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Eastern Region
Leetown Science Center

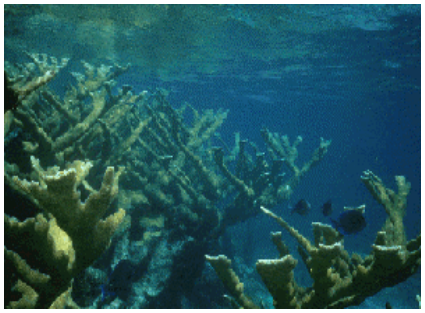
Disease of Coral and Coral Reef Fishes

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

Bicolor Damselfish infected with DNFv

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 and extensive loss of the sea urchin (*Diadema antillarum*) was perhaps 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 palmate*), elkhorn coral (*Acropora cervicornis*) and turtle grass (*Thalassia testudinum*) in Florida Bay may have likewise caused changes in marine fish communities.



Coral Reef — Buck Island National Park

Preparation of Bacteriological Plates

The relationships between biodiversity and ecosystem function in coral reefs, including the resistance to and resilience from disturbances, are unclear. 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 scientists have capitalized on the high-intensity natural light in our greenhouse to develop a 2750 gallon culture system stocked with a range of coral invertebrates and several plant species of interest. Several species (barnacles, sea-cucumbers, anemones, and macroalgae) are reproducing in this system. The appearance of algae (*Halimeda monile*) known to be a major contributor to the production of calcium carbonate sands highlights one of the advantages of the Leetown site; namely the calcium and magnesium-rich water that is needed to successfully culture reef species.

Department of the Interior
U.S. Geological Survey
Homepage: www.lsc.usgs.gov

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LSC Fact Sheet
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Current Research

- **Investigate the biological and paleoecological causes of seagrass die-off.**
- **Develop tissue culture 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.**

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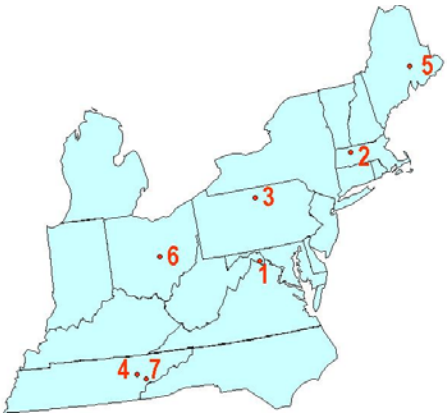
A second greenhouse system provides 1850 gallons and is used for studies involving *Thalassia testudinum* (turtle grass) and associated organisms.

Current research at Leetown focuses on the relationship between seagrass, seagrass pathogens, and environmental factors. Scientists hope that by examining the link between disease, environmental factors, and seagrass over an extended period of time (through core data), we can test hypotheses about the causes of seagrass die-off. Fish health researchers along with geneticists and geologists will utilize experimental data to interpret long-term historical data on seagrass in south Florida that will span 100-200 years. The results of the research can be applied to many areas throughout the southeastern United States and Caribbean where seagrass mortality has been an issue.

Scientists at the Leetown Science Center are also developing tissue culture techniques for the study of disease processes in live coral. The use of live coral and related organisms for laboratory-based *in vivo* studies is certainly beneficial and the development and use of cell culture models offers many advantages. For instance, environmental parameters (temperature, water quality, photoperiod, etc) could be controlled quite specifically in order to evaluate the effects of these abiotic variables at the cellular level. Biotic factors such as the presence of other organisms, including symbiotic algae/ dinoflagellates, could also be manipulated to gauge their relationships to diseases and syndromes affecting corals. Our initial efforts in cell culture will focus on a species of sea anemone (*Aiptasia*) present in abundance in the reef culture tanks. We will then transition our methodology to species of hard coral (*Porites*) and octocoral. Utilizing our primary and established anthozoan cell cultures/cell lines, we will attempt to isolate virus and other obligate intracellular organisms from diseased coral specimens. We will also evaluate the potential for viral agents from marine tropical metazoans (primarily coral reef fishes) and invertebrates (clams, crabs, and shrimp).

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 of these types of important biological molecules are sufficiently conserved evolutionarily to be identifiable by hybridization and/or antibody methods with commonly available reagents. This fact will allow us to measure and quantify the levels of a wide variety of these molecules at the cellular and subcellular level using a Laser Scanning Cytometer (LSC). Since many gene products are regulated by physiological and environmental factors, these molecules can be identified and measured by molecular techniques to provide a profile of health status for use in predictive modeling.

Location of Center Components



Leetown Science Center (1)
-Fish Health Branch
-Aquatic Ecology Branch
-Restoration Technologies Branch

Conte Anadromous Fish Laboratory (2)

No. Appalachian Research Laboratory (3)

So. Appalachian Research Branch (4)

Orono Field Station (5)

Columbus Field Station (6)

Great Smoky Mountain Field Station (7)

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