

NOAA Final Progress Report

Prepared by Eric Borneman

Project title: Development of tools and techniques to restore threatened *Acropora* populations

Recipient: Eric Borneman

Principle Investigator: Eric Hugo Borneman

Geographic location of project: Mona Island

Funding organization: NOAA GCRCGP

Award Number: NA07NMF4630095

Program Officer: Jennifer Koss

Award Period: 08/01/2007 - 01/31/2010

Reporting Period: 08/01/2007– 1/31/2010

Abstract

Elkhorn coral (*Acropora palmata*) and Staghorn coral (*A. cervicornis*) are species that have undergone declines of 80-95% throughout their range due to diseases, hurricanes and other factors, and were recently listed as threatened on the Endangered Species Act. White band disease (WBD) and white pox disease (patchy necrosis) are still common among remaining populations of *A. palmata* throughout the region and need to be addressed in order to help recovery of the species. Little is known about the causes of the diseases and strategies to mitigate impacts have not been developed. Through a pilot experiment during a WBD outbreak on Mona Island, we tested a low-tech method to salvage portions of affected colonies by removing unaffected portions of branches and then reattaching them to the reef. These branch fragments exhibited high survivorship while remaining unmanipulated portions of the colony exhibited complete mortality. While this study identified a viable option for recovering diseased corals, additional studies are needed to determine optimal methods of branch removal and reattachment and evaluate other options for mitigating threats. Through support from NOAA's GCRCGP, we propose to expand the pilot study, evaluating the effectiveness of the removal and reattachment of different sized branches collected at varying distances from the WBD-affected tissues and reattached to different substrates (reef substrate and standing dead colonies) in a variety of orientations and using multiple attachment mechanisms. Survivorship of branch fragments and donor colonies will be monitored over an 18-month period to assess survival and growth rates. Additional efforts will be directed towards reattachment of naturally detached branches, by mitigation of other stressors including diseases and competitive interactions with sponges and algae, and removal of predators. Similar efforts will be targeted at *A. cervicornis* populations on surrounding reefs. Concurrent monitoring of the status of surrounding *Acropora* populations will be undertaken, including extent of disease and predation, as well as the impacts of these factors and long term monitoring as part of ongoing monitoring efforts on the sites. This study will provide information that can contribute to the recovery of acroporids and will

be presented to the management community through various forums and scientific publications.

Changes to Grant

Several changes were required to the proposed grant. Because the boat used to work at Mona Island had not been given permits to operate on Mona Island, the PI was unable to perform the proposed continuing restoration and monitoring work. A request for a one year no cost extension was applied for in January 2009 as well as a change in scope to include studies and possible restoration of fragments within the Rincon population of *Acropora palmata*, as well as other sites that would be possible to access from the mainland, given the potential of not being able to reach Mona Island for the foreseeable future.. The application to NOAA was granted. Applications for permits to conduct work and a proposed scope of work were sent immediately to DNER in Puerto Rico. The permits to conduct work outside of Mona were not granted by DNER, despite being provided the information regarding the now questionable logistics of reaching Mona Island to continue the proposed work.

Work Performed

Assessment of Sites and Restoration Activities

Over the course of the work period, fifteen potential sites were assessed as potential donor sites for restoration of acroporids with white band or other diseases impacting the integrity of parent colonies. Of the fifteen sites, only four were identified as being donor or recipient sites since they had sufficient populations of acroporids and disease present, or were areas that historically supported acroporid populations. Initial work included the assessment of sites and trials to determine best methods of affixing fragments. Subsequent work included the identification and restoration of 137 fragments from diseased colonies from two donor sites to three recipient sites. These fragments were impacted by a severe winter storm that caused the loss of not only almost all restored fragments, but of colonies in the donor population area.

The condition of the donor sites also changed dramatically since the original proposal. The habitat had degraded significantly with the loss of many of the potential donor colonies originally identified. This resulted in far fewer colonies with which to work, as well as a reduced number of colonies with or susceptible to disease.

Snail removal studies indicated that active removal of snails from acroporids may be an effective strategy to mitigate tissue loss on healthy colonies. From the first removal work to the second a year later, the number and mean size of snails had declined, although the sex ratios remained the same.

A major problem that occurred during this work was the unforeseen unavailability of the boat used to conduct research at Mona Island. This boat had been used for monitoring activities for many years, but for two years, legal issues involving the boat captain and

DNER in Puerto Rico prevented him from being allowed to take researchers to Mona Island. The other boat that was available, the Sultana, was only available once as it was its last trip before refitting. Therefore, obtaining access to conduct the work was repeatedly delayed and ultimately halted after the PI failed to locate an appropriately sized fitted and affordable vessel.. In an attempt to circumvent the logistical issues, a one year no-cost extension for the work and a change of scope was submitted as similar work was possible upon locating and conducting work on the Rincon population of *A. palmata* where extensive lesions were present (not WBD, but a different white syndrome that threatened the integrity of the colonies. While the extension and change of scope was granted, DNER in Puerto Rico failed to permit work activities in that area. As a result, only one year monitoring of previous work could be accomplished.

In summary, it is difficult to say if the proposed strategies were effective. Pilot studies suggested that fragments removed from diseased colonies did not get disease and were capable of fusing to substrate and increasing the number of ramets. However, environmental changes were not conducive to rapid growth. Furthermore it is difficult to say whether the restoration efforts would have been successful if it were not for the aberrantly large storm that impacted the island, or the ultimate fate of the fragments that were lost from the restoration site. Natural events are certainly things to consider in restoration, but the survival of other restored fragments in pilot efforts survived other severe events including several hurricanes that passed near or over Puerto Rico and anomalously high sea surface temperatures that resulted in mass bleaching across the island. Timing of restoration and of natural events occurring after a period of time allowing to stabilization of fragments could lead to better results than occurred during this work. In the case of *A. cervicornis* natural fragmentation during storms is a normal mode of asexual spread, and although the attached restored fragments were lost from the site, it does not necessarily indicate that those fragments died and may have been transported to other areas where they may continue to survive and form new colonies. However, quantitative assessment of such events is not possible.

Because of the delays and permitting issues, it was extremely frustrating to be unable to conduct the work as planned. If possible, and despite this grant being closed, it would have been very helpful to extend this project for another year to attempt to continue the restoration on Mona. The boat used and budgeted is again available and the ability to conduct further restorations without having the impact of such an unusual storm would be very helpful in determining if this is a viable means to save the genotypes of diseased corals and increase the ramets and overall populations. The snail removal clearly is an effective tool and can and should be continued to reduce mortality to existing colonies. In summary, the work was not successful, but the concept requires another chance and opportunity without the logistical issues that ensued in Puerto Rico.