April of 2010. Since that time, the Florida Department of Environmental Protection (FDEP) and the Florida Fish and Wildlife Conservation Commission (FWC) have been working collectively to implement a variety of restoration projects across the Gulf Coast of Florida. Funds for these projects include over $100 million for Natural Resource Damage Assessment (NRDA) early restoration, over $50 million from the National Fish and Wildlife Foundation's (NFWF) Gulf Environmental Benefit Fund, and $10 million made available through a settlement with MOEX, a non-operating investor in the lease of the well. To date, over 70 projects have been selected for implementation from these funds. These restoration projects have included a variety of projects such as turtle and shore-bird protection, land acquisition, stormwater treatment facilities, oyster restoration, living shorelines, and numerous projects to increase the public's access to and enjoyment of Gulf Coast waters and beaches, such as artificial reefs, park improvements, boat ramps and dune walkovers.

In this article, we highlight a few of the projects being implemented, and discuss the implications of the recent announcements of BP's agreement in principle to resolve remaining claims and the Gulf Coast Ecosystem Restoration Council's draft Initial Funded Priorities List.

Projects Underway

More information on the 70 projects can be viewed on a user-friendly map that provides geographic locations, fact sheets and photos of the projects.

See: www.deepwaterhorizonflorida.com.

The following projects highlight allowable uses of the funds, and how funds are being leveraged to increase benefits.

Mahogany Mill Boat Ramp and Park

This is a NRDA early restoration project, and is intended to offset some of the lost recreation resulting from the spill. Damages from the spill included not only impacts to natural resources such as marsh habitats, marine mammals, and other species such as shorebirds and turtles, but also included lost recreational use opportunities. The Mahogany Mill Boat Ramp and Park project reconstructed Mahogany Mill Road from Old Barrancas Avenue to Harbor View Marine, resulting in a new public road. The road now meets Escambia County standards to include wider travel lanes, an ADA-accessible sidewalk and infrastructure upgrades that include stormwater, sanitary sewer and potable water. The 2.32-acre park amenities consist of a boat ramp, ADA-accessible piers, sidewalk, picnic pavilion, benches, restrooms and landscaping. Environmental features of the project include porous concrete pavement throughout the parking area, which allows stormwater to infiltrate into the subsurface, eliminating the need for stormwater retention ponds. There will also be a sanitary pump-out facility for use by boaters, as well as an educational kiosk providing information about environmental and wildlife issues.

Escribano Point offers a host of outdoor opportunities, including fishing, camping, kayaking, and wildlife viewing. Gulf restoration funds will help (FWC) achieve the goals of the management plan for the Escribano Point Wildlife Management Area which include increasing the current visitor carrying capacity by more than 50 percent. Photo by Kevin McDonald.

Escribano Point

Escribano Point is a good example of how multiple sources of Deepwater Horizon funding have been leveraged to improve public access and enjoyment, and conservation of natural resources. Uniquely situated in the confluence of the Gulf of Mexico, Pensacola Bay, East Bay, and Yellow and Blackwater Rivers, the Escribano Point region provides stopover and foraging habitat for migrating shorebird species, among which are listed species such as the piping plover, Cuban snowy plover, least tern and black skimmer. This project will

Wayside Park Panorama. Photo: International Dark-Sky Association.

protect the estuarine system and adjacent Blackwater Bay, which contains sea grass beds vital to fish and other marine species such as the listed Gulf sturgeon, while providing the public with improved outdoor recreational experiences through management of the property as the Escribano Point Wildlife Management Area.

Approximately $8.3 million in Gulf spill funds are being leveraged at Escribano Point. MOEX settlement funds were used to purchase parcels in the area, while funds from the NFWF's Gulf Environmental Benefit Fund are being used to acquire additional parcels and provide for long-term management activities, such as prescribed burning, vegetation management and hydrologic restoration. NRDA early restoration funds are being used to enhance public access and enjoyment through new parking facilities, an interpretive fishing facility, primitive camping sites, wildlife viewing areas, and bear-proof containers for trash and storage.

Improving Sea Turtle Nesting Habitat

This is another example of leveraging different Deepwater Horizon funding streams. Coastal habitats and natural resources of the Florida Panhandle were repeatedly disturbed in the course of responding to the oil spill, adding to the preexisting problem of beachfront lighting that impairs sea turtle nesting habitat. Each year across Florida, many nesting females and tens of thousands of their hatchlings are negatively impacted by artificial lights. Disoriented turtles may never make it back to the sea to replenish the population—a population that also suffered casualties due to direct oiling during the spill.

FWC and FDEP are putting $3.4 million to work in the Panhandle over several years as part of a multi-prong strategy to protect public properties where sea turtles nest from harmful lighting practices. The U.S. Department of the Interior also received its own share of funding as part of this same NRDA early restoration project that it is using to address problem lights at Pensacola Beach. Additionally, to date, NFWF has devoted $1.5 million from the Gulf Environmental Benefit Fund to allow The Sea Turtle Conservancy to assess and replace problematic lights on private properties in the region. Multi-party initiatives such as this increase the ability to conduct large-scare restoration.

Panama City Stormwater Management Project

Panama City received a $785,000 grant for the construction of the facility, which will improve the quality of stormwater runoff before it enters St. Andrew Bay. The project included a new stormwater pond, upland irrigation system and an ADA-accessible, paved walking trail through the park-like setting. Urban stormwater runoff and nonpoint source pollution are the most significant sources of water and sediment quality degradation. Stormwater retrofit projects, such as this one, play a key role in preserving waterways by protecting water quality and managing flows. The project will directly improve the water quality of discharges into St. Andrew Bay while benefiting the adjacent wetlands.

Over $25 million in Deepwater Horizon funds are being used to construct stormwater management projects across the Panhandle. This includes $5 million in MOEX settlement funds and $ 20 million from NFWF's Gulf Environmental Benefit Fund. These stormwater projects in Pensacola Bay, Choctawhatchee Bay, and St. Andrews Bay will improve water quality leading to improved habitats and fisheries.

This stormwater facility was renamed Hammons Park in honor of Kenneth R. Hammons, a former city manager. The Northwest Florida Water Management District and the Panama City Engineering Department prepared the permitting and designs for this facility.

BP Agreements in Principle

On July 2, 2015, it was announced that BP had reached agreements in principle to settle all remaining federal and state claims arising from the Deepwater Horizon oil spill. Under the agreements BP will pay:

A civil penalty of $5.5 billion under the Clean Water Act—payable over 15 years.

$7.1 billion over 15 years for natural resource damages. This is in addition to the $1 billion BP previously committed for early restoration. An additional amount of $232 million will be added to the interest payment to cover any further natural resource damages that are unknown at the current time.

A total of $4.9 billion will be paid over 18 years to settle economic and other claims made by the five Gulf Coast states.

Up to $1 billion will be paid to resolve claims made by more than 400 local government entities.

For Florida this will mean:

- $2 billion for economic damages.
- At least $680 million for natural resource damages.
- At least $572 million in RESTORE Act funding .

The agreements in principle are subject to execution of definitive agreements, including a Consent Decree with the United States and Gulf states with respect to the civil penalty and natural resource damages. The Consent Decree will be subject to public comment and final court approval.

Gulf Coast Ecosystem Restoration Council Draft Funded Priorities List

On August 13, 2015, the Gulf Coast Ecosystem Restoration Council (GCERC) released a draft Initial Funded Priorities List (draft FPL). The draft FPL would fund approximately $139.6 million in restoration activities such as hydrologic restoration, land conservation and planning for large-scale restoration projects throughout the Gulf Coast Region. In addition, the Council is reserving approximately $43.6 million for implementation of additional activities in the future, subject to further Council review.

The projects listed in the draft FPL focus on 10 key watersheds through the Gulf, including Pensacola Bay, Apalachicola Bay, the Suwannee River and Tampa Bay watersheds in Florida. The Council's draft FPL identifies approximately $38 million in project funding for the state of Florida, which includes $18 million in Florida-sponsored projects and $20 million in other Council Member-sponsored projects. The Florida projects include stormwater, wastewater, and agriculture best management practice projects to improve water quality, living shoreline and oyster reef restoration, and hydrologic restoration projects to improve habitats.

The draft FPL is available for public review and comment through Sept. 28, 2015, at http://www.restorethegulf.gov/.

Should the BP agreement in principle become a reality, the amount of funds available for various Gulf restoration activities associated with the Deepwater Horizon oil spill may exceed $15.8 billion ($8.1 billion for Natural Resource Damages, $5.2 billion for the Gulf Coast Ecosystem Restoration Trust Fund and $2.544 billion for NFWFs Gulf Environmental Benefit Fund). Of this total, Florida might expect to receive over $1.5 billion for restoration activities over the next 15 to 20 years. Given the myriad of problems and the size and breadth of the Gulf Coast, even these enormous sums of money cannot address all ecological and human needs. However, if used wisely, significant, meaningful, and long-term gains can be realized, as evidenced by the projects currently being implemented.

Plastics & Plankton in Tampa Bay

by David Hastings, Eckerd College

Chelsea Trimmer standing beside rosette water sampler with Niskin bottles used to sample microplastics. Photo Credit: David Hastings.

Most of us have seen plastic garbage floating in the ocean, in Tampa Bay and in our rivers. It looks bad, and can cause harm to fish, birds, turtles, and marine mammals that try to eat it, or are caught up in it. But what about plastic so small that we can't see it with the naked eye?

Each spring, for the past 15 years, advanced undergraduate students from Eckerd College have sailed aboard a FIO vessel as part of their class in chemical and physical oceanography. This is a capstone experience for them in their final year of marine science, and integrates what they have learned in marine science classes. Students sample the water, sediments, and large and small organisms that make a living in Tampa Bay. This includes, of course, the microscopic plankton that make up the base of the food web in Tampa Bay and around the world's oceans.

Three years ago, as part of a research project to count different species of plankton, some keen students noticed a brightly colored piece of plastic in the view of their dissecting microscope. Not just one, but several, and in all of their samples throughout Tampa Bay. What was the plastic doing there? How much is there? Does it change from one place to another, or over time? The students decided to include counting the abundance of microplastics into their project. For the past four years, students have been counting the number of these tiny bits of plastic in Tampa Bay.

As it turns out, Tampa Bay is not unique. The discovery of ubiquitous microplastics in our oceans and waterways has highlighted plastic waste as a significant threat to estuarine health. Microplastics result from the breakdown of larger plastics and fishing line, from laundry lint or plastic microbeads added to cosmetic products. Some marine species consume these microplastics, which can cause digestive blockages. Toxic chemicals stick to the plastic, which can also impact the health of filter feeders such as clams, oysters, shrimp and some fish. There is now evidence that microplastic can be taken up and stored by tissues and cells which provides a way for the toxins to go into these marine organisms.

While most of the microplastics are small fibers, students find an occasional plastic bead in their samples. These are likely from a variety of cosmetics, including facial scrubs and toothpaste, which use these plastic microbeads. Particles which degrade easily can be used in place of these plastic microbeads, which last a long time in the environment, and don't break down easily.

Since students first noticed the microplastics in their samples, another group of students noticed that there is a unique microbial assemblage that is associated with the plastic surfaces. What are the bacteria doing on the plastic? Are they breaking it down? Using it as a free ride in Tampa Bay? They are generating more questions than answers, and that's just what good science does.

Getting aboard the *R/V Bellows* and into Tampa Bay for this two-day research cruise is a remarkable introduction to an outstanding natural field laboratory where students can integrate their understanding of marine systems, whether it's counting plankton or microplastics. What will they find next?

Florida A&M University

by Richard A. Long

Florida Agricultural and Mechanical University as the name implies, is a land-grant institution, as specified by the Second Morrill Act of 1890; since then, FAMU has been expanding its foci areas. This includes making a splash in marine sciences and Oceanography. The majority of this research falls under the School of the Environment's NOAA Environmental Cooperative Science Center (ECSC), which is supported by a $15 million grant from NOAA for five years.

FAMU leads the ECSC in collaborations with partner institutions: Texas A&M University-Corpus Christi, Delaware State University, Jackson State University, University of Texas at Brownsville, and Creighton University; and three National Estuarine Research Reserves: Flower Garden Banks National Marine Sanctuary; the Gulf of Mexico Alliance; and, the Gulf of Mexico Coastal Ocean Observing System. The principle goals of the ECSC education and research are:

- Increasing the number of well-trained and highly qualified scientists and managers, particularly from under-represented minority groups entering the NOAA workforce and other resource management entities;
- Improving the scientific bases for coastal resource management and to develop tools and research products to characterize, evaluate, and forecast coastal and marine ecosystem responses to natural and human induced stressors; and,
- Facilitating community engagement related to the function and relevance of coastal ecosystems and the services they provide to society.

"Our education efforts will focus on training and graduating under-represented minorities and will utilize research as a vehicle to educate students, and develop skills relevant to the modern national and global economy," said Michael Abazinge, principal investigator for the award. To date, 212 students of various levels have been supported and received training.

This past July, Maria Cooksey, an ECSC masters student from the University of Texas Rio Grande Valley participated on a mapping cruise aboard the *R/V Okeanos Explorer.* The 15-day cruise was the first leg of NOAA's Hohonu Moana expedition, which mapped the ridges and seamounts near the Johnston Atoll in the Pacific Ocean that had never been mapped before, in order to support future deep sea exploration operations. Maria developed new skills in acquiring and processing multibeam sonar and sound velocity data to create bathymetric images of an ocean floor. This opportunity provided a complimentary area of research, aiding her in understanding the physical science aspect behind her master's thesis, which aims to characterize benthic invertebrate communities on mesophotic reefs

Top: Close-up image of a Hexactinellid or glass sponge, with commensal anemones growing throughout its tissues. Image courtesy of the NOAA Office of Ocean Exploration and Research. Above: Maria Cooksey learns how to collect or georeference a multibeam sonar image on the Okeanos Explorer *,which will help her ROV research on soft coral and invertebrate communities in the Gulf of Mexico.*

on the continental shelf of South Texas. With the experience that Maria gained on the *R/V Okeanos Explorer*, she hopes to be able to continue her work in habitat mapping and ocean exploration. She has recently accepted a position as a biological scientist at the Florida Wildlife Research Institute in Marathon ,Florida, to study the lobster fisheries.

Recently, ECSE faculty and students have been examining the ability of oysters and the microbial community within them to degrade oil contamination, in an attempt to understand how this component of coastal ecosystems, as well as an important fishery in the Gulf of Mexico, may have responded to the Deepwater Horizon oil spill of 2010.

The ECSC also fosters intercollegiate collaborations within FAMU, by drawing faculty from biological sciences, computer and information science, law school, mathematics, and the school of engineering to assist in carrying out its mission of conducting research and training the future work force.

FAU Making Waves at Every Depth

BY LARRY MACKE

FAU's Harbor Branch is set on 144 acres along the Indian River Lagoon estuary. Below: A remotely operated vehicle is deployed during a 2015 CIOERT research expedition in the Gulf of Mexico.

Florida's coastal zones are ground zero for a number of challenges involving our oceans such as sea level rise and all it entails. Florida Atlantic University (www.fau.edu) spans more than 100 miles of the coast, from Ft. Pierce to Dania Beach, and has a broad oceanographic profile that reaches from the watershed to the deep sea. This enables FAU to be a driving force in ocean research and education, investigating and addressing opportunities and challenges in our marine ecosystems while engaging the next generation of researchers.

In addition to having the Atlantic just east of the university's six sites, the northeast edge of the Everglades is only a dozen miles from the main FAU campus in Boca Raton, where Charles E. Schmidt College of Science researchers study the effects of sea level rise and human-caused stressors on the Everglades. The diversion of water from its natural flow path through the center of the state is one of these stressors, and FAU's Harbor Branch Oceanographic Institute (www.fau.edu/hboi) is studying how this is affecting the St. Lucie and Indian River Lagoon (IRL) estuaries, as well as adjacent Atlantic Ocean coral reefs.

Harbor Branch's location on the IRL in Ft. Pierce facilitates a range of research into the ways that land-use choices affect biologically diverse coastal areas. Studies include real-time water quality monitoring (http://fau.loboviz.com), harmful algal bloom source tracking, marine mammal health and conservation, seagrass ecology and restoration, bacterial analysis and water exchange between estuary and ocean. Ecosystem replenishment can help support weakened areas, and Harbor Branch develops land-based aquaculture systems to produce species both for this purpose and for human consumption, which eases pressures on wild fisheries.

In the open ocean, FAU research reaches from the surface to the benthos: from sea turtles and sharks that spark public interest, to nutrient cycling and primary production, to deep sea coral reefs. The NOAA Cooperative Institute for Ocean Exploration, Research & Technology (www.cioert.org), which is headquartered at Harbor Branch, discovers, maps and studies coral reefs; research includes the ways that reefs at different depths may work together to support fish and other species, and which sponges and other organisms might provide new treatments for diseases such as pancreatic cancer, malaria and tuberculosis. The latter is the focus of the Harbor Branch Marine Biomedical & Biotechnology Research Program.

Marine science depends heavily on technology, and FAU engineers have been opening the ocean to researchers for decades. Focus areas at the Harbor Branch and SeaTech (in Dania Beach) research sites include laser and other sensor systems combined with piloted and autonomous vehicles to advance marine ecosystem characterization and exploration.

Accompanying this research is a wealth of educational experiences such as Semester by the Sea, an undergraduate immersion in marine sciences at Harbor Branch that includes an at-sea expedition experience aboard a Florida Institute of Oceanography research vessel. Harbor Branch also has its Summer Intern Program, which is in its fifth decade of providing undergraduate and graduate students from around the world opportunities to work alongside leading marine scientists and engineers.

All of this work is enabled by partnerships with collaborators from around the world who share our ambition to find solutions to human and environmental issues involving the oceans, no matter the depth.

The Fish & Wildlife Research Institute

BY KELLY RICHMOND

A spotter plane is essential in locating aggregations of adult redfish, such as this one off Tampa Bay. Although the aggregation is obvious from 700 feet in the air, these fish can be difficult to spot from the water.

The magnificent resources of the state of Florida support numerous multi-billion dollar industries that form the foundation of our state's economy. Our world-renowned beaches, spectacular variety of fish and wildlife, diverse habitats, and navigable waters attract businesses and visitors alike. There is no mistaking that economic prosperity, quality of life, and the satisfaction of our many visitors depend on a healthy environment. Florida's ecosystems support fishing and hunting, nature viewing, and other recreational and commercial activities easily exceeding $20 billion in value annually.

Despite the natural wonders surrounding us in Florida, too many people view the natural world as somehow separate from their everyday life. This is especially true for young people, many of whom are less connected to the outdoors than in previous generations. The Florida Fish and Wildlife Conservation Commission (FWC) operates under the reality that people are a part of our ecosystems, not separate from them. As one of the most rapidly growing states in the nation, Florida faces many environmental challenges in the years ahead and it is critical that managers adopt forward-looking, informed management policies to protect critical resources and balance competing demands for limited resources. These management decisions must be driven by sound scientific information. Planning and conducting research to provide this information is the core of the Fish and Wildlife Research Institute's (FWRI) mission.

As the research division within FWC, FWRI operates programs statewide that focus on obtaining the wide-ranging data and information needed by fish, wildlife, and ecosystem resource managers. We have established many collaborative partnerships with other government, academic, non-profit, and private fish and wildlife research institutions. Our programs are diversely funded from user fees such as hunting and fishing licenses, specialty license plates, grants, and state general revenue and are organized to rapidly provide the vital scientific information necessary to conserve and protect Florida's precious natural resources.

Red Drum Research In the Eastern Gulf of Mexico

One of FWRI's many fisheries research projects focuses on the state's most popular sport fish: the red drum (Sciaenops ocellatus).

Thousands of adult red drum gather in nearshore waters during spawning season. These aggregations (groups) often swim at the surface and look like a river of flowing gold. Tides carry the offspring into an estuary where the fish spend their first five to six years and are heavily targeted by anglers. This results in heavy fishing of young red drum that have not yet spawned. When blackened redfish became the craze in the 1980s, the red drum aggregations made it easy to catch huge numbers of adult red drum in purse seines. This combination of events caused concern for the sustainability of red drum populations, leading to the closure of red drum harvesting in federal waters in the Gulf of Mexico. Ironically, because the population assessment of marine fish stocks typically depends on commercial landings data, this led to a new problem: The Gulf of Mexico Fisheries Management Council (GMFMC) does not have the data needed to evaluate the status of red drum populations. To address this problem, researchers at the Fish and Wildlife Research Institute initiated a new study which integrates traditional fishing methods (spotter planes and purse seines) with emerging scientific techniques (genetic analysis and acoustic telemetry) to estimate the red drum spawning population size in the Eastern Gulf of Mexico.

Researchers conduct aerial surveys from Tampa Bay to Charlotte Harbor during the spawning season to identify where red drum gather to spawn. They work with fishermen from Cortez, who use purse seines (a type of net) to collect a large number of samples.

Above: A team of 10 biologists and three commercial fishermen work together to capture and process over 1,000 live adult redfish on the deck of the commercial purse boat. Each fish is quickly measured, assessed for gender, and a small section of tail fin is removed for genetic analysis before being released alive.

These samples are needed to genetically characterize individual fish. The fish are also measured for length, and scientists sample their reproductive glands (gonads). The red drum are then released. Each catch is compared to previous data to see how many repeated fish and new fish are caught. Acoustic telemetry uses small sound-emitting tags to track fish movements to the spawning grounds. These tags also record data on the depth the fish swims and the water temperature, allowing scientists to better understand individual spawning behavior.

The research showed red drum aggregations occur in nearshore waters in August and can continue through mid-November. In 2012, researchers observed six aggregations during aerial surveys and 17 in 2013. No aggregations were sighted off Charlotte Harbor during the 2012 sampling season, possibly due to a red tide occurrence. In 2013, aggregations were detected throughout most of the coastal area surveyed. Scientists took biological and genetic samples from 1,800 fish in 2012 (three aggregations) and 3,400 fish in 2013 (six aggregations). Acoustic telemetry data indicated that most fish use a range larger than the area between Tampa Bay and Charlotte Harbor. Spawning site fidelity was high: 92 percent of the fish detected in both years returned to the Tampa Bay area during the spawning season.

Overall, the first year of this project demonstrated the efficiency and accuracy of the research methods. The results confirmed that genetic tagging is a practical and reliable method for individual identification of red drum in capture-recapture studies. The acoustic telemetry results have improved researchers' understanding of how and where red drum travel. Scientists analyzed and recorded the genetic information about each fish to compare to others collected during future sampling events. This data provides insight about how red drum population trends can inform future conservation and management decisions. For more information about this research and other projects from the Fish and Wildlife Research Institute, visit us online at MyFWC.com/Research.

Florida Gulf Coast University

BY DARREN RUMBOLD

Oyster reef restoration carried out by FGCU through outreach to the local community. Photo courtesy of Florida Gulf Coast University.

Sandwiched between the Everglades and the Gulf of Mexico, Florida Gulf Coast University is in a perfect location for a major marine research center that takes a watershed approach to study some of the most productive estuaries in the world including Charlotte Harbor, the Caloosahatchee River and estuary, Estero Bay (the first Aquatic Preserve in Florida), Naples Bay, Rookery Bay and the Ten Thousand Islands. To this end, FGCU established an undergraduate program in marine science in 2002 that combines aspects of biology, chemistry, geology, and physics and applies a systems approach to identifying and understanding the roles that the oceans play in the functioning of our planet. Soon thereafter, an MS program in environmental science was established.

Our coastal resources are invaluable to the character of Florida and its economic vitality. At the same time, southwest Florida coastal resources are being subjected to environmental impacts from human population growth. Accordingly, the university established the Coastal Watershed Institute, comprised of faculty, staff, students and local researchers external to the university, to take an integrated approach in addressing water resource issues from the headwaters down to estuarine and coastal environments. Our faculty and students investigate how the timing, distribution, quantity and quality (TDQQ) of stormwater discharges affect local ecosystems. In particular, we have studied the effect of TDQQ on the recruitment of crabs, oysters, seagrasses and other valued ecosystem components. However, we do not simply alert resource managers to environmental problems, we are part of the solution. Our faculty and students have worked with federal, state and local agencies to restore coastal watersheds from Lake Trafford to Picayune Strand, to assess water quality in the C43 reservoir tests cells, to recommend modifications in water release schedules from Lake Okeechobee, and to develop the Caloosahatchee Watershed Protection Plan.

To serve as a base of operation for educational programs, community involvement and scholarly research, FGCU acquired a waterfront facility in 2007 and established the Vester Marine and Environmental Science Research Field Station. The property consists of three buildings that house dorms, classrooms, wet and dry laboratories, and offices. The site is surrounded by water on three sides, includes 11 boat slips and provides easy access to the Gulf of Mexico. Research activities at the station are varied and include projects such as: studying carbon transfer from oyster reefs and their importance as habitat to estuarine organisms; effects of sea-level rise acceleration on the geomorphology of fresh and brackish water marshes; effects of oil and dispersants from the Deepwater Horizon blowout on oysters; copepods and early-life stages of finfish; trophic transfer of mercury in a subtropical coastal food web; a survey of mercury accumulation in sharks; the use of our saltwater flume to investigate benefits of seagrass on sediment stability, bioaccumulation and depuration of brevetoxins in a variety of organisms; paleotempestology to reconstruct hurricane frequency and strength over long periods of time; impacts of invasive species such as the green mussel; as well as mesocosm-scale and field research on seagrasses.

Because oceanic processes occur at large spatial scales, we also conduct research in the Caribbean, northern Gulf and as far away as the North Atlantic. Of course we also benefit from our membership within the Florida Institute of Oceanography, which allows us access to FIO resources along with other member resources (such as the use of other FIO member vessels when working outside southwest Florida). This enables us to provide our students the experience of collecting measurements and samples offshore and from other locations, including the Florida Keys. For example, over the past decade, FGCU researchers have led many scientific cruises on the *R/V Bellows* in support our research and to provide students in courses such as oceanography, marine ecology, invertebrate zoology and marine chemistry this experience.

Florida Institute of Technology

BY SHELLEY PRESTON

Standing on top of a brambly dune studded with sea grapes and wispy grasses, Florida Institute of Technology professor George Maul tossed a large measuring tape wheel down to the beach.

Buzzing around the dune below on this roasting Florida June day were several seniors. With sweat running down their faces, these oceanography majors were carrying surveying equipment for gauging beach erosion.

Only a few minutes before, Maul, who didn't appear to be sweating in his khakis and green polo, was briskly walking along state road A1A at Ponce Landing in Melbourne Beach to see how other students were faring with measurements in the opposite direction. They had started their work on a particularly rough section of dune covered in prickly palmetto and tangled vines and had made slow and steady progress southward and across the highway, stopping for a reading every 50 paces.

But they were in error.

"They had the differential leveling wrong, so I made them go back to the beginning and start over," he said with a teacher's knowing smile.

This Marine Field Project is a hallmark of Florida Tech's Department of Marine and Environmental Systems curriculum. Maul knows the best way of learning is by doing—sometimes, as his students will attest, by doing more than once. That is certainly the case with beach erosion: Maul and his students have been taking measurements of Florida beaches for 20 years, pitting his findings against historical survey data to gauge what is really happening to the state's diminishing coastline and whether its demise is accelerating or moving at a gradual pace. (Maul says it's gradual, but punctuated by storms).

Now in his 21st year of teaching at Florida Tech, Maul recently stepped down as department head after 20 years with the intention of spending more time in the classroom. That, and actually taking a summer break, which he hasn't done in decades. But in the same breath he mentions a book he's writing (his eighth) and current research projects, which don't exactly give the impression of a man easing into a more leisurely lifestyle.

The 76-year-old Maul's long relationship with the ocean and all of its mysteries began in his youth in New York. Back then he thought he'd become a sea captain. But it was science that ultimately snared him—first as a student at State University of New York Maritime College at Fort Schuyler, and soon after working through the ranks of the U.S. Coast and Geodetic Survey to become lieutenant commander. More than 25 years of lauded work followed as a research oceanographer and later a supervisory oceanographer with the National Oceanic and Atmospheric Administration.

Some of Maul's research was aboard Florida Institute of Oceanography's *Harvey Bellows*, chasing the currents of the Gulf of Mexico for his doctoral dissertation at the University of Miami. Maul's connection to research vessels runs deep: he currently teaches a course called Research Vessel Operations at Florida Tech and is working on a book intended to guide young, ocean-going scientists and engineers around a research craft and its crew.

Maul's research interests include coastal climate and sea level change and tsunami risk in areas facing the Atlantic basin. His tsunami awareness campaign is well known along Florida's Atlantic coast where he has warned for years that communities need far better warning systems and preparedness. He also volunteers with the National Weather Service to create Tsunami Ready programs for communities in east Florida.

And, earlier this year, Maul published his findings about sea level rise around Florida in *Florida Scientist* and *Marine Geodesy* in an effort to paint a clearer picture of how fast the sea is rising. He says that the public's understanding of sea level rise in Florida is inconsistent. "We asked ourselves the question 'what is the rate of rise of sea level and is this consistent with what people are speaking into public records?' Some people are making statements about Florida sea level rise rates that don't square with the observations. We need to all be on the same page."

The résumé is impressive, yes, but Maul always circles back to his students. Beyond the $4 million endowment he helped secure for his department for visiting professors and research students, he's working on securing scholarship funding for the undergraduate summer research program, which includes projects like beach profiling. "We've been doing this for 32 years, and we hear over and over again from employers who hire our students how important that summer is and the quality of work they are able to do when they graduate from the university," he said.

Maul's interest in the ocean doesn't appear to be waning in any way even after decades of picking through its fathoms. Back at the beach, on one of the thousands of teaching days in his career, he stopped to genuinely marvel at a sea turtle track leading to a sandy pit. "Look!" he said, pointing out the creature's trajectory. "There are nests all over the beach right now. Well, I guess this is the season," he said, as he strode along the bottom of the dune. A closer look at one pit revealed a few round, leathery eggs that had been disturbed, some oozing yolk. "Raccoon, probably," Maul said, shaking his head. "But so many nests here!" As gleeful as if it was the first time he'd ever seen one.

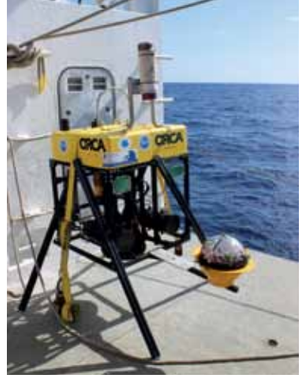
Turning back to the students who were now all on the right track with their measurements, Maul watched the beachside group make its way to the shore break. Two students were holding the level rod steady in the water as another took the reading from the instrument on its tripod. As the waves lapped at the students' ankles, Maul wondered how far out they would be willing to go.

"They could keep going until they are in chest deep water, if they wanted to," he said.

You got the feeling that if it was Maul out there, he'd go in at least that deep.

FLORIDA INTERNATIONAL UNIVERSITY
Marine Science Program

BY HEATHER BRACKEN-GRISSOM



With a student enrollment of over 50,000, Florida International University (FIU) is among the 20 largest universities in the United States. In terms of global rankings, FIU was one of only nine U.S. universities to be named one of the world's best new universities (*Times Higher Education* (*THE*) magazine http://www.timeshighereducation.co.uk/). U.S. News & World Report ranks FIU's graduate programs among the top 25. The Carnegie Foundation for the Advancement of Teaching classifies FIU as a Research University/High Research Activity with annual research expenditures exceeding $100 million.

The Marine Sciences Program is an interdisciplinary program with members from three PhD-granting departments (biological sciences, chemistry & biochemistry, and earth & environment), in addition to the Southeast Environmental Research Center (SERC) and Marine Education and Research Center in the Florida Keys (MERC). During the 2015-2016 academic year, approximately 21 faculty members belong to this program across two campuses (Modesto A. Maidique Campus and Biscayne Bay Campus). Research in the Marine Science Program encompasses a variety of fields and disciplines including coral reef biology and ecology; the ecology of marine megafauna; seagrass biology/ecology; conservation/restoration ecology; wetland ecology, fisheries; microbial ecology; marine genetics; evolutionary biology; and environmental toxicology. The locality of FIU amongst coral reefs, seagrass meadows, and mangrove coastal habitats provides unique opportunity for "backyard" research, teaching and outreach year-round.

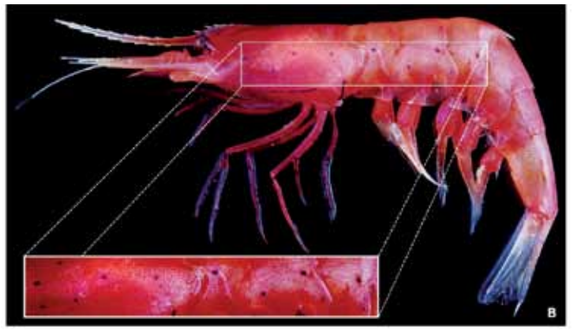
Top: Fig. 4: ROV Explorer and Medusa Lander. Above: Fig. 3: Team of scientists that participated on research cruise.

SOME HIGHLIGHTS OF THE MARINE SCIENCE PROGRAM INCLUDE:

The Marine Sciences Program at FIU is a founding member of the Southeast Regional Acoustics Consortium (SEAC) that conducts acoustics research in the coastal environments of the U.S. from North Carolina to Texas and the U.S. Caribbean.

SERC at FIU has operated one of the longest continuous water quality monitoring programs in coastal ecosystems worldwide with its monitoring program in the Florida Keys National Marine Sanctuary and Florida Bay since 1995 (http://serc.fiu.edu/wqmnetwork/).

FIU operates the world's only undersea research laboratory. The Aquarius Reef Base is run by MERC and is located 60 feet below the surface in the Florida Keys National Marine Sanctuary. Aquarius is a globally significant asset that provides unparalleled means to study the ocean, test and develop state-of-the-art undersea technology, train specialized divers and astronauts, and engage the world's imagination. At Aquarius, scientists are at the cutting edge of research on coral reefs, ocean acidification, climate change, fisheries and the overall health of the oceans.



Left: Fig. 1: Bioluminescent secretion of deep-sea shrimp. Photo: Bioluminescence and Vision, 2015. Above: Fig. 2: Photophores of a deep-sea shrimp. Photo: T.Y. Chan.

FACULTY SPOTLIGHT IN MARINE SCIENCE RESEARCH: DR. HEATHER BRACKEN-GRISSOM

The evolution of bioluminescence and how organisms "see in the dark"

Heather Bracken-Grissom is an evolutionary biologist that uses genomic methods to study the molecular and morphological adaptations of marine invertebrates to extreme environments. After receiving an assistant professor position at Florida International University in 2012, her lab has focused on using genomic methods to study the evolution of bioluminescence and vision in the deep sea.

Bioluminescence is essential to the survival of many organisms, particularly in the deep sea where sunlight is limited. Bioluminescent species depend on the generation of light for communication, feeding and defense. Over 700 genera contain bioluminescent species, 80% of which are marine and depend on the generation of light for communication, feeding and defense. Bioluminescence has been estimated to have evolved 50 or more times among extant taxa, suggesting that the ability to produce light is advantageous to many organisms.

The Bracken-Grissom lab is using genomic methods to test several hypotheses addressing the evolution of bioluminescence and light detection in the deep sea. Decapod shrimp are used as a model organism due to their unique ability to emit and detect bioluminescence. Many deep-sea shrimp exhibit a remarkable mechanism of bioluminescence in the form of a blue luminescent secretion discharged from the mouth (Fig. 1). This luminescent secretion is hypothesized to be a defense mechanism used by the shrimp as a means of startling or distracting potential predators. In addition to secretory luminescence, many species possess a second mechanism of bioluminescence in the form of cuticular photophores (Fig. 2). Photophores are complex, light-emitting organs capable of altering the spectral distribution, angular distribution and direction or intensity of the light emitted. The Bracken-Grissom lab is using DNA sequencing technology to study how these different "modes" of bioluminescence evolved over the course of millions of years within decapod shrimp.

In addition to the evolution of bioluminescence, the Bracken-Grissom lab is also interested in how organisms "see in the dark." They are using molecular methods to explore the visual systems (i.e. eyes) of deep-sea crustaceans, which include crabs, lobsters, isopods, amphipods and shrimp. Specifically, they are interesting in identifying the presence or absence of visual pigment proteins that allow the organisms to see light, and more specifically bioluminescence. These visual pigment proteins are called opsins and previous studies have found evidence that some deep-sea crustaceans have opsins that can detect blue and violet bioluminescent light. The results from this project will allow the researchers to identify the genes responsible for how organisms "see" in the deep sea. Vision and bioluminescence in the deep sea play important roles in predator defense, feeding, and communication, so identifying the molecular underpinnings of this phenomenon is essential for the organism's survival.

In July 2015, the Bracken-Grissom lab participated in a research cruise called "Bioluminescence and Vision on the Deep Seafloor 2015" funded by a NOAA (National Oceanic and Atmospheric Administration) Ocean of Exploration and Research Grant. Bracken-Grissom along with a team of experts in deep-sea invertebrates, vision, and bioluminescence explored depths to 6000 feet in search for new sources of deep-sea bioluminescence and specimens to use in vision studies (Fig. 3). They used specialized equipment such as the ROV (Remote Operated Vehicle) Explorer and Medusa Lander (underwater video camera) to collect and capture footage of deep-sea animals in their natural habitat (Fig. 4). The mission was a huge success and resulted in the discovery of several new species, new sources of bioluminescence and new records for the Gulf of Mexico (http://oceanexplorer.noaa.gov/explorations/15biolum/welcome.html).

Florida Sea Grant

BY DOROTHY ZIMMERMAN

To secure the future of Florida's vibrant economy and healthy coastal environment, it is critical that the state develop a highly educated and trained work force. These individuals will one day embrace new ideas and design the creative management concepts that ensure Florida's ability to compete in a global economy.

As one of the member institutions of FIO, Florida Sea Grant responds to this challenge by providing support for graduate students, in the form of scholarships, fellowships and assistantship funds for students working on Sea Grantfunded research projects.

Florida Sea Grant does not "teach" or "graduate" students in the tradition of an academic department. Support for graduate education is provided through the program's research projects and scholarship programs. Funding comes from both public and private sources.

Over time, this approach has produced substantial results. Recipients of Florida Sea Grant scholarships and fellowships are now working as university faculty members, ocean and coastal scientists at state and federal agencies, science educators and business owners. Many have become national and international leaders in their areas of expertise.

Featured here are some of tomorrow's leaders. These students were chosen for various scholarships and fellowships based on their novel research approaches, their academic rigor and their passion for the ocean.

KAYLEIGH MICHAELIDES

KAYLEIGH MICHAELIDES

Kayleigh Michaelides, a recent graduate of the University of Miami Rosenstiel School of Marine and Atmospheric Science, is tackling coastal issues through policy as a fellow in the Florida Coastal Office of the Florida Department of Environmental Protection. Her fellowship was made possible through a partnership between Florida Sea Grant and that state agency.

During her two-year fellowship, Michaelides has developed projects dealing with areas such as water quality, coastal community resilience, and habitat conservation and restoration. She is currently managing Florida's participation in the Governors' South Atlantic Alliance and the Gulf of Mexico Alliance, which are partnerships among state governors working to sustain ocean resources.

"I believe some of the most pressing issues include sea-level rise and ocean acidification as a result of climate change, habitat loss and degradation, overfishing, coastal and marine pollution, and offshore drilling," Michaelides said. "I believe all of these issues can be tackled by working at the policy and community level. I believe by bridging the gap between science and policy, greater public awareness, legislative support, and participation, these issues can be solved."


MATT DIMAGGIO

MATT DIMAGGIO

Matt DiMaggio, a 2010 recipient of a scholarship from the Aylesworth Foundation for the Advancement of Marine Science, is now an assistant professor of ornamental with the Institute of Food and Agricultural Sciences at the University of Florida.

The scholarship, which assisted DiMaggio while he was completing his Ph.D., is a joint effort of the Aylesworth Foundation, the Southeastern Fisheries Association and Florida Sea Grant. Aylesworth scholarships worth $568,974 have been awarded to 100 students in 14 Florida universities over the past 29 years.

DiMaggio completed his MS and PhD in fisheries and aquatic sciences at the University of Florida, where his research focused on development of the marine baitfish industry in the southeastern U.S. He offered some advice for students working toward a career in research:

"Make the most of your graduate training. Develop a broad foundation in your chosen field and distinguish yourself through productivity and innovation."

MARK LADD

Mark Ladd, a PhD student studying biology at Florida International University, is a 2012 Florida Sea Grant scholar. The program provides financial support to high-achieving graduate or undergraduate students who are enrolled full-time at Florida universities, to support timely and innovative ocean and coastal-related research.

Ladd said the scholarship helped him conduct the first long-term experiment of his dissertation, which focused on the ecology of coral reef restoration.

"We used a holistic approach that incorporated corals, fishes, benthic communities and nutrient cycling to better understand how transplanted coral density influences reef recovery," Ladd said. "This type of work is important for coral reef restoration practitioners, as rearing corals in a nursery is a labor- and cost-intensive operation. These results can be directly applied to improve science-based coral reef restoration methods and maximize the benefits generated from coral reef restoration in South Florida."

Ladd said the results of the experiment are still being analyzed, but preliminary results suggest that corals transplanted at low densities survive better than those transplanted in high densities.

CHELSEA CRANDALL

Chelsea Crandall, a PhD student in fisheries at the University of Florida, is a recipient of the 2014 Florida Outdoor Writers Association scholarship. FOWA scholarships are given each year to college-aged students whose career goals are to communicate to the public an appreciation for hunting, fishing and other aspects of the outdoor experience.

Crandall was chosen for translating her research using short films. She is currently the founding partner of a film company, Ocypode Productions, which makes educational videos about fisheries research.

"I used the scholarship to buy underwater camera housing so we could expand the scope of our storytelling," Crandall said.

Her graduate research focuses on understanding how to better share fisheries science information with recreational fishermen. Crandall's light-hearted documentary about peppermint shrimp research, *Michael and the Peppermints*, was awarded the People's Choice Award at the Beneath the Waves Film Festival.

Crandall's career goals include working at a university so she can combine research and teaching.

"I also want to continue forward with science communication, both through the avenues such as the blog I write for and through future films," she said.

ROBERT ELLIS

Robert Ellis is a 2015 recipient of the Knauss Marine Policy Fellowship. The National Sea Grant College Program and NOAA created the Knauss Fellowship in 1979 to provide educational experiences to graduate students that have an interest in the national policy decisions affecting ocean and coastal resources.


ROBERT ELLIS

Since Florida Sea Grant was established, there have been 54 Knauss fellows from Florida universities.

Ellis, who is earning his PhD in biology at Florida State University, focuses his research on the ecology of red grouper. Although his career goal is to conduct research for a university, he believes the Knauss Fellowship will help him become a better scientist. As a fellow in Washington, D.C., he is serving as the habitat and ecosystems science coordinator in the NOAA Fisheries Office of Science and Technology.

"Engagement with the public and with policymakers is a fundamental requirement of being a good scientist," he said. "I believe that one of the most important ways for scientists to aid policymakers is by synthesizing and communicating technical scientific research."

MARY KATE SWENARTON

Mary Kate Swenarton is a 2015 recipient of the Guy Harvey Ocean Foundation scholarship award. The scholarship, established in 2010 through a partnership between Florida Sea Grant and the Guy Harvey Ocean Foundation, recognizes students at Florida universities whose research focuses on the biology, ecology, habitat or management of fish in Florida's marine environment.

Swenarton, a master's student studying coastal biology at the University of North Florida, is quantifying growth rate and other life history characteristics of invasive lionfish in several different regions of Florida.

"With this information, managers will be able to more accurately estimate population growth," she said. "This way they can determine the removal effort needed to keep lionfish densities under threshold limits."

With the scholarship funds, Swenarton hopes to develop a market demand for lionfish in Jacksonville.

"Developing a lasting commercial market for lionfish in northeast Florida is a goal of mine," she said. "This market could reduce lionfish densities and, as a result, lionfish impacts long term."

FLORIDA STATE UNIVERSITY

Melting Glaciers Have Big Carbon Impact

BY SHAWN STEADHAM

As the Earth warms and glaciers all over the world begin to melt, researchers and public policy experts have focused largely on how all of that extra water will contribute to sea level rise.

But another impact lurking in that inevitable scenario is carbon.

More specifically, what happens to all of the organic carbon found in those glaciers when they melt?

That's the focus of a paper by a research team that includes Florida State University assistant professor Robert Spencer. The study, published in Nature Geoscience, is the first global estimate by scientists at what happens when major ice sheets break down.

"This is the first attempt to figure out how much organic carbon is in those glaciers and how much will be released when they melt," Spencer said. "It could change the whole food web. We do not know how different ecological systems will react to a new influx of carbon."

Glaciers and ice sheets contain about 70 percent of the Earth's freshwater and ongoing melting is a major contributor to sea level rise. But, glaciers also store organic carbon derived from both primary production on the glaciers and deposition of materials such as soot or other fossil fuel combustion byproducts.

Spencer, along with colleagues from Alaska and Switzerland, studied measurements from ice sheets in mountain glaciers globally, the Greenland ice sheet and the Antarctic ice sheet to measure the total amount of organic carbon stored in the global ice reservoir.

It's a lot.

Specifically, as glaciers melt, the amount of organic carbon exported in glacier outflow will increase 50 percent over the next 35 years. To put that in context, that's about the amount of organic carbon in half of the Mississippi River being added each year to the ocean from melting glaciers.

"Although glaciers have low concentrations of organic carbon, the water fluxes from these systems are massive and growing," Spencer said. "The thing people have to think about is what this means for the Earth system. We know we're losing glaciers, but what does that mean for marine life, fisheries, things downstream that we care about? There's a whole host of issues besides the water issue."

Spencer said he and his colleagues are continuing on this line of research and will do additional studies to try to determine exactly what the impact will be when that carbon is released into existing bodies of water.

Diving into Cuba's Scientific Mysteries

BY HAYLEY RUTGER, MOTE MARINE LABORATORY

The United States and Cuba are fundamentally connected by the ocean. Sharks and other fishes, sea turtles and marine mammals migrate between the two nations, which both host coral reefs—"rainforests of the sea."

Both nations have significant marine protected areas and important natural resources that need further scientific study to support management and conservation. However, Cuba—which has protected 20 percent of its coastal environment and has experienced slower coastal development than many other areas—stands out among the Gulf and Caribbean nations for its near-pristine ecosystems and wealth of unsolved scientific mysteries.

This year, an international marine research team dove deeper into those mysteries than ever before.

In February 2015, Mote Marine Laboratory scientists and Cuban and U.S. colleagues placed the first satellite transmitter tags on sharks in Cuban waters, conducted the first coral transplant experiment on a Cuban reef and more. In July, their work was featured front-and-center in Discovery Channel's *Tiburones: The Sharks of Cuba*. Afterward, the spotlight turned to a rare longfin mako shark tagged during the expedition: Tag data revealed the shark had traveled from Cuban to U.S. waters.

Research partners hailed from Mote—an independent, nonprofit, FIO member institution in Sarasota, Florida—from Cuba's Center for Coastal Ecosystems Research, the University of Havana, and other Cuban institutions, and from the Environmental Defense Fund, which organizes U.S.-Cuban collaborations in science and conservation.

Shared Sharks and Corals

The Gulf and Caribbean ecoregion hosts about 20 percent of the world's shark biodiversity, with Cuba at the epicenter, but scientists know relatively little about the status of Cuba's shark populations and their vulnerability to the nation's fisheries. The past 40 years have brought dramatic declines in many shark species. Rebuilding shark populations is critical for ecological balance along with major economic drivers such as fishing and ecotourism.

Many of Cuba's coral reefs have thrived, even though most Caribbean reefs have declined. Science has yet to explain why, or to reveal whether Cuban reefs exchange their drifting larvae with reefs of other nations.

To address these key questions, U.S. and Cuban scientists have needed to overcome the challenges of the multi-decade trade embargo that has severely restricted travel between the two nations. Recently diplomatic relations have improved—which may help increase opportunities for scientific teamwork.

International Dream-Team

For more than 10 years, Mote scientists have been traveling to Cuba and forging collaborations with Cuban institutions, often with the vital assistance of EDF staff who have been developing local relationships in Cuba for more than 15 years. Mote is an independent, nonprofit institution not subject to as many Cuba travel restrictions placed on U.S. state and federal institutions. Mote scientists have been working with Cuban partners to study the nation's sharks and rays, other fishes, marine mammals and corals—and February's expedition advanced their work in exciting ways.

"This expedition allowed U.S. and Cuban scientists to achieve some of the goals we've been dreaming about for years," said Dr. Robert Hueter, director of the Center for Shark Research at Mote Marine Laboratory. "For instance, we had been trying to get permission to deploy satellite tags on sharks in Cuba for at least five years, and we were finally given approval to do that on this expedition, thanks in large part to the great partnership with our Cuban colleagues and EDF. It all came together beautifully."

"Trustful collaboration is the way to go if we want to preserve

our shared resources," said Cuban partner Dr. Jorge Angulo Valdes, director of conservation at the University of Havana's Center for Marine Research. "This expedition showed how much we can accomplish together."

Key Outcomes: Shark Research

During February 2015, the team placed the first satellite transmitter tags on sharks in Cuban waters. Satellite tags can document where sharks travel to better reveal their life histories, habitat use and vulnerability to fisheries.

The team deployed a pop-up satellite tag on a very rare longfin mako shark—one of just a few tagged worldwide and the second tagged by Mote. Since mid-February, the shark departed from waters off Cojimar in northern Cuba, traveled with the Gulf Stream current between Florida and the Bahamas, and then doubled back into the eastern Gulf of Mexico, where it swam in a clockwise loop in April and early May between Florida and Mexico's Yucatan Peninsula. Then in May, the shark swam back along the Gulf Stream, through the northern Bahamas and into deep waters of the open Atlantic, proceeding north until it was offshore of New Jersey in late June. Finally, it headed south to waters off Virginia, and on July 15, its tag popped off and surfaced about 125 miles east of the mouth of the Chesapeake Bay. The total track covered nearly 5,500 miles in five months.

Its travels are raising exciting questions.

"The amazing thing is this longfin mako's tag popped up in nearly the same exact location as another one we tagged in the northeastern portion of the U.S. Gulf of Mexico a few years ago," said John Tyminski, who processed the satellite data and accompanied Mote scientists Hueter and Jack Morris on the expedition. The two longfin makos followed similar paths, and both were mature males.

The sharks might have been drawn to the same area for mating, but satellite tags alone cannot confirm that or rule out other possibilities like feeding or just passing through.

The shark tagged in Cuba spent the majority of its time in depths less than 1,640 feet, but it dove to 5,748 feet, more than a mile deep.

Three silky sharks were fitted with satellite tags in the Jardines de la Reina (Gardens of the Queen) National Marine Park off of Cuba's south coast. Two had pop-up satellite tags that surfaced just over a month later, revealing that the sharks had made movements away from the inshore reef area where they were tagged and into deeper offshore waters, spending most of their time in the upper water column but also diving during the day. One reached a maximum depth of 2,073 feet (632 meters). The third silky shark wears a real-time satellite transmitter that can relay data to scientists when the shark's fin surfaces—but so far it has tended to stay below.

Such findings are valuable. Cuba is poised to develop its first national plan of action for sharks—an effort that is drawing upon the expertise of Cuban scientists, EDF staff and Mote's Center for Shark Research.

"Across the Gulf of Mexico region, our long-term aim is that improved international cooperation, science, and management and the exchange of expertise will lead to the recovery and long-term health of shark populations," said Daniel Whittle, Cuba program director for EDF. "Sharks have been around for 400 million years. We don't want them to disappear on our watch."

Key Outcomes: Coral Research

February's expedition also focused on the spectacular coral reefs in the Gardens of the Queen sanctuary.

"It's incredible," said Dr. Kim Ritchie, manager of the Marine Microbiology Program at Mote. "There are big, beautiful stands of elkhorn coral as far as the eye can see, and schools of fish we're not used to seeing in the Florida Keys."

Ritchie said there's a lot to learn about Cuba's reefs. Elsewhere in the Caribbean, scientists have documented the "genetic fingerprint" of elkhorn corals to understand which corals are related and where their larvae might have started life before settling to grow into adult corals. But in Cuba, the genetics of corals remain largely unstudied, and so do the microbes that can significantly influence coral health.

February's expedition laid groundwork for those types of research and more.

In the Gardens of the Queen, the researchers conducted the first coral transplant experiment in Cuban waters by attaching healthy elkhorn coral fragments to dead coral skeletons to see if they can restore new coral growth to a depleted reef. To observe the results, a return trip to the site is planned.

"We were able to find a piece of coral that had broken off in the good area and transplant it in many small pieces to an area in the desolate stand to see if the drastic difference between the two areas was caused by location or genetics," said Dr. Dave Vaughan, manager of Mote's Coral Restoration Program, who worked with Cuban partners on the coral transplant. "This will tell us if these healthy corals have special resilience to stressors like disease or if perhaps they're in the right location to be less affected by storms. Coral transplant studies are vital for informing reef restoration efforts in Cuba, Florida and the Caribbean."

The team also shared coral survey and sampling methods with the hope of one day partnering to generate some of the first genetic and microbiological data to help better understand these resilient corals. This expedition was key to laying groundwork for the future of U.S.-Cuba coral research.

Partners from this expedition aim to keep working together, strengthening scientific exchange to unlock the mysteries of our shared waters.

New College of Florida

by David Gulliver

It's a beautiful mid-May day on Tampa Bay, off St. Petersburg, perfect for sailing, suntanning and sharks.

Especially sharks, and in this case a blacktip shark, which is exactly what New College of Florida Prof. Jayne Gardiner has her hands full with—quite literally—at this moment.

The year-old shark wiggles in the grasp of Gardiner and a student, unaware that it is part of an effort to help its species thrive.

The professor and her students are part of a consortium of labs around the Gulf of Mexico studying shark nursery grounds. The New College team fishes in Sarasota Bay and Tampa Bay, determining which species are found in what areas, and how that relates to the marine environment.

Gardiner quickly places the shark into a holding tank so it can recover. Then the team quickly brings it out for an examination. They note the species and gender, weigh and measure the shark, and tag it them with a numbered dart tag, inserted into the musculature at the base of the dorsal fin. Within a few minutes, the shark is back in the water and swims off.

"We record the location where each fish was caught, so if a fisherman later catches a tagged animal, we can get an idea of where these animals go and how quickly they grow," Gardiner said.

They also note the location and conditions including water temperature, salinity and dissolved oxygen, visibility, and the type of seafloor structure—mud, sand, rock or seagrass. As they fish, they are looking, in particular, for areas that have relatively higher numbers of newborn or juvenile animals.

New College of Florida students Charlie Edelson and Lisa Crawford with Prof. Jayne Gardiner (at left) study the response of sandbar sharks to electric fields at Mote Marine Laboratory in Sarasota.

The project, headed by the NOAA Panama City Lab, is called the Gulf of Mexico Shark Pupping and Nursery Areas Project, or GULFSPAN. "Accurate knowledge of these areas is critical for successful management of fishery stocks and conservation efforts," Gardiner said.

Shark science, and other areas of marine biology, go on year-round at New College.

Sandra Gilchrist, director of the college's Pritzker Marine Biology Research Center, has long-running projects on the behavior of hermit crabs. And her students have pursued a number of projects, involving both animals and plants, relevant to the Gulf Coast marine environment.

Pollution in lakes and the Gulf of Mexico, and its effects on marine life and migratory birds is a growing concern. Gilchrist's students examined the efficacy of common wetlands plants—blue flag iris, Muhley grass, yellow canna and black needlerush—and how they function in tandem to reduce stormwater pollution.

They found that while the blue flag iris provides color and wildlife attraction to remediation sites, it is not as effective as yellow canna in uptake and sequestration of pollutants.

Restoring seagrass is an essential component of restoring life to Florida bays. Gilchrist's students tested ways to increase the success of seagrass restoration projects.

Seagrasses are sensitive to siltation from construction projects

and to degradation from propeller scars. The students used pre-planted mats of coconut fiber matting, which degrades over time, to keep the newly planted seagrass in place. The matting was most effective in decreasing the in-fill time in areas with large scars to close the gaps more quickly.

Another project looked at one impact of the most common activity on Florida's beaches: How sounds, such as those generated from foot traffic on beaches, affect burrowing behaviors of crustaceans, such as fiddler crabs that perform many ecological services.

Consistent vibrations, Gilchrist said, cause fiddler crabs to recede back to a burrow with consistent vibration, affecting their feeding and social interactions at low tide. However, when the vibration ceases, they will return to the activities, but remain closer to burrow entrances.

And there is still more with sharks.

In January, New College students Charlie Edelson and Lisa Crawford worked at Sarasota's Mote Marine Laboratory examining the sensitivity of the electrosensory systems of adult sandbar sharks.

To test the sharks' perceptiveness, the students created a weak electric field in the Mote lab tank. The sharks typically respond to the field by turning toward the electrodes, on an acrylic plate, and biting at them.

Because the electric field weakens over distance, the students could look at the position where the sharks first orient themselves toward the electrodes to calculate the strength of the field and minimum current that will get the sharks to respond.

They found that the larger sharks are extremely sensitive to weak electric fields, which means that they can potentially detect prey from a greater distance than smaller animals. This has both academic relevance—helping us understand how sharks locate prey, especially in murky water—and commercial importance, perhaps guiding better design of fishing gear that would reduce accidental catching of sharks, a big problem in Florida's grouper and snapper fishing industry, Gardiner said.

The students' work is receiving notice. Edelson and Crawford presented their research in August at the American Fisheries Society meeting in Portland, Oregon.

Gilchrist's student Robert Manley has been researching the behavior of mantis shrimp—better known as "snapping shrimp," or, more infamously, as "thumb-splitter" by divers who have gotten too close. Mantis shrimp can shatter crab shells—or human thumbs—with their claws, that strike as fast as bullets and generate a shock wave in the water.

They are also known for having complex eyes capable of seeing in the ultraviolet range.

Manley monitored infrared light impact during mantus courtship, hunting, predator avoidance and shelter construction and presented his work at the Society of Comparative and Integrative Biology last year.

Another Gilchrist student, Abigail Oakes, did her senior thesis on an offshoot of her marine biology studies. Oakes, an avid sailor, worked with groups of high school students to measure the effectiveness of using the science of sailing to reinforce STEM education.

Education and outreach has been central to marine biology at New College. Gilchrist also runs PUSH/SUCCESS, a summer program that brings middle and high school students, from demographics underrepresented in science, to the college for a two-week introduction to college-style research, lab work, report writing and presentation.

It's aimed at encouraging them to pursue medicine and science for further study and a career. The program, entering its 13th year, has nearly 200 graduates to date.

Marine biology students are a large contingent of the roughly 20 percent of New College students who graduate with a major in STEM fields. One of the most recent is 2015 graduate Melissa Marquez, who came to New College from Miami.

As a girl, she says, she was fascinated with misunderstood predators, and sharks are the most misunderstood of all.

So as a college student, Marquez has spent virtually every summer and vacation studying sharks. She participated in tagging missions in the Bahamas and off South Africa, collecting research that became her senior thesis on the habitat use and migration of 34 great white sharks, examining factors including magnetic fields and fish populations.

Along the way, she founded her own non-profit, Sarasota Fins, to do educational programs in local schools. The website offers teachers bilingual infographics on sharks and the children's books Marquez has written about the creatures.

Marquez, who just returned from a conference in England, is headed to graduate school at for a master's degree in marine biology at the Victoria University of Wellington in Wellington, New Zealand.

She says the research-oriented faculty and program at New College is the reason for her achievement.

"Had I gone anywhere else, I wouldn't have been able to volunteer at Bimini's Biological Field Station just after my first semester of college," she said. "Instead of my advisers meeting my internship in South Africa with skepticism, they embraced it, wished me luck, and provided me resources to study and use. The unique school encouraged my unique love."

NOVA SOUTHEASTERN UNIVERSITY

Halmos College of Natural Sciences & Oceanography

BY RICHARD DODGE

Nova Southeastern University's (NSU's) Halmos College of Natural Sciences and Oceanography (HCNSO) provides high-quality research as well as undergraduate and graduate education programs in a broad range of disciplines, including natural sciences, marine sciences, mathematics, biology (pre-medical, pre-health profession) and chemistry. Located on two southeast Florida campuses: at the entrance to Port Everglades with immediate access to the Atlantic Ocean and at the main campus in Fort Lauderdale.

An integral component of HCNSO is Department of Marine and Environmental Sciences that focuses in the life and earth sciences on issues that concern the ocean, atmosphere, and the land. Opportunities exist at the undergraduate (BS) and graduate (MA, MS, and PhD) levels in marine biology and in environmental science. Coursework includes a wide array of topics from general marine biology, ecology, and geology to molecular biology, and genomics.

In addition to teaching, the Department is committed to excellence in research and service providing a wide variety of opportunities and connections for students. Our graduates have become academic or professional scientists; working in industry, government, non-governmental organizations, or academia as biologists, geologists, physicists, professors and teachers.

Environmental science/studies graduate and undergraduate programs provide comprehensive knowledge of Earth's physical, chemical and biotic systems. The practical application of science, sociology and ethics to solve problems created by the impact of human activity on the environment is emphasized. Areas of study include: wetlands ecology, ecotourism, geographic spatial analysis, sustainability issues, public health and marine biology. Students share a common set of courses in their beginning years to ensure an overview of the subject. Students later select major electives. Undergraduate programs can be completed within a four-year period. An internship is required of all students in this program. The MS program can be completed in two years. There is a thesis and capstone (non-thesis) option.

The marine biology curriculum prepares students for a career or further graduate study. Core courses are in the biological and physical sciences. The curriculum leads to a degree that is designed as a solid basis for entering the field of marine biology, as well as preparation for further graduate study in this area. The program of study focuses on the life processes, environment, ecology and interactions of marine organisms. Offered are BS, MS and PhD programs.

Since formation, Nova Southeastern University's activities at the Halmos College of Natural Science and Oceanography have a long history of conducting high quality ocean research in a variety of topics and disciplines. Initially concentrating primarily on physical oceanography, today the HCNSO faculty, researchers, staff and students pursue studies and investigations in a variety of oceanographic and related fields including marine biology, geology, ecology and physics of the marine realm.

HCNSO faculty and staff are included within four departments (marine and environmental sciences, biology, chemistry and physics, and mathematics). They are academics, professors, researchers and teacher/mentors. Their work is published in the peer-reviewed literature. Much research is extramurally funded through grants, cooperative agreements, contracts, and awards from federal, state, and local governments, from NGO's, and from private organizations and foundations.

Regions of research and study interest include not only Florida's coastal waters and the continental shelf/slope waters of the southeastern United States, but also the waters of the Caribbean Sea, the Gulf of Mexico, and the Antarctic, Atlantic, Indian and Pacific Oceans.

Smithsonian Marine Station

Smithsonian Marine Station at Fort Pierce

by Laura Diederick

The Smithsonian Marine Station at Fort Pierce (SMSFP) is a center for research and education in the marine sciences, specializing in studies of biodiversity and ecology of the marine and estuarine ecosystems of central and south Florida. The facility is a field station of the Smithsonian Institution, administered by the National Museum of Natural History (NMNH). It provides a vital link between tropical and temperate ecosystems in the Smithsonian's coastal network of marine research stations, which includes an array of laboratories and research vessels spanning the western Atlantic coastal zone and across the Isthmus of Panama. SMSFP hosts Smithsonian scientists and their colleagues from around the world, with over 100 scientific visitors annually. With its availability of excellent laboratory facilities and easy access to a variety of marine and estuarine habitats, the Station provides unique opportunities to conduct field research in a region of the continental United States with high marine biodiversity.

The Smithsonian Marine Station is located on the Indian River Lagoon (IRL), an estuary extending along more than one third the length of the east coast of Florida. The IRL is widely recognized as one of the most diverse estuaries in North America and has been designated by the Environmental Protection Agency as an Estuary of National Significance. This region of Florida's coast, characterized as a transitional zone where temperate and tropical waters overlap, offers access to a great variety of habitats and an extraordinary diversity of both temperate and tropical species. The variety of habitats in the lagoon ranges from mangroves, salt marshes, and seagrass beds to sand and mud flats, and intertidal oyster beds. Along the coastal shores of the barrier islands, which separate the lagoon from the Atlantic Ocean, are long stretches of sandy beaches, and in the nearshore waters, paralleling the shoreline, are a series of ridges formed by coquina outcrops, which in shallow waters provide a substratum for sabellariid worm reefs. The broad continental shelf with its sandy plains and shoals extends offshore to the Florida Current, a component of the Gulf Stream System. Along the edge of the continental shelf just to the north of Fort Pierce and continuing northward for 167 km is a unique Oculina coral reef formation. Located at depths from 70-100 m and consisting of pinnacles 3-35 m in height, this unusual deep water ahermatypic (lacking zooxanthellae) Oculina reef formation has been recognized by the National Oceanographic Atmospheric Administration as a Habitat Area of Particular Concern. In addition to the diversity of habitats found locally, the Florida Keys, home to the only living tropical coral reefs in the continental United States, are within a few hours of travel.

The facilities at the Smithsonian Marine Station include an 8,000-square-foot building containing laboratories for histology, chemistry, microscopy, electrophoresis, and DNA studies, and offices for use by resident staff, visiting scientists, and postdoctoral and pre-doctoral fellowship recipients. Specialized equipment in these laboratories includes recirculating seawater systems, temperature-controlled aquaria and incubators, equipment for preparing tissues for light, confocal and electron microscopy, an ultra-cold freezer, equipment for electrophoresis, a thermocycler for DNA amplification, high-performance liquid chromatographs, a gas chromatograph/mass spectrometer and a UV-visual spectrophotometer. For microscopic studies, equipment is available for light, epifluorescent, and Nomarski microscopy, photomicrography, macro photography, video recording and editing, inverted microscopy, and scanning

Dr. Andrew Altieri, a researcher at the Smithsonian Tropical Research Institute (STRI) in Panama, samples on an oyster bed in the Indian River Lagoon during a field expedition to refine sampling protocols for the Smithsonian's Marine Global Earth Observatories (MarineGEO) initiative.

confocal laser microscopy with enhanced computer operated image analysis system. Our 2,400-square-foot storage building includes an expanded shop with new power tools, including a commercial quality vertical bandsaw, horizontal bandsaw and drill press. An outside shade house is also available for experiments in growth studies of vascular plants. A wet laboratory with flow-through seawater system piped from the Fort Pierce Inlet greatly enhances the ability to maintain marine organisms and conduct experiments.

The Marine Station owns four boats for use in field studies: a 17-foot Boston Whaler and 21-foot Carolina Skiff for research within the Indian River Lagoon, a 21-foot center-console boat to access nearshore waters, and a 39-foot vessel, the *R/V Sunburst*, which is used in the offshore waters of the continental shelf and Florida Current for dredging, trawling, coring and plankton tows.

In 2015, the Smithsonian marked 44 years of research in Fort Pierce and 15 years of operation at its location on South Hutchinson Island along the Fort Pierce Inlet. The current location of the research campus has allowed the Smithsonian Marine Station to increase and strengthen the breadth and diversity of its research and to attract new collaborative interactions. In October 2012, the Smithsonian announced the formation of the first worldwide network of coastal ecological field sites to standardize measurements of biological change. The Smithsonian Marine Station is one of four sites within the Tennenbaum Marine Observatory Network that will launch the project. By studying these sites with the help of Smithsonian experts and collaborators in biology, ecology and anthropology, and using technologies like DNA sequencing, the project will provide an unprecedented understanding of how marine biodiversity is affected by local human activities and global change, such as ocean warming, acidification and rising sea levels.

In the service of the Smithsonian's ongoing mission for both the increase and diffusion of knowledge, the Smithsonian Marine Station at Fort Pierce supports a robust education and outreach program. Central among these efforts is the Smithsonian Marine Ecosystems Exhibit, housed at the St. Lucie County Aquarium. The live displays are more than just fish tanks, they are functioning model ecosystems, accurately representing the diversity and complexity of marine and estuarine life on Florida's east coast. Smithsonian staff and researchers were also actively engaged in community outreach, offering monthly tours of SMS, coordinating several large-scale events, and hosting community events throughout the year.

For more information on the resources available at the Smithsonian Marine Station, or to inquire about reserving laboratory facilities, please contact Dr. Valerie Paul at paul@si.edu.

Top: *The experimental ocean acidification (OA) system at SMS. This array of 12 independent, temperature controlled aquaria is connected to an automated CO2-dosing system that allows scientists to examine how marine organisms respond to different temperature and CO2 levels.*
Middle: *Researchers from throughout the Smithsonian met at SMS to launch the Tennenbaum Marine Observatories Network (TMON), a long-term, worldwide research program focusing on understanding coastal marine life and its role in maintaining resilient ecosystems.*
Bottom: *A mangrove tree crab, Aratus pisonii, right at home on the prop root of a red mangrove, Rhizophora mangle. The 2-cm crustacean is preyed on by birds, terrestrial mammals and larger crabs but can scuttle along at one meters per second to evade predators.*

Many in central Florida call Dr. Walters the "The Oyster Lady" because she has been promoting the importance of restoring the eastern oyster Crassostrea virginica on the east coast of Florida long before it became an accepted practice.

UNIVERSITY OF CENTRAL FLORIDA

The Oyster Lady

BY ZENAIDA KOTALA

The tiny, mushy mollusks usually slurped up at local bars and restaurants may be the eco-friendly heroes that end up saving Brevard County's Indian River Lagoon.

Knee-deep in murky water for several hours this week, community volunteers, Brevard County Natural Resources employees, Brevard Zoo employees and University of Central Florida students worked alongside UCF biologist and professor Linda Walters deploying "gardened" oysters into the lagoon with hopes they will take root and help clean the waterway.

Amid periods of rain and sunshine, the teams deployed hundreds of oysters in pilot reefs along key sections of the lagoon in Melbourne Beach, Port St. John and Merritt Island. The UCF biology students and Walters will monitor the growth and health of the oysters to see if they flourish and start filtering the lagoon's water. Oysters can clean up to 50 gallons a day for their 20-year life span with no ill side effects. If the experiment works, they could end up being the answer to the pollution that's hit the lagoon in the past few years.

The lagoon runs for 156 miles through five counties including Volusia and Brevard and has an estimated economic impact of $3.7 billion per year. But the Brevard portion of the lagoon—which includes the Indian and Banana Rivers—has seen a severe spike in pollution, which reeks and has been linked to allergic reactions among some nearby residents. The pollution also creates multiple algae blooms each year that kill fish and potentially the other creatures that eat the contaminated fish.

Walters has been studying intertidal oysters and their role in the natural ecosystem for the past 17 years in Volusia County in the Mosquito Lagoon—the northern portion of the Indian River Lagoon system. With the help of the Brevard Zoo, she and a team of more than 40,000 volunteers have established 68 oyster reefs in Mosquito Lagoon since 2007, providing substrate for more than 6.9 million oysters. In Canaveral National Seashore waters, these restored reefs now boast more than 700 live oysters per square meter. The location of all restored reefs were set on the historic footprints of reefs lost within the past 50 years because of boat and wind wakes dislodging the oysters and pushing them out of the intertidal zone.

To see what was possible in Brevard County, where the number of historic oyster reefs is very limited, Walters teamed up with Brevard County Natural Resources and Brevard Zoo. With $500,000 from the state, the team is tackling three issues: whether the oysters will grow in the lagoon, whether those oysters can be used to create oyster reefs in the lagoon, and finally, an analysis of how successful the oysters are at removing nitrogen and phosphorus from the water.

Oyster gardening began in January in Brevard County when the zoo began offering two-hour workshops. Volunteers were shown everything they needed to grow the baby colonies under docks.

This week was the first time the volunteers delivered their fully grown oysters for planting in key areas along the Indian River Lagoon. The results thus far of the gardening project were positive. There were many more adult oysters than the organizers expected. Volunteers enjoyed good-natured competitions for largest oysters (4.7 inches), most oysters (gardeners from Malabar), and all sorts of questions and comments about the associated biodiversity. The volunteer gardeners talked about what they encountered raising their oysters, such as barnacles, crabs and shrimp.

The zoo will continue to offer oyster gardening workshops as part of the project with hopes of having 1,000 gardeners preparing oysters for introduction into the lagoon by the end of 2015.

"The zoo's mission is wildlife conservation through education and participation and this project perfectly embodies that mission. We are educating Brevard County residents about the importance of oysters to our lagoon and are empowering them to join us in our conservation efforts to save the lagoon," said Sammy Anderson, lagoon restoration specialist at the zoo.

Despite success in the Mosquito Lagoon, this project is not a sure bet.

"A primary focus is testing if we can build oyster reefs in locations where there is no historical footprint of oysters," Walters said. "That's our role in this project. It's very exciting."

Walters and her students will monitor the oysters for weight gain, growth and survival, as well as salinity, water temperature and other indicators through March. Depending on the results, the experiment may be expanded to others parts of the lagoon.

The University of Florida

BY PETER SHENG & JESSICA LONG

The University of Florida has a long history and strong foundation in marine science and oceanographic research and education, distributed among the main campus in Gainesville Florida and two advancing marine laboratories at the picturesque coastal towns of St. Augustine on the Atlantic coast and Cedar Key on the Gulf Coast. At the main campus of Gainesville, marine and oceanographic research and education take place at the College of Engineering which houses the graduate program of coastal and oceanographic engineering, the College of Liberal Arts and Sciences which offers a BS program in marine science as well as graduate programs in geology, biology, and zoology, and the Institute of Food and Agricultural sciences which houses an interdisciplinary ecology graduate program as well as a fishery program. UF scientists focus on research and education in physical, chemical, biological, and geological aspects of marine and oceanographic science and engineering: including coastal and estuarine processes and exchanges; marine geochemistry and sedimentary processes; storm surge and coastal inundation; climate change and impact on coastal and marine systems; coastal resilience and climate adaptation; harmful algal bloom; and ecosystem services; etc. UF marine and oceanographic scientists and engineers have significant research support from NSF, NOAA, Office of Naval Research, U.S. Integrated Ocean Observing System, NIH, U.S. Fish and Wildlife Service, U.S. Geological Survey, Florida Sea Grant, as well as numerous Florida agencies. UF scientists are engaged in the Consortium for Ocean Leadership (COL), South East Coastal Ocean Observing Regional Association (SECOORA) and the Gulf of Mexico Coastal Ocean Observing System (GCOOS). In addition, UF is the host of the Florida Sea Grant. At the two coastal laboratories, UF scientists are looking at key issues facing Florida, our environment and our health using marine animals and cutting edge research techniques at these two locations. The Whitney Laboratory for Marine Bioscience in St. Augustine, and the Seahorse Key Marine Laboratory on a small island off Cedar Key in the Cedar Keys National Wildlife Refuge both operate under one umbrella of the University of Florida's Whitney Lab. In the following, we highlight the activities of these two UF Coastal Laboratories.

Through a 200-gallon-a-minute sea water system that pumps from the Atlantic Ocean, the Whitney Lab takes advantage of its unique location to offer over 60 scientists and staff a glimpse into evolutionary biology and as well as how animals interact with their environment using vision, hearing and their sense of smell. Proximity to marine life and using advanced molecular imaging techniques allows researchers to understand more about how animals develop and adapt to their changing environment, including neural pathways involving learning and memory. Through research at Seahorse Key, they also seek to learn how changes to our coasts are impacting the environment through coastal geochemical research, research on mangrove populations and carbon cycling, Seahorse faculty also focus on mutualist relationships between colonial nesting birds and snakes, and ecological phenomena associated with island

biogeography and terrestrial marine transitions.

This would not be possible without significant research support through key initiatives led by scientists at the laboratory; for example Director Mark Q. Martindale's work with the starlet sea anemone Nematostella vectensis looking at how life forms may have grown, developed and regenerate is sponsored by NASA and the National Institutes of Health. Ever fascinated by biodiversity and nature's solutions to key problems, Dr. Martindale and his colleagues are looking across many organisms and using experimental embryonic techniques . He and his team discovered a stem cell counting mechanism responsible for important factors in adult body plans of

marine organisms. This research also has human implications as cell count by the embryo is a critical part of development failures of which can lead to cancer.

Dr. Leonid Moroz's research into evolution of the comb jelly and how memory works has led to recent ocean voyages to sequence marine organisms at sea. Even with fantastic sea water systems, many fragile marine animals do not make it to the laboratory for study. With the help of a 141-foot yacht loaned as a research vessel for this purpose, Dr. Moroz and his team recently sequenced over 22 organisms, including rare comb jellies. Moroz has put together a mobile lab that can be placed onboard that can be linked by satellite to UF's high performance supercomputer, the HiPerGator. His research is also expanding into looking at the memory of Cephalopods, and he recently was awarded National Science Foundation (NSF) funds to support this new line of research. His research group with new private support will be setting out to conduct more on-ship sequencing this fall with the UF Alumni loaned vessel, the 141-foot *Copacetic*.

Inspiring and training future scientists is a key commitment of the Whitney Laboratory and its Gulf Coast partner Seahorse Key Marine Lab. Currently, graduate study is through each faculty's home department, and students can complete their graduate degrees at Whitney in biology, in the School of Medicine's Interdisciplinary Program (IDP), engineering, the Department of Cell Science in the College of Agriculture, and soil and water sciences in the College of Agriculture and Life Sciences.

Both Labs have a commitment to inspire youth to pursue science and have active K-12 STEM marine science programming that serves over 4,600 area youth in 8 counties. Hands-on science classes are held at Whitney's 17,000-square-foot Center for Marine Studies, which opened in 2007, a teaching and conference center that was made possible by generous Whitney trustees, private donations and matched by state dollars. At Seahorse Key Marine Laboratory, Coastal Science classes are held for area youth, as well as summer camps for students from the Bronx, making full use of the *R/V Discovery,* a 42-foot custom built research vessel operated by the marine laboratory.

The next wave... Whitney's Research Village design and build is underway to expand housing for visiting scientists and students to conduct research collaborations and training at this interdisciplinary research institute. In two years, it will be embarking on a capital campaign to build a new cutting edge Academic Research Laboratory Building for the growing research team. Whitney Lab is also partnering with the local conservation community to open a Sea Turtle Research and Rehabilitation Hospital this fall. Seahorse Key Marine Laboratory is partnering with others at the University and other colleges to conduct more coursework on the island as well as continue its outreach programs on Cedar Key. A new two-coast Marine Conservation Graduate Student Fellowship will be starting next year for graduate work on mangrove expansion, biodiversity and biogeochemical cycling, bringing the two laboratories together in key issues facing Florida while training future scientists to help us address tomorrow's challenges.

UNIVERSITY OF MIAMI

New Research Facility Transforms UM Rosenstiel School Campus

BY DIANA UDEL

One thousand gallons of seawater is being pumped every minute into research laboratories at the new Marine Technology and Life Sciences Seawater Complex located on the University of Miami's Rosenstiel School of Marine and Atmospheric Science campus. Research in two critical focus areas—air-sea interactions and marine life science—is being conducted inside the 86,000-square-foot LEED-certified facility. The seawater-equipped complex supports groundbreaking ocean and atmospheric research on hurricanes, coastal structures, marine life, and human health and disease, and more.

Alfred C. Glassell, Jr. SUrge-STructure-Atmopshere-INteraction lab (SUSTAIN) in the Marine Technology Life Sciences Seawater Complex at the University of Miami Rosenstiel School of Marine and Atmospheric Science. Photo credit: Gort Photography.

When you first enter the new building, you will arrive at the one-of-a-kind Alfred C. Glassell Jr. SUrge-STructure-Atmosphere-INteraction (SUSTAIN) tank, a 38,000-gallon research facility capable of simulating 3-D wind-wave flow and surge produced by category-5 hurricane force winds in complex coastal conditions. It's the only laboratory in the world capable of generating such high force winds in a 3-D test environment over water. SUSTAIN provides scientists and engineers with a unique test site to study how hurricanes intensify to improve prediction and forecasting models, and the impacts of extreme weather conditions to improve the design of coastal structures. The facility offers a realistic, but controlled environment to conduct tests on the next generation of building materials that can withstand more intense storms, and to engineer new ways to prevent water intrusion in buildings. This research is critical to improve our understanding of extreme weather events, and their impacts on our coastal communities to help minimize damage to homes and businesses and the loss of lives in vulnerable coastal regions around the world in the face of climate change.

According to the National Weather Service, "storm surge is often the greatest threat to life and property from a hurricane." The destructive power of storm surge, along with rising sea levels, places our community and coastal structures at even greater risk.

Having access to this type of state-of-the-art research laboratory, scientists from around the world can develop and test new technologies to improve hurricane intensity and coastal storm surge forecasts to protect communities from the greatest impacts of these storms. UM researchers are using the facility to conduct the advanced studies on extreme weather that are necessary to improve hurricane intensity forecasts and design more resilient and sustainable coastal structures.

Marine Life Science

The Marine Life Sciences building, also located within the Marine Technology and Life Sciences Seawater Complex, provides a dedicated space for the study of marine animals, the critical connections between oceans and human health, and the impacts of evolving climate on marine organisms and ecosystems.

The Marine Life Science Center brings together the Rosenstiel School's internationally recognized research in tropical marine biology and biomedicine under one roof. The Center provides a

dedicated space for maintaining and studying living marine animals, including several species of fish and corals. The space also houses the National Institutes of Health-funded National Resource for *Aplysia*, the only facility in the world that cultures and raises sea hares (*Aplysia californica*) for scientific research in aging, memory and learning. A recently published study by UM Rosenstiel School researchers on *Aplysia* is helping to better understanding the underlying mechanisms of the nervous system that contribute to age-related memory loss in humans.

Researchers are also conducting research on the impacts of oil spills on fish. The RECOVER team (Relationships of Effects of Cardiac Outcomes in fish for Validation of Ecological Risk) recently received a $9 million research award from the Gulf of Mexico Research Initiative (GoMRI) to conduct further studies on the impacts and toxic effects of crude oil on ecologically and commercially valuable fish that reside in the Gulf of Mexico. The RECOVER team will conduct marine life studies at the molecular, cellular, organ level and whole animal physiology, as well as behavioral studies at different life stages for two important Gulf of Mexico fishes, the coastal redfish and the pelagic mahi-mahi. Previous studies by RECOVER consortium members showed that fish embryos and larvae exposed to crude oil during early development results in malformation of hearts, which likely results in mortality or reduced cardiac performance in surviving individuals. The RECOVER team also recently published a study that showed that such surviving individuals display reduced swimming capabilities.

Another recent marine life study by UM Rosenstiel School scientist Claire Paris was the first to document that fish larvae produce sound. This is a true discovery as it reveals the existence of a communication system for young fish larvae.

Cutting-edge coral reef research, for which the Rosenstiel School is renowned, is focused on helping to assess and measure the effects of climate change and ocean acidification on global reef-building processes. Two recent studies by UM Rosenstiel School researchers are shedding light on the future of corals in the face of climate change. One study from Professor Chris Langdon's team found that critically endangered Staghorn coral benefit from supplemental nutrition to mitigate the adverse impacts of global climate change. The results are the first to document that an endangered coral species, which was once found widely throughout South Florida and the Caribbean, can buffer the effects of increased CO_2 in the ocean by increasing feeding rates.

The second study from Associate Professor Andrew Baker uncovered why some threatened Caribbean star corals "swap" algae partners to help them recover from bleaching events. The findings are important to understand the fate of coral reefs in a warming ocean.

UM was awarded a $15 million grant from the National Institute for Standards and Technology (NIST) of the U.S. Department of Commerce for the new Seawater Complex, which is funded by the American Recovery and Reinvestment Act (ARRA). Generous gifts from the Marta Weeks Family, G. Unger Vetlesen Foundation and the Ambrose Monell Foundation made the construction of the Marine Technology and Life Sciences Seawater Complex possible.

Preview the Marine Technology Life Sciences Seawater Complex video, *A Momentous Transformation* at: https://www.youtube.com/watch?v=mUXis-CQGIA.

University of North Florida

BY COURTNEY HACKNEY

The Environmental Center at UNF provides trips for students to learn about the St. Johns River which flows through downtown Jacksonville.

The University of North Florida (UNF) is situated near the Atlantic Ocean, lower St. Johns River and the Intracoastal Waterway—no other university in the country has all of these coastal habitats in such close proximity—which makes it an ideal location for the Coastal Biology as well as Coastal and Port Engineering programs. Both programs are located in state-of-the-art academic facilities, nestled on 1,381 acres amid beautiful lakes and 12 miles of nature trails, which features more than 500 types of plants and hundreds of animals, some even threatened or endangered. UNF has an average enrollment of more than 16,000 students and provides them with a personalized, hands-on education, offering small-class sizes that average 32 students, with a student-to-faculty ratio of 20:1.

UNF boasts six Flagship programs including coastal biology. These programs were selected for Flagship status because of their excellence in the scholarly accomplishments of their faculty. The Department of Biology hosts the Coastal Biology Flagship program. Within the various degree tracks, or concentrations, students can pursue interests in marine biology or ecology through specialized electives and field/lab experiences with professors. The Department of Biology is the largest science department at UNF and boasts six different academic concentrations, three devoted to the biomedical sciences and three oriented around the coasts and oceans. Students with defined interests in various areas of environmental science and an interest in employment immediately after graduation find the Coastal Environmental Science track best fits their interest. This degree program allows a student to explore other academic interests, e.g. environmental law or business, while gaining a solid foundation in science before graduation. Students more interested in research, advanced degrees or students who are uncertain of their career path find the coastal biology or ecology & evolution tracks best fits their needs. The Department of Biology prides itself in offering close contact between faculty and undergraduate students, which translates into 70 percent of graduates having spent time with faculty on research programs or in an internship. Many undergraduates are co-authors of scientific papers presented at meetings in the U.S. and around the world. A wide variety of jobs await UNF's coastal biology students upon graduation in the local region as well as around the state and country. A high percentage of graduates in coastal biology concentrations also move on and gain advanced degrees. The Department of Biology also offers Master of Science and Master of Arts degrees. Most graduate student research revolves around the coast. For additional information, visit the Department of Biology website at http://www.unf.edu/coas/biology/.

One of the new programs at UNF is the coastal and port engineering concentration, housed in the College of Engineering within the Civil Engineering Program. This program offers a rare opportunity for students to gain experience in solving a wide array of coastal and oceanic problems upon which the coastal communities and industry rely.

UNIVERSITY OF SOUTH FLORIDA
The College of Marine Science

BY ELLEN PRAGER

The mission at the USF College of Marine Science is to increase the fundamental knowledge of global ocean systems through research and graduate education with emphasis on assessing and predicting the impact of human-ocean interactions.

Deepwater Horizon Oil Spill

The College of Marine Science has been a leader in tracking the Deepwater Horizon oil spill, determining its subsurface extent, toxicity and ecosystem impacts. With a $20.2 M renewal grant, USF is now working with 18 collaborating institutions in five countries to advance our understanding of the processes and mechanisms involved in marine blowouts and their environmental consequences.

Is that really grouper on your plate?

Dr. John Paul and his collaborators have developed GrouperCheck, a handheld DNA sampler and analyzer to fight fish fraud. The mislabeling of fish is now recognized as an immense and costly problem. With plans to expand GrouperCheck technology to other seafood, these scientists are creating innovative ways to combat the problem.

Red tides

Scientists at USF, including Drs. John Walsh, Chuamin Hu, Chad Lembke, Jason Lenes, and Bob Weisberg, are working hard to better understand harmful algal blooms and their impacts. Red tides occur on Florida's west coast and can negatively affect human health, marine life and the shellfish industry.

This is an image of a massive 2005 red tide event from Frank Muller-Karger's remote sensing group created by processing data from NASA's Aqua satellite.

How do we assess fish populations?

Working with his students and collaborators, Dr. Steve Murawski has developed and tested an innovative towed camera system to assess the abundance and habitat requirements for reef fish populations on the West Florida Shelf and elsewhere.

Antarctic researchers in South Florida?

With the addition of several new faculty, USF has created a Southern Ocean Group to study warming, sea level rise, ice sheet collapse and glacial melt in Antarctica. Understanding these processes, past and present, will allow us to better prepare as sea level rises. This is especially important in South Florida where the low-lying coast makes the region especially vulnerable to flooding and other impacts. Other important areas of research include coral reefs, remotely operated vehicles and gliders, invasive lionfish, regional sea level rise and flooding, changing oyster populations, real-time access to ocean observations and coastal ocean circulation modeling.

Master's and PhD programs are offered in:

Biological oceanography, chemical oceanography, geological oceanography, physical oceanography and marine resource assessment.

Outreach and Education

The College also strives to contribute to the community and K-12 education through its active outreach and education programs, including the St. Petersburg Science Festival, Oceanography Camp for Girls, Spoonbill Ocean Science Bowl, Professional development and field courses for teachers, Marine Debris Clean Community Partnership and FL Teen SciCafé.

University of South Florida, Tampa Campus

BY VALERIE J. HARWOOD

The Department of Integrative Biology (IB), located on the University of South Florida Tampa Campus, is home to more than 700 undergraduate and 50 graduate students. A research faculty of 18, plus eight postdoctoral research associates conducts ecological and evolutionary research in marine, freshwater and terrestrial ecosystems. Undergraduate students have the opportunity to participate in research projects of the faculty. The diversity of faculty interests is reflected in undergraduate curricula that support a broad selection of marine and environmental coursework, with majors in marine biology, environmental biology, and environmental microbiology. The undergraduate programs are supported by three instructors who work closely with the other faculty members to develop innovative teaching methods (Prevost) and enrichment opportunities for majors. Among these enrichment opportunities for students interested in marine biology is an underwater research methods course conducted each summer in Curacao [2 photos of students diving]. A newly-developed undergraduate program in biosecurity is set to be introduced this year.

We have placed IB research into broad thematic groupings

to effectively illustrate its linkages with FIO emphases. One such grouping involves research on WATER-BORNE POLLUTANTS AND PATHOGENS. Potential environmental effects of the Deepwater Horizon oil spill in the Gulf of Mexico are the subjects of several current research efforts in IB. One research group, for instance, is examining the effects of the oil spill on beach food webs in Tampa Bay (Bell). Another research group is exploring changes in the genetic diversity of the common salt marsh plant *Spartina alterniflora* (smooth cordgrass) in Louisiana following the spill, as well as the contaminant's impact on gene expression in the plant species using cutting-edge microarray technology (Richards). These studies form a portion of the research carried out by these groups in seagrass, salt marsh and mangrove systems. In other coastal and freshwater systems, IB faculty study the movements and toxic effects of agro-chemicals (Rohr), the survival and proliferation of pathogenic bacteria (Harwood), and the effects of reclaimed water used for lawn irrigation on the chemistry and biota of soils (Lewis).

CLIMATE CHANGE.

Questions about the effects of climate change on ecosystems drive the research of many IB faculty. IB is developing a graduate certificate program in agricultural biosecurity with a grant from the USDA (Rohr, McCoy, Mushinsky). The associated research focuses on the impacts of climate change on insect plant pests. Plants may also have altered phenotype (observable characteristics) due to climactic conditions, and understanding the role of epigenetics in phenotypic plasticity (variability) may allow mitigation of damage to crops and ecosystems (Richards).

Temperature variability associated with global climate change has (and will have) potentially profound impacts on host-pathogen interactions and the spread of disease, which has been documented in amphibian populations (Rohr). As CO_2 levels rise, effects on food webs are anticipated, and IB researchers are studying the phenomenon in coastal scrub forests (Stiling). The world's oceans, and the many billions of tons of carbon sequestered there, are a focus of research on global climate change. Dr. Scott studies the ways in which autotrophic marine bacteria concentrate CO_2 in order to efficiently produce the organic compounds they require for growth (carbon fixation). This type of fundamental research increases our understanding of carbon cycling by microorganisms, which may ultimately be the key to mitigating the effects of increased CO_2 emissions on global climate change.

PHYSIOLOGICAL ECOLOGY

How do "complex systems evolve in the face of changing and conflicting functional demands" (S. Deban)? The function and evolution of animal movement has captivated biologists for centuries. Biomechanics (e.g. the interaction of the muscle and skeletal systems) and physiology are overlapping and complementary areas that contribute to our understanding about how animals move, and how these systems evolve (Deban).

A number of IB faculty work on questions about how physiological adaptations of organisms contribute to their success, whether they are predators, such as sharks, or prey, such as copepods. The success

of these animals depends on a complex interplay of physiology and behavior within their respective habitats. Sharks and rays (elasmobranchs) share a common ancestor with early bony fishes in a lineage that diverged over 400 million years ago. Their diverse, and sometimes unique feeding mechanisms provide a fertile area for study of the function and evolution of feeding systems in fishes and aquatic vertebrates (Motta).

The interactions of marine organisms with the surrounding physical fluid environment influence predator-prey relationships, as well as large-scale ecosystem and evolutionary processes. State-of-the-art, high speed imaging techniques such as particle image velocimetry (2D) and holographic cinematography (3D) captures feeding, mating, swimming, and migratory activities, providing new insights into the effects of fluid dynamics and turbulence on their lives (Gemmell).

Imagine a sea slug that "steals" the photosynthetic machinery (chloroplasts) from an algal symbiont and uses them to make its food [sea slug photos]. This phenomenon, observed in *Elysia chlorotica*, represents a ground-breaking discovery of gene exchange between sea slugs and algae (Pierce).

DISEASE ECOLOGY

The impact of infectious disease on populations and on ecosystems is included in the research area of many IB faculty. The ecology of the "flesh-eating" marine bacterium Vibrio vulnificus is complex, involving multiple habitats and several routes of infection for humans. Climate change and pollution may increase the prevalence of this frequently lethal pathogen (Harwood). Other disease ecology emphases with broad implications for all ecosystems include the influence of the vertebrate immune system on invasiveness (Martin), effects of herbicides and pesticides on the susceptibility of vertebrate hosts to infection (Rohr), mathematical modeling and epidemiology of disease patterns (Johnson).

INVASIVE SPECIES

Invasive species are a major threat to ecosystems worldwide. Understanding the principles that govern characteristics that contribute to invasiveness, as well as those that inhibit or mitigate invasion, will help preserve species and ecosystems. Research approaches in IB include the effects of herbivory (Stiling), a conceptual framework for understanding invasion (Fox), the influence of the immune system, physiology and behavior on invasiveness (Martin), and epigenetic influences on plant invasiveness (Richards).

CONSERVATION AND RESTORATION.

Tampa Bay seagrass bed were decimated by increasing nutrient pollution up until the 1970s. Work by ecologists coupled with pollution relief via upgraded wastewater treatment plants has contributed to a major comeback in this ecological resource, which

provides a nursery for many important aquatic species, as well as contributing to water clarity and conversion of pollutants to seagrass biomass. The mangrove communities rimming Tampa Bay provide many of the same benefits. Broad-ranging studies of the effects of urbanization and anthropogenic activities on these resources and their associated fauna have contributed to a better strategies for preservation and restoration (Bell).

POLICY

Translating science into action and policy takes time, exceptional communication and patience. Current and emeritus IB faculty help develop policy for ecosystem and resource management at the local, state and national level (Crisman, McCoy, Ogden).

UNIVERSITY OF WEST FLORIDA
Generations at Sea

University of West Florida

BY WADE JEFFREY

University of West Florida Professor Wade Jeffrey began his oceanographic career on the *R/V Bellows* as a graduate student in 1982 at the University of South Florida. It was that early teaching cruise for his Biological Oceanography course that convinced him that yes, oceanography was indeed what he wanted to do. During his graduate studies he participated in six additional research cruises aboard the *Bellows*. Flash forward to 1997 when he became an assistant professor at UWF and recognized the value that the *Bellows* had on his own education, he set out to bring the ship to Pensacola to support the courses he was now teaching, including biological oceanography and oceanographic techniques.

The *Bellows* supported ten teaching cruises for Dr. Jeffrey's courses. One of the students who went to sea was Katherine Edwards, now a high school science teacher in Santa Rosa County. As the value of the *Bellows* was recognized, other UWF faculty incorporated it into such courses as coral reef ecology, marine vertebrate biology, and marine invertebrate biology. UWF became the second biggest user of FIO ships. Because typical marine biology majors at UWF now might make as many as six trips aboard the *Bellows* by the time they graduated, Jeffrey looked for a different student audience and created a new dual enrollment oceanography course, which targeted outstanding high school students in the Pensacola area for a hands-on oceanographic learning experience. One of those students was Katherine Edwards 'sown daughter, Hannah Edwards, who took part in the 2011 course.

Katherine Edwards and Adelyn Benz and their puffer fish aboard the RV Bellows

After the Deepwater Horizon oil spill in 2010, Jeffrey teamed up with fellow UWF professor Richard Snyder and turned his use of the FIO vessels to oil spill-related research. Between 2011 and 2014 they lead 20 research cruises in the northeast Gulf of Mexico where four graduate students earned their MS degrees and approximately 20 more undergraduate students participated in sample and data collection. The FIO vessels have an excellent history of serving UWF students in high-impact learning practices and providing the skills and experiences for future generations of oceanographic researchers.

It wouldn' t surprise us one bit if Dr. Wade Jeffrey's eyes were shut behind those sunglasses. He handles niskin bottles so often it's second nature swapping out hardware.

Clearwater Marine Aquarium

by Lisa Oliver

Acoustic Studies on Turtles

Clearwater Marine Aquarium (CMA), a marine life rescue center, is embarking on a research project involving acoustic studies on sea turtles. The current knowledge of Green and Kemp's Ridley sea turtle hearing does not deem whether sea turtles have the ability to detect noise in the marine environment nor does it tell us if we can estimate the effects of noise exposure on sea turtle behavior and hearing. CMA seeks to find that out. We have a unique opportunity, in that we have sea turtles that have been trained to approach targets and show promise for being used to collect a behavioral audiogram.

The significance of this study is that it can lay the foundation for future, more comprehensive studies of sea turtle sensory processes. The data will provide information on how broad-band noise masks the hearing of sea turtles and will also allow determination of how natural ambient noise may mask sea turtle hearing.

A Hawksbill turtle glides through the water with a satellite transmitter fixed to its carapace. Photo: Jake Levenson.

Sea Turtle Fibropapilloma Study

Clearwater Marine Aquarium is embarking on a study to examine the role of the chelonid fibropapillomatosis-associated herpesvirus (CFPHV) in sea turtle fibropapillomatosis (FP). The virus has been around for years, with much research, yet the cause is still unknown. Additionally, there has never been a vaccine created to treat this potentially fatal virus. CMA is looking into DNA studies and the genetic makeup of FP virus in an effort to create a vaccine that will ultimately treat the virus.

Saint Petersburg College Partnership

Over the past decade, CMA has conducted otter trawls of Clearwater Harbor and the Clearwater Bay estuary. During the otter trawls, fish and invertebrate counts are conducted. CMA has 54 sampling sites in the estuary.

Clearwater Marine Aquarium recently initiated a collaborative study with St. Petersburg College (also an associate member of FIO) and Dr. Linae Boehme with the creation of a new research internship for SPC students. This internship provides an opportunity to work on one of CMA's vessels and to participate in the otter trawls while also working through the trawl data, analyzing it to determine species riches, species abundance and seasonality trends over the 10-year period. In addition, the study is looking at the reproductive success of fisheries significant species, as well as indicator species.

Wild Dolphin Study

Clearwater Marine Aquarium has also initiated a dorsal fin photo identification study in late 2013 to document the ecology of the bottlenose dolphin population of Clearwater Bay and Clearwater Harbor. Incidental photos of dolphins are taken during eco boat tours conducted by CMA using National Oceanic and Atmospheric Administration (NOAA) Dolphin SMART guidelines.

Like a human fingerprint, no two dorsal fins are exactly the same. Each dorsal fin has its own unique shape, height, thickness, markings and notches. A dolphin's dorsal fin acquires various scars and markings during the dolphin's lifetime. Because of their unique nature, pictures of dorsal fins are used to identify wild dolphins. Individual identification of members during photo ID studies assist with the attainment of information on group structure, site fidelity, movement patterns and population size. The Clearwater Bay and Clearwater Harbor study will also further serve in the understanding of the extent of human activity and its impact on the resident dolphin populations. The data obtained from this study will aid in the making of informed conservation and management decisions regarding dolphins and dolphin habitat for the west-central Florida dolphin populations. Clearwater Marine Aquarium's study aids in covering the gaps with current studies along the west-central coast and will serve to assist similar dorsal fin ID programs already in existence to better understanding the nature of Atlantic Bottlenose Dolphin populations on a much larger scale.

Most recently, we had the fortunate sighting of a dolphin, Troy, that was successfully rehabilitated by CMA in 2006.

The Florida Aquarium
Inspiring the Next Generation of Environmental Stewards

by Debbi Stone

While The Florida Aquarium has been building upon its efforts to expand research and conservation, primarily focused on coral, sea turtles, sand tiger sharks, and ecosystem health, a large past, present and future focus is on education. Whether working with the pre-school students to discover what resides in their own backyards or engaging with high school students in robust lab programs, or engaging visitors of all ages in our exhibit galleries or partnering with local colleges and universities to provide student internships, the Aquarium strives to promote education as a means to fulfill our Vision to Protect and Restore Our Blue Planet.

In the fall of 2014, two grants enabled the Aquarium to implement a year-long program for 10 Title 1 elementary schools (60% or more of students qualify for the free or reduced lunch program) in Hillsborough County. With three years of funding in place, we completed our first year-long program in the 2014-2015 school year and have embarked on a second year with a new group of fifth graders (though many of the teachers with whom we are working are returning to the program with their new, incoming fifth graders). A NOAA-funded B-WET grant (Bay Watershed Education and Training) and a U.S. Environmental Protection Agency–Gulf of Mexico Program Regional Partnership Program grant has enabled us to implement Watershed Investigations: Engaging Youth in Exploring Climate Change in Tampa Bay and the Gulf of Mexico. Reaching approximately 1,200 fifth graders each year, our goal is to inspire a generation to become lifelong, scientifically literate citizens through providing an opportunity to engage in hands-on science and exploration, something many of the students have never done before.

How is climate change impacting the Gulf region now? How will it affect people, flora, fauna and habitats in the future? Watershed Investigations explores these vital questions while focusing on the health of Tampa Bay and Gulf of Mexico and introducing youth to local watersheds, climate change and the role students can play in protecting our water resources.

Students gather data to capture a snapshot of current conditions at the Florida Center for Technology and Conservation, a unique partnership among the Aquarium, Tampa Energy Company and the Florida Fish and Wildlife Conservation Commission. This site in Apollo Beach features diverse watershed habitats that students study to then use critical thinking skills to predict how climate change will impact their region in five years as well as 50 years from now. Activities and curricula align with state science standards and Principles of Climate Change Literacy.

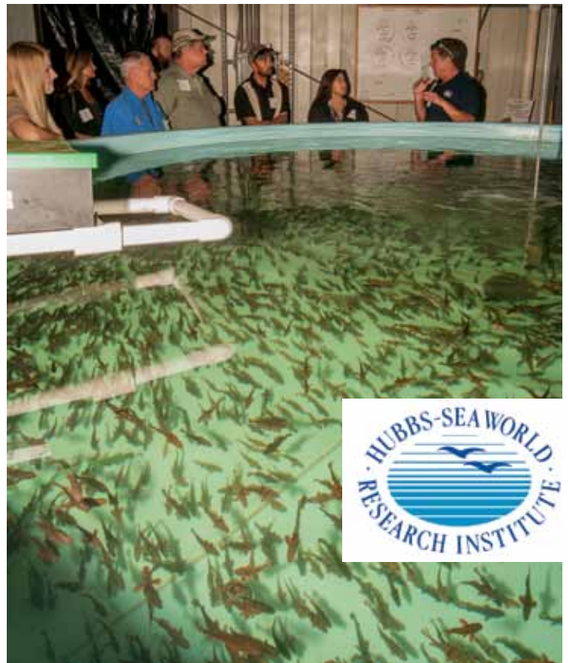
A small crab offers a big pinch of curiosity for this Florida Aquarium student who learns from Senior Education Manager Tristin Ware.

Hubbs-SeaWorld Research Institute

BY STEPHANIE ROBITAILLE

Hubbs-SeaWorld Research Institute (HSWRI) is a public, non-profit charity dedicated to providing effective solutions to conflicts that arise between human activity and the natural world. Hubbs-SeaWorld scientists apply sophisticated technologies to seek solutions that protect and conserve marine animals while benefiting humans and their reliance on marine resources. The Institute also recognizes the critical importance of scientific literacy as a foundation for competing in the highly technical and competitive global economy, and strives to provide innovative education programs to promote scientific literacy among our children and young scientists. The Institute was founded in 1963 to conduct research in the tradition of world-renowned scientists, Dr. Carl L. and Laura C. Hubbs. Since our founding ,our charter has been: "To return to the sea some measure of the benefits derived from it."

Hubbs-SeaWorld Research Institute operates three laboratories in California and Florida with a focus on four core areas of research: aquaculture, bioacoustics, ecology and physiology. We work on a variety of marine and terrestrial species including birds, seals and sea lions, polar bears, killer whales, dolphins, whale sharks and important fish species. The unique relationship between the Institute and SeaWorld parks allow scientists and students to conduct research that cannot be reproduced anywhere else. Likewise, our unique skill set and bicoastal locations allow our scientists to have a wide-ranging effect on both the understanding of coastal and marine species and the conservation of habitats throughout the United States. Work in Antarctica and throughout the Pacific allows our expertise to be applied to global conservation issues.



The Institute has been operating in Florida since the late 1970s when a team of researchers first began to study the dolphins of the Indian River Lagoon (IRL). The IRL is widely recognized as the most diverse estuary in North America and is considered one of the most important places in the Southeastern United States because of its importance as an economic and biological resource for tourism, recreational fishing and wildlife habitat. The IRL is currently at the forefront of conservation concerns due to long-term impacts of disturbance to the system. Changing water quality and other impacts have influenced the system such that there has been a reduction in seagrass coverage, reduced water clarity, increasing harmful algal blooms, and mortality events in a variety of species including fish, pelicans, manatees and bottlenose dolphins. HSWRI is a leader in a collaborative effort to understand the impacts of these effects on the biodiversity of the lagoon. We regularly collaborate with neighboring groups such as the NOAA Fisheries' Southeastern U.S. Marine Mammal Stranding Network, the FFWCC's Florida Wildlife Research Institute, and universities including the Florida Institute of Technology and Florida Atlantic University, and our zoological partner, SeaWorld Orlando.

Our current focus in Florida is on the population of bottlenose dolphins in the IRL and the adjacent beaches. Since 2001, there have been four Unusual Mortality Events that have impacted the local dolphin populations. The IRL stock of dolphins is particularly vulnerable because it represents a small and resident population, which depends on the lagoon for each individual's lifespan. HSWRI is leading the way to discover the cause and effect of the die-offs on the IRL dolphins. To do this, we employ a variety of techniques including aerial and boat-based surveys with robust study design, recovery and in-depth examination of stranded dolphins, rescue and tracking of sick or injured animals, and comprehensive population modeling to understand long-term trends in population structure.

Results of our research are regularly published in peer-reviewed journal articles, but the strength of these studies lies in our ability to communicate these scientific findings to the managers and agencies responsible for monitoring the health of the ecosystem. We recognize that in order for these data to be applied to conservation, they must we passed on to multiple stake-holders. The Institute has a strong and growing focus on education and citizen science: each year, we participate in dozens of outreach events, student projects and community events to engage the public. At the heart of our work is a dedicated group of trained volunteers that participate in all aspects of our lab and field work. Our team of scientists, students and volunteers work together to provide the fastest and most comprehensive response to critical events along the east coast of Florida.

Jacksonville University

BY QUINTON WHITE

Marine Science Research Institute at Jacksonville University opened in 2010 as a Gold certified Leadership in Energy and Environmental Design (LEED) facility as part of a planned complex focusing on the St. Johns River. The goal of the university in establishing the new institute was to provide a premier biological and environmental research and education facility.

The MSRI is situated on the riverfront portion of JU's 200+-acre campus. The MSRI's ground floor provides dedicated space for work with live specimens in ambient temperatures. The second level contains teaching and research labs, classrooms, meeting areas and a screened observation deck. The building boasts several innovations in sustainable consumption, including rain water harvesting for wastewater processing and boat wash down, a wetlands system for storm water treatment and extensive use of recycled building materials.

While the primary emphasis is hands-on biological research and study, the MSRI's programming also incorporates elements of chemistry, physics and physical science, as well as life sciences, which collectively help further students' knowledge of the environment and sustainable practices to preserve the future. The MSRI is home to the Millar Wilson Laboratory for Chemical Research, the Florida Fish and Wildlife Conservation Commission Laboratory and the offices for the St. Johns Riverkeeper. These industry professionals perform diverse studies of local freshwater, estuarine and saltwater conditions, and then work closely with professors and students to connect concepts in the classroom with applications in the workplace.

Recently, the MSRI added the *R/V Larkin* to its programming. A Coast Guard-certified pontoon research vessel, the *Larkin* is JU's own "floating classroom," fully equipped with on-board lab stations and capable of accommodating classes of up to 28 students. This innovative teaching space brings students out of the traditional classroom setting onto the St. Johns River and into the vast natural laboratories available for observing river life up-close.

These unprecedented hands-on research experiences naturally foster success in undergraduate and postgraduate fields. Undergraduate students can obtain either a Bachelor of Science (BS) or Bachelor of Arts (BA) degree in marine science. On a graduate level, JU offers Master of Science (MS) and Master of Arts (MA) degrees in marine science.

Research at the MSRI has been far ranging from nearshore to oceanic, from coral reefs to diamondback terrapins to

oceanographic drifters.

Dr. Dan McCarthy's research, in collaboration with Drs. David Vaughan (director of Mote Marine Laboratory in Summerland Key, FL) and Michael Childress (Clemson University, SC), investigates the role of reef fish in affecting coral health. The previous paradigm has been that overfishing of parrotfish throughout the Caribbean has decreased the intensity of herbivory on macroalgae to the point where algae grows profusely out competing corals for space. The resultant effect is that corals are drastically reduced in abundance, which concerns coastal managers and fisherman, and affects coral reef ecotourism. However, recent, yet very limited, research suggests that parrotfish may sometimes feed directly on the corals themselves thereby resulting in reef degradation. In the Florida Keys, Mote has observed parrotfish feeding on coral transplants that they deploy to restore degraded reefs. Therefore, parrotfish may sometimes positively or negatively affect coral reef health. Consequently, in order to better understand the factors that affect coral reefs as well as more effectively manage transplant restoration techniques, it is essential that the herbivore, algae & coral interactions are studied for the geographic area concerned.

Every classroom should be like the 48-foot long R/V Larkin *bringing the lecture to the environment.*

Danielle D'Amato's graduate research project with Dr. John Enz has focused on diamondback terrapins. They are the only brackish water species of turtle found in North America uniquely adapted to variable environment of saltwater marshes and estuaries. Due to commercial harvesting for food in the early 20th century, the population was severely reduced, but prohibition saved this species because the sherry used in their preparation was no longer available. Diamondback terrapins are a keystone species to wetlands and marshes in the U.S. As important components of the saltmarsh ecosystem, it is necessary to inventory and monitor populations throughout their range.

No previous population study exists on the diamondback terrapins on Cumberland Island. The main purpose of their study is to provide baseline population data that will be used for the continued long-term monitoring and management of this species on the Island. Another major objective is to identify the active nesting sites on the Island and make recommendations for protection, if warranted.

Danielle spent her summer living on Cumberland Island in search of diamondback terrapins. It was an adventure in heat, humidity, ticks, and mud with her days traversing the marshes and creeks looking for nests, tracks, and of course, actual terrapins which are much better suited to existence in the marsh than a graduate student, and proved to be highly elusive.

The oceanographic marine drifters used by Dr. Jeremy Stalker's physical oceanography class were built out of polyvinyl chloride (PVC), wood, canvas and other flotation devices with a global positioning system (GPS) attached to the top of the construction. These drifters were released just offshore from the mouth of the St. Johns River and allowed to move with the ocean currents. They are designed to keep the bulk of the apparatus under water so wind is a minimal factor in influencing the movement. Once released, the GPS transmits the position of the drifter up to eight times a day for up to eight months depending on battery life. These projects are designed to benefit the student, and to advance our understanding of the mechanics of the ocean to aid in modeling for everything from coastal erosion, sea level rise and fisheries management.

One drifter, "Wilson," was an old volleyball with a GPS unit on top. Identification information, messages, phone numbers, and JU bling were added in case the drifter washed ashore somewhere in the Atlantic. The drifters are not expected to be recovered and the GPS and the unit are usually lost in the course of the study.

This data in added to global models of ocean currents, and is tracked using the Google Earth program. The drifter project is maintained by the National Oceanic and Atmospheric Administration NOAA and is available on the web for access to the drifter data (http://www.nefsc.noaa.gov/drifter/). The drifter was launched with two others (that sank or beached), and is still transmitting as of September 2015.

SANIBEL-CAPTIVA CONSERVATION FOUNDATION

Sound Science Surrounds Sanibel & Captiva Islands

BY ERIC MILBRANDT, PHD, DIRECTOR

In southwest Florida, many people move to enjoy warm water, sunshine and abundant opportunities to get out on the water. Boating and fishing in the protected waters of Pine Island Sound and the waters surrounding Sanibel and Captiva islands are a close runner-up to the beaches, which are world-class destinations for shell collectors. Bird watching is also very popular because of the J.N. "Ding" Darling National Wildlife Refuge and is also the physical location for the Sanibel-Captiva Conservation Foundation (SCCF) Marine Laboratory.

The SCCF Marine Laboratory opened its doors in 2003 because of increasing concerns about water quality, declines in biodiversity and habitat losses. The Marine Lab was founded on the principal that science and research are necessary to inform the public and decision-makers about resource management. The SCCF Marine Laboratory has focused on applied research about the estuary and Gulf of Mexico and have included studies about the causes of stranded macroalgae on the beaches and the nutrient sources that cause contamination and algae blooms. In 2007, the SCCF Marine Lab started the River, Estuary, and Coastal Observing Network (RECON) to provide real-time salinity, temperature and other optical properties (e.g. turbidity, chlorophyll, fluorescent organic matter). The network informs weekly technical calls about the condition of the estuary with water and resource managers.

More recently, scientists at the SCCF Marine Lab have pioneered mangrove, oyster and submerged aquatic vegetation (SAV) restoration techniques. Heavy volunteer investment and meticulous scientific study have resulted in restoration of oyster reefs, a resource with 90% loss in the region due to poor water quality and development. Some 500,000 mangrove propagules were used to restore a 125-acre embayment on Sanibel with some 1,500 hours of volunteer participation. These efforts plus the excellent publication record have solidified the SCCF Marine Lab as an authority on the marine environment and has attracted $4 million in grant awards since 2003. Follow us on Twitter @SCCF_Marine_Lab or like us on Facebook.

SRI International

by Grant Palmer

SRI International is a non-profit research & development institute with a mission to develop world-changing solutions to make people safer, healthier and more productive. Our legacy of achievements includes the first computer mouse and interactive computing, drugs for malaria and lymphoma, the first telerobotic surgical system, the U.S. HDTV standard, the U.S. Department of Education technology plan, and much more.

SRI's research and development is focused on: advanced technology and systems, biosciences, education, and information and computing sciences

In addition to R&D, SRI moves its work from the laboratory into solutions. We develop new products, license our technology, and spin off ventures. We also form strategic partnerships and offer a set of innovation programs.

Our Menlo Park, CA headquarters in Silicon Valley, south of San Francisco, is complemented by locations throughout the U.S., plus Japan and Greenland.

The SRI Marine & Space Sensing (MSS) Laboratory in St. Petersburg, Florida is part of the Advanced Technology and Systems Division and the Ocean & Space Systems Center. The MSS Laboratory provides tailored sensing solutions for harsh, remote, and access-limited environments ranging across deep ocean, near-shore & inland waters, the atmosphere and space.

Key capabilities include:

Sensors & Instruments: R&D of in situ applications in air/ocean/space

- Engineering research & development from science to product
- Industry-leading small size/weight/power extreme environment sensors for liquid & gas chemical/biological analysis
- Tracking systems with micro-optical tags

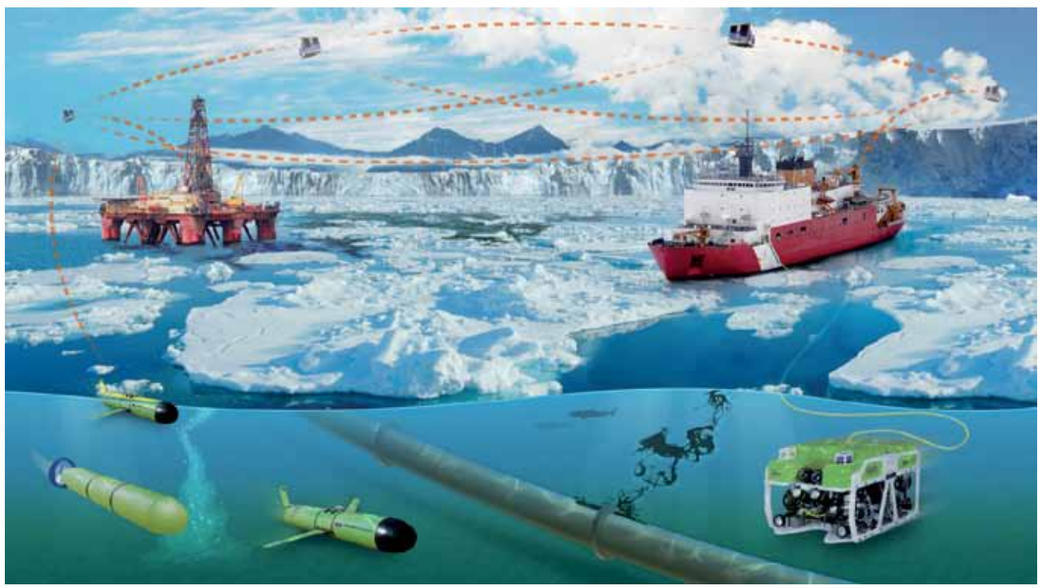
R&D of Ocean Systems, with Marine Operations for T&E Support

- SRI/MSS is an unbiased prime contractor for early concept definition and platform/element selection phases on new system development programs
- Broad ocean systems development, integration & test capability for missions including environmental awareness, oil & gas applications, and defense/security
- Technology expertise & unique sensor tools significant for autonomous air/surface/underwater vehicles and space systems
- Cost-effective facilities, equipment, staff, and ocean test range for marine operations
- Unmanned vehicle integration and in situ data processing expertise backed up by greater-SRI software, autonomy, RF communications, bioscience and robotics resources

Research projects for ocean environmental science

- Unique sensor technology and customized integrated systems
- Successful track record of cost-effective research missions across the world's oceans

SRI Marine & Space Sensing Laboratory in St Petersburg, FL: Tailored sensing solutions for harsh, remote and access-limited environments.



St. Petersburg College

by Linae Boehme

Professors at St. Petersburg College conduct research on local marine environments. A vital part of our research is the involvement of undergraduate students.

Dr. Monica Lara and Dr. Heyward Mathews head up a multi-year research project comparing offshore artificial reefs with natural reef ledges. The first part of the project studies the effects of artificial reefs on the abundance and diversity of organisms in the surrounding sediments. The second part deploys larval light traps to study the recruitment of settling organisms to artificial reefs. The light trap project looks for trends in the types of recruits, their life stages as well as the impact of seasons on the supply of settling organisms. Our students participate in all aspects of the research. They collect samples from reef sediments and light traps. Under the direction of Dr. Lara, students identify the organisms in each sample. While the light trap research is currently being conducted offshore, students are designing modified traps for use in shallower mangrove environments.

Reef Monitoring, a non-profit group started by the above professors, involves students in campaigns to combat the invasive lionfish. Through their involvement in Reef Monitoring's Lionfish Safari, students collect samples from lionfish for further study of life-history characteristics, feeding, growth and habitat use.

Thanks to the opportunities for collaboration offered by FIO, Dr. Linae Boehme-Terrana is working with the Clearwater Marine Aquarium to investigate seasonal variations in fish populations in Clearwater Harbor, Florida. Not until after the BP oil spill did the scientific community realize that we lacked basic information about many Gulf of Mexico estuaries. This collaborative project works to fill that gap. Students not only collect new data but also analyze historical data.

St. Petersburg College is also looking forward to expanding student opportunities at the Bay Pines STEM Learning Center. The facility is located on the intracoastal waterway in Seminole, Florida. Construction is set to begin in the summer of 2015.

UNIVERSITY OF SOUTH FLORIDA ST. PETERSBURG

What does invertebrate research at the USFSP look like?

BY HEATHER JUDKINS

Invertebrate research is well underway at the University of South Florida, St. Petersburg! Cephalopod researcher, Dr. Heather Judkins, oversees an active research lab that in a typical semester is used by undergraduates, graduate students and visiting scientists. The focus of much of this research is on cephalopods—the octopods, squids and their relatives.

Undergraduate biology students have worked on a variety of invertebrate projects through the USFSP biology program including: examining the impact of warmer temperatures on Ribbed Mussels (*Geukensia demissa*), documenting the distribution and abundance of benthic octopods in the Gulf of Mexico, examining the regeneration rates of a brittle star species (*Ophiocoma echinata*), and various projects involving DNA sequencing to learn the process as it relates to cephalopod phylogeny.

Undergraduate marine biology students experienced life at sea on the *R/V Bellows* as a part of a long-term biodiversity survey that Dr. Judkins began in 2012. Students learn about sampling techniques that are used by researchers at sea and collect data for the project along the way. Back in the classroom, students use past and current data to discuss any changes that might have been documented on the West Florida Shelf.

Two new graduate students joined the lab this year, Brenna Meath and Amanda Sosnowski are starting their master's projects this semester, both involving cephalopods. Both are co-advised by Dr. Judkins and Dr. Mya Breitbart and Dr. Ernst Peebles from the USF College of Marine Sciences. Brenna will be examining inshore squid (*Doryteuthis sp.*) eye lenses and Amanda will be working with cephalopods from the northern Gulf of Mexico, focusing on barcoding and genetic diversity within species groups.

Cephalopod biogeography, taxonomy and phylogeny have been the focus for Dr. Judkins's research since 2003. She is a co-principal investigator of the Deep Pelagic Nekton Dynamics of the Gulf of Mexico (DEEPEND) Consortium which investigates the genetic, species, and population diversity of the midwater column (surface to 1500m) using a multiple opening and closing net system over a three-year period.

All the invertebrate projects conducted in the lab are made possible by the support of USFSP, USF College of Marine Science, GoMRI, the Florida Wildlife Research Institute and FIO. All of the partners are essential to the successful invertebrate program, allowing undergraduate and graduate students to further their education through research experiences, which will provide them a solid foundation for future educational and employment opportunities.

Starting back left: H. Judkins, R. Cuba, S. Bruzek, A. Burnham, Gabriella Chisari, Britini Copeland, Tiffani Coleman, Erin Walters, Karsen Lonzo.

Roffer's Ocean Fishing Forecasting Service, Inc.

BY MITCH ROFFER

Roffer's Ocean Fishing Forecasting Service, Inc. (ROFFS™) is a scientific consulting company based in West Melbourne, Florida, that is involved with fisheries oceanography and environmental science. Founded in 1986 by Mitchell A. Roffer, PhD in Miami, Florida, we are best known for our tactical and strategic fisheries forecasts that are the result of the integration of satellite and other fisheries oceanographic data. However, we are intensively involved a broad range of projects from ship routing, oil and gas drilling operations, seismic and fish surveys, fisheries development, aquaculture, environmental monitoring and applied scientific research.

Oceanographic Fishing Analyses

All of our operational fish forecasting products are designed to allow fishing vessels to concentrate their fishing effort in the most productive waters to increase operational efficiency. The analyses incorporate numerous factors including water temperature, water color, orientation of local currents, history of ocean fronts, bottom topography, biological quality of the water (chlorophyll, plankton, clarity, colored dissolved organic matter, etc.), forage preference of the target species, availability of forage, as well as, habitat preference of the forage and target species.

Our analyses have been used successfully by commercial, professional tournament, recreational fishermen and researchers for a variety of fish species including tuna, marlin, sailfish, swordfish, mahi, wahoo, shark, mackerel, sardine, anchovy, pilchard, herring, bluefish, squid, as well as, cod and hake.

Fisheries Research

ROFFS™ continues to work on numerous fisheries related consulting and research projects. Some of these have involved bluefin tuna, other tunas, mahi, billfish, sharks, squid, pilchard, including work on migrations, daily movements, population dynamics and reproductive ecology in both domestic U.S. and international waters. In addition, we have been involved in marine mammal population surveys and stranding investigations along the U.S. east coast and in the Gulf of Mexico. The research involves providing real-time oceanographic analyses operationally to a variety of federal and state governmental, as well as academic researchers. We have conducted research related to new fisheries development in waters off the Azores, Oman, Libya, South Africa and United States (Hawaii). ROFFS™ also provides services for aquaculture site evaluations and penning operations. We are presently involved in a collaborative research project with National Marine Fisheries Service that is primarily funded by NASA related to highly migratory species reproductive ecology, habitat modeling and stock assessment. ROFFS™ is also involved in fisheries oceanographic research with the U.S. Integrated Ocean Observing System (IOOS), Southeast Coastal Ocean Observing Regional Association (SECOORA) involving demersal fish species stock assessment.

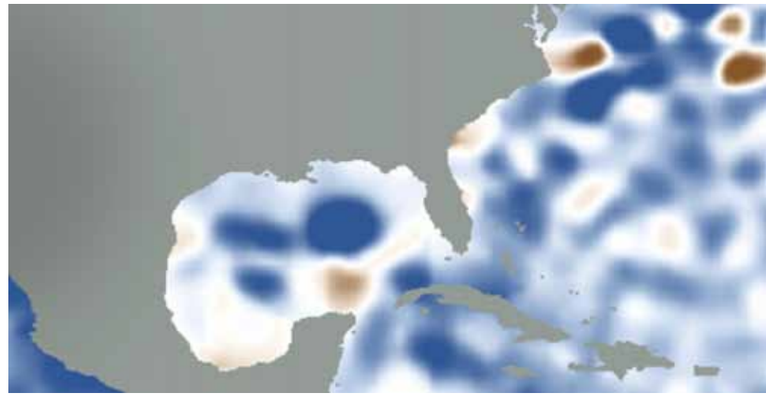


Figure 1: Color enhanced infrared satellite image of the Gulf Stream from the Florida Keys to Jacksonville, Florida. Warmer temperatures are shown with the warmer colors, i.e., red-orange warmer and blue-green cooler. The satellite data are calibrated using local NOAA buoys (e.g. Cape Canaveral) and FIO institutional weather buoys, such as the ones from University of South Florida. These buoys are critical for getting waves, winds and temperature data.

Oil and Gas Industry

Leveraging our skills and experience in remote sensing and operational oceanography we also provide real-time ocean current information to the oil and gas industry on world-side basis for oil drilling operations, redeployment of equipment, seismic surveys and ship routing. Our products are designed to provide real-time detailed information on ocean conditions to maximize the operational efficiency and for risk abatement.

Office of Homeland Security

ROFFS™ is active in Homeland Security issues related to search

and rescue and environmental science and monitoring issues. We provide real-time analyses related to the location and movements of specific water masses that may carry pollutants. Our expertise and reputation resulted in a contract as the "Independent Scientist" for the State of Florida Department of Environmental Protection Piney Point Phosphate Waste Water Dispersal Program (2003–2004). After hurricanes Katrina and Rita in the Gulf of Mexico in 2005 we provided daily maps of the distribution of the coastal, potentially polluted waters that were used by numerous federal, state emergency management officials, resource managers and oceanographers. In 2010, in response to the British Petroleum Deepwater Horizon oil spill, episode ROFFS™ produced a widely used daily Oil Oceanographic Analysis that provided maps and analyses on where the oil and water—oil-dispersant mix had moved and where it was likely to travel over the next 24 hours.

ROFFS™ also provides search and rescue support and other environmental monitoring (chemicals, biota and currents) to both government and private entities.

Scientific Research and Management

We remain active in both the scientific community, as well, as the fisheries resource management community locally, regionally, nationally and on an international basis. We are currently funded by the National Aeronautics and Space Administration (NASA) to study the effects of climate and ocean variability on highly migratory pelagic fish resources and to develop easy-to-use satellite based tools for resource managers. We have been a member of NASA's Biodiversity & Ecological Forecasting Science Team since 2004. We are also working on tarpon and bonefish research with the Bonefish and Tarpon Trust and billfish research with The Billfish Foundation. ROFFS™ is an active participant in several regional and state associations. ROFFS™ is an institutional host in the Southeast Coastal Ocean Observing System Regional Association (SECOORA). ROFFS™ is an associate member in the Florida Institute of Oceanography and a member of the Florida Ocean Alliance. Mitchell A. Roffer, president, is also an adjunct faculty member of the Florida Institute of Technology, Department of Marine and Environmental Systems.

The finer one looks at the ocean the larger the plastic pollution problem appears. Plastics never disappear but break down into smaller pieces. A strand of microplastic is stuck to a Copepod off the coast of China. Read more about research on the impact of microplastics by Eckerd College's Professor David Hastings on page 38. Photo: Dr. David Hastings.

60 miles offshore and clinging to a buoy, it's not a survivor story but a maintenance call. A USF team preps a buoy swap by removing instruments before its pulled onto the R/V Weatherbird II *and replaced with a new mooring. Credit: Mark Collins.*

How rare is this deep water Arrowhead Dogfish? Only four have been seen in the Gulf of Mexico. This shark was caught off the R/V Weatherbird II *in the northern Gulf on a #MudNBlood cruise.*

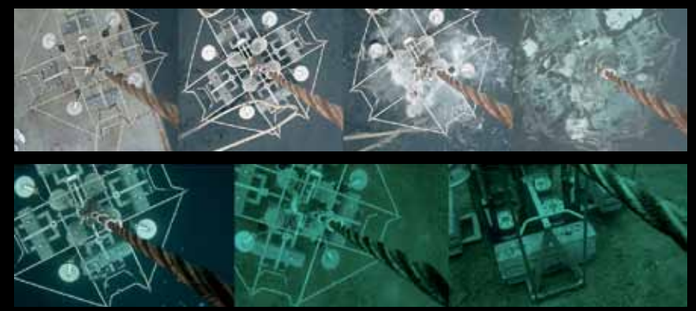
These amazing critters were classified and photographed by Dr. Arthur Ankur from the Florida Museum of Natural History. The specimens were collected on the R/V Bellows *during a cruise in the Florida Keys. See more cool images by Dr. Ankur at https://goo.gl/aXzDFx.*

COOL PHOTOS

A Caribbean Reef shark swims by students snorkeling at Looe Key during the 2015 Marine Field Study class. "We saw the biggest diversity of marine life at Looe Key," says student Pat Malloy. "The best part of this week was being out on the boat and literally snorkeling at a new area every day. Photo: Pat Malloy.

Fish need to hide when these two show up. FIO Director Bill Hogarth caught this big snook with Capt. Michael Anderson in Tampa Bay. Speckled trout and Spanish mackerel hit all day and you can tell by their smiles. Photo: www.reelanimalsfishingshow.com

Image sequence showing a Multi Corer dropping off the R/V Weatherbird *and sinking to the bottom to collect four undisturbed sediment samples from the Gulf benthos. Photo: Andrew Warren.*



HACKNEY'S COURSE

BY MARK COLLINS

Capturing the essence of Florida's many coastal environments is hard to do in a textbook. Successful learning means actively participating in the science. Getting hands dirty in the field is what all budding marine scientists do to get exposed to the research trade. A successful program in FIO's goal as an academic infrastructure support organization is the marine field studies class that takes students around the state to learn first-hand about each unique ecosystem. From Perdido Bay to the Florida Bay, students are learning key techniques in surveying marine environments aboard research vessels and participating in the field studies. This university-level program is one-of-a-kind, amalgamating active researchers within specialized regions of interest. The collaboration of five SUS schools forged a curriculum providing four credits called OCB 3108.

Getting wet above the reef is part of the experience at KML.

Hands-on learning like this is essential, but developing an interactive program uniting separate schools and implementing the logistics from accreditation, subject material and travel has been a difficult accomplishment. The impetus for the FIO Marine Fields Study program came from FIO Director Dr. Bill Hogarth. He wanted students to experience field work before entering their science careers. Dr. Hogarth pitched the concept to Dr. Courtney Hackney who directs the University of North Florida's Coastal Biology Program and then all the pieces fell into place. The vision to link students together with expert professors, ecosystems and research resources around the state became a reality.

You could say Dr. Hackney was destined for a successful career in biology. Growing up in the Florida Keys, he became a product of the environment growing from his surroundings and learning from his family who were commercial fishermen. Mangroves, clear water and fishing formed the foundation for cultivating a lifelong study of wetlands and its ecological functions. Dr. Hackney received his bachelor's at the University of South Alabama, then stay at Emory University for a master's in biology and received his PhD in zoology from Mississippi State University.

Although sandy quartz beaches make up 60 percent of the Florida coast, this leaves hundreds of miles for various coastal environments from mangroves to salt marshes and tidal river deltas to the limestone Keys. This type of diversity drew Dr. Hackney back to Florida. The campus of UNF is within 15 miles of unique wetlands that provide diverse areas of study in the Atlantic, St. Johns River and Intracoastal Waterway. No other university in the country has all of these coastal habitats in such close proximity—a perfect setting for teaching how the natural world works.

The beginning of the FIO field marine studies course came out of Dr. Hackney's experience working in so many coastal environments in the U.S. and worldwide. He recognized the resourceful talent pool in the State University System and recruited professors active in research, and specialized in knowing the intricacies of Florida's unique ecosystems. Key to the success was the collaboration with professors who showed a vision to grow a first-class program, including Dr. Heather Judkins USFSP, Dennis Hanisak FAU, Darren Rumbold FGCU and Jeff Eble UWF. Each have the passion to bring students into the field where they can experience realistic scientific methods. That experience can't be printed in a textbook, yet it is often the first glimpse a student gets operating postgraduate.

Developing the program took time, but its roots are digging deeper and the fruit is student engagement. Junior and senior level undergraduate students experience the environments instead of just seeing it in a lecture. Students move from location to location gaining a hands-on appreciation of the area, and this translates to what type of jobs and research opportunities are

Students pull in the bongo net and inspect the collection cup holding the concentrated plankton during the offshore class on the R/V Weatherbird II.

available. Many are able to focus and target their science careers and chose a direction for graduate work.

UNF biology student Meg Simon says the course "was definitely an eye-opener week for me. One reason I wanted to take this class was so that I could narrow down what I want to focus on in the field of marine biology."

For five-and-a-half-weeks Dr. Hackney says "we push the students to their physical and mental limits." The field course is nonstop learning and traveling. The fatigue may be high for both the faculty and students, but at the end of the tour students are ecstatic. FGCU student Lisa Rickards learned about endurance. "We started a 24-hour experiment comparing the abundance and species richness of two locations along a time gradient. We all started out strong, but by around 11 p.m. you could tell we were exhausted! We returned to campus around 1 p.m. Wednesday and everyone passed out."

Dr. Hackney emphasizes the role humans play in shaping our natural world. Students are preparing to tackle big problems like climate change. The human element has altered the natural environment. Salt water is moving further upstream in the St. Johns River and threatens the estuary. Beach erosion and sea level rise are turning freshwater wetlands into saltwater ecosystems. Students see how mangroves are moving northward from established habitats. The stopover for students at UNF provides a vantage point showcasing impacts from coastal development and marine operations impacts on right whale breeding waters.

Students from FIO member institutions discover new areas of the state. Says USF Senior, Samantha Blonder, "This course is really important to see the different schools and how they focus in the environment around them. We only get to see what's around us, so it's really cool to see the different interactions of the four environments and also meet people from all the schools and professors."

For the third year, the course has grown from five universities participating to seven and more may be in the works. FIO provides the financial support for the summer course, vessel and student fellowships. Dr. Hogarth says, "It is important to get students involved in the marine environments and learn about the great diversity and opportunities provided by the marine resources. They are a major economic driver for Florida providing $30 billion to the economy. This is more than the citrus, cattle, ranching and space industries combined."

Twelve faculty are engaged with the two cohorts. The concept is growing and Dr. Hackney foresees the program expanding toward FIO supporting online education programs with weekend field experience and including more universities. It could also provide marine science teachers with specialized summer training to build upon the program's success and future expansion.

Collecting specimens is the quick part before students discover the taxing process involved in classifying organisms.

Science South of the Border

BY SHERRYL GILBERT

With 13 scientists aboard, the *R/V Weatherbird II* fired up its engines earlier this month at the USF College of Marine Science in St. Petersburg, Florida, for its straight shot across the Gulf of Mexico into Mexican waters. Their science mission is to begin the first ever Gulf-wide fish health survey establishing much needed baseline information about some dominant Gulf fish like red snapper, golden tilefish, king snake eel and Atlantic sharpnose sharks.

Steven Murawski, chief scientist for the expedition and director for the Center of the Integrated Modeling and Analysis of the Gulf Ecosystem (C-IMAGE) is leading a team of researchers on a 22-day sampling expedition through the southern Gulf of Mexico. C-IMAGE—a Gulf of Mexico Research Initiative (GoMRI)-funded consortium of 19 institutions from six countries—is committed to understanding the complex chemical and biological interactions related to marine oil blowouts of the Gulf of Mexico. Murawski's team of technicians, graduate students and post-doctoral researchers began studying the impacts of oil exposure on fish just after the Deepwater Horizon (DwH) blowout.

Their attention now turns to the southern Gulf of Mexico. In 1979, the Ixtoc-I exploratory well suffered an oil blowout followed by 10 months and 3.5 million barrels of spilled oil into the southern Gulf of Mexico. Shortly after, PEMEX, the Mexican state-operated oil company, established an exclusion zone around the Ixtoc-I site. Only vessel traffic directly related to platform operations is allowed in the 4,000-km2 exclusion region, until now. Our researchers gained special access through the Mexican government to conduct scientific fishing within the exclusion zone.

After arriving and being processed at the intake Port of Progresso on September 17, 2015, the *R/V Weatherbird II* made its way north, then gradually southwest along the Yucatan Shelf. The research team sampled from sunrise to past sunset, often averaging 14-hour days at transects 32, 33, and 34 in the northwest Yucatan.

Dr. Shannon O'Leary is a genomics researcher from Texas A&M University, Corpus Christi, who is aboard the vessel for the three-week trip. "We were all very curious to see what we would get on our first set [in the exclusion zone]. Theory is that if nobody has fished here for so long, we should have more fish, bigger fish and a greater diversity of fish. On the other hand, there is quite a bit of pollution from the well heads and the associated activities of building and maintaining the platforms."

Time told the story—large numbers of fish, mostly Gafftopsail catfish were caught there. These catfish have been studied for PAH exposure (a toxic derivative in oil) around the exclusion zone, so having samples within the Ixtoc-I vicinity offers an interesting historical perspective, especially since they are found on the bottom and in contact with possibly oiled sediments.

Research published last year from C-IMAGE found evidence of a marine snow event associated with the DwH spill creating a mechanism for oiled particles to reach the seafloor. Initial sediment work around the Ixtoc-I site from C-IMAGE collaborations with members of the Instituto de Ciencias del Mar y Limnología at Universidad National Autónoma de Mexico (UNAM) and USF indicate a similar event may have occurred in the southern Gulf. This finding may have cascading effects on burrowing fish and other benthic marine life.

Researchers are collecting fish muscle, bile, blood, liver, heart, otoliths, eyeballs and fin clip samples for genomic studies, stock health assessment, PAH compound concentrations, and any sublethal symptoms that may be related to long-term low levels of hydrocarbon exposure through habitat or diet. They continue to survey the commercially relevant red snapper and other fish of interest like golden tilefish and king snake eel.

After visiting the exclusion zone, researchers from UNAM, TAMU-CC, USF, and Florida State University continued to sample southwest then northwest along Veracruz. This region is the expected resting place for a majority of oil following the 1979 Ixtoc-I disaster. In these shallowest stations, researchers caught 15 tilefish and large numbers of Gulf hake. "The significance of this catch cannot be overemphasized," Murawski said. "We now can compare tilefish in the southeast Campeche region near the oil producing area with a similar catch from earlier in the expedition (perhaps non-polluted).

The full science party (from left to right): Balbina Suárez Achával, Itzel Michel López Durán, Juan Antonio Frausto Castillo, David Portnoy, Brittany Verbeke, Joel Ortega-Ortiz, Amy Wallace, Erin Pulster, Shannon O' Leary, Susan Snyder, Kristina Deak, Lt. Paola Moreno, Gustavo Enciso Sánchez, Steven Murawski, Daniel Gasca Flores, José Martín Ramírez Gutiérrez.

This species is predominant and highly polluted in the northern Gulf. We can now answer the question, are tilefish equally heavily polluted by PAHs in the entire Gulf or just in the vicinity of the DwH?"

Dr. Adolfo Gracia is the UNAM science lead for C-IMAGE and a member of the Mexican Academy of Sciences. He has been studying shrimp fisheries in the southwest Gulf of Mexico and impacts of environmental contamination for over 30 years. "The fish cruise was extremely successful we can hardly wait to see the findings and compare them with existing data of sediment oil and biological analyses recorded by UNAM and our C-IMAGE partners in the Ixtoc-I area. This will give important hints for understanding long-term fish communities and ecosystem responses to oil megablowouts." His team returns to Mexico City with hundreds of biological samples that will be analyzed over the next year.

The research team will exit Mexico at Tuxpan and begin their five-day journey home along the longest axis of the Gulf, west to east. While underway, the science will continue. Researchers will measure basic oceanographic variables and collect water to gain information about the vertical and horizontal distributions of plankton, fish eggs and larval distributions across the Gulf. They will also take water samples to assess microplastic concentrations across the Gulf.

C-IMAGE scientists will return to the southern and western Gulf next year to continue the fish survey and to establish baseline fish health metrics.

Oil rigs pepper the horizon offshore Mexico.

RESCUE

Pulled from the sea, the crew of the *R/V Weatherbird II* saves a man's life.

The *R/V Weatherbird II* crew searched through the darkness and pulled a man who had been treading water near the mouth of Tampa Bay. The *Weatherbird* was returning from a research trip that studied trace elements in the Gulf of Mexico. Captain Brendon "Boomer" Baumeister responded to a Coast Guard Pan Pan distress call about a man overboard in Tampa Bay. The *Weatherbird* was just two miles away and immediately headed to the area using its spotlights to cut through the darkness. The crew listened for any signs of distress and had to shut down unnecessary equipment like exhaust fans onboard to reduce background noise. Back and forth, the lights searched for a man floating in the dark water between Egmont Key and the Sunshine Skyway bridge. Birds attracted to the light and choppy waves made the search difficult. After nearly an hour floating in the water, engineer Al Savor heard the man screaming.

"We saw a head and this little hand sticking up from the water and we realized that was him and he was alive," Captain Brendon Baumeister said.

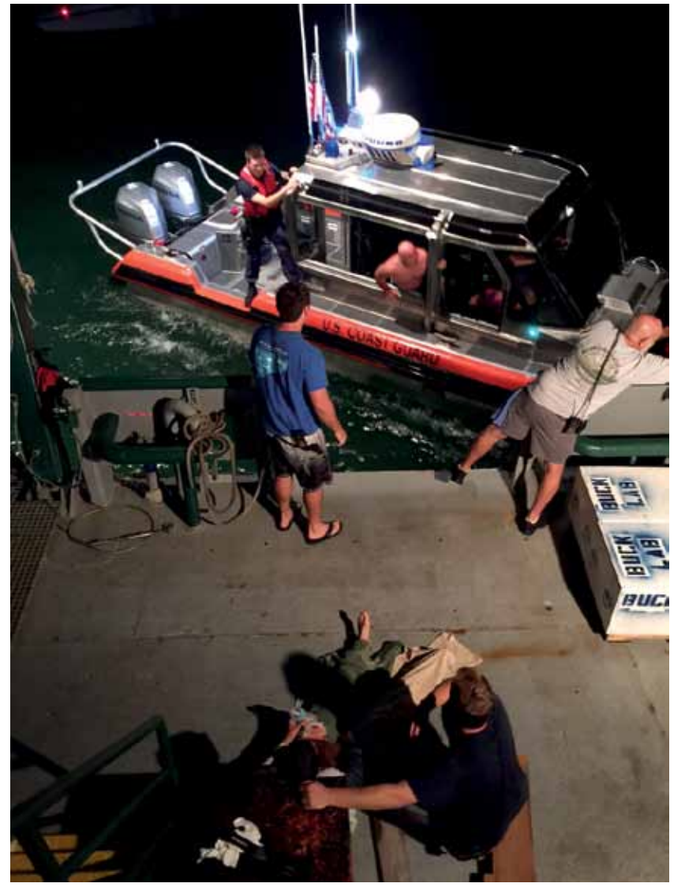
Savor threw a life raft out to the man and the crew was able to pull him into the boat. He had treaded water for more than an hour without a life jacket. "The words that came out of his mouth, 'thank you, thank you, thank you,'" Savor said.

In total, three lives were saved that evening. The man pulled onto the *Weatherbird* initially fell off a small powerboat. Two others fell overboard trying to grab the man.The remaining passengers called the Coast Guard who were quick to rescue the two others. Once aboard the *Weatherbird*, the man was treated for dehydration and fortunately was not seriously hurt.

The Coast Guard brought the two other survivors and united the friends together on the deck of the ship.

"[They] just fell on top of him weeping, hugging him then turned their attention onto us and gave us bear hugs," Boomer said.

Coast Guard Sector St. Petersburg honored the crew and recognized them for heroism. USCG Sector Commander Captain Case presented an award to the team and complemented FIO Director Bill Hogarth for and outstanding crew. Just about every Tampa Bay media outlet came to the ceremony for a follow-up story.



Media cover the Coast Guard award ceremony for the crew of the R/V Weatherbird II.

Bouncing Back from the Oil Spill

FIO Leads Florida RESTORE Act Centers of Excellence Program

Imagine counting the number of grouper with eavesdropping underwater robots, or locating the hiding spots of young sea turtles during a mysterious period know as a hatchling's lost years. These discoveries would be significant, especially when calculating the impact the Gulf oil catastrophe may have on these science projects. Soon we will have a clearer picture of problems facing the Gulf, from invasive lionfish to long-term oil effects on deep sea fish. Help for Gulf ecosystems comes from FIO's support for the Center of Excellence grant program designed to drive technology developments and promote innovative restoration science.

The road to recovery has been a long process, but efforts to build a stronger Gulf of Mexico is progressing five years after the Deepwater Horizon oil spill. In September 2015, the Florida Institute of Oceanography (FIO) received funding to host the Florida RESTORE Act Centers of Excellence Program (FLRACEP). Centers of Excellence grants to begin this year will focus on fisheries and wildlife research and monitoring projects from the Everglades to the deep sea.

The initial eight Centers of Excellence will support 10 projects for a total of $2.8 million to improve the health of the Gulf and fortify its ecosystems. The FLRACEP selected projects that focus on providing science for natural resource management, resources that are foundational to Florida's economy. Funded activities include those listed over the next three pages.

As a sponsor of the RESTORE Act, Senator Nelson stated, "I am pleased that Florida's natural resources are finally receiving RESTORE Act funding to help restore and build our natural resources. As evidenced by our stated intent to have FIO host the Centers of Excellence program, I am confident that FIO and its university partners will help us learn about the oil spill's environmental and economic impacts, which may go on for many more years."

In 2013, the RESTORE Act passed with FIO designated as the Florida entity to receive the funds to establish Florida's Centers of Excellence Research Grants Program in support of science, technology development and education related to the 2010 Deepwater Horizon oil spill. The Act highlighted the need to engage institutions of higher education in Gulf-wide recovery.

Representative Kathy Castor observed, "One of my overriding goals following the BP Deepwater Horizon disaster is to ensure that the Gulf of Mexico is restored environmentally and economically. FIO, located at USF St. Pete, and its world-class College of Marine Sciences, will lead our once-in-a-lifetime opportunity to restore the environmental and economic vitality of the Gulf of Mexico by providing the science and engineering expertise required for successful restoration. I am thrilled to see our vision for the Florida Marine Science Centers of Excellence come to fruition."

Treasury regulations for the RESTORE Act were finalized in October 2014, enabling FIO to begin implementing the program using funds from Transocean's settlement in 2012. This began with a public scoping process to identify program priorities, followed by a recently completed expert peer review process to select the first Centers of Excellence to be funded. In July 2015, BP settled out of court for another $5.5 billion for RESTORE Act Clean Water Act penalties, which will provide FLRACEP with another $22 million over 15 years.

For details on the RESTORE Act, FLRACEP rules and policies, and the new Centers of Excellence, visit FIO's web site: http://www.fio.usf.edu/research/flracep.

Principal Investigator, Center of Excellence Institution	Grant Title
Mike Allen, University of Florida	Improving observations and models to reduce lionfish in the northern Gulf of Mexico
Jerry Ault, University of Miami	Optimizing economic value and sustainability of recreational Florida fisheries
Beth Babcock, University of Miami	Better use of directly-observed data in ecosystem simulation models
Kevin Boswell, FL International University	Informing fishery-independent reef fish surveys through advanced survey techniques
Jane Caffrey, University of West FL	Evaluating the role of artificial reefs as hotspots of biological productivity
Dean Grubbs, FL State University	Long-term effects of DwH oil spill on large, deep-sea fishes
Chad Lembke, University of South FL	Robotic monitoring of red grouper in the eastern Gulf of Mexico
Kate Mansfield, University of Central FL	Tracking sea turtle "lost years" in the Gulf of Mexico
Ernst Peebles, University of South FL	Egg and larval DNA barcoding to support Gulf reef fish stock assessments
Brian Walker, NOVA Southeastern University	Developing habitat maps to inform fish surveys, management strategies and climate change research

Examining Fisheries Impact of Invasive Lionfish with an Ecopath with Ecosim Model

University of Florida

Principal Investigator: Dr. Mike Allen

This project will develop new observations and ecological models to evaluate lionfish impacts on native reef fish. In the past decade, invasive lionfish (*Pterois volitans/miles complex*) originally from the Indo-Pacific, have rapidly colonized the northern Gulf of Mexico, and their numbers are increasing exponentially. Recent studies in other Atlantic regions indicate that the invasion has potentially devastating impacts on native reef fish populations and reef ecology, and threatens valued reef fisheries such as snappers and groupers. Interestingly, density is an order of magnitude lower on natural reefs than on artificial reefs. Natural habitat may be more adapted to control populations (e.g., predators, resource competition) (per S. Smith). Many restoration projects are now creating new artificial reefs, which may actually provide more room for lionfish expansion, perhaps countering intent to promote fish production and opportunities.

Biological and Economic Indicators for Assessing Recreational Fisheries

University of Miami

Principal Investigator: Dr. Jerald Ault

Marine recreational fishing in Florida is a multi-billion dollar enterprise, an order of magnitude larger in economic value than commercial fishing, generating more in annual revenues than the entire Florida citrus industry. Hundreds of species are reported by fishers to state and federal databases; however, less than 10% of these species have up-to-date stock assessments. Many exploited species are primarily targeted by the recreational fleet and their total economic value (dollars and jobs) is unknown. Thus, managers cannot accurately know if these stocks are fished sustainably and in an economically efficient manner. Intent is to facilitate stock assessment science by providing accurate effort estimates for more species, especially for recreational fisheries CPUE levels which have higher uncertainty. CPUE is a key indicator of need for expensive and time-consuming full stock assessments. The project will not be running assessments, but producing data for use in SEDAR assessments.

Improving the Use of Products Derived From Monitoring Data in Ecosystem Models of the Gulf of Mexico

University of Miami

Principal Investigator: Dr. Elizabeth Babcock

Ecosystem models are management tools that inform fisheries stock assessments, how to sustain living resources, and may be used to guide restoration decisions made after the Deepwater Horizon oil spill. Models now used in the northern Gulf of Mexico (GOM) require more and better inputs from fisheries catch data, fisheries-independent survey data and remote-sensing data from satellites. This project will develop a framework for improving the use of products derived from monitoring data in GOM ecosystem models. Tasks include: 1)review current use of monitoring data inecosystem models; 2) conduct workshop with modelers, survey scientists, and fishing industry representatives in order to recommend ways to improve use of monitoring data and related products in GOM ecosystem models; and 3) suggest survey improvements needed to fill critical data gaps.

Kevin Boswell (left) works up a seine haul of nearshore arctic habitats off the Beaufort Sea in the Arctic Ocean.

Fishery-Independent Surveys of Reef Fish Community, Size and Age Structure off Northwest Florida

Florida International University

Principal Investigator: Dr. Kevin M. Boswell

Marine and coastal fisheries trail only tourism as Florida's most important sources of revenue. A significant component of this fishing effort is focused on reef habitats, which are critical habitat for many exploited species. The health of reef ecosystems has been degraded by numerous crises, such as sedimentation, hypoxia, red tide events, invasive lionfish and the 2010 Deepwater Horizon oil spill (DWH). Baseline information at the necessary scales for evaluation of these impacts is lacking. Additionally, advances in stock assessment models have led to an increased demand for reliable, inexpensive, non-extractive and non-destructive data collection techniques. The goal of this study is to apply advanced technologies to improve the quality and scope of fishery-independent data used to parameterize reef fish stock assessment models. Advanced sonar and remotely operated vehicle technologies are reliable, cost-effective survey methods for assessing reef fish communities across large areas (km2) of reef habitat in a non-extractive and non-destructive manner. Cross-shelf surveys will assess fish community size structure, spatial distribution and biomass, and resource utilization around both artificial and natural reefs.

Evaluating Fish Production and Ecosystem Impacts of Artificial Reefs

University of West Florida

Principal Investigator: Dr. Jane M. Caffrey

Evaluating the role of artificial reefs as hotspots of biological productivity in marine fisheries is important to Florida's economy. Several marquee species (gag grouper, gray triggerfish, greater amberjack and red snapper) are overfished. Deepwater Horizon oil spill early restoration programs are funding artificial reef

Above: *Jane Caffrey who worked on water quality issues and seagrass restoration in local estuaries is going to study reef productivity.* Right: *Deep fish expert, Dr. Dean Grubbs hauls a bluntnose sixgill shark onto the* R/V Weatherbird II.

deployments off the Florida Panhandle to generate new fishing opportunities and compensate for lost use due to fishery closures during the spill. This research will examine the effect of artificial reef habitat on ecosystem productivity. Specifically, it will address the question whether artificial reefs create biogeochemical hotspots and increase rates of primary productivity, which then enhances secondary productivity including fish production. Results will contribute to reef fish management in the region, affect the perception of artificial reefs as a management tool, and help evaluate the utility of using artificial reefs to mitigate lost production of reef fishes due to events such as the Deepwater Horizon oil spill.

Monitoring Oil Spill Effects and Recovery in Large Deep-sea Fishes

Florida State University

Principal Investigator: Dr. Dean Grubbs

Prior to the Deepwater Horizon (DWH) oil spill, knowledge was limited concerning communities of large bottom-dwelling fishes living below 200-meters in the northern Gulf of Mexico. Since the spill occurred at 1,500-meters, these communities were directly affected. Early post-spill research examined the community structure and the toxicological responses to oil exposure of deep-sea bony fishes, sharks and hagfishes living at depths of 200-2,000-meters from offshore of Louisiana to southwest Florida. Some species show signs of oil exposure, often correlated with distance from the well site, whereas others do not. In some species these effects weren't apparent until three years after the spill, reflecting a time lag for effects to transfer up the food chain. Toxicological responses may be dissipating in some species but remain persistent in others, illustrating the need for long-term monitoring of the effects of the spill. This project will continue monitoring trends in relative abundance and toxicological responses of large deep-sea fishes at stations sampled since April 2011, providing a seven-year time series of the effects of the spill on these poorly-studied species.

Demonstration of Fisheries Assessment Applications for Underwater Gliders

University of South Florida

Principal Investigator: Mr. Chad Lembke

This project will use cutting edge ocean observing underwater gliders equipped to record water quality variables and fish locations and behaviors. The demonstration will focus on Red Grouper over a seasonal sampling plan within a study area comprising the Gulfstream Natural Gas Pipeline on the West Florida Shelf. Red grouper comprise a large and economically important fishery in the Gulf of Mexico. A key data need for their management is to

accurately assess their distribution and how it interacts with fishing pressure to affect the ratio of males to females and productivity. Underwater gliders have demonstrated for over a decade their ability to deliver cost effective water column data. This project will use new technological payloads on the robots including acoustic tag receivers, passive acoustic recorders and echosounders to collect assessment information for fish ecology and habitat.

Ontogenetic Shifts in Sea Turtle Habitat Use and Foraging Ecology

University of Central Florida

Principal Investigator: Dr. Katherine Mansfield

Marine turtles are late-maturing, migratory species that inhabit diverse habitats during different stages of their lives. All sea turtle species spend their first years at sea, yet very little is known about where these turtles go and how they interact with their environment between the time they leave their nesting beaches as hatchlings through their early years as oceanic juveniles—"the lost years." The Deep Water Horizon oil spill occurred in an important habitat for young sea turtles transitioning from oceanic to coastal habitats. To meet species recovery goals, the status and condition of sea turtle stocks must be understood across all life stages and all habitats. This work will focus on the understudied habitat of offshore Sargassum seaweed mats.

Dr. Kate Mansfield is studying the sea turtle hatchings "lost years" with satellite tracking.

Egg and Larval Barcoding for Gulf DEPM Stock Assessments

University of South Florida

Principal Investigator: Dr. Ernst Peebles

Genetic identification of fish eggs has proven to be the most reliable method available and is being used increasingly to provide definitive species-specific information. The project investigators recently developed a highly reliable DNA barcoding approach for identifying large numbers of individual fish eggs. Fish eggs will be sampled along two transects that cross the entire Gulf of Mexico, in partnership with the CIMAGE II Consortium. Application of DNA barcoding to individual fish eggs will inform future DEPM efforts in the Gulf of Mexico regarding the feasibility and expected outcomes of applying DNA barcoding at large geographic scales.

Hardbottom Mapping and Community Characterization of the West-Central Florida Gulf Coast

Nova Southeastern University

Principal Investigator: Dr. Brian Walker

The continental shelf off Florida's west coast is a mosaic of fish habitats including seagrass beds and carbonate reef outcroppings (hard bottom) that are essential fish habitat. Habitat maps and community baseline data, however, are nonexistent for a majority of the region. This collaborative effort between Nova Southeastern University, Florida Fish and Wildlife Conservation Commission, NMFS and other scientists will characterize and map continental shelf seagrass and hard bottom habitats in nearshore areas fished by many recreational fishermen. Objectives include: 1) Map hard bottom and seagrass beds using various data types including sonar and satellite imagery; 2) Conduct underwater remote and SCUBA diver surveys to validate the map and associate community information to habitat classifications; 3) Compare and integrate sonar and satellite maps; and 4) Develop recommendations as to how satellite data can best be utilized to improve survey scope and efficiency. Outputs will provide the first hard bottom habitat map and baseline community characterization for 1,600-square-kilometers of the West Florida continental shelf adjacent to Tampa Bay.

Keys Marine Lab

BY MARK COLLINS

At a remote section in the middle of the Florida Keys, FIO's Keys Marine Lab (KML) research center is tucked away under the sway of the coconut trees. Here, nature's scenery provides a photogenic backdrop. The morning quiet is broken by a gasp as a sea turtle surfaces for air in the snug harbor out back. A cormorant rests on a limestone outcrop while a pelican glides past its *Pelecaniforme* cousin and exposed spiny lobsters cling to rocks imaginably taking advantage of KML's protected access.

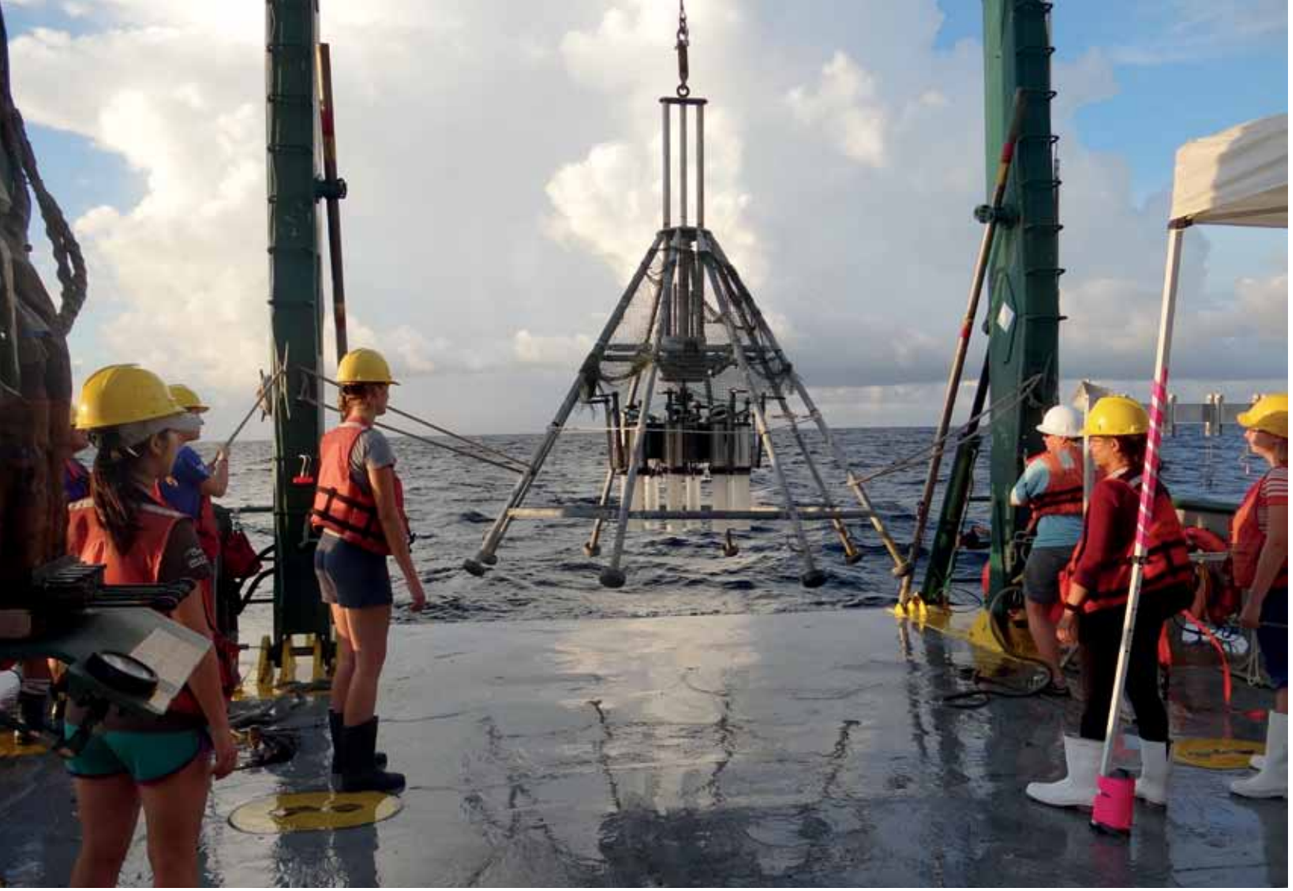
The lone flashing yellow light in Layton briefly slows tourists bound for Key West, and in the haste, few passing through the Overseas Highway realize this intersection is a starting point for hundreds of scientists at KML since 1987. Here, a fleet of powerboats provides access to the only tropical and subtropical marine ecosystem in the United States; combined with the invaluable resources at the field station, researchers from across the country, especially state university faculty and students, are enabled in discovery and understanding of the marine environment.

Acres of waterfront straddle the Florida Bay with an arrangement resembling a vacation fish camp paradise or a divers dream. Three buildings provide accommodations from quick dorm-like stays to long-term, bungalow-style retreats. With private boat ramps, onsite airfill and gasoline stations, the property is designed to get people into the field while providing the educational facilities and tools that can help lead to successful grant funding.

With increasing carbon dioxide sinking into the seas, a growing concern for researchers is the impact it has on ocean acidification. Glance around and you notice several intricate pipes, pumps and massive tanks. On Duval Street this could be mistaken for a brewery, but here, this network hooks into KML's seawater system. KML recently engineered a state-of-the-art seawater system to investigate the sensitivity with which corals respond to sea water quality. Computers monitor row after row of holding tanks ensuring accurate water chemistry for up to four different formulas. Degassing chambers remove hydrogen sulfide and increase oxygen while regulating carbon dioxide. Water used in the tanks comes from the ground possessing an ideal PH that is nearly neutral. The remoteness of the lab from urban centers contribute to the purity of the water.

In the summer, 24 statewide university undergraduates arrive for the field studies in marine sciences class. Students snorkel during the week comparing underwater ecosystems and document the biodiversity at various stations in the Atlantic and Gulf. KML's classroom and laboratories shape foundational experiences learned in the field and prepare the future scientists for career applications.

Stroll away from the education center, past a pavilion shading dozens of glass aquariums, and you come across a small island surrounded by 225-thousand gallons of saltwater. Here, scientists monitor and conduct tests on larger fish. Look closely in this man-made lagoon and a shark fin cuts the surface. Under a rock, the resident grouper flashes its skin color as predators swim past. In this controlled environment, the saltwater lagoon system replicates a natural ecosystem providing a window into the behavior of marine animals. The convenience of the lagoon next to the real thing allows scientists to quickly capture and transport specimens with minimal stress.



In this time lapse photo, CARTHE member Conor Smith deploys a GPS drifter, which sends accurate surface flow data to modelers and responders. Photo: CARTHE.

Coordinating Across Disciplines

BY MARK COLLINS

After the 2010 Gulf oil spill, BP and the Gulf of Mexico Alliance agreed to create a fully independent research board to commission long-term studies relating to oil spills in marine and coastal ecosystems, called The Gulf of Mexico Research Initiative. It is responsible for developing all requests for proposals, funding decisions and reviewing research progress in the Gulf.

FIO Director Bill Hogarth sits on the GoMRI board and assists in its ability to understand, respond to and mitigate the potential impacts of oil spills on marine and coastal ecosystems. The organization is doing this by engaging the expertise of some of the world's most respected scientists. Many of the experts are FIO members and tap into the resources and funding provided by our organization.

The success of the GoMRI depends on a combination of regional knowledge with regional, national and international research innovation. GoMRI has funded a consortia here in Florida to improve long-term environmental health.

CARTHE: The Consortium for Advanced Research on Transport In the Environment

Primary Investigator: Tamay Özgkömen

CARTHE is a research team dedicated to predicting the fate of oil released into our environment to help inform and guide response teams, thereby protecting and minimizing damage to human health, the economy and the environment. They are operated out of the University of Miami's Rosenstiel School of Marine and Atmospheric Science.

C-IMAGE: The Center for the Integrated Modeling and Analysis of Gulf Ecosystems

Primary Investigator: Steven Murawski

The C-IMAGE consortium is an international collection of experts committed to studying the fate and impact of Gulf oil spills on the ecosystem. By looking back at the IXTOC-1 spill in the southern Gulf, C-IMAGE can predict the long-term recovery process of the DwH system. They are operated out of the University of South Florida's College of Marine Science.

DEEPEND: Deep Pelagic Nekton Dynamics of the Gulf of Mexico

Primary Investigator: Tracy Sutton

The DEEPEND consortium characterizes the oceanic ecosystem of the northern Gulf of Mexico to infer baseline conditions in the water column. This information will establish a time-series with which natural and anthropogenic changes can be detected. DEEPEND is operated out of the Halmos College of Natural Sciences and Oceanography at Nova Southeastern University.

RECOVER: Relationship of Effects of Cardiac Outcomes In Fish for Validation of Ecological Risk

Primary Investigator: Martin Grosell

RECOVER is a research team dedicated to further the understanding of oil-induced effects on fish and their potential for recovery. It is the mission of RECOVER to better understand the toxic effect of oil on pelagic and coastal species of fish and recognize future impacts on economies and the environment. RECOVER is headquartered out of The University of Miami's Rosenstiel School of Marine and Atmospheric Science.

DEEP-C: Deep Sea to Coast Connectivity In the Eastern Gulf of Mexico

Primary Investigator: Eric Chassignet

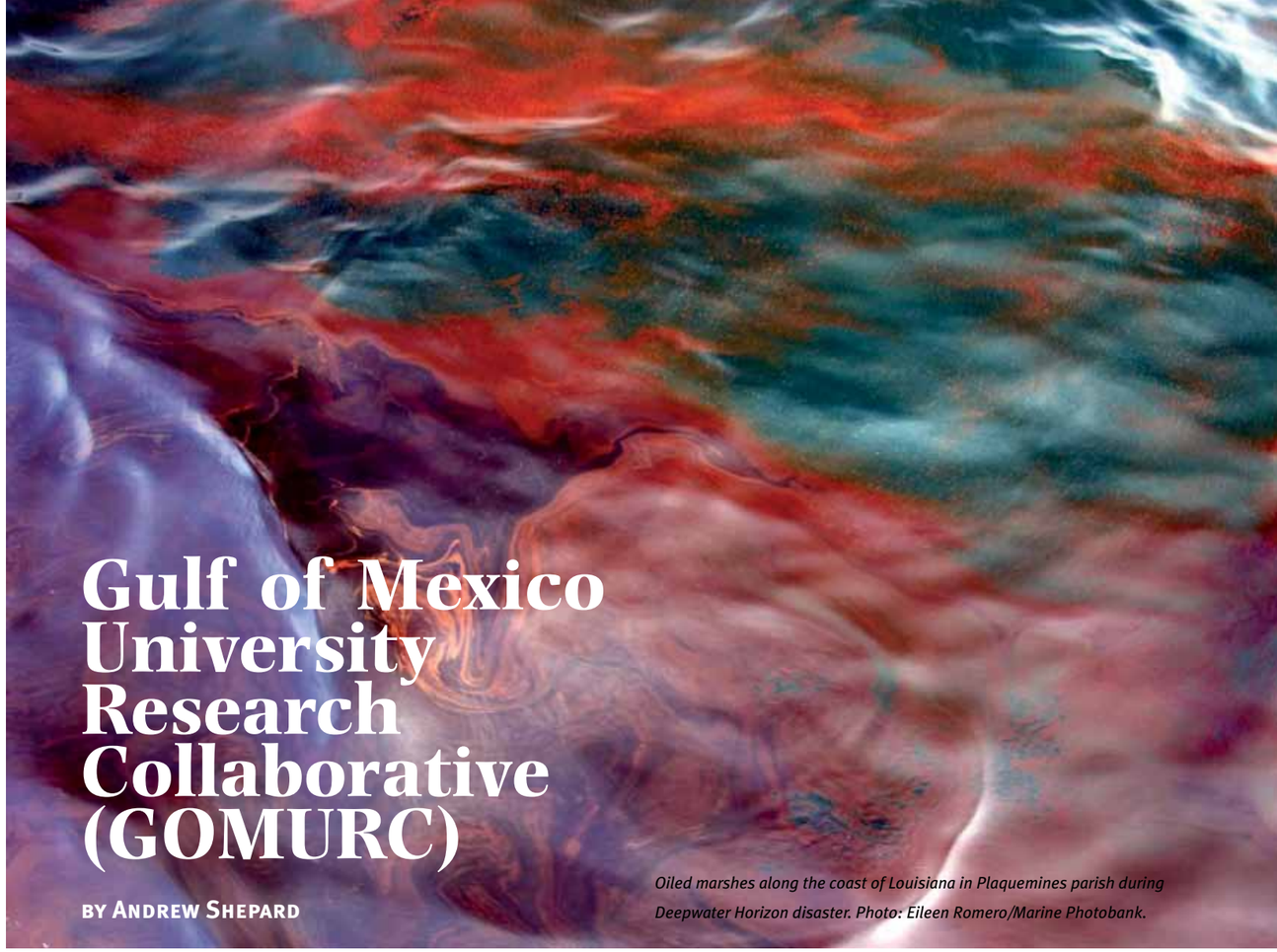
The Deep-C consortium investigates the environmental consequences of petroleum hydrocarbon release in the deep Gulf on living marine resources and ecosystem health. Deep-C examines the geomorphologic, hydrologic, and biogeochemical settings that influence the distribution and fate of the oil and dispersants released during the Deepwater Horizon (DwH) accident, and use the resulting data for model studies that support improved responses to possible future incidents. It is centered at Florida State University's Center for Ocean-Atmospheric Prediction Studies.

Florida Oceans Day

FIO organizes a special day each year to inform Florida's legislators and citizens about the significant role the oceans have supporting Florida's economy and jobs. Florida Oceans Day is held at the state capitol in Tallahassee. It brings together public and private partners to make the oceans and shore cleaner and more productive. The Florida Ocean Alliance and Mote Marine Laboratory sponsor the event with educational outreach exhibits in the capitol rotunda.

This year's theme was ocean stewardship and legacy. By protecting the resources we can ensure that growing pressure on ocean use in the future will be managed properly. Florida grew to the third most populated state in 2015, and educating residents about healthy coastal ecosystems will be key to protecting the ocean for future generations.

FIO is planning the next Florida Oceans Day in February 2016 as a way to bring together the science community, environmental groups, lawmakers and business leaders.



Gulf of Mexico University Research Collaborative (GOMURC)

BY ANDREW SHEPARD

Oiled marshes along the coast of Louisiana in Plaquemines parish during Deepwater Horizon disaster. Photo: Eileen Romero/Marine Photobank.

Gulf of Mexico oil spill recovery and building a healthy environment requires Gulf research universities.

The Deepwater Horizon (DWH) platform explosion and subsequent oil spill in 2010 in the northern Gulf of Mexico was the largest event in U.S. history and cost the responsible parties more than any past environmental disaster. Over $40 billion dollars in criminal and civil penalties for environmental and economic restoration will mostly be spent by government agencies. Gulf citizens and regional universities must also play a lead role in restoration efforts to assure that these billions successfully aid both recovery and the long-term environmental and economic health of the region.

In the wake of the oil spill, universities from the five U.S. Gulf of Mexico states united to form the Gulf of Mexico University Research Collaborative (GOMURC) intended to promote large-scale, long-term science and education initiatives required to address Gulf ecosystem-wide stressors such as hurricanes, climate change and oil spills. Initial funding and coordination came from the Florida Institute of Oceanography (FIO) and the University of South Florida. Currently encompassing 80 institutions, GOMURC promotes research enterprises that span the scale and scope of state boundaries.

Through a variety of advocacy and coordination activities, GOMURC informs research activities and science-based policy development to understand, restore, protect and sustain affected natural resources.

The DWH spill and the 1989 sinking of the Exxon Valdez in the Gulf of Alaska were the two worst spills in U.S. history. Oil and impacts continue to plague the Alaskan ecosystem. The DWH event was six times larger than the Alaska event; five million barrels spread over 68,000 miles of ocean, 16,000 miles of oiled coastline, spread from the coast to the deep sea. Whereas the tanker carried refined oil, the DWH spill consisted of many species of hydrocarbons from asphalts to methane gas. Gulf natural resources have been and continue to be impacted in every major habitat type. Over three-quarters of the funds for environmental and economic recovery have so far gone to state and federal government projects. Eighty percent of these projects focus on building coastal infrastructure (for example, beaches, boardwalks and boat ramps), not restoring damaged environments.

Recovery from the DWH event will require a range of approaches and solutions from buckets and rakes for coastal restoration projects, to advanced research and technologies for marine monitoring and

restoration. All efforts are required by law (RESTORE Act) to be based on sound scientific methods and analysis. Gulf research universities are the local citizens with the required skills, capabilities and knowledge to support conservation and restoration science and technology. Funding from the early rapid response programs, for example, the BP-funded Gulf of Mexico Research Initiative, has reinforced a diverse and capable Gulf science community familiar with the spill, its impacts and remediation. Gulf-based university faculty members engaged in all of the Initiative's research consortia and are co-authors on 85% of resulting publications.

Gulf research universities have the required local assets. When a complex, ecosystem-scale catastrophe strikes, like the DWH spill or hurricanes, first responders are the most critical element in mitigating damages. First response has to be urgent and careful, accounting for many factors such as public safety and not causing more harm than good. In addition to industry and government assets at the DWH well site trying to contain the geyser in 5000 feet of seawater, the first vessels on scene assessing impacts were from academic institutions, which immediately shared results and data in unprecedented ways. Gulf universities rival all other regions in the country in the number of science and technology degrees, students, publications and patents.

Gulf research universities provide return on investment. They contribute critical resources to the national economy; 80 marine research universities in the Gulf generate an estimated economic impact (contribution to Gross Domestic Product) of $528 billion per year, over a quarter of the total economic impact for all business sectors in the five Gulf states, which together support 13% of the national GDP.

GOMURC's priorities call for academic partnerships that promote successful, sustained Gulf ecosystem recovery efforts through discovery, innovation and new talent to carry out the technical work required. Gulf restoration must be based on the "best available science." All restoration programs need to use independent, expert peer review and science-based requirements to select projects, and treat ecosystem restoration projects as science experiments guided by appropriate research and monitoring.

Gulf restoration must be monitoring and assessed at the project and ecosystem levels to evaluate and adapt restoration efforts, for baselines needed to assess long-term impacts, and to prepare for future events. Over 80% of projects funded to date do not support any environmental monitoring. All restoration funding programs need to share plans, funding and capabilities to support the required regional system.

Gulf restoration will involve dozens of programs and thousands of projects with overlapping objectives. Best practices developed by scholars to coordinate include use of conceptual models to identify gaps and fund priorities, communities of practice to promote input and support from all stakeholders, and unified data and information management systems.

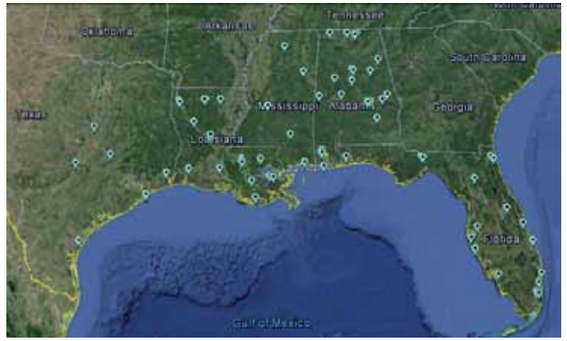
Gulf damage assessments and restoration must consider non-market ecosystem services, such as protection of life and property afforded by a healthy, resilient environment (green infrastructure). Values in dollars are required to explain the true worth of Gulf natural capital, both for damage assessment and to credit responsible parties for related restoration costs.

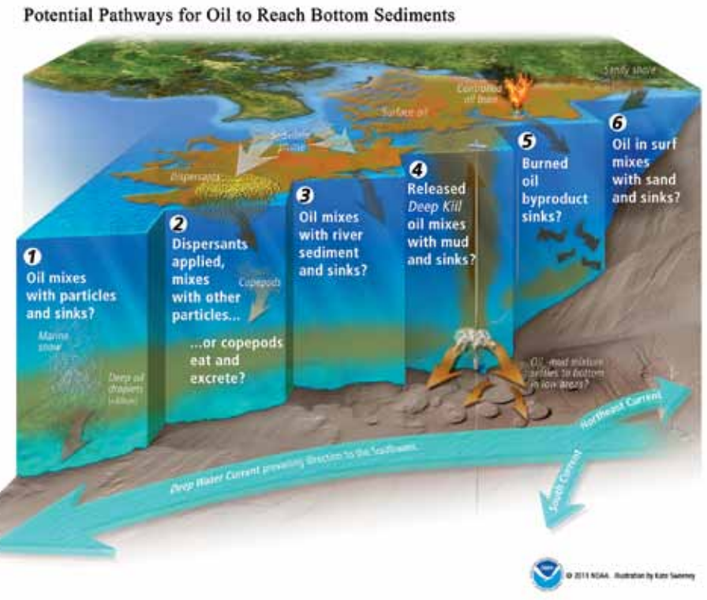
Gulf restoration project findings need to be assimilated in a Gulf-wide status report of ecosystem recovery, prepared and vetted by experts and adapted to new results. A regional capacity led by the academic community should be established to support this outcome, again cost-shared by all restoration program partners.

Finally, Gulf restoration programs, as well as the sustainability of Gulf resources, are long-term programs that need to be addressed by the next generation of skilled scientists and engineers. Science-Technology-Engineering-Mathematics (STEM) education programs for secondary school and university teachers and students should include experiential (hands-on) learning opportunities, curriculum development and access, and funding for student internships, fellowships and post-doctoral programs.

Considering climate change, severe storm predictions and the continued need for Gulf energy resources, future disasters are expected. The National Research Council's 2012 report, Research Universities and the Future of America: Ten Breakthrough Actions Vital to Our Nation's Prosperity and Security, contended that the nation must "reaffirm, revitalize, and strengthen substantially the unique partnership that has long existed among the nation's research universities, the federal government, the states, and philanthropy by enhancing their roles and linkages." Gulf restoration-related resources offer an unprecedented opportunity to do this in the Gulf region. Penalties from DWH spill responsible parties should be used to increase engagement and capabilities of Gulf academic partners, and educate the next generation of scientists and engineers required to support Gulf recovery and response to future disasters.

GET CONNECTED: The Gulf of Mexico University Research Collaborative is a networking resource for updates on the latest scientific research, restoration and opportunities in the Gulf of Mexico. Sign up for email alerts from GOMURC's news blog at www.gomurc.org. Interact with GOMURC staff on Twitter (@GOMURC) and Facebook (facebook.com/gomurc.org).





Above: *GOMURC members include 80 research institutions that are members of their Gulf states' research consortia. Photo: GOMURC, Google Earth.* Left: *Fire boat response crews battle the blazing Deepwater Horizon rig April 21, 2010. Photo: U.S. Coast Guard/Marine Photobank.*

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Range: 3500 NM
Endurance: 10 days
Crew Berths: 7
Scientific Berths: 13
Satellite Iridium, CTD, Carousel
12 liter Niskin bottles, EK60
Thermosalinigraph with Wetstar
Flurometer, Millipore filtration

KEYS MARINE LAB

Dorms with 24 beds,
1 private house,
Dry & wet labs,
220,000 gallon saltwater mesocosym,
Seawater system tanks,
Boat fleet: 30' 22 person
25' 11 person
24' 8 person
18' 4 person
14' 2 person

RV BELLOWS

Length: `71'
Homeport: St. Petersburg, FL
Range: 1200 NM
Crew Berths: 4
Scientific Berths: 10
Satellite Iridium, CTD
Carousel, Thermosalinigraph with Wetstar, DAS computers

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