

## Coral Diseases of the Lower Florida Keys

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A coral disease is defined as any impairment of the organism's vital bodily functions or systems, including interruption, cessation, proliferation or other malfunction, originating from either biotic or abiotic sources. Diseases of corals and other reef organisms may be increasing as global and local ecological changes occur, and, therefore, may serve as indicators of such changes.

Coral growth rates range from 10 centimeters per year for the branching corals (Acroporids), to 1 centimeter per year for the brain and star boulder corals. Coral disease mortality rates, under ideal conditions, can be as high as 1 centimeter per day for white plague disease, and 1 millimeter per day for black-band disease. You can understand why scientists are very concerned about the presence of diseases in coral reef ecosystems when the disease rates for a single day challenge the coral's annual growth rate.

Coral Diseases in the Florida Keys National Marine Sanctuary Coral diseases were observed in the tropical western Atlantic such as "black line disease" and "plague" and described as far back as the early 1970s. Traditionally, scientific studies have focused on the incidence of a single disease within a small geographic area.

Scientists began to focus increased attention on coral diseases in the Florida Keys National Marine Sanctuary during the summer of 1995 due to reports from the National Undersea Research Center in Key Largo, and in 1996 due to reports from Craig Quirolo at Reef Relief. Both groups were concerned that disease outbreaks were occurring along the reefs at alarming rates. A group of scientific experts and resource managers were promptly called upon to conduct a rapid assessment of disease outbreaks in the Lower Keys, including field observations and collections. Dr. Deborah L. Santavy of the U.S. Environmental Protection Agency (EPA) was involved in this work and her research and monitoring in the sanctuary continues today. While coral reefs are in decline throughout the world, disease and bleaching appear to be among the leading contributing factors in the Florida Keys.

The objective of Dr. Santavy's survey is to use quantitative assessment methods to characterize the distribution and frequency of coral disease in the Lower Florida Keys. The EPA has conducted research cruises each summer since 1997, sampling 36 sites on the reefs between Key West and the Dry Tortugas. The study utilizes a circular (10 meter radial arc) transect method developed by Edmunds in 1991. Coral counts, diseased coral counts, and bleached coral counts are recorded to determine the distribution and frequency of disease. Data reveals 11 disease conditions affecting 18 species of stony corals and sea fans. According to research completed in 1998, the greatest incidence of disease and bleaching was found on the Key West reefs, where approximately 22% of the corals were diseased and 26% were bleached.

The focus of the sanctuary's involvement in coral disease work includes assessment, treatment, and ongoing monitoring. For example, sanctuary staff supports the EPA disease cruises each summer, and the sanctuary funded the development and implementation of the Marine Ecosystem Events Response Assessment (MEERA) rapid-response program at Mote Marine Lab.

The MEERA program encourages the public to report unusual or significant biological events that adversely affect marine organisms, such as disease outbreaks, coral bleaching, fish kills, and algal blooms (including red tides). These reports will help scientists and resource managers coordinate the early detection and assessment of such events by sending out response teams.

The sanctuary staff of Looe Key National Marine Sanctuary began monitoring a severe outbreak of black-band disease on the sanctuary's fore reef in 1986. Harold Hudson of the U.S. Geological Survey initiated an experimental treatment program in 1987. He removed the black band, which appears as the interface between live tissue and dead skeleton, with a vacuum technique that used air to lift the black band of disease off the surface of the coral skeleton. As some microscopic filaments inevitably remained, he discovered that applying modeling clay (by pressing it into the coral skeleton) would successfully smother the unseen pathogen. Today, this work continues, as severe outbreaks were observed again in 1995, 1996 and 1999. Monitoring to determine the success of treatment is under way.

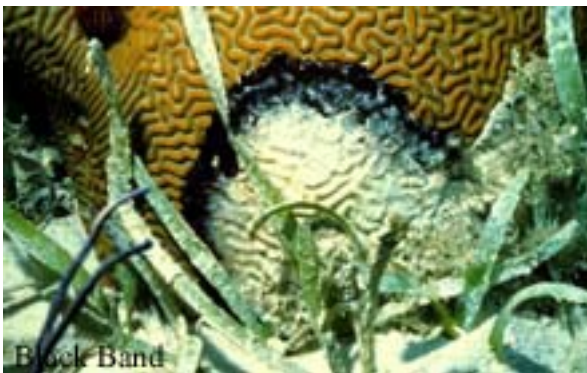
**Coral Bleaching** Coral colonies among the coral reef appear in a variety of colors due to the presence of a microscopic algae that lives within their tissues. Through the process of photosynthesis, the algae provide oxygen that fuels respiration in the coral. Likewise, the coral produces carbon dioxide that is utilized by the algae. The two work cooperatively in a beneficial relationship, which is described as "symbiotic," to maximize growth.

Coral bleaching is described as the loss of symbiotic algae or algal pigments from the coral tissues (gastrodermal cells), which results in the appearance of the white coral skeleton through the translucent coral tissue. The corals appear white, as though it has "snowed" on the reef, and tissue loss may occur if the condition persists for a period of time. Coral bleaching is a generalized stress response to extremes of temperature, salinity, ultraviolet radiation, changes in the level or quality of light, sedimentation and turbidity, and possibly, carbon dioxide increases. In the Mediterranean, scientists have isolated a *Vibrio* bacterium that causes bleaching. By definition, coral bleaching is considered a diseased condition of corals.

Coral bleaching observations have been recorded and monitored by the Keys sanctuary staff since a severe bleaching event in 1988. Sanctuary Superintendent Billy Causey has documented coral bleaching events at Looe Key in September 1990, and throughout the Keys in 1998. These periods were characterized by doldrum, lake-like conditions resulting in warm water temperatures, as high as 93°F, along the reef tract. During the 1990 event at Looe Key, the staff conducted surveys and collected bleaching data. A

range of 75% to 90% of all coral species located in the reef crest zone were bleached. While corals are often able to survive bleaching events, sometimes the tissue dies back. Mortality had occurred, in this case, shortly after the bleaching event, which affected mostly fire coral and elkhorn coral. The sanctuary staff continues to document the reef's condition, in collaboration with EPA, during the annual research cruise.

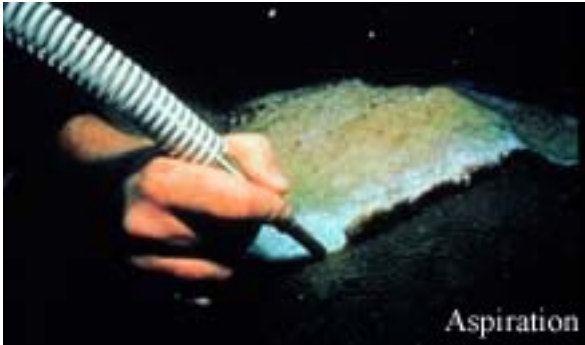
For More Information on Coral Diseases Descriptions of coral disease types and their symptoms can be found in a the paper entitled "Microbial Pests: Coral Diseases in the Western Atlantic" by D.L. Santavy and E.C. Peters (1997 Proceedings of the 8th International Coral Reef Symposium 1:607-612.) or on The Coral Disease Page Web site.



Black-band disease, a complex of cyanobacteria and other micro-organisms, is destroying the living tissue of this brain coral located at Bird Key in the Dry Tortugas. (Photo courtesy of Don DeMaria)



This elliptical star coral, at Sand Key Reef, is infected with a white plague type II pathogen. The yellow-orange area is the remaining living tissue not yet effected by the disease. (Photo courtesy of G.P. Schmahl)



Harold Hudson, FKNMS Coral Reef Restoration Biologist, is seen aspirating the black band from the surface of a brain coral using a vacuum operated apparatus of his own design. (Photo courtesy of FKNMS)



This star coral has lost its symbiotic algae, giving it a white appearance. Coral can survive for a without this algae, but if expelled for an extended time, the coral will die. (Photo courtesy of FKNMS)