

# Coral Restoration Bonaire

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The Nature funding from the Netherlands' Ministry of Agriculture, Nature and Food Quality (LNV) (previously Ministry of Economic Affairs), has helped Coral Restoration Foundation Bonaire (CRFB) to take the next step in restoring Bonaire's shallow reefs. Throughout the past two years, 5,000 Staghorn corals (*Acropora cervicornis*) were outplanted back to Bonaire's shallow coral reefs, which brings since 2013 the total of outplanted acroporid corals to 20,000. To accomplish this ambitious goal, the capacity of the nursery was expanded and a comprehensive monitoring program was established. The Foundation also took an important step strengthening its logistics and network to become a more independent organization.

## Local Dive Operators Involvement

Partnering with local dive shops has been key to the success of CRFB's programs since the beginning. These dive operators (CRFB Dive Shop Members) execute a practical restoration program that not only re-grows local reefs, but engages the community and builds their businesses with paying customers that return year after year to help maintain the nurseries and the reefs they helped replant. Through a successful educational program, local dive operators train regularly resident and tourist scuba divers who are the actual volunteer man power of the island coral restoration program.

The Foundation was established thanks to the support of Dive Buddy Dive Resort with Harbour Village Beach Club and Eden Beach Resort joining later. Thanks to the

Nature Funding for the BES islands, this partnership has expanded once again. Two new local dive operators, Gooddive and Tropical Divers have also joined the Foundation, bringing the total number of dive shops supporting coral restoration on Bonaire to five. This funding was crucial catalyst in allowing smaller dive shops to join the cause.

Thanks to the expanded dive shop membership facilitated by the project, the Foundation has increased its educational presence throughout the island. Recognizing the importance of involvement from all parts of the community for a restoration program to succeed, future plans focus on three components: 1) a greater presence with the island's youth through increased educational programs in schools and a more intensive involvement with the STINAPA Jr. Rangers program, 2) reaching more of the visiting and local divers by getting more dive shops involved with the program, and 3) continued awareness and educational communications with residents of the island.

The locations for each nursery were surveyed and approved by the Bonaire National Marine Park (BNMP) with Gooddive's coral nursery located at Something Special and Tropical Divers' at Calabas Reef. Both dive shop's nursery has five trees and can hold up to a total of 500 Elkhorn and Staghorn corals. Trained staff members are responsible for nursery maintenance and related coral outplanting activities in the area. As the network of Dive Shop Members expands, more and more trained manpower is available for the actual restoration of Bonaire's reefs.



*Nursery installation day at Gooddive*

Photo by: © CRFB

### Coral Outplantings and Restoration Sites

To guarantee the production of the 5,000 corals needed to restore the four snorkeler accessible sites, an expansion of the main production nursery was necessary. The nursery in Klein Bonaire was expanded to 51 trees, bringing that nursery's capacity to 6,522 corals (+54%), and allowing for enough corals to remain in the nursery after the project for future restoration efforts.

Four snorkel-accessible sites around Bonaire were selected, upon BNMP approval: Playa Lechi, Jeff Davis Memorial, Salt Pier, and Pink Beach. The number of corals needed for each of the four restoration sites has been determined according to the abundance restoration criteria listed by NOAA in the 2015 Recovery Plan for Staghorn corals, which requires the establishment of approximately 25% of live Staghorn Coral cover in the restored areas (National Marine Fisheries Service, 2015). With these criteria, each site is comprised of 1,250 Staghorn corals spread over 150m<sup>2</sup>.



*Outplanted corals at Jeff Davis Memorial*

*Photo by: © David Fishman.*

The restoration technique used by CRFB is known as coral gardening, whereby fragments from a healthy, robust wild population are fragmented and grown in nurseries on Christmas tree-like trees. These trees are structures with a PVC trunk and fiberglass branches on which coral fragments are suspended.

When the fragments have reached maturity, they are then outplanted to degraded reef areas. Between January 2017 and March 2018, according to the planned activities, 1,250 nursery-reared coral colonies from 11 different genotypes were outplanted at Playa Lechi, Jeff Davis Memorial, Salt Pier, and Pink Beach, covering an area of 600 m<sup>2</sup>, for a total of 5,000 Staghorn corals. Outplanting requires the use of supporting horizontal bamboo structures elevated 10-20 cm from the bottom in order to support the corals in the first phase of their growth on the rubble bottom and limit the predators' abundance. At each site, 50 square bamboo structures were installed at each restoration site. Each structure supports 25 corals of the same genotype.

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## Coral Monitoring Program

The outplanted corals at the four restoration sites have been carefully tagged and monitored over time, taking pictures at the outplanting day, two weeks, three months, six months and one year after outplanting them. The pictures have been subsequently analyzed using CPCe to gather coral cover and mortality data of the different corals genotypes.

The data collection is still in progress, but preliminary results on the first two sites, show large differences in growth between the locations. On average coral cover at Jeff Davis increased linearly 0.06% per day or 21.6% per year with very little mortality. In front of the main urbanised area, at Playa Lechi, growth was erratic and mostly negative (E. Meesters & F. Viridis, unpublished data). Environmental conditions in front of Kralendijk are presumed to be responsible for the lack of growth and high mortality of the restored staghorn corals there.

The monitoring will continue after the funding period has concluded, data analysis and the results will be published in cooperation with Wageningen University. The systematic assessment of this data will guide the Foundation toward doing more of what works, giving key insights into restoration site selection factors, genotype performance, and overall coral coverage after one year. This will allow for adapted and refined

strategies, based on knowledge acquired from both field work experience and both quantitative and qualitative results of the monitoring program, that better allocate the Foundation's limited resources.

### What's next?

Great progress has been made growing and replanting branching *Acropora* corals in Bonaire and throughout the Caribbean. The restoration success of Coral Restoration Foundation Bonaire with *Acropora cervicornis* (staghorn coral) has been especially noteworthy, thanks to the simplification of logistics and built capacity, the Foundation has been able to scale up its restoration program effectively, and the techniques used to achieve those results are now being duplicated elsewhere in the Caribbean.

Based on the coral restoration experience gained over the years and recognizing the urgency of the threats facing our reefs, CRFB is now embracing a more comprehensive vision and expanding to new techniques, to give Bonaire's reefs a helping hand on an ecological scale, focusing on not only genetic diversity, but species diversity as well. These new techniques and species will be part of a broader, more inclusive reef restoration approach the Foundation has recently adopted.



**Top left :**  
Outplanting day  
data collection

**Top right:**  
1-year  
data collection

**Bottom Left:**  
Outplanted staghorn  
corals at Tori's Reef

**Bottom Right:**  
Outplanted  
staghorn corals  
at Jeff Davis Memorial

Photos by:  
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