

## USGS NSF GRIP, GSP Opportunity

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- **USGS Center:** National Wildlife Health Center
- **Project Title:** Fighting the Tide: Combating Coral Disease and Disappearance Within the Florida Reef Tract Using Models
- **Summary:**

In an unprecedented large-scale mortality event, Florida has lost >90% of many coral species. This event is unusual due to its expansive spatial extent, the number of affected species (at least 21 scleractinian coral species), and severity of losses (> 95% for *Dendrogyra cylindrus*), effectively eliminating some species from the tract. The Florida Reef Tract generates over \$6.3 billion annually through income and expenditures and supports over 71,000 jobs in south Florida. Loss of these reefs may also threaten food supplies and human safety, as they are a major spawning ground for economically important fish and they help protect coastal communities from storm surges and erosion that are both projected to increase with sea-level rise.

Scientists from multiple state and federal agencies and universities are working to determine optimal sampling designs for scientist and citizen groups charged with documenting the severity and spread of this mortality event. Traditional design-based sampling techniques are insufficient for measuring the extent and prevalence of this problem. Because of the naturally sparse distribution of coral, critical changes in coral communities may go undetected until the coral loss is so dramatic (>50%) that recovery will be impeded. In this study, we will explore model-based surveillance designs via statistical simulation techniques to assess various sampling designs for efficiently and effectively monitoring coral communities and their health. We will also investigate the sensitivity of various monitoring metrics in coral communities to determine the most suitable for capturing important changes. This project could change the paradigm of how patchy phenomenon, such as coral diseases, are monitored and will have immediate ecological impacts.

A second objective is to examine previously collected long-term datasets on environmental variables to determine their potential contribution to the continued spread of this mortality event in Florida's coral communities. Our long-term goal is to determine if we can elucidate the drivers of this mortality event and whether they can be modified to ensure that this biologically diverse and economically important resource is not lost.

**Project Hypothesis or Objectives:** Coral disease surveys generally involve traditional design-based surveillance approaches through the random deployment of belt transects of varying length, enumerations of normal and diseased colonies, and estimation of prevalence of various lesion types. However, these standard approaches often fail to rigorously measure important changes in coral health and discern causative agents, and therefore fail as a monitoring program. Our main objective is to develop and evaluate various model-based surveillance designs to determine an optimal sampling strategy that will aid managers in assessing changes in health of coral reefs and the determinants affecting long-term sustainability. A secondary objective is to evaluate historical, long-term datasets and determine their value in understanding current conditions and driving processes.

**Duration:** Up to 12 months

**Internship Location:** Madison, WI

**Field(s) of Study:** Life Science

**Applicable NSF Division:** OCE Ocean Sciences, DEB Environmental Biology, DMS Mathematical Sciences

**Intern Type Preference:** NSF Graduate Research Fellow (GRF) via the Graduate Research Intern Program (GRIP)

**Keywords:** sampling design, coral, disease, mortality, web application, surveillance, quantitative ecology, epidemiology, ocean, coastal, marine

**Expected Outcome:** Web-based tool to assist coral managers with assessing sampling strategies to evaluate prevalence of coral disease based on local conditions. At least one manuscript, led by the student, on model-based survey designs for coral diseases. A second manuscript on spatial environmental drivers of the coral mortality event is possible, depending on the skills, interest, and time available for the student.

**Special skills/training Required:** Familiarity with coral reef ecology is a bonus but not essential, quantitative or statistical knowledge and modeling using the R statistical program is required, and familiarity with Shiny or other web application development tools is desirable.

**Duties/Responsibilities:** Candidate will work with USGS statisticians and wildlife disease specialists to develop and explore the model-based surveillance techniques and assess metrics for monitoring change in the health of coral colonies. This will entail intensive computer programming and evaluation of results, and effectively communicating with coral managers and project personnel. The results of this development will be a web-based tool that will allow managers the ability to assess the efficacy of various sampling strategies using the surveillance techniques explored by the student under their local conditions. Building on this, a second objective is to examine previously collected long-term datasets on environmental variables to determine their potential

contribution to the continued spread of this mortality event in Florida's coral communities. Candidate will interact with scientists from USGS, Florida Department of Environmental Protection, National Oceanic and Atmospheric Administration, National Park Service, Mote Marine Laboratory, and The Nature Conservancy who are directly involved with real time on the ground management of coral diseases issues as well as scientists with expertise in statistical modeling. This consortium will provide the student unique perspectives and networking not available in most academic settings.