

# Rehabilitating coral reefs damaged by bleaching



With the assistance of the donations you provided through Global Giving, Coral Reef CPR was able to complete a coral restoration project in South Malé Atoll, Maldives, where we transplanted over 1000 large, reproductively mature corals onto degraded reefs and expanded the existing coral nurseries with 1400+ new coral fragments. From April 10-25, 2018, Coral Reef CPR worked in partnership with Aquafanatics and Anantara Resorts (Dhigu and Veli) to complete the next phase of coral nursery and coral restoration project off Veli and Dhigufinolhu (Dhigu) Islands.



**Locations of coral nurseries and coral restoration sites in South Malé, Maldives.**

The field activities focused on four aspects: 1) nursery maintenance; 2) expansion of coral nurseries through addition of new fragments to coral ropes and coral tables; 3) outplanting of nursery-grown corals onto degraded reefs; and 4) maintenance and expansion of the Aquabar snorkel trail.

Corals within the four nurseries (Aquabar, Advanced Snorkel Area, Veli lagoon and Dhigu House Reef) have all shown substantial growth, with over 97% survival since establishment of the nurseries and a 500-1000 fold increase in biomass of corals. Coral fragments were 9-18 months old and had increased in size from single, unbranched 3-8 cm fragments to highly branched juvenile and adult coral colonies ranging in size from 12-80 cm diameter (depending on species and age). Growth has varied depending on species and location of the nursery, with slower growth rates seen at the deeper outside site (Dhigu House Reef). Many of the ropes containing the fastest growing staghorn corals had shown so much growth and were now so heavy that they were lying on the sand and at risk of mortality due to burial.



**Comparison of the same rope nursery at Aquabar in February 2017 (left) and April 2018 (right). These corals are between 6-7 m depth.**

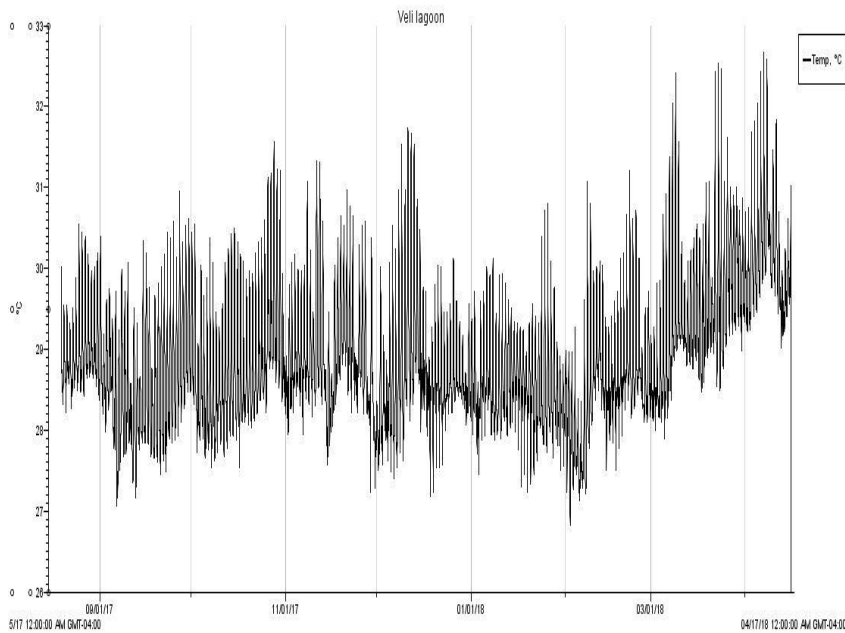


**Comparison of the same rope nursery at Dhigu House reef in October 2016 (left) and April 2017 (right). These corals are between 12-13 m depth.**



**One rope nursery, 14 months old in April 2018.**

All ropes and tables within four coral nurseries at Dhigu and Veli, South Male Atoll were cleaned to remove algae, sediment and competing invertebrates, corals were elevated off the sediment (for those ropes that were now lying on the bottom), and coral colonies were monitored and photographed. Nurseries were in extremely good shape, with minimal problems with fouling organisms. Some corals showed minor bleaching, as this was the period of seasonally elevated water temperatures and temperature meters at nurseries recorded temperatures of 31-32° C during April.

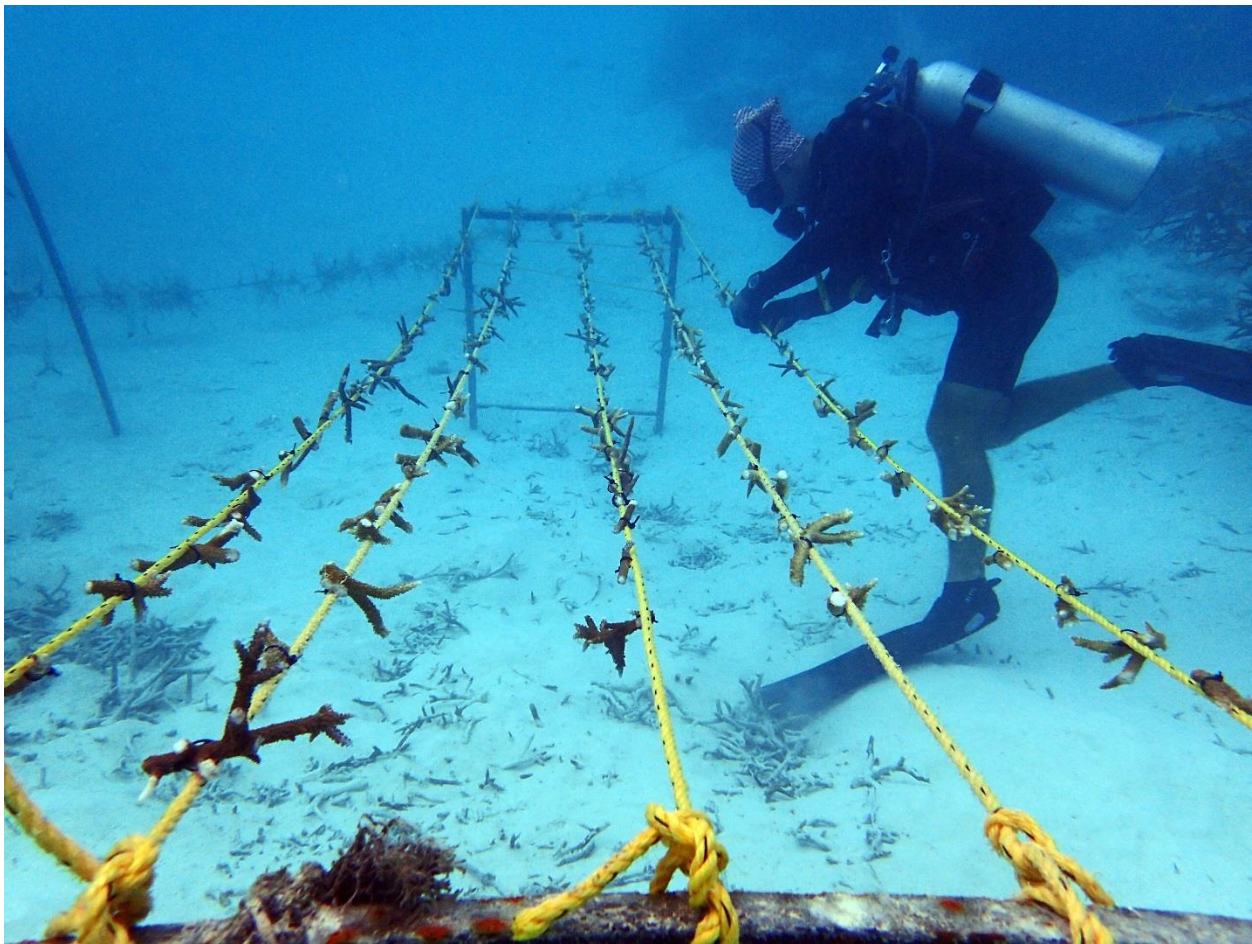


**Temperature on the seafloor within Veli Lagoon from August 2017-April 2018.**



**Two new coral tables at Veli Reef**

A total of four coral tables (400 corals total) and 27 coral ropes were established within existing nurseries on Veli, Aquabar and Dhigu House Reef. These contained 1484 coral fragments. All fragments are second generation clippings from nursery grown corals and no new corals were sampled to expand the nursery. The fragments used for these new ropes and tables are all pieces that broke off from the existing corals grown in the nurseries, either naturally, or during the translocation of the corals. Because these broken branches were in the sand, they that would have otherwise died.



#### **Attaching staghorn coral fragments to a new rope nursery at Veli, South Malé Atoll**

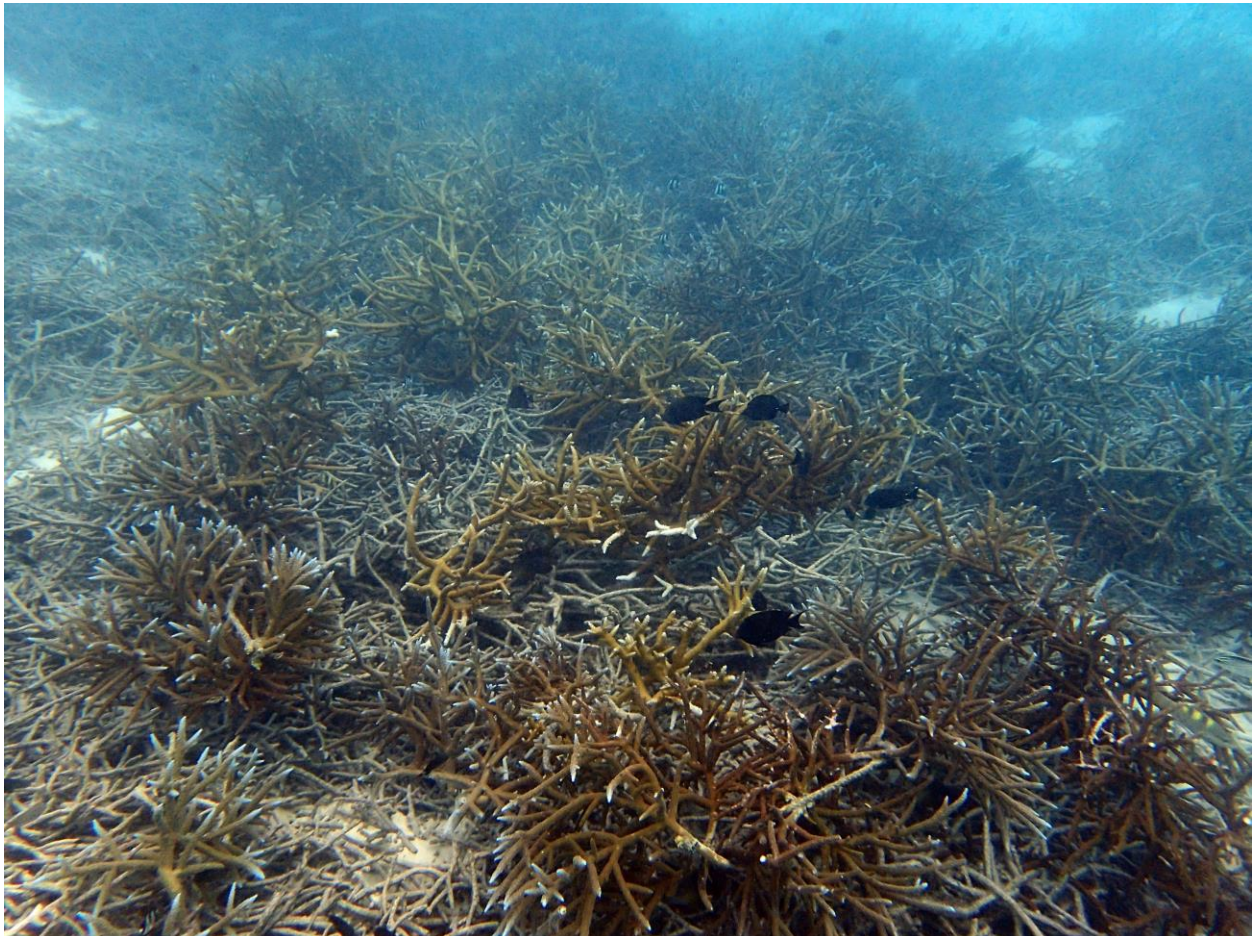
Corals from one table and eight ropes at Veli Nurseries were transplanted onto dead staghorn framework around the water villas, targeting four restoration areas. Additional ropes of staghorn coral (n=6) were transported from the Aquabar nursery to Veli restoration sites. Large staghorn coral colonies now exist adjacent to the walkway between water villas (in 0.5-1 m depth) in two locations, and they form two dense thickets, each 25 X 10 m in size, within the central part of the lagoon. Four new tables (100 corals per table) were established near the pontoon dock and ten new ropes were attached to three nursery frames.



**Relocating corals from Aquabar Nursery to Veli Reef. The corals are floated to the surface using lift bags, then towed behind a small whaler.**

Three ropes were transplanted from three frames at Dhigu House Reef onto a degraded section of reef. This included six species of *Acropora*, and 120 corals. Three new ropes were established to replace those removed. All coral fragments used to expand the nurseries were second generation corals pruned from existing colonies within the nursery, and no coral was removed from natural reefs.

All of the ropes (n=10) from two nursery frames at Aquabar were transplanted onto two reefs, Veli and Aquabar Snorkel trail. Six ropes of staghorn coral were moved to Veli reef and four ropes containing five different species of *Acropora* were transplanted to the Aquabar snorkel trail. Ten new ropes were established on the existing two frames using broken branches that were salvaged during the transplantation process.

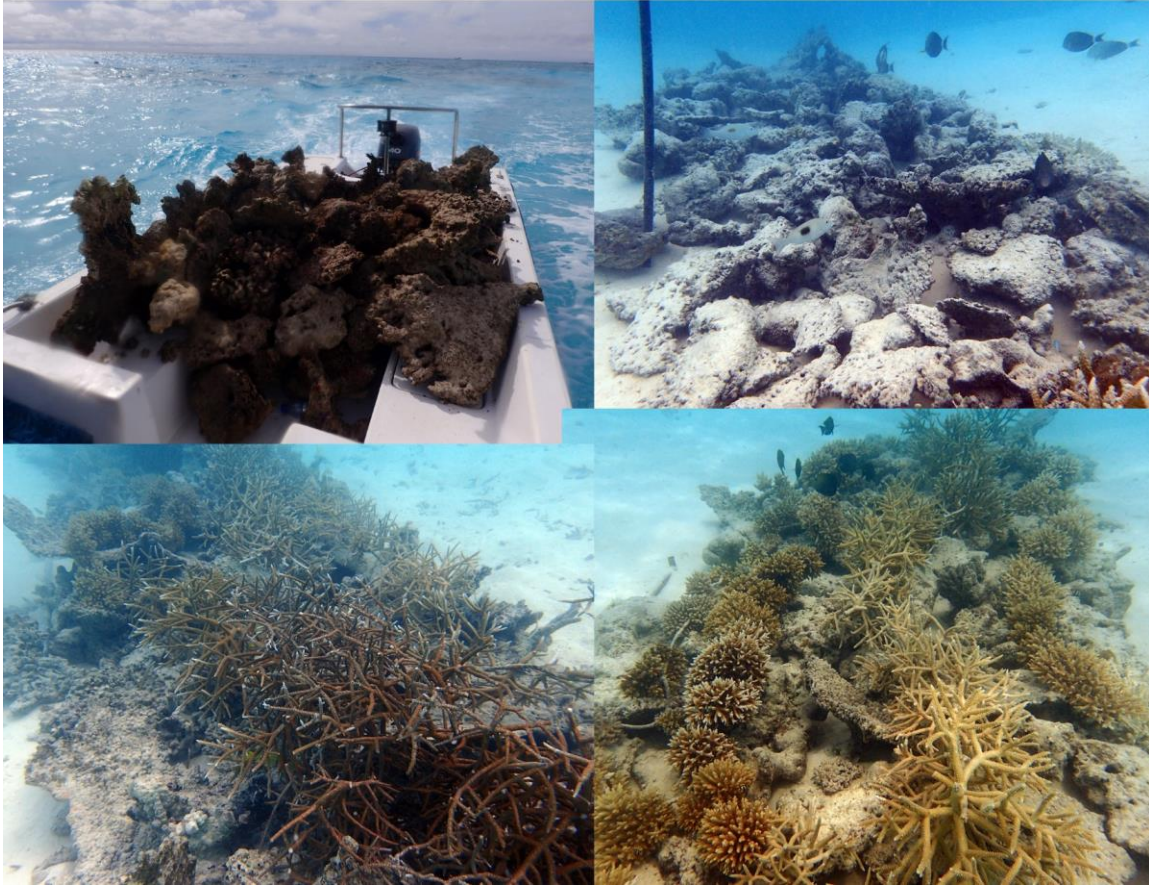


**At Veli Reef, the seafloor was covered in dense thickets of staghorn coral until the bleaching event in April 2016. Over a period of three weeks, 98% of the corals died within this lagoon and graveyards of skeletons remained. Over the last two years, these skeletons have begun to collapse, causing reef-associated fish to lose their shelter and feeding areas. We were able to restore two large areas, each 25 m X 10 m, and also planted additional colonies at two other locations. The corals were planted on top of the collapsed staghorn coral skeletons, elevating them off the sand.**

Aquabar snorkel trail has done extremely well since first established in February 2017, with branching corals showing high rates of growth. Nursery-grown staghorn and table acroporid colonies planted on this reef increased from 15-20 cm colonies to bushes that were 60-150 cm in height/diameter. Maintenance of the trail was minimal, consisting primarily of addition of reef substrate, overturning corals that had become dislodged from the trail, removal of coral eating snails from four corals, removal of two corals infected with black-band disease, and removal of one crown of thorns starfish that was consuming staghorn coral colonies. The trail was expanded in length (5 m at the beginning and 5 m at the end) and width (three new areas were added). Dead coral branches and boulders were collected from an adjacent shallow reef and used to build a new reef framework. Nursery-grown *Acropora* corals were planted onto the new reef framework to create a dense thicket of staghorn coral and a thriving living reef structure.



**The Aquabar Snorkel Trail, 15 months after we restored this reef. The staghorn corals were grown in our nurseries and planted as small colonies and have grown 30-50 cm in height over the last year.**



**Creating new reef habitat to extend the Aquabar Snorkel Trail. Using our nursery grown corals we were able to nearly double the size of the snorkel trail. This required the collection of dead coral skeletons from a neighboring location and building a reef framework. The corals are then secured to this new reef.**

The work undertaken by Coral Reef CPR through our HARP program has been a highly successful CSR initiative that demonstrates the feasibility of a simple, low-tech, low cost coral restoration effort. Following the devastating 2016 coral bleaching event, we established coral nurseries using small coral fragments that were rescued from locations and conditions where they would have died. By attaching these to plastic mesh-covered tables and ropes suspended off the bottom, we were able to preserve this genetic stock of corals and grow them into large sexually mature colonies that could be transplanted onto the reef, restoring badly degraded habitats. In the first phase of our coral restoration we successfully created a diverse, flourishing snorkel trail and have established large staghorn thickets on a reef that sustained >99% coral loss. Both of these are located close to shore and are frequently visited by resort guests. We also transplanted corals onto the house reef, transforming a rubble/hardground area that had died during 2016 into a high-relief coral forest now occupied by hundreds of reef fish. Thousands more of our nursery-grown corals are ready to transplant back onto the reef, and the nurseries contain enough coral to provide 2<sup>nd</sup> and 3<sup>rd</sup> generation fragments that can be used to further propagate these corals.

## Acknowledgements

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