

Disease of Coral and Coral Reef Fishes

The occurrence of disease in coral reef systems is a growing environmental crisis that threatens the biological diversity of the world's oceans.

The Department of the Interior protects sensitive habitats amounting to about 3,600,000 acres of coral reefs and other submerged lands. These reefs are important ecosystems in 13 National Wildlife Refuges, 10 National Parks and in certain territorial waters such as the Wake Atoll.

Over the past several decades, there have been over 34 documented mass mortalities involving corals, sponges, urchins, mollusks or fish and there is some direct evidence to suggest that the frequency of these marine epizootics is increasing. These mass mortalities often result in significant shifts in coral community structure. The sudden



Preparation of Bacteriological Plates

and extensive loss of the sea urchin (*Diadema antillarum*) was perhaps



Coral Bleaching of *Porites astreoides* (normal on left—bleached on right)

one of the first well-studied epizootics in the Caribbean. The loss of this primary herbivore on coral reefs resulted in broad-scale ecological change affecting many reef organisms, including the associated fish communities. Other mass mortalities in staghorn coral (*Acropora palmata*), elkhorn coral (*Acropora cervicornis*) and turtle grass (*Thalassia testudinum*) in Florida Bay may have likewise caused changes in marine fish communities.

The relationships between biodiversity and ecosystem function in coral reefs, including the resistance to and resilience from disturbances, are unclear.



Coral Reef — Buck Island National Park

Massive fish kills in the northeast Caribbean within State waters of Barbados, Trinidad, Tobago, Guyana, Grenada, St. Thomas and The Grenadines in 1999 were caused by septicanemic *Streptococcus iniae*; a serious bacterial disease of marine fishes. Many other reports of fish kills were often associated with instances of poor water quality. These epizootics and other reports of diseases of coral reef and associated fishes have shown that a variety of bacterial, viral and fungal pathogens and several host-ectoparasite relationships directly effect fish health. However, in general there are few observations of disease in coral reef fishes and consequently, little effort to document associated bacterial and viral pathogens.

Scientists at the Leetown Science Center have developed marine aquaculture and experimental systems to explore the characteristics and processes of disease as it affects coral reef organisms. Since August of 2002

Current and Planned Research Activities

- Investigate the role of reef connectivity in maintaining diversity.
- Develop molecular techniques for the study of disease processes in live coral.
- Develop molecular biomarkers indicative of coral health status.
- Study the effect of herbicides (such as Atrazine) on corals, symbiotic dinoflagellates, *Thalassia*, and other reef organisms.
- Determine if and how corallivorous reef fishes serve as vectors of coral disease.

scientists have capitalized on the high-intensity natural light in our greenhouse to develop several large culture systems stocked with a range of coral invertebrates and plant species of interest. These systems are described in another USGS Fact Sheet (<http://pubs.usgs.gov/fs/2004/3116>). The success of the LSC laboratory systems is indicated by the diversity of species that they support. Currently, the LSC systems maintain over 200 species of plants and animals, including macroalgae, submerged aquatic angiosperms (true seagrasses), many types of calcareous algae, mollusks (snails and clams), echinoderms (seastars, urchins, brittle stars), numerous cnidarians (corals, anemones), crustaceans, and an array of worms of various phyla.

Research at Leetown focuses on the relationship between reef organisms, pathogens, and environmental factors. A major bleaching event that occurred in the Caribbean in the fall of 2005 was studied by USGS scientists in conjunction with the U.S. Park Service. Importantly, *non-invasive, non-destructive sampling methods* were developed by USGS scientists and employed to accomplish sampling needs and get statistically significant numbers with minimal impact on the reef organisms. Sterile, foam swabs were used to sample healthy and diseased coral and material was transferred to specially prepared “gene cards” for

storage and transport to the laboratory. This card-based sampling method allows room temperature storage of DNA samples for years and eliminates problems with often-used low temperature storage and transport from remote locations. Further details can be found in another Fact Sheet (<http://www.coralreef.gov/library/pdf/DOI%20bleaching%2011-06.pdf>).

A current study, in conjunction with scientists at the University of the Virgin Islands is focused on understanding reef connectivity. The genetics of two reef-building corals (*Acropora palmata* and *Montastraea annularis*) as well as a commercially valuable reef fish, the Nassau grouper, are being studied to determine how the dissemination of juveniles is influenced by ocean currents. Another part of this study is being conducted in the Leetown greenhouse facility to test the effects of dissolved organic carbon and current flow on coral-associated bacterial flora. These experiments examine the possible influence of excess nutrients from runoff in the production and/or exacerbation of coral disease.

In general, the relationships of coral health to diseases are largely unexplored and unknown. To explore these relationships scientists will develop molecular biomarkers indicative of coral health status. Many important biological molecules are relatively conserved

evolutionarily, and this allows them to be identified by polymerase chain reaction (PCR), hybridization, and/or antibody methods. A suite of assays that could be used to measure and assess the physiological status of these life functions in key coral species would be a useful management tool for use in predictive modeling.

To test this approach of biomarker identification, the expression of several gene families was investigated to study the molecular mechanisms functioning in the deep-sea coral, *Lophelia pertusa*. In conjunction with other USGS scientists, and with the support of the Minerals Management Service, samples were collected from a Gulf of Mexico site known as Visoca Knoll using the Johnson Sea-Link deepwater submersible. Utilizing advanced forms of polymerase chain reaction, four previously unknown expressed genes were discovered by Leetown scientists that are associated with vegetative growth, division, gamete development, and skeletal biomineralization.

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