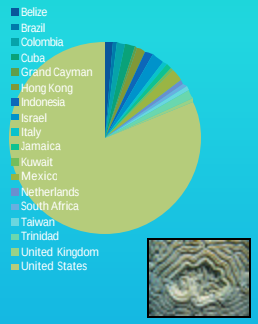
Thirteen years of investigating Florida Keys' reefs through the course "Diseases Of Corals And Other Reef Organisms"

Esther C. Peters[1,3,4], Robert B. Jonas[1], Thomas R. Cuba[2,3], Erich Bartels[4], and David E. Vaughan[4]

[1]George Mason University, Fairfax, VA USA [2]Delta Seven, Inc., St. Petersburg, FL USA [3]Stillwater Research Group, St. Petersburg, FL USA
[4]Mote Marine Laboratory, Tropical Research Laboratory, Summerland Key, FL USA

Overview

Dr. Erich Mueller proposed offering an advanced 1-week course on coral diseases when Mote Marine Laboratory opened a lab on Pigeon Key and asked Dr. Peters to teach this in the summer of 1997. With the exception of 1999, when the Pigeon Key facility was closed after Hurricane Georges, the course has been offered every summer, now at Mote's Tropical Research Laboratory on Summerland Key. This is the longest-running course on diseases of tropical marine organisms that has been offered anywhere. Up to 15 participants have been accommodated each year. Participants from the United States (79%) far outnumbered those from 17 foreign countries (21%). Most participants have backgrounds in marine biology, ecology, microbiology environmental science, veterinary medicine, science policy, and coastal or reef management. Academic credit is available through George Mason University, Nova Southeastern University, or your university. Many Florida institutions have been represented in the course, including several universities, Florida Keys National Marine Sanctuary, Florida Fish and Wildlife Research Institute, Florida Department of Natural Resources, Broward County Department of Planning and Environmental Protection, U.S. Geological Survey, U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency/Gulf Ecology Division, The Nature Conservancy, and the Florida Aquarium.



Year	Professionals	Graduate Students	Under-graduates	Total Students
1997	2	6	3	11
1998	5	6	0	11
2000	7	4	2	13
2001	6	6	0	12
2002	6	5	0	11
2003	4	9	0	13
2004	10	3	1	14
2005	8	2	2	12
2006	0	4	0	4
2007	3	8	2	13
2008	5	4	0	9
2009	10	5	0	15
2010	2	6	0	8
13 Years	68	68	10	146

Classroom and Laboratory Sessions

During the last three decades, the potential for severe impacts to coral reef populations and communities from the effects of various diseases has been recognized. Diseases of corals, fishes, coralline algae, sea urchins, and sea turtles have been described, sometimes with wide-ranging effects. Coral diseases are affecting increasing numbers of corals and the Florida Keys has been particularly hard hit. The focus of the lectures and laboratory sessions is the pathobiology of reef organisms. Methods of studying diseases are explained and hands-on work during the course includes physiological, histological, and microbiological techniques. We work closely with the Coral Disease and Health Consortium (CDHC), an activity of the U.S. Coral Reef Task Force, to present current multidisciplinary protocols for disease diagnosis. Laboratory processing of the microbial consortia obtained from black band diseased corals provides participants with a basic understanding of microbiology and microbial communities, including preparing samples, culturing microorganisms, identifying bacteria using selective media and Biolog plates, and performing molecular genetics investigations.

The fish on the left is "ADR"

Dr. Jonas evaluating vibrio bacteria from black band mats cultured on TCBS agar

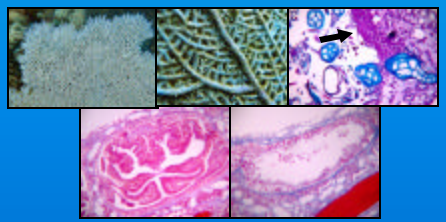
Good news for Looe fore reef?

Field Activities

Six dives are included during the week of the course. Participants perform a radial transect survey at Looe Key Reef to learn how to collect data on coral species and diseases by this method and observe many examples of coral diseases (unfortunately). We recorded the demise of an *Acropora palmata* colony in the transect over several years and it has not been colonized by other corals. Other data are collected, and participants can work with various transect tapes, quadrats, video and still camera photography, and PAM fluorometer. We also obtain samples of coral mucus, diseased and healthy coral tissue, microbial consortia (e.g., black-band mat), and other materials under FKNMS permits and use them to train participants in disease diagnosis procedures. These samples are usually taken from other areas in the Sanctuary. Tissue samples have been fixed and processed to prepare thin stained sections mounted on microscope slides for examination with light microscopy. While too few samples have been diligently analyzed for a peer-reviewed publication, observations of new diseases based on field signs include new parasites, pathogens, and unknowns (see below). By bringing together each summer groups of bright participants to explore the reefs, a few pieces can be fit into the puzzle, or those that don't fit can be discarded, to contribute insights to help FKNMS and other reef managers develop more effective conservation strategies over time.

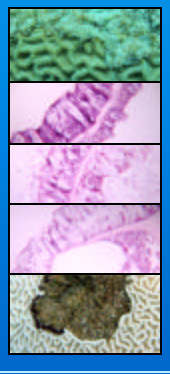
"New" diseases of corals found on Florida Keys reefs that need further study

"Scuzzy" (?) Sea Fans



Dr. Peters was fascinated by sea fans after working with Drew Harvell's lab and observed during course dives that colonies sometimes had fine white material sloughing off the blades (above left) or faint green fouling over the tissues (above center). Some were completely fouled with dense mats of algae and cyanobacteria. Histopathological examinations showed filamentous algae (stained with alcian blue, above right) eliciting an immune response from amoebocytes (arrow) and necrotic tissue. Healthy polyp architecture (below, left) is compared with complete loss of polyps from a blade with sloughing—how can this be possible, do they recover or?

Colpophyllia natans Concerns

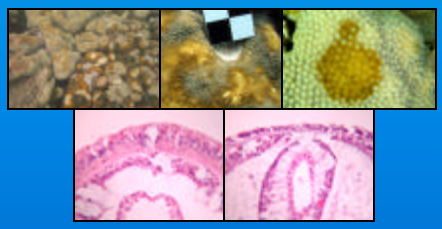


Dr. Cuba noticed that many colonies of *C. natans* (and other species) have sediment and algae on their skeletons and directly in contact with tissue. (top left). Although the tissue grossly appears normal, the margins are not actively growing and might be receding slowly. This species has also been affected by very rapid tissue loss, as Jim Kidney reported in his presentation to the class in 2004, as well as a mysterious mottled bleaching. Microscopically, growing margins actively secrete mucus and have healthy zooxanthellae (second, left). Receding margins are losing zooxanthellae and producing abundant pale mucus in the epidermis and gastrodermis but mesoglea is thinner (center). Finally, cells become necrotic and gastrodermis sloughs off the mesoglea (fourth left). The cause is uncertain (could fungi have something to do with this?), but the tissue alterations show why receding margins are vulnerable to other disease agents (bottom left).

Siderastrea Bullseye Bleaching

Diego Lirman sent a photo of an *S. siderea* colony he found in Biscayne National Park with an unusual pattern of alternating pale and dark bands to Dr. Peters in 1997 asking "What's this?" Similarly bleached colonies have now been found on Florida Keys reefs to the Dry Tortugas. A course participant found one at Looe Key reef in 2006 (top right). In 2008 we were able to obtain tissue sample cores from a similar lesion on a large colony at Sugarloaf Bank (second right) Bleached areas had swollen, pinkish tissue. Microscopically, the coral tissue was within normal limits (third right), except that oral gastrodermis had few symbiotic algae, some cells free in the lumen of the gastrovascular cavity, and more mucus production; aboral gastrodermis had necrotic debris and misshapen and vacuolated algae with pycnotic nuclei, indicating the algae had died (bottom right). The following year the colony had no signs of bleaching, normal coloration returned!

Star Coral Discoloration



In 2007 we investigated a MEERA report made by The Nature Conservancy (above left) of discoloration and tissue loss occurring at Sugarloaf Bank. Celia Torres had photodocumented similar lesions on *Montastraea faveolata* on Keys reefs in 2004 during her master's thesis research (above center). By the time we arrived all corals there had bleached, but we fixed samples in 2008 (above right). Histopathological examination revealed vacuolation and erosion of the epidermis, then tissue loss (below right) compared to normal (below left), but no obvious cause. The etiologic agent may kill thraustochytrid fungi of the opaque pigment.

For more information contact: epeters2@gmu.edu, 703-993-3462. The next course will be held August 7-14 at Mote Marine Laboratory's Tropical Research Laboratory on Summerland Key, Florida, about 24 miles east of Key West: www.mote.org/Keys/adv_courses_2011.phtml

Acknowledgements: We thank Erich Mueller, whose vision led to the development of this course and the Summerland Key Tropical Research Laboratory; assistants Dan Gallagher, Lauren Waters, Katie Victor, Geoff Cook, and several Mote Interns; the Florida Protect Our Reef Grant Program; the Florida Keys National Marine Sanctuary; Brian Keller, for continuing inspiration; and all of the participants who taught us, too!