



# Tidings

*A publication of the Florida State University Coastal & Marine Laboratory*

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## Dead Zones in the Ocean: Effects of Low Oxygen on Coastal Fish and Fisheries

By Kevin Craig

The number of coastal ecosystems experiencing low dissolved oxygen, also known as hypoxia, has doubled each decade since the 1960s. These 'dead zones' are the result of excess nutrients that make their way into estuaries and other nearshore habitats, fueling the production of large algal blooms that are then decomposed by bacteria, robbing the water of its oxygen. The same coastal habitats that are susceptible to hypoxia also serve as nursery grounds for juvenile fish and shrimp that, in many cases, support important commercial and recreational fisheries.

Much of my recent research has focused on the northwestern Gulf of Mexico shelf, the site of the largest dead zone in the western hemisphere and the third largest in the world (~20,000 km<sup>2</sup>, or the size of New Jersey). I collaborate closely with a number of researchers from both state and federal agencies, as well as from other universities. Our research approaches include shipboard sampling and aerial surveys to document habitat loss caused by hypoxia and its effects on diet, growth, reproduction, and trophic interactions of major species on the shelf.

Our results indicate that hypoxia has a negative effect on the lipid levels and energy reserves of brown shrimp (*Penaeus aztecus*), the major species harvested in the commercial fishery, and this may have contributed to the decline in the size of shrimp that has occurred over the last 20-30 years. We have also found that shrimp, numerous species of juvenile fish, and sea turtles aggregate just outside of the hypoxic zone, along with the commercial shrimpers. Juvenile fishes and sea turtles are incidentally harvested as bycatch, with as much as 10-20 pounds of bycatch taken for every pound of shrimp harvested. These species appear to successfully

avoid the low oxygen but as a result are more susceptible to fishing mortality. Preliminary results from a current project indicate that hypoxia impacts the reproductive development of Atlantic croaker (*Micropogonias undulatus*), such that individuals fail to reproduce or produce fewer or lower quality young. Understanding the effects of hypoxia has important implications for fisheries management in the Mississippi watershed.



# Message from the Director

Undergraduate students who participate in research activities have a greater sense of what it takes to be a scientist. Not only do they develop a set of technical and intellectual skills that they might not otherwise have developed in the classroom, but they gain confidence in their ability to work independently on difficult problems and a sense of both social and scientific responsibility. Nothing clarifies one's life choices like experience.

The Certificate Program in Marine Biology (developed 10 years ago by Bill Herrnkind and me for biology majors and run by the FSU Coastal and Marine Laboratory) is designed to fill this niche for FSU undergraduates interested in marine science. The two-year program starts with a seminar course that emphasizes critical thinking, reading scientific literature, honing scientific writing skills, and making career choices. It continues with a hands-on research internship with a marine scientist mentor, culminating in a research paper and oral presentation at a symposium, with several students each year publishing their results in scientific journals. The goals are to increase students' awareness of the issues and challenges of marine science and conservation, to have them experience the thrill of making real contributions to advance scientific knowledge, and, along the way, to have them discover what really grabs their interest.

This past summer, 9 certificate students conducted research at the FSUCML, on campus, in Tate's Hell State Forest, in south Florida, and at the National Marine Fisheries Service in Panama City. These include the following:

**Joshua Brower.** Seagrass animal community changes across time and space in Apalachee and St. Joe bays.

**Jessica Cope.** Do diurnal differences in activity of the Florida manatee affect its vocal behavior?

**Carley Knight.** The effects of salinity on oyster drill predation rates and how this all ties into the changing salinity in Apalachicola Bay.

**Ian Kutch.** Energetic model for estuarine fish and the effects of temperature and size.

**Alejandra Mickle.** Correlation of predator-prey abundance in seagrass communities of Apalachee and St. Joe Bays.

**William Overholt.** Classifying microbial community shifts with the addition of ethanol-amended subsurface sediments.

**Patrick Raley.** A comparison of the differences in relative abundance of reef fish on the inner shelf of the northeastern Gulf of Mexico using baited and unbaited digital video drop camera arrays

**Erin Simmons.** Modeling gag grouper (*Mycteroperca microlepis*) population dynamics to understand population genetics

**Troy Simon.** The effect of hydrologic alteration on the macroinvertebrate assemblages of first order creeks in the Florida panhandle.



Carley Knight



Jessica Cope

Two more students completed Honors-in-the Major theses, including **Kelly Preston**, an FSU Senior conducting work on habitat use of bottlenose dolphins in St. George Sound, and **Alicia Brown**, a 2008 FSU graduate who studied the effects of salinity on disease in Apalachicola oysters.

The Program also serves as a stepping stone for students interested in pursuing a graduate degree, effectively so given that over 90% of the students leave FSU for graduate schools within the United States (e.g., Duke University, Harvard, North Carolina State University, Nova S.E. University, Delaware, FSU, Stony Brook University, University of Alaska, Oregon State University, University of North Carolina, University of Florida) and abroad ( James Cook University in Australia, and Victoria and Dalhousie universities in Canada).

We are quite proud of the accomplishments these students make and have plans now to expand the program's interdisciplinary nature and extend the opportunities to students at an earlier stage of their undergraduate careers.

For more information about the Certificate Program in Marine Biology check: [http://www.bio.fsu.edu/coleman\\_lab/certificate\\_program.php](http://www.bio.fsu.edu/coleman_lab/certificate_program.php)



Ian Kutch

## News and Notes

“**TEAM OYSTER**”, led by FSUCML post doctoral associate, **Dr. Laura Petes**, and undergraduates **Carley Knight** and **Alicia Brown** (both students in the Certificate Program in Marine Biology) had a very active summer.

Carley's research focused on predator- prey interactions, and revealed that the abundance of oyster drills (predatory snails) and their predation rate on oysters are affected by salinity. At low salinity, snails suffer high mortality and so predation on oysters is low, while at high salinity, their abundance and feeding rates on oysters increase. This research was supported in part by the First William F. Herndon Undergraduate Marine Research Scholarship Award.

Alicia's Honors Thesis work revealed that Dermo, a protozoan parasite that infects oysters, is much more prevalent (higher number of infective cells) and the disease more severe when water temperatures are warm than when they are cool. Alicia's work was supported in part by a Bess Ward Honors Thesis Award (\$1,000) from the Honors in the Major Program.

Laura expanded on the oyster drill study to find that oyster drill egg capsules show delayed hatching and reduced hatching success at low salinity, supporting the idea that this oyster predator is affected by changes in freshwater input into the estuary.

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**Dr. Felicia Coleman** spoke recently on the effects of low water flow in the Apalachicola River on the ecology of the marine ecosystem with **Senator Bill Nelson**, **General Schroedel** of the U. S. Army Corps of Engineers, and aides of **Congressman Allen Boyd**. She was subsequently invited by Congressman Boyd to speak at the Apalachicola River and Bay Congressional Forum in Chattahoochee.

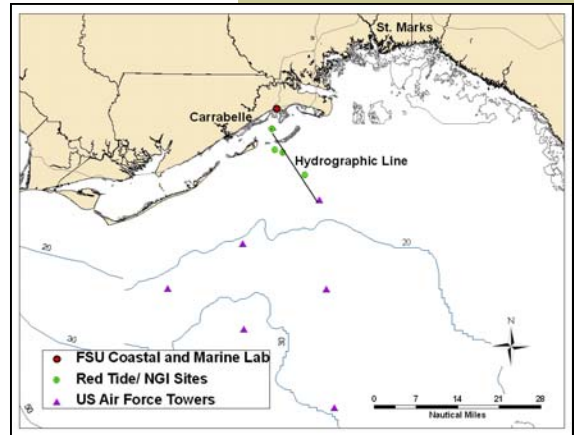
The Current Meter Facility (CMF) is a part of the FSU Department of Oceanography and offers support with marine operations, research cruises, instrument deployments and maintenance, and data acquisition. Presently, the CMF supports two research projects out of the FSU Coastal and Marine Laboratory.

Monthly cruises aboard the *R/V Seminole* for Red Tide monitoring are supported by the CMF. Water samples are collected and analyzed for the dinoflagellate *Karenia brevis*, the Florida red tide organism. Water quality parameters such as temperature, salinity, dissolved oxygen, pH, and chlorophyll are collected along a hydrographic transect line to the offshore US Air Force Tower N7, also known as the K Tower.



The CMF also supports the Northern Gulf Institute (NGI) research by deploying sub-surface oceanographic instruments at three sites along a hydrographic transect. Ocean currents and surface waves are measured by Acoustic Doppler Current Profilers, and Yellow Springs Instrument Company (YSI) equipment is used to measure water quality parameters. These instruments are maintained using SCUBA, which is supported by the FSU Academic Diving Program. The measurements will be used for a large-scale ecosystem model of the Big Bend Region.

For more information see the FSUCML website: <http://cmf.ocean.fsu.edu/>



## Publications and Grants

### SCIENTIFIC PAPERS

- Coleman, F.C.**, et al. (ed.). 2008. Life history in fisheries ecology and management. Proceedings of the 6<sup>th</sup> William and Lenore Mote Symposium. *Bulletin of Marine Science* 83(1).
- \***Petes, L.E.**, B.A. Menge, and A.L. Harris. 2008. Intertidal mussels exhibit energetic trade-offs between reproduction and stress resistance. *Ecological Monographs* 78(3):387-402.
- \***Petes, L.E.**, B.A. Menge, F. Chan, and M.A.H. Webb. 2008. Gonadal tissue color is not a reliable indicator of sex in rocky intertidal mussels. *Aquatic Biology* 3: 63-70
- \***Stallings, C.D.** 2008. Indirect effects of an exploited predator on recruitment of coral reef fishes. *Ecology* 89(6):2090-2095.

### GRANTS

- Coleman, F.C.** 2008. Support for publication of the Proceedings of the 6<sup>th</sup> William and Lenore Mote Symposium. Curtis and Edith Munson Foundation, \$5,000.
- Coleman, F.C.** 2008. Support for the 6<sup>th</sup> William and Lenore Mote Symposium. Gordon and Betty Moore Foundation, \$15,000.
- Coleman, F.C.** 2008. Support for publication of the Proceedings of the 6<sup>th</sup> William and Lenore Mote Symposium. Florida Fish and Wildlife Conservation Commission, \$10,000.
- Engstrom, R. T.**, and **F.C. Coleman**. 2008. Planning Grant for Comprehensive Facility Enhancement of The Florida State University Coastal & Marine Laboratory. National Science Foundation, \$24,992.
- Engstrom, R. T.** 2008. FSU Coastal and Marine Laboratory 2009 Open House. Franklin County Tourist Development Council, \$2,000.
- Grubbs, R. D.**, **C. Koenig**, D. Thistle, **J. K. Craig**, G. Naylor, M. Huettel, J. Chanton, T. Miller, C. Ward, **F. Coleman**, D. Levitan, **L. Petes**, **C. Stallings**, **T. Engstrom**, and D. Ferrell. 2008. \$20,502. Zeiss Stereo Microscope with Color Imaging for Users from Multiple Disciplines. FSU Research Foundation Equipment and Infrastructure Enhancement Grant.
- Petes, L.E.**, and **F.C. Coleman**. 2008. An ecological approach to oyster reef restoration in Apalachicola Bay. USFWS Coastal Program in the Florida Panhandle Grant, \$15,466.
- Petes, L.E.**, and **A.R. Hughes**. 2008. Florida's Coral Reefs: Threats, Decline, Management, and Signs of Hope?; Florida Sea Grant, Newell Seminar Series, \$900.

\* The research for these papers was conducted while our faculty and post-doctoral researchers were at other institutions, but some of the writing and editing was accomplished at the FSUCML.

Fall 2008

## Marine Ecology for Teachers Program at FSUCML

By Bill Herrnkind

The 6-week summer NSF Inquiry program for Science Teaching hosted twelve teachers in 2008, both local and from across the US, as well as four FSU Science Teaching grad students. The diverse sea life of marine habitats near FSUCML served as the inducement to curiosity by the participants who then generated brief research projects based on the questions they raised. While Prof. of Biological Science **Bill Herrnkind** (Emeritus) guided them through their inquiries, Master Science teacher and naturalist **Jeff Dutrow** guided them through a pedagogical translation of their scientific investigatory processes as a model for K-12 classroom inquiries. The participant studies conducted included testing multiple hypotheses that potentially explained



the benefits of climbing above water at high tide by salt marsh periwinkles, testing the efficiency of predation by moon snails on different clam species with varying shell thickness, and determining the sensory stimuli that triggered escape swimming by scallops. After the science projects, each of the participants designed inquiry exercises, for his or her classroom, ranging from the physics of acceleration to the influence of earthworms on plant growth. Graduate students in Science Education will track the success of the inquiry experience in classroom practice of the teachers in subsequent years.

## Graduate Student Slumber Party



During the last academic year (2007-2008), we started an annual tradition, the Graduate Student Slumber Party to entice new and returning grad students to conduct research at the FSUCML. The tradition continued this year, as students and faculty celebrated (a very active verb during the event) the beauty and natural diversity of the Big Bend region. Students from the departments of biological science and oceanography gathered for a retreat to enjoy a good meal, hear a few lectures, and rub shoulders with FSUCML faculty and staff in a relaxed setting overlooking Apalachee Bay. Following an overnight stay in our dorms, everyone embarked on field trips on foot and by boat to find

shore and marine organisms near the Lab, before heading back to Tallahassee with lunch in hand. Stay tuned for our late summer announcement for the Fall 2009 Graduate Student Slumber Party. We hope to attract even more of you who conduct marine-related research--both faculty and students—to this relaxing event.

Fall 2008

## Facilities



New stairs



New ADA ramp



New gas tank

Three important improvements to the FSUCML facilities were completed over the past 6 months. First, we upgraded two entries into the Main Lab building to meet Americans with Disabilities Act (ADA) requirements. A new ramp that replaced an old staircase, and a new set of stairs that replaced a very steep ramp. Second, we have replaced the fuel tanks and fuel station for the boats. This involved removing the old gas and diesel tanks, creating a new slab, and installing the new tank. We were thrown a curve when we discovered an old tank buried and filled with concrete below the old slab. And, third, we replaced an air-conditioning unit for the main lab.

## NSF Facility Enhancement Planning Grant

The FSU Coastal and Marine Laboratory received a \$25,000 grant from the National Science Foundation to develop a comprehensive plan to improve its facilities. Plan development will occur in four phases:

- (1) Site analysis and initial data gathering. This involves collecting data about our current facilities.
- (2) Needs assessment. This consists of site visits to a number of marine laboratories and holding stakeholder workshops. To date we have visited the Grice Marine Laboratory at the College of Charleston, the Darling Marine Center at the University of Maine, and the Dauphin Island Sea Lab.
- (3) Design and development. This phase will take place with architects and engineers in a charrette.
- (4) Cost estimates and phasing. Engineers and architects will develop this final element of our planning and provide a logical framework for improving the facilities that we have and growing to meet needs that we anticipate over the next decade or two.

The Lab staff will work closely with FSU Facilities Planning staff to dream a little bit and develop an energy-efficient, well-equipped laboratory and short-term living quarters to support research in the biologically rich Big Bend region. We will seek input at our planning meetings this fall.

Fall 2008

## 2009 FSUCML Lecture Series Second Thursday of the Month (usually)

- 22 Jan. 2009 **John Bruno**, Univ. North Carolina., "Florida's Coral Reefs: Threats, Decline, Management, and Signs of Hope ?" This is an Elise B. Newell Seminar sponsored by Florida Sea Grant.
- 12 Feb. 2009 **Don Strong**, U.C. Davis, Bodega Marine Laboratory, "Ecological and Evolutionary Misadventures of Invasive *Spartina*"
- 12 Mar. 2009 **Anne Rudloe**, Gulf Specimen Marine Lab, "Sea Turtles"
- 9 Apr. 2009 **Ken Heck**, Dauphin Island Sea Lab, "Consumers Rule: Predator Primacy in Shallow Benthic Ecosystems"
- 14 May 2009 **Bill Arnold**, Florida Fish and Wildlife Research Institute, "Bay Scallops, Population Connectivity, and the (Painful) Development of an Ecosystem Approach to Fisheries Management"
- 11 June 2009 **David Kimbro**, FSUCML, "The Effects of Non-native Predators and Coastal Oceanography on the Health of Oyster Habitat"
- 10 July 2009 **TBD**
- 13 Aug. 2009 **Helen Light**, FSUCML, "Water-Level Decline in the Apalachicola River and Effects on Floodplain Ecology"
- 10 Sept. 2009 **Jack Rudloe**, Gulf Specimen Marine Lab, "Shrimp"
- 9 Oct. 2009 **Gil Nelson**, Gil Nelson Associates, "Coastal Vegetation of the Florida Big Bend"

Check our website for more information about these speakers at: <http://www.marinelab.fsu.edu/outreach.html#lecture>

## Education

**OCB5930-02. Phylogeny of Marine Microorganisms.** Summer 2009. *Joel Kostka* (FSU Dept. of Oceanography)

**BSC 4934/BSC 5936 AAUS Scientific Diving: Methods for Scientists.** Fall 2009. Teacher *TBD*.

**Introduction to Geographic Information Systems (GIS) for Coastal & Marine Applications.** 13-15 July 2009; *Xiaojun Yang* (FSU Dept. of Geography). Geared for those with little or no previous GIS experience, participants will learn how to use GIS to address coastal environmental issues.

**Evening at the Edge.** 8 May and 20 June with *Bill Herrnkind*. A short lecture and walk in the intertidal zone designed to educate and inspire coastal citizens through hands-on experience about the strange and wonderful sea life along our pristine shores and shallows.

**Big Bend Birding.** April and October of 2009 with *Todd Engstrom* and others. Co-sponsored by the Apalachicola National Estuarine Research Reserve. This course includes a short lecture, an overnight stay at the FSUCML, and a day of birding at some of the finest natural areas in north Florida.

**ISC 5535 Research for Teachers—Inquiry in Marine Ecology** (6 hrs). *Bill Herrnkind* (FSU Emeritus Department of Biological Science). This course is a six-week, full-time, research experience for pre-service teachers to use and apply the scientific inquiry process in a marine environment. The primary goal is to promote the practice of inquiry in K-12 science teaching and learning. It will be taught in summer 2009.



**Mission:** To solve ecological problems through innovative, interdisciplinary research in coastal and marine ecosystems of the northeastern Gulf of Mexico and provide scientific information as the basis for sound policy decisions.

**Become a Friend of the FSU Coastal and Marine Laboratory!**

Join a group of dedicated people who support our mission. You can help us by making a private tax - deductible gift. Gifts of any amount are important, whether it's for our general operations or to an endowment dedicated to providing scholarships to undergraduate and graduate students for research.

If you are interested, please print this page, fill in the information below, and send a check to:

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Would you like for your gift to be anonymous?      Yes      No

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Are you interested in becoming a volunteer?      Yes      No

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