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FINAL REPORT
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Project Title:

Mapping the Spatial Distribution of Diseases Affecting Elkhorn Coral within Virgin Islands National Park: A Closer Look at an "Endangered" Reef-building Species

Submitted by:

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Introduction

Over the last three decades, the most significant decline in shallow coral reefs in the Caribbean, including those in Virgin Islands National Park, St. John, was the dramatic loss of elkhorn coral (*Acropora palmata*). In the 1960s and 1970s, elkhorn coral was the main reef-building coral at depths of less than 10 m in the US Virgin Islands (USVI), growing in nearly mono-specific stands on the reef crest and in the upper and lower forereef zones of well-developed fringing and bank barrier reefs and on isolated patch reefs. This species is a critical structural component that provides essential habitat for fish and other organisms. In the mid 1970s and 1980s, white band disease (WBD) and hurricanes caused dramatic declines (in some cases over 90%) in *A. palmata* (Gladfelter 1982, Rogers et al. 1982, Aronson and Precht 2001) not only in the USVI but throughout the Caribbean. These corals were responsible for the overall physical structure of these reefs. Their loss dramatically changed the nature of the reefs and had undocumented effects on associated reef fishes and other organisms, such as endangered hawksbill turtles that use the reefs for shelter and feed on reef organisms. This regional loss of *Acropora palmata* (and *A. cervicornis*) was the most dramatic change to occur on Caribbean reefs in the last 30 years, and both species are now being proposed for listing as "threatened" under the Endangered Species Act (Diaz-Soltero 1999, Bruckner 2002, NOAA Federal Register March 18, 2005). There is now limited evidence that elkhorn coral is increasing in abundance at sites in the USVI, although no reef sites that have been examined have as much elkhorn coral as in the 1970s.

Elkhorn coral appears to be recovering slowly within Virgin Islands National Park and on other St. John reefs, but white band and white pox disease may delay or even prevent this recovery. The objective of this project is to map elkhorn reefs within the park using a GPS unit to record the number of living colonies, their size distribution, and the prevalence of white pox and white band disease.

Major Goal of the Project:

The major goal of this project is to map the spatial distribution of elkhorn colonies around St. John by size classes and disease occurrences (see Figure 1 for a portion of this map). The project to date has been even more successful than we anticipated, given the challenges of working on very shallow corals in frequently rough conditions. Thirteen (13) reef zones (11 inside Virgin Islands National Park and 2 outside) with a total of 3,628 colonies have been surveyed successfully (Figure 2). Photographs of each colony have been taken and cataloged and all data have been entered into a database. (Details on methods are available upon request.)

This project augments the more detailed, long-term research that we have been doing at Haulover Bay (beginning in February 2003) and Hawksnest Bay (beginning in May 2004). At these two sites, we photograph and survey a subset of elkhorn colonies to learn more about the fate of individual coral colonies, specifically, the progression of diseases; healing of white pox lesions; and effects of predation and fragmentation.

Genotype Analysis of elkhorn colonies from Haulover Bay

We were very fortunate to be able to use some of the funds for this project to support analysis of the genotypes of 48 colonies that we are monitoring in Haulover Bay. Dr. Iliana Baums, University of Miami, recently developed microsatellite markers that allow the identification of sexual recruits vs. clones (via fragmentation and re-attachment of elkhorn branches) (Baums et al. 2005). The Haulover colonies are dispersed quite widely over a distance of about 500 m, in a zone that formerly had one of the most impressive elkhorn stands in the US Virgin Islands (Beets et al. 1986).

Major findings to date:

- Prevalence of white pox (Figure 3) at the 13 sites (i.e., number of colonies with this disease) ranged from less than 1% to 34.7% (Figure 4).
- White band disease, thought to be responsible for the extensive declines in elkhorn in the 1970s-1980s, was only noted on one coral.
- In some cases, colonies have new lesions that do not resemble those caused by white pox or white band (similar lesions have been noted on colonies in the Florida Keys).

- Most colonies fell into the smaller size classes, and few very large colonies were observed (Figure 5). Smaller size classes possibly indicate a recovering population. The presence of new, sexual recruits is an indicator of recovery. However, although we have seen some colonies that are clearly sexual recruits, it is not usually possible to distinguish recent recruits from remnant patches of live tissue.
- White pox was more prevalent on colonies in the two largest size classes (maximum dimension 51-100 cm, and greater than 1 m) (Figure 6).
- Disease may be positively correlated with high seawater temperatures, as suggested by our monthly monitoring of elkhorn colonies at Haulover and Hawksnest. One site (Salt Pond) was surveyed twice, in September 2004 when temperatures were relatively high (based on data from *in situ* temperature sensors at several locations around St. John) and disease prevalence was 34.7 % and again in January 2005 when temperatures were lower and prevalence was 5.2 %. However, the colonies at Salt Pond sustained considerable damage from Hurricane Ivan when it passed south of the island in early September 2004, and disease could be correlated with physical damage.
- No pattern has emerged to date indicating that reefs with greater use by humans have higher prevalence of white pox. For example, Trunk Bay, which is one of the most visited beaches in the Caribbean, had a very low amount of white pox. The highest disease prevalence was at Salt Pond, which is a relatively popular snorkeling spot, but sewage is not likely to be a problem here or at Trunk. Trunk Bay and Salt Pond are being studied under our recently-funded DCWF 2005 proposal.
- The genotype analysis identified 43 different genotypes out of 48 colonies that were sampled. The predominance of colonies from sexual recruits may help to explain the wide variability in the fate of these colonies, with some exhibiting rapid growth, some showing progressive loss of tissue to disease, and some exhibiting diseases that appear to be different from either white band or white pox.

Map Product

This final report is accompanied by the primary product of this research, a map entitled "Distribution of Size Classes and Disease of Elkhorn Coral (*Acropora palmata*) in Selected Bays Around St. John, U.S. Virgin Islands". The map provides introductory information, the results of the study, and a reference to the value of these data as a baseline for future research on the status of elkhorn coral around St. John.

In the map, each of the 13 sampling locations are shown, and enlargements of each bay are provided along with information on coral colony size classes, percent of disease within each sample area, the size of the area surveyed, and a measure of the density of

colonies within each area. In addition, photographs and graphs) depict an elkhorn colony before and after infection with white pox, disease prevalence for the 13 locations surveyed, total number of colonies in each size class, and the corresponding prevalence of disease.

Long-term success of the project

The project has already produced very valuable data on a coral species that is now being considered for listing under the Endangered Species Act (no other coral has ever been listed). The recent Status Review of *Acropora* spp. (available at the following web site <http://sero.nmfs.noaa.gov/pr/protres.htm>) included data from this project. At the end of the project, the results will be submitted for publication in a peer-reviewed journal.

All or a subset of the zones that have been surveyed should be re-surveyed in 2 or more years to determine if elkhorn coral is increasing in abundance around St. John. In addition, the research that DWCF is funding on elkhorn corals at two of the sites (Trunk Bay and Salt Pond) over the next year will help to determine trends in abundance and factors that could limit recovery.

Partnerships

This has been a very effective collaboration among individuals with the US Geological Survey, the University of the Virgin Islands, Friends of Virgin Islands National Park, the National Park Service, and many volunteers.

Students of Tabor Academy surveyed elkhorn colonies using our protocol around Whistling Cay, Brown Bay, and Ramgoat Cay, St. John, and contributed their data to us.

The Ocean Conservancy has offered to make the final report available on their web site.

We have also benefited from frequent discussions with other coral reef scientists in NOAA (Dr. Margaret Miller, Dr. Dana Williams, and Dr. Andy Bruckner). We frequently send images of elkhorn colonies with different conditions to our colleagues to confirm our identifications. The field of coral disease research is new, and little is understood about these diseases to date. The causes of white band and white pox are not known, although some white pox lesions have been associated with a bacterium found in the waste of humans and other animals.

The data on disease prevalence obtained during this project was incorporated into the NOAA Status Review for the *Acropora* spp., a document that is now being used to determine if elkhorn coral will be listed as threatened under the Endangered Species Act. This project also was a valuable learning experience for Erinn Muller and Pedro Nieves. They both learned more about the process of recording scientific data in the field, interpreting the data, and presenting them graphically.

Acknowledgements

Special thanks to Karen Brady with Friends of Virgin Islands National Park for administering this grant. We also thank the following for support in the field: Carrie Stengel and Devon Tyson (both with the National Park Service), Emily Burton (Friends of VINP), Dan Holstein, Brian Bell, and Tony Spitzack.

Spreading the word about the project:

Pedro Nieves will present the map produced under this project in a special session on coral diseases at the 18th Biennial Conference of the Estuarine Research Federation, in Norfolk, Virginia (October 2005). Erinn Muller will present some of the results of this research at this meeting as well.

C. Rogers and E. Muller gave presentations that referred to this project (and acknowledged the support of the DWCF) at the Coral Reef Task Force meeting in December 2004 in Miami.

Erinn Muller described this research in an article that was published in the newsletter for the Friends of Virgin Islands National Park (circulation over 3,000). The project was also described in the Virgin Islands on-line newspaper "The Source" (www.stjohnsource.com)

Erinn Muller also gave a presentation describing the results of this project at the Association of Marine Labs of the Caribbean 32nd meeting in Curacao, 2005.

References

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Beets J, Lewand L, Zullo E. 1986. Marine community descriptions and maps of bays within the Virgin Islands National Park/Biosphere Reserve. Virgin Islands Resource Management Cooperative. Biosphere Reserve Research Report 2. National Park Service. 117 pp.

Bruckner AW (editor) 2002. Proceedings of the Caribbean *Acropora* Workshop: Potential Application of the US Endangered Species Act as a Conservation Strategy. NOAA Tech. Memorandum. NMFS-OPR-24, Silver Spring, MD.

Diaz-Soltero, H. 1999. Endangered and threatened species; revision of candidate species list under the Endangered Species List. Federal Register 64 (no. 120). June 23, 1999.

List of captions for Figures (see DisneyFigures.ppt)

Figure 1. Detailed results from Yawzi Point depicting the size class distribution and prevalence of white pox on *Acropora palmata*.

Figure 2. The elkhorn coral zones surveyed around St. John.

Figure 3. An elkhorn coral with white pox disease.

Figure 4. Distribution of white pox disease on *Acropora palmata* throughout the 13 study sites of St. John, USVI.

Figure 5. Size class distribution of *Acropora palmata* from 13 sites in St. John, USVI

Figure 6. The prevalence of white pox on *Acropora palmata* of four different size classes from 13 locations on St. John.

BUDGET EXPENSES

Item	Amount
Researcher Salaries	\$9,740
Genetic Testing	\$2,160
Travel	\$2,500
Total	\$14,400

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