

Final Report for Florida Department of Environmental Protection (DEP)

Project Title:

Coral Restoration and Youth Environmental Education

Principal Investigator:

Joey Mandara - STEM Director, Florida Sea Base- Boy Scouts of America

Project Dates:

2/22/2021 to 6/21/2021

Background:

Florida's Coral Reef ecosystem supports 70,000+ jobs equaling \$8.5 billion in sales and income annually. In the Florida Keys, 58% of all jobs are tied to the reef with marine activities generating \$3.38 billion in sales and income annually. However, Florida's Coral Reef has been in sharp decline; from coral coverage of 60-70% a few decades ago to as low as 1% to 2% today.

The Boy Scouts of America (BSA)'s Florida Sea Base has a functioning land based coral nursery (one of a few in the Keys) with 12 raceways growing ~6,000 corals and a STEM program that serves 3,500 young men and women each year. Under the guidance of our STEM Director, youth will participate in the fragmenting, growing and planting of corals to restore our reefs, specifically bouldering species. They will also participate in monitoring and collecting data on the coral along with other programs to support the ocean environment.

As reef restoration work continues, a need to focus on slower growing bouldering and mounding corals needs to be explored (Forsman et al., 2015). Bouldering and mounding corals have seen a further decline in coral cover due to SCTLD. Originating off the coast of Miami in 2014, SCTLD has traveled along the Florida Keys reaching the Marquesas (Precht et al., 2016; Muller et al., 2020). This disease effects ~23 of the stony coral species in the Caribbean and Western Atlantic. All corals that are affected are slower growing species (Rosales et al., 2020). Due to their slow growth rates, these species have not been focused on for restoration (Page et al., 2018).

The micro-fragmentation method, coupled with ex situ nurseries will focus on bouldering/ mounding corals such as star and brain corals. This method allows coral of opportunity to be fragmented into square centimeter pieces, requiring little material to be collected from the wild (Page et al., 2018). Growing fragments in tanks keeps small fragments in disease free and stable conditions year-round and gives practitioners daily access to care for corals (Forsman et al., 2015). Cutting corals to such a small size, in stable condition, allows for corals to accelerate in growth, which in the wild is advantageous for survival (Forsman et al., 2015; Okubo et al., 2006). These fully grown fragments will either be fragmented again to restock the nursery or

outplanted onto degraded reefs (Page et al., 2018). Utilizing these proven restoration methods, Florida Sea Base will expand and explore land-based restoration techniques, developing best management practices with the help of scouting and non-scouting groups participating in the Marine STEM curriculum

The benefits of this project are tangible and immediate; growing and planting thousands of corals on Florida's Coral Reef and engaging young women and men to become "citizen scientists" and ocean champions, making a positive difference in the environment.

Tasks:

Proposed Task 1: Add 5 raceways to the coral nursery by building the platforms, running and connecting plumbing, building shade structures, connecting to drainage field and ensuring all are fully operational. This will also include an aquaculture pump to support the expanded nursery operation.

Completed Task 1:

- Florida Sea Base added 7 new 178-gallon raceways, totaling 19 raceways on site. Each raceway has the potential to hold up to 1,000 corals. This work consisted of making raceway legs and leveling raceways.
- All 7 raceways were connected to our main system for both air and water. The following was constructed for each raceway.
 - 1 Standpipe: To control the water level.
 - 1 "Snail Cover": To prevent snails from escaping through the standpipe
 - 1 Air Wand: To create water movement and off gas seawater.
 - Raceway Lid: To shade corals and prevent freshwater intrusion.
- Though this was not part of the initial construction plan, a 135 gallon degas tower was constructed to ensure the main system could maintain proper water quality with the addition of raceways. A new degas tower was constructed since BSA corals receive its water supply from a saltwater well approximately 90ft in depth. This water is century old seawater, which is naturally protected from disease contamination, and is filtered through the ground, however this water is low in pH and contains ammonium and H₂S.
- The BSA nursery is currently utilizing 15 raceways holding 8 different species of corals and different fragment sizes (micro-fragments to broodstock).
- Two shade structures were purchased and constructed to cover all 19 raceways. One 34' L x 54' W x 8'H and one 18'L x 25'W x 8'H shade structure.

Proposed Task 2: Operate the coral nursery with current and expanded raceways; grow coral and document all aspects of coral nursery operation to include genotypes, fragmenting, growth, health, water quality and status for outplanting. The corals currently in the nursery include the following species; *Orbicella faveolata*, *Solenastrea bournoni*, *Psuedodiploria clivosa*, *Pseudodiploria strigosa*, *Acropora palmata* and *Porites astreoides*. Additional species will focus on bouldering coral including *Montastraea cavernosa*, *Orbicella annularis* and *Colpophyllia natans*.

Completed Task 2:

- BSA's Coral nursery inventory at the start of the grant was ~4,150 consisting of 7 species: *Orbicella faveolata*, *Solenastrea bournoni*, *Psuedodiploria clivosa*, *Pseudodiploria strigosa* *Acropora cervicornis*, *Acropora palmata* and *Porites astreoides*.
- To date the coral nursery is housing ~6,725 corals consisting of 8 species of corals. *Orbicella faveolata*, *Solenastrea bournoni*, *Psuedodiploria clivosa*, *Pseudodiploria strigosa* *Acropora cervicornis*, *Acropora palmata*, *Porites astreoides* and the addition of *Montastraea cavernosa*.
- On 6-2-21 an email acting as a temporary permit was issued to BSA, allowing for the collection of 17 pieces of *Psuedodiploria clivosa* (6 fragments), *Montastraea cavernosa* (5 fragments), *Orbicella faveolata* (6 fragments). As of 6-16-2021 BSA has received their FKNMS permits allowing for the collection of corals from partnering and rescue nurseries as well as construction sites, if approved by FKNMS staff.
- During this project timeline the following number of fragments per species were produced:
 - *Acropora cervicornis*: 2,127 consisting of 48 genotypes
 - *Porites astreoides*: 446 consisting of 4 genotypes (*All fragments were produced by scouts*)
 - *Psuedodiploria clivosa*: 187 consisting of 1 genotype
 - *Orbicella faveolata*: 101 consisting of 5 genotypes
- During the fall season BSA had 8 STEM crews working in the nursery and to date, for the summer program, BSA has had 9 crews working in the nursery. This totals 136 individuals on a rotating basis, that worked in the nursery.
- Activities included:
 - Stock Enhancement: Groups that visit Brinton Environmental Center will have the opportunity to take part in the micro-fragmentation process of bouldering and branching coral species.

- Coral Husbandry: Groups will have the opportunity to learn about the biology of corals and what parameters are required to keep corals healthy by conducting water quality, PAR measurements, coral feeding, and cleaning of tanks.
 - Water Quality: Groups will learn about the header tanks that run a land-based nursery as well as use equipment that tests for pH, salinity, temperature and PAR levels.
- During this time records were kept on mortalities, fragments produced, broodstock accrued, quarterly inventory per species, water quality, PAR readings, and filter changes.
 - Per the request of FWC, BSA has also established a Veterinary-Client-Patient Relationship (VCPR), with an approved veterinarian. During the first year of our VCPR we are required to have our contact conduct three site visits. Dr. Ari Fustukjian conducted his first visit during February of 2021. He conducted his second visit in June 2021 to see the completion of our nursery expansion. We plan to have his third site visit in the fall of 2021, and potentially approve corals for outplanting if all permits are acquired.

Next steps:

- The BSA nursery will continue to expand their inventory to up to 10,000 coral fragments throughout 2021 and 2022.
- BSA will be acquiring more parent colonies/ genotypes to the species currently housed in the nursery.
- BSA would also like to collect *Orbicella annularis*, *Colpophyllia natans*, and *Diploria labyrinthiformis*.
- BSA will work with FKNMS and Mission Iconic Reefs staff to establish outplanting locations for corals that are grown out over the summer of 2021.
- BSA will amend current permit and acquire FWC permit/ SAL to allow for outplanting of corals in the fall of 2021.

References:

Forsman ZH, Page CA, Toonen RJ, Vaughan D (2015), Growing coral larger and faster: micro-colony-fusion as a strategy for accelerating coral cover. PeerJ3:e1313; DOI10.7717/peerj.1313

Okubo N., Motokawa T., Omori M. 2006. When fragmented coral spawn? Effect of size and timing on survivorship and fecundity of fragmentation in *Acropora formosa*. Mar Biol (2007) 151:353–363 DOI 10.1007/s00227-006-0490-2

Page CA, Muller EM, Vaughan D. 2018. Microfragmentation for the successful restoration of slow growing massive corals. Ecological Engineering 123: 86-94

Precht WF, Gintert BE, Robbart ML, Fura R, Van Woesik R. 2016. Unprecedented disease-related coral mortality in Southeastern Florida. Scientific Reports 6(1):31374

Rosales SM, Clark AS, Huebner LK, Ruzicka RR and Muller EM (2020) Rhodobacterales and rhizobiales are associated with stony coral tissue loss disease and its suspected sources of transmission. front. Microbiol. 11:681. doi: 10.3389/fmicb.2020.00681