

# 2020 ANNUAL REPORT

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## 1 WELCOME – A COVID'S PERSPECTIVE

One of the biggest lessons we can all learn from corals is the importance of adapting to environmental conditions. When we created our goals for 2020 we did not see the specter of Covid-19 on the horizon and, for the first few months of 2020, we were well on our way towards meeting these goals. In mid-March our world changed drastically as travel, airports, and social interaction ground to a halt. Much like the sudden environmental changes that corals have experienced worldwide, we too experienced a drastic change to our environment.

At RRFB we made the decision to take on the restrictions imposed by Covid-19 by adapting to our new reality, tackling new challenges that we could not have foreseen without the limitations imposed by a global pandemic. RRFB grew as an organization in 2020 by approaching these challenges with open minds and creative solutions. Adapting to a world with Covid-19 pushed us to find new ways to manage partnerships with other organizations, organize our volunteers, and collaborate with researchers from around the world, while restoring Bonaire's reefs.

What does this mean for our annual report? It means that rather than highlighting the limitations and restrictions we experienced, we are instead focusing this report on how, keeping our goals in mind, we grew and improved during the past year with minimal references to Covid–19. Covid–19 imposed unexpected challenges, but it also gave us the gift of emerging from these challenges as a stronger organization. Just like our corals, we have chosen to thrive.

**Reef Renewal Foundation Bonaire Team** 





#### **OUR MISSION**

Reef Renewal Foundation Bonaire protects and restores coral reefs in Bonaire by:

- Developing new and innovative ways to restore reefs that are supported by research collaborations and shared worldwide
- Training, engaging, and inspiring the community locally and internationally through volunteering, educational events, and outreach
- Demonstrating that through community efforts there is still hope for coral reefs

#### **OUR VISION**

The vision of Reef Renewal Foundation Bonaire is a world:

- Where knowledge and experience can be shared
- Where reefs are protected and restored
- Where reef degradation is halted
- Where ocean awareness is promoted

#### **BOARD OF DIRECTORS - - -**



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Christine M. Wall Director





Francesca Virdis Project Coordinator



Sanne Tuijten Assistant Coordinator



Elizabeth McWhinnie Reef Restoration Technician



Ken Nedimeyer Technical Advisor



Dr. Erik Meesters Scientific Advisor







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WHERE ARE WE NOW?

NURSERIES	Coral capacity	
A. Oil Slick Leap	100	
B. Knife	900	
C. Buddy's Reef	4,000	
D. Something Special	500	
E. Harbour Village	1,000	
F. Eden Beach	500	
G. Joanna Sunchi	5,620	
H. Calabas Reef	500	
I. Bachelor Beach	300	
J. Punt Vierkant	1,000	
TOTAL	14,420	

**#** outplanted corals Acropora Acropora **OUTPLANTING SITES** cervicornis palmata 1. Jeff Davis 3,021 n/a 2. Oil Slick Leap n/a 861 3. Buddy's Reef 6,919 1,914 4. Harbour Village 861 156 5. Eden Beach 257 546 6. Something Special 467 240 7. Knife n/a 1,418 8. Mi Dushi I 5,183 n/a 9. Mi Dushi II n/a 1,451 10. Carl's Hill n/a 1,390 11. South Bay 1,288 330 12. Playa Lechi 1,250 n/a 13. Calabas Reef 265 220 14. Salt Pier 1,250 n/a 15. Tori's Reef 2,987 n/a 16. Pink Beach n/a 1,250 TOTAL 26,449 7,075





## 4 REEF RENEWAL BONAIRE RESTORATION IN A GLIMPSE





## 5.1 Nursery

Since 2012, RRFB has used the coral tree nursery design to grow endangered coral species. Trees are anchored to the seafloor just offshore and float in the water column. Corals are propagated using fragmentation and, depending on the species morphology, are either hung from the branches of the trees or secured on trays. The coral fragments hang in the nursery for several months until they reach proper size for outplanting.

## 5.1.1 Nursery Activities and Monitoring

In 2020, Reef Renewal Foundation Bonaire managed eight nurseries. Four nurseries, which accounted for 87.5% of the total nursery coral capacity, were used by RRFB for the production of corals to be outplanted to targeted reef sites. The remaining nurseries were primarily used by RRFB Dive Shop Members for educational purposes and volunteer training.

Two production nurseries have been installed temporarily (pop-up nurseries) in the same reef sites where the produced corals are later outplanted. These on-site nurseries allow more time for corals to acclimate to the site conditions before being outplanted. Furthermore, by eliminating coral transportation between nursery and outplanting sites, these nurseries simplify logistics and reduce stress on corals. The pop-up nurseries are monitored year-round via in-water surveys to gather production, health, and overall nursery performance data.



## **Nurseries Overview**





## 5.1.2 Branching Coral Nursery

In March 2020, RRFB installed a 10-tree pop-up nursery at Punt Vierkant on the southern coast of Bonaire. The new nursery will stay at Punt Vierkant for at least three years to produce thousands of *Acropora cervicornis* coral colonies that will be outplanted in the same site where this coral species used to thrive in the past.

The pop-up nursery at Knife, which was installed in 2019, has produced 1,046 *Acropora palmata* corals that were outplanted during 2020 in the nearby shallows. At the end of the year, RRFB selected the best performing genotypes, based on previous outplanting monitoring data, to propagate, cutting the number of genotypes in the nursery from 18 to 9.







## 5.1.3 Boulder Coral Nursery

The boulder coral fragments at the Buddy's Reef nursery grew and acclimated to their new environment during the past year. Since their installation in September 2019, the corals' health and growth have been monitored approximately every 6–10 weeks via in-water surveys and photo documentation. Nursery coral capacity 432 # species # genotypes Total production 3 24 288

Dead corals

### 5.1.4 Bleaching

At the end of 2020, Bonaire's reef experienced large-scale bleaching due to prolonged warm water temperatures. As a result, RRFB decided to intensify the monitoring effort at the nurseries to assess coral performance and the potential ability to recover from thermal stress.

No bleaching or paling of the coral fragments was observed at any of the 8 *Acropora* nurseries. However, the boulder coral fragments did show signs of thermal stress. From November 2020 until March 2021 RRFB monitored the level of bleaching and following recovery for the boulder coral fragments.

Survival

84.72%

During the monitoring time, 45.38% (113 fragments) of the corals in the nursery showed signs of bleaching or paling. Of all the three species, *Montastraea cavernosa* fragments showed the least signs of stress (13.95%) while more than

half of the fragments of *Orbicella annularis* (55.26%) and *Orbicella faveolata* (69.41%) were affected by the warm water temperatures. However, over 80% of the corals were able to recover and only 16.81% of the corals died, with no significant difference in the recovery among the three species. Notably, all the coral fragments that died already had some partial tissue mortality due to previous stress.



Orbicella faveolata on Nov 23rd, 2020 (bleaching signs)



Orbicella faveolata on Feb 10<sup>th</sup>, 2021 (recovery)



## 5.2 Outplanting Activities

There are two types of restoration sites where RRFB and its dive shop members outplant. At training sites outplanting is done frequently, but in small batches, by RRFB dive shop members mainly for training or educational purposes. At the other restoration sites, outplanting of large amounts of corals is done by RRFB staff with a few efforts over the course of one to two years at each site.



## 5.2.1 Outplanting Site Monitoring

Monitoring via data collection is an important part of the coral restoration project and is critical to assessing the progress and success of restoration efforts. Monitoring corals throughout each step of the restoration process allows RRFB to determine where problems arise and adapt strategies to improve overall goals and success. Goals are translated into measurable objectives and associated with metrics, like coral live tissue and cover, health, growth, mortality and stressors, which are then monitored and tracked over time.





### **Monitoring Activities**

Reef Renewal Foundation Bonaire has developed a monitoring program that focuses on two different time scales.

**Short-term Monitoring:** During the first 1-2 years, depending on the coral species, the monitoring is primarily focused on assessing individual colony performance us-

ing underwater visual surveys. It aims to provide useful information for understanding the success of the outplanting strategy and technique and compares the performance of different coral genotypes in the short term.

**Long-term Monitoring:** Spawning observations as well as photomosaic analysis of the entire reef site offer a better understanding of how outplanted colonies are growing and performing over the entire site as well as the effects of restoration efforts on other organisms. Monitoring is completed annually or biannually at each restoration site collectively providing a comprehensive assessment of overall project success in the long term.

#### **Monitoring Overview**





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#### **Monitoring Per Site**







\*Coral cover of targeted species only \*\*avg. size of restored corals is not available for *Acropora cervicornis* as the coral colonies fuse together.





## 5.3 Larval Propagation

Through a partnership with SECORE International, RRFB uses larval propagation to scale up restoration efforts on Bonaire while providing feedback to improve techniques. By taking advantage of corals' natural sexual reproduction, larval propagation has the ability to produce millions of genetically unique coral offspring. During mass spawning events, gametes are collected using nets and taken back to a lab to be fertilized. The resulting embryos are kept in floating pools, called Coral Rearing In-situ Basins (CRIBs), to complete their development into larvae. Using CRIBs allows RRFB to contain swimming coral larvae until they settle onto specially designed ceramic substrates, called Seeding Units, which are later outplanted back onto the reef.

## 5.3.1 Coral spawning monitoring

Coral spawning monitoring is a crucial tool for restoration efforts. These observations help RRFB narrow spawning prediction windows and, therefore, assign resources more efficiently during gamete collection, the first step of the larval propagation process. Furthermore, witnessing outplanted corals spawning is a critical benchmark be-cause it is an unquestionable sign of coral health and restoration success. Thanks to participating volunteers, the monitoring was extended across multiple months and sites, which allowed RRFB to record extensive spawning observations of several coral species along the west coast of Bonaire.





## 5.3.2 Larval Propagation activities

RRFB focused the 2020 larval propagation activities on *Colpophyllia natans*, which is predicted to spawn in September and October each year. Collection, netting and, outplanting training sessions for the staff were conducted to build team capacity and reinforce best practices for future spawning events. During this time, RRFB also tested new net designs and netting procedures to adapt gamete collection to large branching coral specimens. Despite the small spawning events, RRFB staff successfully collected and fertilized gametes during both months and, for the first time ever, reared coral larvae in the CRIB.





## 5.4 Outreach & Education

RRFB is turning the tide of reef degradation by taking collective community action and educating the public about reef science and restoration. Through interactive in-person and virtual events, RRFB reaches local and international audiences of all ages, fostering a movement of reef stewardship among devoted and budding conservationists.

## 5.4.1 Dive Shop members

Dive shop members are an essential part of RRFB's outreach program. Through organizing events, giving presentations, and training volunteer divers, they serve as the public's first point-of-contact with the Foundation and play an essential role in encouraging the public to become involved in the restoration project. In addition to reinforcing reef-friendly diving practices, dive shop members, through the PADI Reef Renewal Diver specialty course, train RRFB's volunteer divers. In 2020 RRFB was proud to add Beyond the Corals, Divi Dive Resort, and VIP Diving to the dive shop member network.



To make teaching and learning about restoration science more accessible, RRFB developed a comprehensive encyclopedia of terms and topics that instructors can reference as a supplemental teaching aid and use to expand their own knowledge. As of 2020, prospective Reef Renewal Diver instructors also have the opportunity to learn how to confidently teach the course with the help of RRFB's first Reef Renewal Diver Instructor Trainer.





## 5.4.2 Educational Events

Educating the public about reef restoration is the first step towards protecting reefs. In January, RRFB gave a presentation about coral spawning and larval propagation at a STINAPA Connecting People with Nature event. The packed presentation included locals, visitors, and students from an international university. A few weeks later, interested locals and visitors had the chance to join Reef Renewal volunteers and try their hand at coral nursery maintenance during the two-day **Bon Doet** event.



Through youth-focused events, RRFB can inspire even the youngest future reef protectors. In February, RRFB led a special youth presentation and snorkel tour to 20 children and their families from Bonaire, the Netherlands, and other Caribbean islands who were visiting Bonaire as part of **Familie Expeditie**. Later in the spring, Coordinator Francesca Virdis led a virtual class about reef restoration with 24 Italian students, ages 9-10.

RRFB is also proud to offer opportunities for **local young adults** to get involved in reef restoration. In November RRFB embarked on program with Jong Bonaire to train 4 young adults as RRFB volunteers and continue to offer special diving opportunities beyond the course. Throughout the year RRFB also continued its Junior Ranger program: offering training updates, virtual presentations, spawning monitoring dives, and nursery/outplanting dives. The Junior Rangers also represented RRFB though an interactive booth at a World Wetland Day event held at Lac Cai in February.

In 2020, RRFB and MBO expanded programming beyond year 2 and 3 students in the Hospitality track to include thrice annual educational events open to the entire student population. 40 MBO students visited RRFB HQ in January to learn about the organization and see first-hand the work that goes into restoring Bonaire's reefs.







## 5.4.3 Volunteer Program

In 2020 RRFB's volunteer program became more essential than ever before. RRFB's dedicated local and longterm stay volunteers stepped up to keep the mission of the Foundation going through unprecedented times. Consequently, RRFB developed further opportunities for committed local and long-term visitors to get involved, including nursery maintenance teams. Through the **nursery team** approach, volunteers commit to taking care of a RRFB-assigned shore-accessible nursery through 2-4 dedicated dives each month. These teams report back information regarding coral health and the state of the nursery trees to RRFB HQ. The work done by these volunteers is pivotal to maintaining nurseries across Bonaire while freeing resources to focus on outplanting and research. The

Foundation is also committed to retaining volunteers. In February RRFB **conducted a survey** with volunteers to determine ways to increase their retention. As a result, RRFB has since begun to offer skills updates, more varied volunteer opportunities, and more opportunities to dive independently of RRFB staff-led volunteer activities.



## 5.4.4 Internship Program

RRFB offers internships throughout the year to undergraduate, graduate, and recently graduated students. These internships develop the skillset of the next generation of restoration practitioners by providing interns with hands-on training in reef restoration practices, as well as experience working with an NGO. RRFB hosted two international interns during the 1st quarter of 2020, before travel restrictions were imposed.





## 5.5 International Collaborations in Scientific Research

Over the course of 2020, RRFB collaborated with four researchers on three different projects. These collaborations investigate research topics that aim to inform and advance RRFB's project and contribute to a better understanding of reef restoration science worldwide.



Epigenetic responses to environmental stressors in Acropora corals, and applications to coral reef conservation

Project Leader(s): Serena Hackerott and Dr. Jose Eirin-Lopez, Florida International University (FIU) Environmental Epigenetics Lab. Student: Serena Hackerott, PhD student FIU (USA). Period: Summer 2019 – Summer 2021 Project description: This two-part study investigates the role of acquired epigenetic modifications in helping two important Caribbean reef-building coral species, Acropora cervicornis and A. palmata, cope with stressors associated with global change. During the proposed project, in collaboration with RRFB, corals have been sampled monthly and site-specific environmental conditions have been monitored to 1) characterize the effects of seasonality and site-specific environmental conditions on coral epigenetic modifications and their connection with coral health; and 2) to evaluate the role of epigenetic modifications in mediating the "nursery-effect", or measuring the effect of the environmental conditions where a coral is raised on its ability to tolerate subsequent exposure to stress.





Application of bacteria as probiotics in coral reef restoration at Bonaire, Caribbean Netherlands

Project Leader(s): Maarten Morsink, PhD Wageningen University, Naturalis Biodiversity Center (NL)
Period: January 2019 – June 2020
Project description: Corals show high survivorship under natural reef conditions but remain under threat by



environmental disturbances. A promising intervention to increase reef persistence and resilience is to manipulate the coral-as-

> sociated microbiome. At present, the composition of the microbiome in nursery-reared and outplanted corals on Bonaire is unknown. The aim of the current project is to identify and isolate naturally occurring beneficial bacteria that may stimulate the resilience of these corals. In the future, a selection of these beneficial bacteria can be applied to the corals to increase their resilience against environmental disturbances.



### The effect of *Acropora cervicornis* restoration on fish communities in Bonaire

Project Leader: Erik Meesters, Wageningen Marine Research

**Students:** Anne Top, MSc student at Wageningen University; Sander Heijnens, Bs student at University of Utrecht.

Period: September 2020 - January 2021

**Project description:** RRFB has restored large patches of *Acropora cervicornis* over the last years. This study compares fish diversity and biomass as well as coral cover and recruits between recently outplanted patches, wild thickets, and degraded reefs. The



goal is to establish a baseline and assess the effect of the outplanted corals on fish communities in the shallow reefs of Bonaire. Knowing the diversity and abundance of marine life in restored reefs in comparison to degraded and healthy natural reefs is key to establishing a baseline and understanding how outplanting sites may support local reef systems.



### Reef Renewal

## 6 LOOKING FORWARD: OUR GOALS FOR 2021

#### Nursery

- install 1 new nursery
- increase coral nursery capacity at least 5%
- propagate 2,000+ star coral fragments in preparation for outplanting
- extend monitoring to more than 20% of all the nursery corals

## Outplanting

- outplant 7,000 Acropora corals corals to the reef
- target 1 additional restoration site for Acropora cervicornis
- increase outplanted *Acropora palmata* to over 25% of total outplanted corals
- extend monitoring to 60% of restoration sites

## Larval propagation

- monitor spawning of 4 coral species
- perform collection and fertilization on 3 coral species
- deploy the larva rearing pool (CRIBs) twice
- outplant 1,500+ Seeding Units back to the reef

### **Outreach & Education**

- support 1,000+ volunteer dives
- engage at least 200 people through online educational events
- train 10 local youth through the RRFB specialty courses

#### Research

- host at least 3 new international researchers
- find a partner to conduct coral genetic analysis



	2020	2019
	USD	USD
REVENUE	117,776	152,546
Cost price revenue	(16,594)	(47,000)
GROSS PROFIT	101,182	105,546
EXPENSES		
Personnel	65,141	60,243
Social security	8,528	7,904
Sales	4,005	14,839
Housing	16,244	-
General	17,440	21,257
Depreciation	10,399	5,376
TOTAL EXPENSES	121,757	109,619
OPERATING RESULT	(20,575)	(4,073)
Financial (revenue) and expenses	(1,217)	(698)
BALANCE OPERATING STATEMENT	(21,792)	(4,771)





## 8 DONORS

RRFB's work would not be possible without the benevolent support of individuals, corporations, and foundations. RRFB is grateful to all the thoughtful individuals who donated tools and materials to support the efforts throughout 2020. While it is impossible to list every contributor to Reef Renewal Foundation Bonaire, RRFB thanks all of the supporters for giving Bonaire's reef a helping hand.

RRFB apologizes for any errors or omissions, if there is need for corrections, please email info@reefrenewalbonaire.org.

## Reef Builders (\$1000+)

- Jess Early & the Bender Family
- Ann & Craig
- Anna Goodman
- Ben Thayer
- Felsten Fishman Family Foundation
- NJ Bonaire Divers
- The Sherwood Family
- Friends and Family from Gwen Wiegerink and Herma Merx Roozendaal
- Jon Stryker
- Judith Lewis
- The John Akin and Mary Stevens Charitable Fund
- Mike and Anner Davis
- In memory of Patrick Poggy
- Rob Fishman & Sue Eysmann
- Drs. Marjorie A. Hoy and James B. Hoy
- The Stevens Gang

(\$500-999) - Nicolas Tang & Family

**Coral Outplanters** 

- Alain de Brouwer
- Silver Shark LTD
- Brave Water Foundation
- Marcel Schmid
- Bon Doet
- Bandaris BV
- Brandon and Catherine Behringer
- Craig Beaton
- The Coral Project
- David Peet
- James Cole
- James Maxwell
- Rotary Club Bonaire
- UC Berkeley Divers &
- Friends – The Dubachs
- THE DUDACI
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- Paul Driscoll
- Richard Lowery
- Rob Unruh
- Roy Hans
- Tricia Coe
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- Orca Scuba

Nursery Tree Fillers (\$100-499)

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- Jonathan Grund
- Karen Banta
- In honor of Cathleen
- and David Whillock - Marcia Dysart
- Mark and Molly
- Mark and Molly FingerMary K. Roberts
- Michael Feibus
- Natalie & Jason Snyder
- Ralph and Patricia Jones
- Ralph Bathelt
- Ruth Winters
- Simon D Gordon
- Wendy Watson
- Simon Blower
- Mark Stein
- HUIN JUEI

#### Fragment Makers (\$50-99)

- Aniella Tang – Betsy Kellum
- Caley Satterfield
- Mark and Candace Padover
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- Charlotte Hesterman
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- Judith Schuurhuis

- Frank Ernst



## 8.1 Partners













me water bear



Coral Restoration Consortium

### **Special Thanks and Credits**

Our success would not be possible without our dedicated supporters near and far. On that note, RRFB wants to thank our committed team of volunteers for giving their time and effort to support Bonaire's reefs year-round — from loop making, to tree cleaning, to coral outplanting, your hands make a difference.

A special thanks goes to **Buddy Dive Resort** for providing RRFB team and its volunteers with tanks, staff, and boat rides every year, allowing for countless hours to be spent underwater restoring reefs.

Reef Renewal Foundation Bonaire would like to thank the generous photographers whose photographs are featured in this report: Lorenzo Mittiga, David J. Fishman, Ocean Eyes Production and SECORE International.