



Response to Stony Coral Tissue Loss Disease outbreak with antibiotic treatment.

Progress Report: November 2020 to August 2022

DNER Permit #2020-IC-028 (O-VS-PVS15-MA-00059-18022020)

DRNA Permit #2021-SCTLD-002 (O-VS-SCT01-00002-22042021)

Prepared by:

Catalina Morales Ruiz, Sea Ventures Inc.



November 2022

Executive summary

Stony coral tissue loss disease (SCTLD) was detected in Puerto Rico around September 2019. Since then, different governmental and non-governmental agencies, accompanied by NGOs and private companies, have joined efforts to respond to this event. This report summarizes the efforts made by Sea Ventures Marine Response Unit (MRU) in responding to this disease between November 2020 to August 2022 with the support of NOAA Restoration Center and other partners. To date, a total of 2,279 colony treatments (Amoxicillin + Base2B) has been applied at least once during field efforts between Sea Ventures, DNER, Marine Science Department, and HJR Reefscaping. Roving dives have been performed in 18 sites to evaluate SCTLD prevalence and inform response efforts, expanding awareness of SCTLD presence on the south coast of Puerto Rico. To monitor the effect of the treatment in this reporting period, 106 colonies were tagged across six sites (21 colonies in Palominos Sand Slide, 13 in JBNERR, 26 in Cayo Coral, 19 in Pinaculos, 17 in Turrumote I and 10 in Turrumote II). Of these fate-tracked colonies, 89% have survived to date. By the last visit in August 2022, an average of 40% of colonies did not show signs of active tissue loss lesions. The remainder of the colonies needed reapplication of treatment due to the progression of previously treated lesions or the appearance of new lesions. Observations during fate-tracking site visits reveal the mass mortality of highly susceptible *Meandrina meandrites* and *Dendrogyra cylindrus* with nearly 100% mortality in wild colonies across sites. Collaborative work has been key to carrying out the different efforts to apply treatment and detect the disease at the sites. It is recommended to continue visiting the reefs mentioned in this report since the disease persists, and many colonies whose lesions stopped may be reinfected again.

Study sites

Between November 2020 – August 2022, a total of 24 sites have been visited for treatment application (6 priority sites) and roving dive surveys (18 sites) (Figure 1). During this period of work, some of these sites have been visited only once due to multiple factors such as time, logistics, budget, and disease dynamics.



Figure 1. Sites visited between November 2020 and August 2022 for SCTL D treatment and roving diver surveys.

Research Permit

These field operations were carried out under DNER Scientific Research Permit No. 2020-IC-028 (O-VS-PVS15-MA-00059-18022020) and emergency permit No. #2021-SCTL D-002 (O-VS-SCT01-00002-22042021).

Treatment application

Antibiotic treatments were applied to diseased colonies in 6 priority reef sites with known SCTL D outbreaks: Palominos (Sand Slide) in Fajardo; Cayos La Barca (Dos Palmas) in JBNERR; Cayo Coral and Turrumote II in Guanica, Pinaculos and Turrumote I in La Parguera. Base2B + Amoxicillin treatments were applied in sites where an ongoing outbreak of SCTL D has been confirmed by various coral disease experts. Reef sites with colonies to treat were selected based on several logistical and biological criteria including accessibility, exposure to wave action, abundance and size of diseased colonies, and disease prevalence. Treatments consist of a mixture of human-grade Amoxicillin and the silicon-based paste Base2B following protocols by Neely et al (2020).

Sea Ventures

Treatment material was provided to DNER to expand the number of colonies treated across sites during DNER field trips as part of the collaborative response efforts to SCTL D in Puerto Rico.

Treatment effects

To evaluate the effects of the treatment, a total of 20 colonies were tagged at Palominos Sand Slides, 13 colonies in JBNERR, 26 in Cayo Coral, 19 in Pincaulos, 17 in Turrumote I, and 10 in Turrumote II. During each visit, the number of treated lesions was annotated, and treatment was reapplied if there was the presence of active lesions. Tagged colonies were visited at variable frequencies due to available funding for boats, available personnel for monitoring activities, and weather conditions. Treatment effectiveness was calculated as the number of tagged colonies without active tissue loss lesions divided by the total number of tagged colonies (% of tagged colonies).

All the data and pictures generated from both the treatment application and the roving dive surveys were delivered to the DNER Coral Program staff and shared with different researchers from Puerto Rico through the monthly meetings convened by the DNER to update and discuss SCTL D status in Puerto Rico.

Data access

All SCTL D treatment interventions and roving diver survey data have been compiled into a unified database custody of Sea Ventures MRU. A copy of the treatment data has been shared with the PR-DNER monthly. Roving diver survey data has been shared as well with PR-DNER as requested in the permit. The data matrix is accessible online in a google drive link:

<https://docs.google.com/spreadsheets/d/1VmQY27CBX9iIQE7gEAt7iXeRYJBdWMCgQVUP7qFXwKA/edit#gid=1037068128>

Results

In this reporting period (November 2020 – August 2022) a total of 2,279 colony treatments have been applied during 45 sites visits at 6 priority sites by joint efforts between Sea Ventures, the PR-DNER, the Department of Marine Sciences University of Puerto Rico, and HJR Reefscaping. The total amount of applied treatment by Sea Ventures in this period was 115 Base2B treatment jars and 57.5 amoxicillin jars. The results of treatment and roving dive survey efforts per site by Sea Ventures are detailed next.

Treatment monitoring:

- Monitoring of a subset of priority coral colonies from various species has been performed at 6 sites in the reporting period (Table 1). A total of 106 colonies, representing 9 species, were tagged, and revisited to evaluate disease progression and reapply for treatment if needed.
- The vast majority of these (87%) were *Orbicella faveolata*, *O. franksi*, *Colpophyllia natans*, *Montastrea cavernosa*, and *Pseudodiploria strigosa*.

- During each visit, tagged colonies were inspected to annotate several metrics to track colony status and disease progression. These included % recent mortality, number of lesions treated, and disease status.
- By August 2022 the mean survival rate across all tagged colonies and sites was 89%. Cayo Coral was the only site with a survival rate below 90%, with 50% (Table 1, Figure 2-A). Cayo Coral was also the site with the highest species diversity of tagged corals for fate tracking.
- Due to the high relative abundance of *M. meandrites* at Cayo Coral, a highly susceptible species to SCTL, 5 colonies were tagged for fate-tracking. This was a good opportunity to evaluate treatment effects in this species given its patchy distribution across the archipelago and rapid mortality during SCTL outbreaks. Unfortunately, mortality rates in *M. meandrites* were 100% despite bi-weekly treatment reapplication, a similar result to *D. cylindrus* in Cayo Diablo during the summer of 2020 - 2021.
- Changes in the percent colony recent mortality between visits were indicative of disease progression at the colony level. The difference in recent tissue mortality (between the most recent and the first visits) showed an average increase of 20% across all colonies and sites (Table 1, Figure 2-B). This suggests that the treatment helped to slow down or even halt the lesions in most colonies.
- The proportion of tagged colonies that had visible active lesions was annotated per visit to evaluate treatment effectiveness. By the last visit, an average of 40% of colonies did not show signs of active tissue loss lesions (Table 1, Figure 2-C). The remainder of the colonies needed reapplication of treatment due to the persistence of previously treated lesions or the appearance of new ones.
- Monitoring of tagged colonies allowed us to detect new lesions that appear even after several months after a colony was treated with success (Figure 3). This highlights the importance of continuous monitoring to increase the success of this treatment method.
- Treatment of rare *O. faveolate* giant colonies has been successfully started at Pinaculos and Turrumote I (Figure 4). These colonies have a diameter and height of between 2 and 5 meters. In August 2022 these colonies presented the first SCTL lesions and thanks to constant monitoring, treatment efforts were started before the disease spread through these colonies. A new monitoring cycle started with about 10 tagged giant colonies at these sites in September 2022.
- Treatment efforts at Sand Slide have decreased significantly as disease prevalence has decreased at this site and many diseased colonies are no longer found.

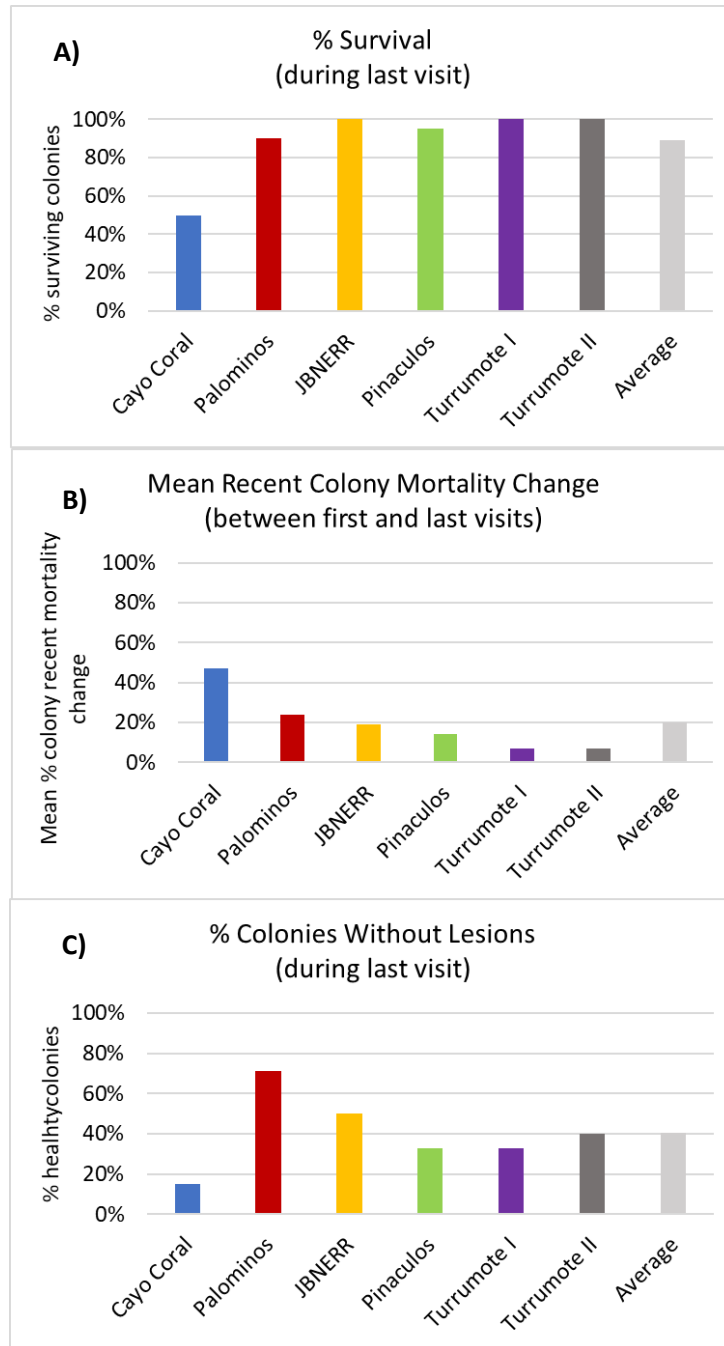


Figure 2. Colony fate tracking metrics of 106 tagged colonies across 6 priority sites in Puerto Rico. A) Survival rates per site, B) Mean increase in recent colony mortality percentage per site, C) Proportions of colonies that remained without active lesions.

Sea Ventures

Table 1. Metadata of tagged colonies for treatment fate-tracking.

Site	Col. Av. Mort. Increase	Surv. %	# tag Colonies	% healthy on last visit	# Treatment Visits	Period
JBNERR	19%	100%	13	50%	4	Mar. 12, 2021 - Sept. 21, 2021
Palominos	24%	90%	21	71%	11	Nov. 18, 2020 - Mar. 28, 2022
Cayo Coral	47%	50%	26	15%	10	Dec. 3, 2021 - Jul. 13, 2022
Pinaculos	14%	95%	19	33%	10	Feb. 2, 2022 - Ago. 2, 2022
Turumote I	7%	100%	17	33%	4	May 31, 2022 - Ago. 2, 2022
Turumote II	7%	100%	10	40%	2	Apr. 25, 2022 - Jul. 13, 2022
Average / Sum	20%	89%	106	40%	41	Nov. 18, 2020 - Ago. 2, 2022



Figure 3. Example of lesion progression in a treated *D. labyrinthiformis* colony (tag# 66) at Pinnacles (La Parguera). During April and May, the treated lesion halted, but in June some new lesions appeared.

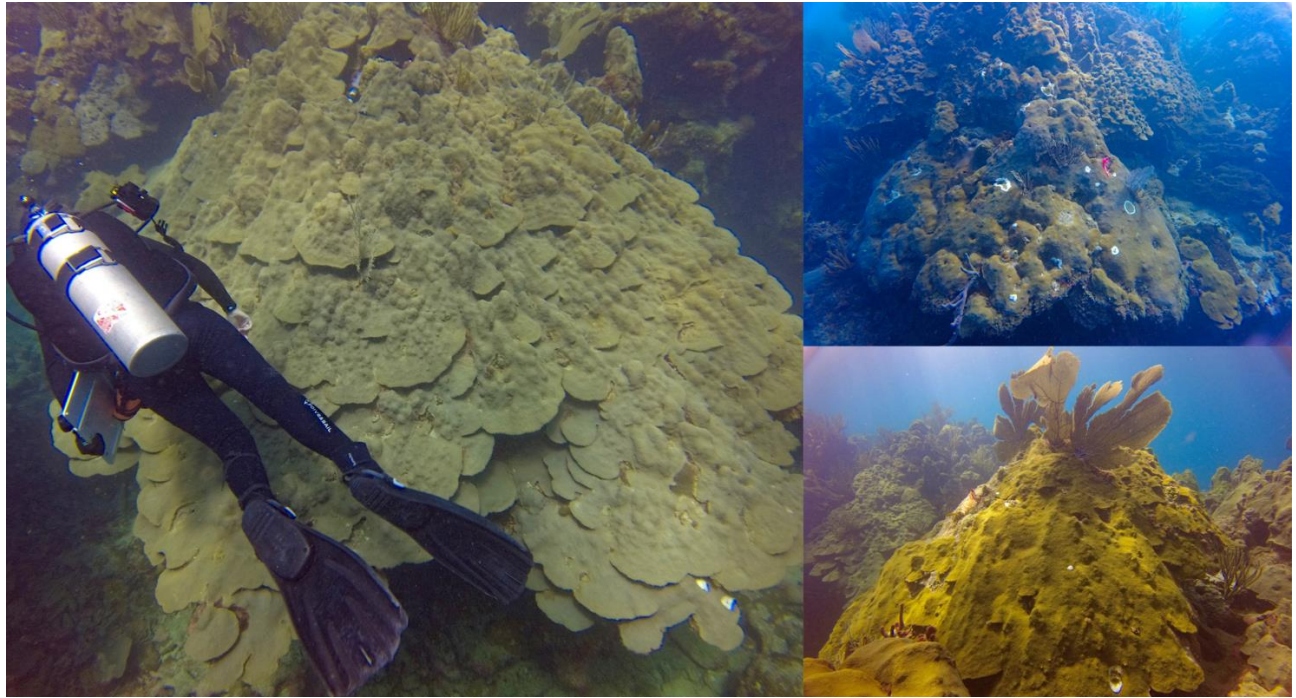


Figure 4. Example of *O. faveolata* giants at Pinaculos with initial lessons of SCTL D.

Roving Dives

- Roving dives have been performed in six sites to evaluate SCTL D prevalence and inform response efforts, expanding awareness of SCTL D presence on the south coast of Puerto Rico
- During the period covered by this report, multiple roving dives were carried out, mainly in La Parguera and Guanica areas, to monitor the progress of the disease and determine when treatment efforts should begin at priority sites such as Pinaculos and Turrumote.
- This monitoring of the disease was carried out thanks to the joint efforts between Sea Ventures, the PR-DNER, the Department of Marine Sciences University of Puerto Rico, and HJR Reefscaping.
- Thanks to these roving dives, we observed that the disease moved from east to west, first reaching Guánica and then La Parguera. Also, a distance to shore and depth gradient was noted based on the timing and differential prevalence levels across sites. Reefs at the shelf edge were found to have higher prevalence and mortality compared to mid-shelf and inner-shelf sites. However, after several months, disease prevalence at mid-shelf sites such as Pinaculos increased to similar levels to the outer shelf.

Conclusions and recommendations:

- It is recommended to continue treatment efforts in reefs where the disease has recently arrived, such as Pinaculos and Turrumote. Monitoring giant *O. faveolata* colonies is very important since few places are found with this type of giant colony.

Sea Ventures

- Starting in September 2022, a new monitoring cycle will begin in which a master's student in marine sciences (UPRM Department of Marine Sciences) will be doing her thesis. In this monitoring cycle, we will be focusing mainly on Turrumote I and Pinaculos, two extremely important reefs due to the abundance, diversity, and size of colonies of species susceptible to SCTL D such as *C. natans* and *O. faveolata*.
- For future monitoring cycles, it is recommended to focus efforts on species such as *O. faveolata*, *C. natans*, *P. strigosa*, and *D. labyrinthiformis* since they are species that respond very well to treatment.
- It was observed that the treatment is not effective in *M. meandrites* and *D. cylindrus*, despite all the efforts that were made to save some colonies, the result was not what was expected.
- It is recommended to continue monitoring sites such as San Cristobal in Paguera since this reef has a large number of very large colonies of the species *P. strigosa* and it is expected that it will get infected sometime in 2022 or 2023.
- Although in Sand Slide the prevalence of the disease has decreased and it is not necessary to go monthly, it is recommended to continue monitoring it at least every three months to assess if an outbreak of SCTL D recurs and the long-term survival of tagged treated colonies.