Support for Effective Management and Engagement of Stakeholders of USVI Marine Managed Areas

October 2016-September 2021

Figure 1 TNC staff gives presentation to Coralpalooza participants to gain interest in the EEMP volunteer program in June 2018.

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NOAA CORAL REEF CONSERVATION PROGRAM

Background

In 2003, the St. Croix East End Marine Park (STXEEMP) became the first multiple-use marine park established in the US Virgin Islands. The marine managed area comprises 17 miles of shoreline, 60 nautical square-miles, four of St. Croix's Areas of Particular Concern, and includes a range of coastal habitats including salt ponds, mangroves, sandy beaches, sea grass meadows, and coral reefs. The coral reef resources within the STXEEMP are important to the rest of St. Croix as they serve as refugia for multiple reef fish species that are vital to the recovery of the island's reef ecosystems. Additionally, St. Croix's east end had the largest concentration of high-resilience coral reef sites in an island-wide relative resilience analysis conducted by Maynard and others in 2014. The Nature Conservancy's US Virgin Islands program and the TNC/NOAA CRCP Cooperative Agreement has supported the St. Croix East End Marine Park through conservation action planning, strategically filling capacity gaps, and assisting with the implementation of projects. In recent years, support has been provided to update the management plan and implement on the ground conservation and research projects including the enhancement of park reefs by out-planting nursery-grown corals.

Building resilience by eliminating or reducing anthropogenic threats is necessary for the recovery of USVI reefs and the services that they provide, which are disappearing. However, in the Caribbean, natural recovery will be slow to occur given the algal-dominated status of many reefs. The pro-active collection of "fragments of opportunity" (corals broken through natural processes), propagation, and re-attachment onto key coral reef sites, provide a win-win scenario for corals that would have died if left unattended and for reefs that struggle to naturally recover. Continued support is needed for coral restoration in STXEEMP as it is one of the best-suited areas for coral reef restoration activities on St. Croix. Because of its location on the easternmost end of St. Croix and the prevailing east-to-west current, the out-planting of corals in the STXEEMP should eventually lead to more corals and fish able to re-seed the park as well as adjacent reefs. By engaging the local community and protected area managers to implement coral restoration at the STXEEMP, the visibility and use of the park will also increase, leading to a greater understanding of the park, support of park projects, and compliance to rules and regulations.

By continuing to support place-based, site level management of the St. Croix East End Marine Park, we are addressing goals 2, 4, 5, and 6 of the USVI Coral Reef Management Priorities. Specifically, we are transferring information to the public, restoring fisheries resources, recovering affected coral reefs through restoration, and improving coordination and communication among coral reef practitioners.

Coral Restoration Plan for the East End Marine Park

Initial discussions with the Department of Planning and Natural Resources (DPNR) and staff at the East End Marine Park (EEMP) solidified the main goals for incorporating restoration as a part of outreach efforts for the park. Staff expressed a desire for a small demonstration nursery that could provide active outreach and volunteer opportunities. TNC put together a methodology plan for creating a small demonstration nursery as well as a community engagement plan describing how to incorporate the demonstration site into outreach efforts, both of which were reviewed and approved by DPNR, EEMP and NOAA liaisons. See Appendix A for the In-Water Methodology and Appendix B for the Community Engagement Plan.

East End Marine Park Coral Restoration Efforts

In addition to the outreach specific demonstration site, this funding also allowed the TNC Coral Restoration Program to continue to grow and plant corals in the East End Marine Park. As this work is

very dive and labor intensive, the team was able to use travel funds to cover room and board for 2 volunteer associates each year to help carry out this work.

The grant period began with outplanting 300 *A. palmata* corals at sites inside the park in 2017. From April through May 2018, TNC divers outplanted 2,560 Acropora cervicornis corals at eight sites in the EEMP. The sites were selected using the TNC Site Selection Survey methodology and corals were outplanted using a combination of epoxy and nail/zip tie method of attachment. Each site contained clusters of 5-10 coral colonies and had between 3 and 5 different genotypes represented. Each site was monitored between three and four months after outplanting and showed an average of 99% live tissue per cluster of outplants.

In 2019, volunteers were able to help build and install a new nursery in the park near Channel Rock. This nursery contains twelve trees with 50 *A. cervicornis* on each, as well as 6 A-frame structures also containing *A. cervicornis*. Table structures for microfragmented corals were installed and stocked the following year. While the focus that year was on the building of the additional nursery, the team was also able to outplant 650 *A. cervicornis* in 2 new plots adjacent to the previous year's restoration sites.

In 2020, the restoration team carried out some field-based fragmentation of *A. palmata* and *O. annularis*. The corals were cut into five centimeter squared fragments and then epoxied onto existing skeleton in arrays of 5-6 corals. A total of 53 coral fragments were outplanted in this way in the EEMP near Channel Rock. Additionally, the team outplanted 99 A. cervicornis on the Cramers Park forereef.

Throughout the years of the grant nurseries were maintained regularly including cleaning structures, performing health checks and removing predators.

Figure 2 TNC diver outplants A. cervicornis in the East End Marine Park, May 2019..

Training EEMP Staff

On September 11 and 12, 2018 a 2-day training was held for 3 staff of DPNR/EEMP on coral restoration and nursery practices. The training included a classroom day with a presentation about restoration techniques and discussion on application in the EEMP and an in-water training to go over

nursery maintenance skills and procedures. The classroom and in-water portions of the class were led by TNC restoration practitioners.

Later that year in November 2018, TNC staff held a tutorial on coral nursery structure building with the EEMP. The group built two tables that would be the first structures launched at the new EEMP demonstration site.

Figure 3 TNC and EEM staff participate in a nursery methodology training in September 2018. Photo credit Lisa Terry.

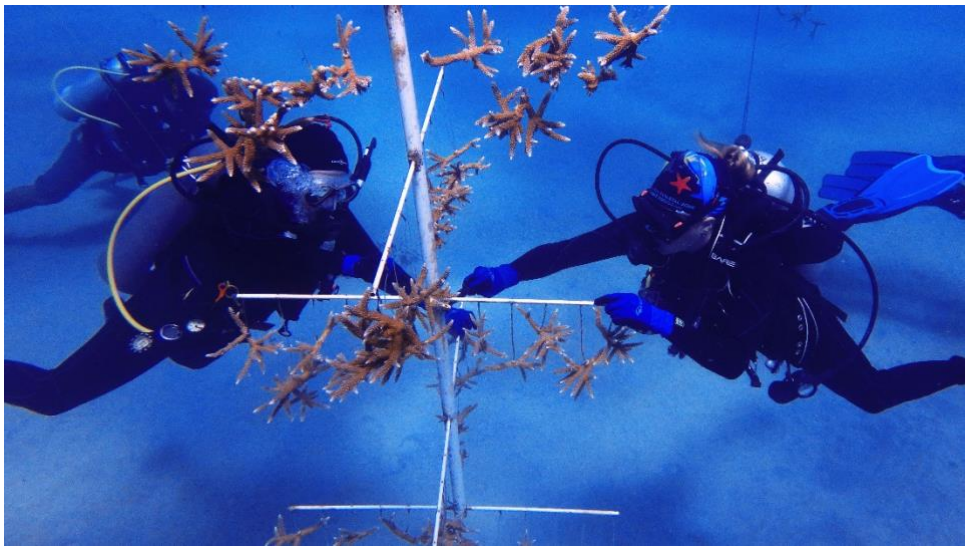

Figure 4 EEMP staff practice cleaning coral structures in preparation for maintenance of the EEMP demonstration site, September 2018. Photo credit EEMP.

Figure 5 EEMP staff build PVC tables for the new demonstration site, November 2018. Photo credit Lisa Terry.

Creating a Demonstration Nursery

After months of planning, in February 2019, permits were approved and two coral nursery structures were installed at the new demonstration site at Cramer's Park in the East End Marine Park. In the weeks that followed, EEMP staff and the TNC dive team scouted for fragments of opportunity and fragmented them further to stock the installed tables. The tables included 51 fragments of varying numbers of *A. palmata, C. natans, E. fastigiate, M. cavernosa, O. annularis, and O. faveolata*. Following installation, EEMP staff and TNC worked together to ensure monthly maintenance and monitoring were completed each month. As the Coral Patrol volunteer program was created and grew, those volunteers were incorporated into monthly maintenance efforts, cleaning structures and monitoring the health of the corals.

The following year in July 2020 the corals from the demonstration site tables were outplanted onto the nearby patch reef selected by EEMP staff. Both the TNC dive team and the staff of the EEMP participated in the outplant event since it was the first one with the intent that later outplant events would be run by EEMP staff and volunteers.

In December 2020 and January 2021, TNC and EEMP staff were able to re-stock both of the demonstration site tables with new corals. One table was stocked with *A. palmata* which was collected and fragmented underwater. The other table was stocked with 6 different species of coral which were brought to the TNC Coral Hub Lab and fragmented in the land-based nursery before being brought back out to Cramer's Park. Two staff from the East End Marine Park participated in a training on cutting corals in the lab and a separate training on cutting corals underwater.

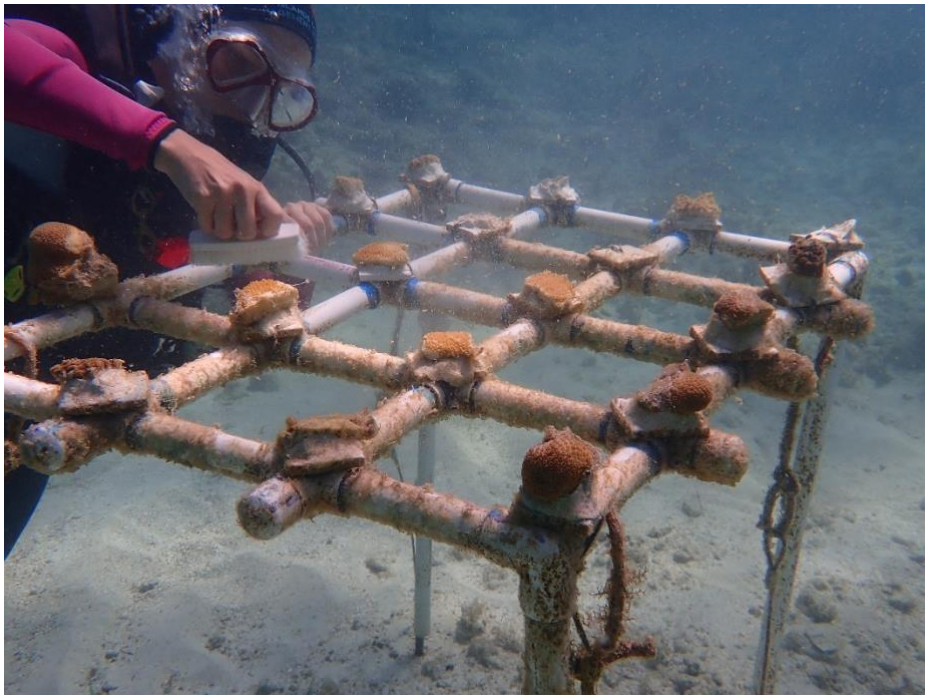

Figure 6 EEMP staff performs monthly maintenance on the EEMP demonstration nursery coral table, 2019.

Coral Patrol

The restoration program for the East End Marine Park is also engaging stakeholders through volunteers. EEMP and TNC have teamed up to create a coral focused volunteer group called the "Coral Patrol." The group consists of interested residents of St. Croix that are certified SCUBA divers. Staff put together a full day training for the volunteers that consisted of a half day of classroom followed by a dive in a coral nursery for in-water practice. The classroom training included a presentation on the EEMP and restoration techniques and practices. Volunteers were able to practice structure building and repair, epoxy use, cleaning technique and disease identification in the classroom. The in-water training showed volunteers how to clean a coral nursery structure and gave them the opportunity to practice in the coral nursery. The trainings took place on June 29th, 2019 and July 27th, 2019 and included 16 participants. The group was then utilized for two nursery cleanings that year in the month of September—one at Channel Rock Nursery and one at the Cramer's Park Demonstration Site—where volunteers assisted EEMP staff with cleaning nursery structures.

In the third year of the grant, the Coral Patrol was able to participate in nursery cleaning in the demonstration site as well as the larger Channel Rock Nursery. As the pandemic began in 2020, in-person activities came to a halt. This provided a good opportunity to catch up on some behind the scenes work. TNC put together resources and materials for the EEMP staff to be able to train volunteers themselves. The group met to go through a training on how to teach the classroom part to volunteers. During this time the team also purchased and put together supplies for the EEMP to be able to maintain and outplant on their own.

In the final year of the grant TNC staff worked with EEMP staff to solidify next steps for the Coral Patrol volunteer group. The Education and Outreach Coordinator for the park was able to get a tour of the TNC Coral Hub and a digital introduction was made to the Coral Patrol volunteers to effectively "hand off" coordination of the group to the new Outreach Coordinator.

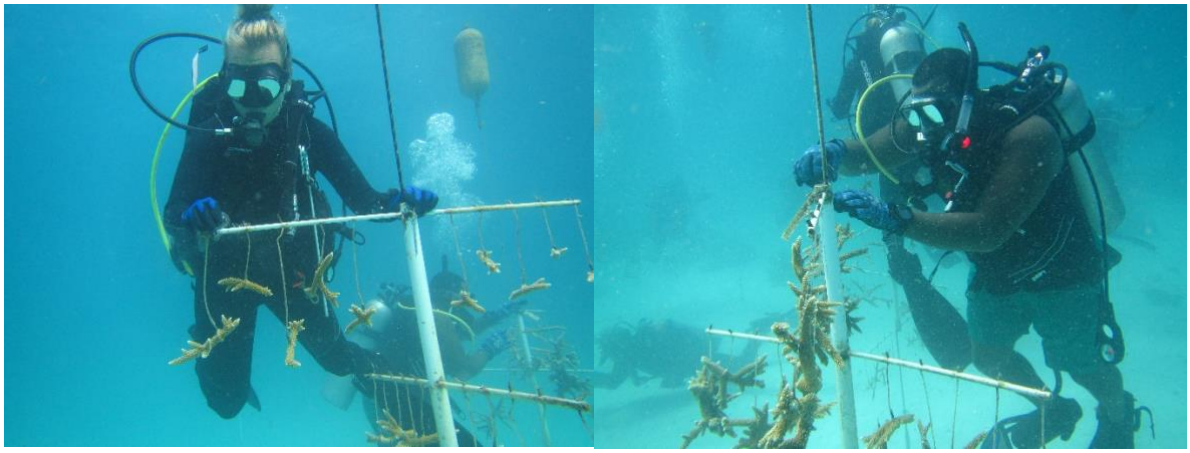

Figure 7 Coral Patrol volunteers practice cleaning nursery structures in the Channel Rock Nursery in the East End Marine Park in 2019 as a part of their nursery maintenance training.

Outreach Events and Educational Resources

The goal of utilizing restoration as a tool for outreach was primarily focused on the demonstration site and the Coral Patrol volunteer group. However, it was recognized that there are many ways restoration can inspire outreach events and materials.

In June 2018, TNC, the EEMP, and local businesses worked together to put on "Coralpalooza," an outreach event focused on coral nurseries and restoration. During this event, both TNC and EEMP had an information table and collected a list of interested volunteers for the future EEMP demonstration site. TNC staff gave a talk about coral restoration and partnered with a local dive shop to give tours of the current coral nurseries in St. Croix. This was the first promotional event to gather interest for the EEMP nursery demonstration site.

Coralpalooza 2019 was held June 7 and 8 and included a lecture series Friday night at the East End Marine Park, as well as an environmental information fair and coral nursery day at Cane Bay, St. Croix on Saturday. Speakers from The Nature Conservancy, the University of the Virgin Islands and the National Park Service spoke about a variety of coral-related topics to 60 attendees on June 7th and 30 divers and snorkelers participated in the coral nursery talk and tours held on June 8th. The Nature Conservancy staff gave presentations to groups of divers and snorkelers about the nurseries and coral restoration in St. Croix and a local dive shop provided tours to the participants of the nurseries located in Cane Bay.

Two videos were developed to support the park and the Coral Patrol volunteer group. One video is a summary of the citizen science initiatives of the East End Marine Park which can be shared with interested individuals, students and tourists. The second is a training video for coral restoration volunteers meant to streamline and standardize the volunteer training process. The volunteer training video can also be used to educate more general audiences about how coral restoration works. The videos are already being shared via social media and digital communication, and will be featured in the Visitor Center at the East End Marine Park. The videos can be found here:

Training video -https://youtu.be/_gqCkRXLrog
EEMP video- https://youtu.be/eYJdQJpwnGo

Figure 8 St. Croix residents listen to lectures from TNC, NPS and UVI representatives about coral related topics at the EEMP offices in Great Pond as a part of the Coralpalooza celebration in 2019.

Coral Restoration Learning Exchange

The Nature Conservancy held the first ever US Virgin Islands Coral Restoration Learning Exchange on July 7th and 8th, 2020 with 20 attendees from 5 different organizations across the territory.

In the midst of a global pandemic, coral restoration practitioners gathered virtually over 2 afternoons to discuss novel restoration techniques, funding opportunities, species selection and genotyping and spatial mapping of restoration outplants. Coral restoration practitioners from 5 different organizations in the USVI attended and participated in the learning exchange. During the exchange, each organization presented on their current restoration program and participants performed a SWOT analysis and outlined collaborations for coral restoration projects in the USVI. Presenting organizations included: The Nature Conservancy, St. Croix East End Marine Park, National Park Service, University of the Virgin Islands and Coral World Marine Park.

The discussion portion of the exchange began with a SWOT analysis which identified a myriad of internal strengths and weaknesses, and external opportunities and threats facing coral restoration operations in the USVI.

An important focal topic of the learning exchange was how the presence of Stony Coral Tissue Loss Disease (SCTLD) affects coral restoration projects throughout the territory. On Day 2, the group welcomed Dr. Erinn Muller from Mote Marine Lab to present on how Florida has pursued coral restoration activities in the face of Stony Coral Tissue Loss Disease epidemic (active since 2014 in the FL Keys). Dr Muller highlighted a few key strategies for restoration practitioners in the USVI: susceptible species prioritization in areas without SCTLD, utilizing Acroporids in areas with SCTLD, and genotyping outplants.

The remainder of day 2 was spent discussing 4 restoration topics, prioritized by the group in a pre-workshop survey. Practitioners discussed novel restoration techniques including nursery structures, novel outplanting methods, microgragmenting on land, and scaling up larval propagation for restoration. Participants outlined current and future collaborations in funding opportunities. Species selection and genotyping were also discussed and several existing partnerships were identified to support genotyping USVI corals and the group emphasized the importance of consistency in methods for future sharing opportunities. The final discussion was on spatial mapping of restoration sites and the group decided to continue the use of the CRC Restoration Database Map at this time and plan to discuss a territory specific ArcGIS product such as StoryMap in the future.

As the year continued and restrictions lessened, the group was able to carry out two different in-person add-ons to the virtual learning exchange. The in-person add-on's were kept to small groups so

that COVID-19 protocols could still be followed. The first was supporting the staff of the EEMP to go to St. Thomas for some additional training on Stony Coral Tissue Loss Disease so that they can properly monitor their park and incorporate disease response into their own restoration work. Two staff and one volunteer from the Friends of the East End Marine Park group were able to work with CORE and the VICDAC members to get first hand experience identifying and treating Stony Coral Tissue Loss Disease (SCTLD), diving with DPVs, applying amoxicillin infused ointment, colony culling/amputation, and coral rescue.

In December 2020, a second in-person event was able to be carried out in St. Croix. Two researchers from UVI visited the TNC Coral Innovation Hub in St. Croix to perform an experiment looking at the effects of disease on newly settled corals and fragmented corals. The results of the experiment showed increased stress and susceptibility when fragments were freshly cut vs. when fragments were allowed to heal their scars before being exposed to disease. Additionally, the UVI team was able to share techniques and knowledge with the TNC team about equipment used and tips for future experiments and the TNC team was able to provide the UVI team with practice monitoring juvenile polyps under the microscope.

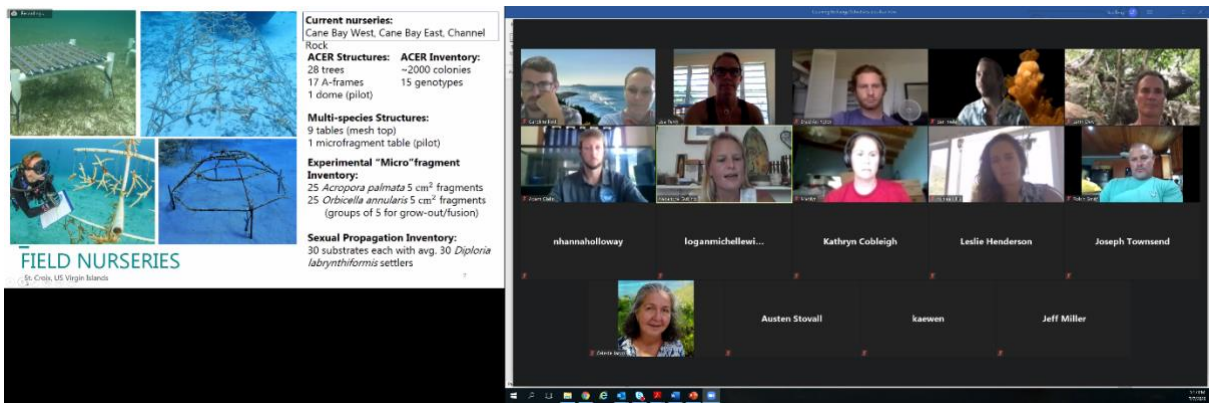

Figure 9 Screenshot of virtual Coral Restoration Learning Exchange while Alex Gutting from TNC is presenting on restoration efforts in St. Croix.

Figure 10 Caroline Pott from the EEMP practices removing a diseased O. annularis from the reef using a hammer and chisel at the Learning Exchange in-person add-on in St. Thomas.

Figure 11 Logan Williams from Coral World shows where culled corals are treated with amoxicilin-dosed water during the Learning exchange add on in St. Thomas.

Figure 12 Sonora Meiling from The University of the Virgin Islands performs a transmission experiment on newly settled corals at the TNC Coral Innovation Hub in St. Croix during the in-person add on to the Learning Exchange.

Figure 13 Lindsay Dade from The University of the Virgin Islands examines coral recruits using a microscope as part of the disease transmission experiment at the in-person add on held in St. Croix.

As the science of coral restoration continues to grow, it stands as a vital piece of coral reef conservation. Marine managed areas have a unique advantage protecting important coral reef habitats, but considering the dire state of corals around the globe, protection alone might not be enough. Coral restoration provides an opportunity to jump start the revitalization of these ecologically important areas. As a hands-on method with visible results in a short time, restoration is also an attractive

science that can inspire interest in community members to learn more about the park and its efforts. To this end, the projects accomplished as a part of this task have brought energy and recognition to the park, as well as physically improved reefs on a local level through direct restoration of corals. The demonstration site and Coral Patrol provide opportunities for community members to get involved in the park and learn more about restoration. The learning exchanges have helped the territory advance its restoration efforts and increased collaboration among partners. The reefs of the East End Marine Park now contain thousands of more corals providing structure and habitat to important fish and reef creatures. The collaboration with the East End Marine Park to carry out these initiatives leveraged key expertise and funding when local resources were unable to do so alone. Now with a successful pilot nursery underway, the East End Marine Park and the Department of Natural Resources can more easily secure funding to continue restoration efforts on their own.

Appendix A

EEMP Coral Restoration Program:

Methodology for in-water activities

Introduction:

Established in 2003, the St. Croix East End Marine Park was created to manage the marine resources within the park boundaries. Many of the bays within the park once contained healthy populations of Elkhorn and other threatened corals. Today, colonies that remain are often spread too far apart to reproduce sexually, reducing the genetic diversity of the population—making them susceptible to further population declines. Through this project The Nature Conservancy (TNC) and the St. Croix East End Marine Park will aid in the recovery of critical species within the St. Croix East End Marine Park (EEMP), while connecting people to the park through coral conservation and engagement opportunities.

The TNC coral restoration program will continue to grow and outplant corals strategically in the EEMP with guidance and assistance from park staff. A report of all corals planted within the EEMP will be provided to the park each year. Focus will remain on *Acropora* spp corals with the intention of expanding to various boulder species including *Orbicella* spp through innovative propagation techniques.

An essential component of this partnership between TNC and EEMP is the installation of a demonstration coral nursery to be managed and maintained by EEMP staff and the "EEMP Coral Gardeners", a group of trained and designated EEMP volunteers. As such, the installation of a small-scale demonstration coral nursery at Cottongarden Bay/Cramers Park will facilitate the restoration of reef sites near this coral nursery, and/or throughout the EEMP, and will engage the EEMP Coral Gardeners in the coral restoration process. After members of the EEMP Coral Gardeners attend a restoration training seminar at the EEMP, they will be able to sign up for supervised maintenance trips to get signed off for in-water volunteer work. These maintenance trips will be supervised by trained staff from the EEMP or The Nature Conservancy.

The involvement of the St. Croix community in this project creates a new group of coral reef stewards to promote the protection and preservation of our natural resources. By participating in the coral restoration process first hand, EEMP Coral Gardeners will serve as representatives of the EEMP Mission which is *"to promote marine stewardship and responsible use of significant coastal and marine resources through:* ***resource protection, and restoration, policy engagement, improved inter-departmental and multi-agency collaboration, and education and community engagement*** *to protect and preserve ecological and cultural values for residents and visitors.*" Establishing this small-scale coral nursery within the EEMP also serves as a site of redundancy for the preservation of coral fragment genotypic diversity in concurrence with the other TNC managed nurseries throughout St. Croix. Additionally, this restoration project will provide new outreach and education materials for the EEMP to use in the 2019 opening of the only natural history Visitor's Center on the East End of St. Croix at 5005 Estate Great Pond, Christiansted, VI. Thus, this project aims to not only engage local volunteers through the EEMP Coral Gardeners group, but also any land-based visitors who wish to learn more about the importance of coral restoration on St. Croix.

Methodology:

This project will include the following in water activities:

1. Assessment and selection of suitable site for coral nursery demonstration site
2. Implementation of a nursery demonstration site and nursery maintenance
3. Outplanting and monitoring at selected restoration sites
4. Training of STXEEMP staff and Friends of STXEEMP volunteers

1. Assessment and selection of suitable site for coral nursery demonstration site

Previous assessments suggested the following locations as possible locations for the proposed coral nursery demonstration site:

- Great pond bay
- Turner hole
- Jack bay
- Issac bay
- Cramer park
- Knight bay
- Green cay

Additional data was collected based on the following parameters:

- Existing wild populations
- Depth
- Water quality
- Wave exposure
- Human Activities/Impacts
- Connectivity
- Space competitors Organisms that compete for space such as gorgonian canopy, encrusting sponges, algae.
- Historical presence or absence of *Acropora* corals
- Accessibility by volunteers and general public

After multiple site visits and surveys, Cottongarden Bay at Cramer's park was selected as the ideal location for the EEMP coral nursery demonstration site.

2. Implementation of a nursery demonstration site and nursery maintenance

A demonstration nursery will be constructed with the goal of growing corals to outplant at the park in later years and to engage park volunteers. It will be located at Cramer's Park with easy access for park staff and volunteers. The area has been surveyed and an appropriate site has been selected for the

installation. As in accordance with the established guidance on *Acropora* nurseries the nursery will be located at a depth of 8-15 feet. The site is sandy substrate and sparse seagrass and an area of low human impacts (within MPA). A table and/or tree nursery will be constructed using PVC and anchored using rebar. The nursery will grow Elkhorn coral (*Acropora palmata*) as well as any other available fragments of opportunity from the list below. Coral fragments will be tied on using plastic ties or epoxy. Only fragments of opportunity will be collected (pieces of coral broken by natural processes like big waves, storms, etc that would otherwise perish).

Basic nursery maintenance will be conducted on a regular basis, using brushes and scouring pads. Because maintenance activities do not require extensive knowledge of coral biology, volunteers from the Friends of St. Croix East End Marine Park and recreational divers will be trained to assist with maintenance of the demonstration nursery.

Proposed location of demonstration site at Cramer's park

Potential outplant areas outlined in pink. Both are ground-truthed patch reefs.

Potential table/tree structure areas in sand outlined in yellow. Both are ground-truthed sand patches.

Potential table/tree structure area in thin seagrass outlined in green. Ground-truthed sparse seagrass.

List of possible corals to include in the nursery based on available fragments of opportunity.

Scientific Name	Common Name
Acropora palmata	Elkhorn coral
Acropora cervicornis	Staghorn coral
Acropora prolifera	Fused Staghorn coral
Pseudodiploria strigosa	Symmetrical Brain
Pseudodiploria clivosa	Knobby Brain coral
Montastrea cavernosa	Great Star coral
Orbicella faveolata	Mountainous Star coral
Orbicella annularis	Lobed Star coral
Orbicella franksi	Boulder Star coral
Dichocoenia stokesi	Elliptical Star coral
Dendrogyra cylindrus	Pillar coral
Colpophylia natans	Boulder Brain coral
Diploria labyrinthiformis	Grooved Brain coral
Porites porites	Clubtip Finger coral
Porites furcata	Branching Finger coral
Porites astreoides	Mustard Hill coral

Methods and diagram for building table structure

Table Nursery

Materials:

Quantity	Item
1	1 full length of 3/4" length of PVC
1	20' ½" length of rebar
12	3/4" PVC Caps
32	5" long ¾" PVC pieces
20	>30" medium zip ties
20	6cm x 6cm tiles
20	¾" PVC crosses
4	¾" PVC corners (elbows)
1	5 – 10 pound mallet

Cut the length of PVC pipe into 4 pieces of equal length - these will become the legs of the table. The length of these legs depends on the desired height of the table off the bottom. Place the legs of the table into the 4 PVC corners/elbows. Cut a length of PVC into 32 pieces each 5" long and connect these to each other using the PVC crosses (see diagram) and then connect to the legs of the table. Drill a hole into the center of each piece of clay tile as well as the center of each PVC cross. Zip tie each clay tile to the table through the holes in the crosses. Cut the rebar based on the desired height of the table from the bottom e.g. cutting the rebar into a 7 feet long piece will give 2 feet into sand to anchor the table and 5 feet above sand. Use a 5 to 10-pound mallet to drive rebar into the sediment.

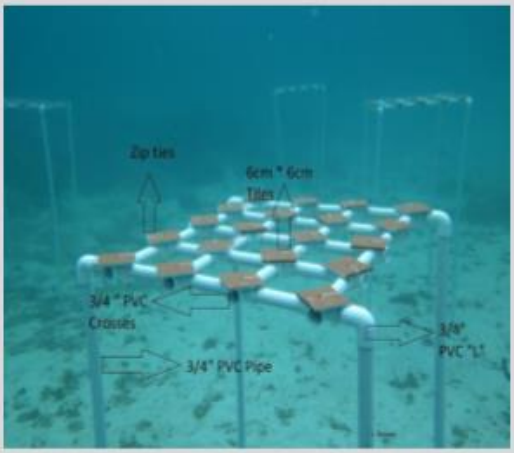

Figure 10: Labelled diagram of a fully assembled tree table nursery structure showing placement of all components

Methods and diagram for building a tree structure.

Tree Nursery

Materials:

Quantity	Item
1	1 full length 1/2" PVC pipe
1	15' Rope (Long lasting - marine)
1	Buoy
1	2' rubber hose/piping (to prevent chafing of the rope)
1	PVC glue/cement
1	duckbill anchor
75'	heavy fishing line
100	fishing line crimps
5	1/2" PVC crosses

Cut the PVC pipe is into 4 pieces each 12" in length and 10 pieces each 18" in length. The 18" lengths will serve as the branches/stem/trunk of the tree. The heavy fishing line should be cut into 50 x 15" long pieces and each should be outfitted with a metal crimp so that one can create a sliding loop. Drill five (5) evenly spaced small holes into the 10 x 18" pieces of the PVC and attach fishing line crimps to the end of each piece of fishing line. All the crimp lines should be attached to the branch pieces via the drilled holes and another crimp.

Starting from the bottom, attached two branches and one stem/trunk piece to a cross, arrange the next cross/branch/stem perpendicular to the one below and continue until all 5 branches are attached. Tie the buoy to the end of a 15 – 20 feet line and feed the line through the trunk of the tree (sometimes attaching the line to a small metal rod can help work it through). Once the line runs all the way through the trunk, secure the line around the bottom PVC cross so that it will not slide. Slide the tubing/hose piece over the end of the rope and then tie onto the loop of the duck bill anchor.

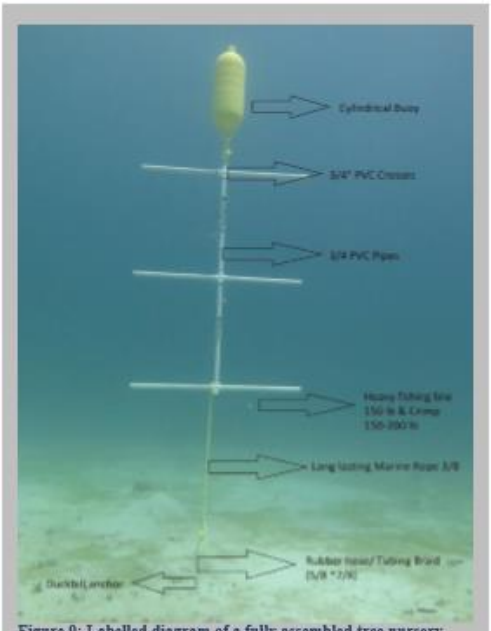

Figure 9: Labelled diagram of a fully assembled tree nursery structure showing placement of all components

Nursery Maintenance and Monitoring

Basic nursery maintenance will be conducted on a regular basis, using simple hand-held tools (see specifics below), to minimize fouling from other organisms including macroalgae, sponge and fire coral.

Maintenance activities may include the following:

a) Removal of algae and other fouling organisms (tunicates, sponges, hydroids, etc.) by hand or with small brushes.
b) Active propagation and fragmentation of corals to increase nursery stock available for outplanting.
c) Removal by hand of coral predators such as snails, fireworms and damselfish.

d) Attachment or stabilization of fragments or colonies using epoxy or cement.
e) Repairing of damaged modules, line materials, attachment materials and/or anchoring materials.
f) Isolation or removal or treatment of diseased corals.

Monitoring parameters include the following:

a) Initial measurement: when a fragment is brought into the nursery after transplantation, the fragment is measured for total live tissue.
b) Fragmentation measurement: each time a colony in the nursery is fragmented, the live tissue of the donor colonies is measured.
c) Number of branch tips – branch tips should be considered any tissue ›1 cm.
d) Maximum branch width – width of branch at base of colony or fragment.
e) Condition – disease, predation, bleaching, algal and other overgrowth, breakage, tissue loss.
f) Mortality – number of fragments or colonies with complete tissue loss.
g) Water quality – collecting basic information on water quality, such as temperature and light
h) Photographs – photographs of nursery colonies can provide a valuable permanent visual record of these parameters.

Tracking:

Tracking of individual fragments or colonies for growth or productivity (by individual or genotype) will be done through position mapping.

3. Outplanting and monitoring at selected restoration sites

Outplanting efforts will occur annually at selected sites. The goal of the outplantings are to outplant enough nursery-grown colonies from a variety of different donor colonies or genotypes to enhance the potential for sexual reproduction and recruitment, thereby enhancing the ability of the population to contribute to its own recovery. Initially, TNC staff will lead out-planting efforts annually while providing opportunities for STXEEMP staff and volunteers to participate. Once trained, EEMP staff will continue to lead outplanting efforts for the demonstration site.

Before outplanting each nursery coral will be evaluated to ensure that only colonies that present a visual suggestion of good health are placed out of the nursery. Colonies to be outplanted will meet the following criteria:

- For *A. palmata*, measure at least 5 cm x 5cm.
- Show no visible signs of disease or injury.
- Have actively growing tips.
- Have 100% live tissue and no lesions.
- Show robust coloration (golden-tan to a dark brown).

Transport:

If site locations are far enough that corals cannot be transported underwater, corals will be transported in coolers on boats to the outplant sites with transport times less than 1 hour. This has been an effective method tested by TNC. TNC vessels will be used for outplantings and staff will follow the following NOAA approved Vessel Best Management Practices.

Coral Attachment:

Coral outplants will be attached using cement or 2-part marine epoxy. The choice of adhesive depends on local availability, the environmental conditions at the restoration site, the size and morphology of the corals.

The following adhesives can be used for attachment:

1. Ordinary Portland cement mixed with sand and freshwater (try to avoid using saltwater as this may interfere with the setting process and strength of the concrete) has been widely used, sometimes with admixtures to alter the rate of setting of the concrete.
2. Type II Portland cement or specialist sulphate resistant marine cements with microsilica- based additives are recommended for use in the marine environment and can be used if available locally.
3. Two-party epoxy putty (e.g., All Fix, AquaMend, Epoxyclay Aqua) appear the easiest to use and most cost effective.

Outplants will be appropriately spaced within plots and between plots within sites to allow access for monitoring and maintenance. Typical spacing of outplanted corals is 0.5–2 m. Outplants will have a maximum spacing of 50–100 cm between colonies within plots to increase the potential for cross fertilization of gametes during spawning events.

Tracking:

Corals will be tracked as individuals or as clusters using mapping and photography.

Monitoring and Maintenance:

A core set of out-plant sites will be monitored quarterly to assess success. Data will be collected on the following parameters:

a) change in coral cover
b) survivorship of out-planted corals
c) species diversity at out-plant sites
d) abundance of key species (fish and other food species) utilizing out-plant sites
e) notes on condition, including bleaching, disease, predation and breakage

4. Training of STXEEMP staff

Staff from STXEEMP and volunteers from Friends of East End Marine Park will be trained in both the theory and practice for the following topics:

- Coral nursery and restoration program design
- Site selections processes for nurseries and out-plant sites
- Nursery maintenance
- Monitoring of nurseries and outplant sites

Appendix B

EEMP Coral Restoration Program:

Community Engagement Plan

Goal: Create more opportunities for engagement with the park through restoration activities

Provide an easily accessible (via snorkeling) coral nursery demonstration site to use as an engagement tool for the park and it's education goals; create a small volunteer program of divers led by EEMP staff to provide the maintenance, upkeep, and outplanting of corals in the demonstration site; help volunteers and visitors understand the importance of coral reefs and provide a concrete action they can take to help reefs.

- Create a restoration demonstration site in the EEMP and a volunteer program to support the care and maintenance of the site (See "Methodology" document for creation and care of demonstration site)
- Incorporate coral restoration into suite of educational and promotional materials at EEMP

Intended Audience: park visitors and local residents; recreational divers in St. Croix, USVI; CRABBS dive club members; JSIS student divers; DWP divers; visiting tourists; student groups;

Tasks to achieve Goal

- TNC to train EEMP staff on restoration work (Year 2)
- Create a demonstration site in EEMP (TNC & EEMP support) (Year 3)
- Create a volunteer program and train volunteers in nursery maintenance (TNC/EEMP) (Year 3)
- Outplant corals from demonstration site each year (TNC & EEMP & volunteers) (Year 3 and 4)
- Create educational materials (modules/presentations), informational handouts (brochures, etc), videos, demo table, and signage relating to the coral restoration work being done in the EEMP (TNC and EEMP work together) (Year 2,3,4)

Phase I: Start Nursery, recruit volunteers

- Train EEMP/DPNR staff in coral nursery and restoration
- Select shore accessible site and install nursery in EEMP
  - TNC to help with install and provide all materials for building structures
  - Suggested 1-2 PVC tables, anchored with re-bar and duck bill anchors
  - Suggested species: palmata fragments, dendrogyra (if available), microfragments of O.fav
- Purchase kayaks appropriate for carrying dive gear to be used to assist with maintenance dives.
- Train volunteer divers using the PADI Coral Nursery and Restoration Specialty Diver Course or EEMP Coral Nursery Training (to be developed) and have volunteers assist with monthly maintenance of the nursery structures.
  - Develop an EEMP Coral Nursery Training Course that includes an introductory lecture, a manual to read, and accompanying EEMP staff on a nursery maintenance dive

- Monthly maintenance provided by volunteers or EEMP/DPNR staff when volunteers unavailable

Phase II: Incorporate outplanting

- Train staff and select volunteers in outplanting methods and host outplant dives during outplant season (Jan-June)
- Shore dive to outplant corals on a nearby lagoonal patch reef
- EEMP/DPNR staff work with volunteers to execute outplanting corals

Phase III: Regular presentations and snorkel tours offered by EEMP

- In addition to volunteers diving on the nurseries, offer a snorkel tour to residents, tourists, any other interested parties to get a quick presentation and then snorkel to view the nursery and/or outplants
- Talk and snorkel held quarterly, once a month or as requested; led by EEMP staff or coral gardener volunteers