

Reefs of Hope: Coral Restoration for Climate Change Adaptation
Workshop Report, Plantation Island Resort, Malolo, Fiji 5-15th November 2025



Summary

The Reefs of Hope Malolo Workshop (5–15 November 2025, Plantation Island Resort, Fiji) was implemented as part of the UNEP-supported No-Cost Extension (NCE) to strengthen Fiji’s coral-reef climate adaptation capacity. The workshop successfully delivered a number of UNEP outputs under Activity 2 (National Implementation & Training) and Activity 3 (Creation of Multi-Genetic Breeding Populations & Monitoring Systems).

A total of 14 participants from Government ministries, NGOs, community and youth partners, resort teams, and international collaborators were trained in the Reefs of Hope adaptation strategies, including nursery design, coral handling, translocation, A-frame out-planting, coral-disease management, monitoring, and COTS control.

The workshop resulted in major field achievements for the Malolo site including reinforcement of the Bula gene-bank nursery, reorganization and harvesting of Paradise Nursery, establishment of a dedicated Coral Hospital at Bella's Nursery, and creation of Fiji's first coral regeneration patch with multi-genetic staghorn corals and settlement structures to support recruitment experiments. Monitoring infrastructure was strengthened through temperature-logger deployment at 3 new sites, deployment of 12 fish-house settlement units, and training in UV-based juvenile-coral detection. The team also documented natural *Porites rus* spawning and removed 300 Crown-of-Thorns Starfish to protect priority restoration sites. These outputs directly fulfil Fiji deliverables under the No Cost Extension, including national-level capacity building, nursery strengthening, regeneration-patch creation, monitoring preparation (survival, recruitment, temperature, and reproductive condition), and COTS management.

The detailed evidence, photographs, technical outputs, and activity documentation supporting these results are presented in this report.

Workshop Participants: 14; 9 women, 5 men

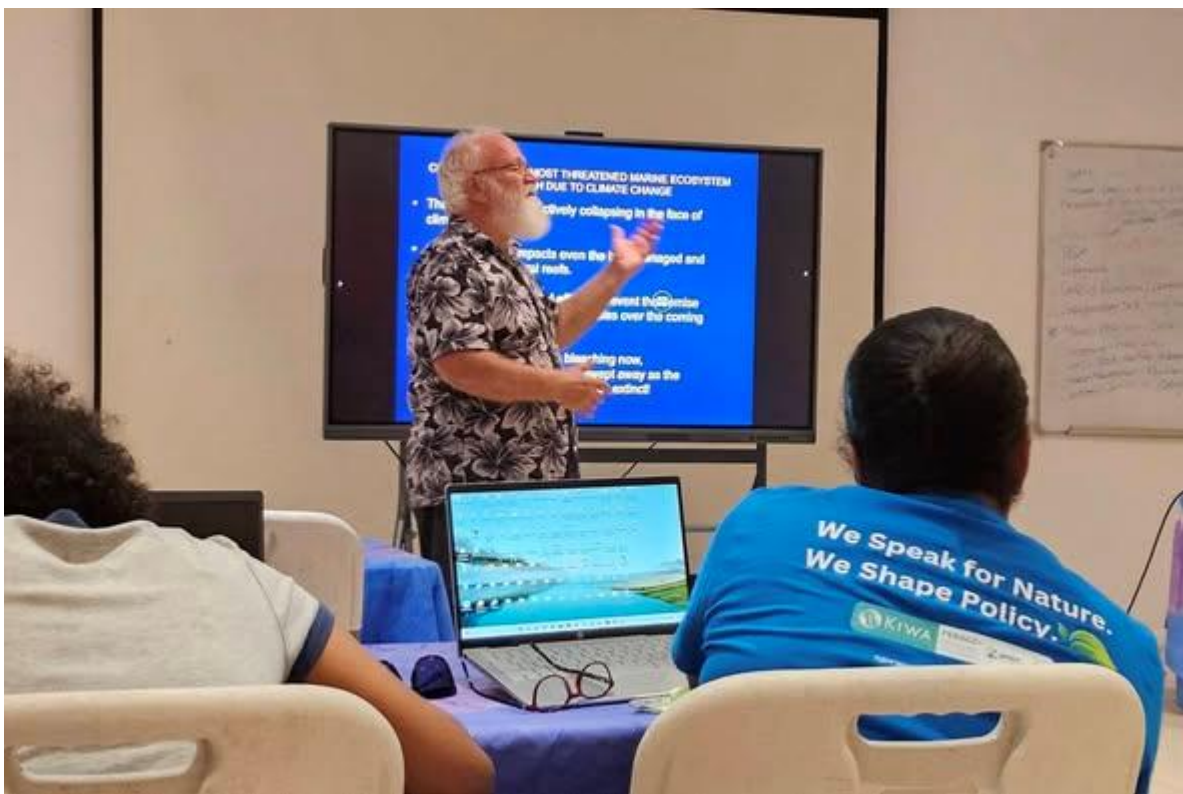
- Corals for Conservation (C4C): Dr. Austin Bowden-Kerby, Susana Vulawalu, and Kelly Mammel
- Plantation Island Resort: Luisa Nadavobalavu and John Kean Suiloa
- Fiji Government Provincial Environment Officers: Fidelis Matata (Ba) and Jessie Mule Siga (Nadroga)
- Coral Conservation Society (Canada): Leona and Dave Kustra
- Global Vision International: Dr. Mark Griffiths
- Planet Ocean (visiting yacht): Sonja Napetschnig and Tom Puchner
- Dulcinea Tours: Marica Talatoka Kafoa
- Tropica Resort: Laisani Waqa

Classroom Sessions

Five x 2hour sessions focused on the theory and methods behind the Reefs of Hope Ocean Decade Action for climate change adaptation, with a plan for securing heat adapted corals via gene banking as well as nature-based coral reef recovery for climate change adaptation via creation of regeneration patches. Other sessions focused on Coral Identification and the use and care of the COTS vinegar injector guns.



Classrooms sessions at Plantation Island Resort (PIR) Photos by Susana Vuilawalu and below by Tom Puchner



Work Accomplished During Educational Field Activities

Bula Nursery Repairs and Maintenance

The Bula Nursery was partially collapsing in three places due to inadequate construction, and as the corals have more than doubled in size and weight over the past year and a half. As the weight will continue to increase over the coming years, the structure must be strengthened for it to last, and overgrown corals will need to be trimmed and replanted, with the surplus heat-adapted corals planted onto the reef in restoration sites.

About ten new cross supports were added to the weaker sections and priority areas of the structure. A side brace support was added to the letter L at the most vulnerable part of the nursery as protection from cyclones. An assessment of the need for additional braces and supports was made in preparation for cyclone season, and further work will follow this guidance as Bula Nursery is of such importance to the visibility of the programme.



Reenforcing BULA nursery tables with support rods. *Photos by Leona Kustra*



The corals are becoming heavier, more than doubling in weight over the past year. *Photo Tom Puchner*

A coral taxonomist Dr. Douglas Fenner, will be coming in 2026 to assess the nursery and to list all the diverse coral species in the collection, grouping them into reproductive groups, and determining which species need to be targeted for more collecting. Another scientist, Dr. Daniel Barshis, will be testing selected corals from the nursery to determine the precise level of intense heat resistance they exhibit. A third scientist, Spencer Miller, will create a three-dimensional photos and films of the nursery to measure growth using photogrammetry.

New Coral Planting and Trimming Method for Bula Nursery Corals

Branches of heat-adapted staghorn corals were collected from West Nuku hot pocket, trimmed of 5-8 branches, bunched together, and tied with a thin cable strap to form a “coral bouquet”, and planted to Bula Reef to replace corals which had died in the nursery from disease. In the future, this method will become the primary method for keeping the fast-growing staghorn corals under control in the nursery, with each large coral colony replaced every three years or so as part of a systematic maintenance programme to prevent the fast-growing corals from overgrowing slower-growing species and to keep the weight of the corals in the nursery from getting too heavy. The rest of the colony is then removed from the nursery and out planted into regeneration patches on the reef. In this way Bula Nursery will produce large coral colonies ready for breeding and capable of hosting sizable fish populations, including farmer damselfish which can help prevent COTS predation.



Creating “bouquets” with West Nuku Point heat-adapted staghorn coral. *Photo by Leona Kustra*

“Coral Hospital” Created for Relocating Diseased Corals from Bula Nursery

Bula Reef Nursery is intentionally located in a large low-flow reef pool to protect the structure from wave action and storm currents. Corals adapted to such low-flow conditions are doing very well there, however, table-forming corals and short and fine-branched corymbose and digitate corals, which prefer higher flow environments, have sometimes done poorly in the site, and many have died or have sickened and have been removed. Coral species with these growth forms should be removed early on, when they first show signs of disease, placing them within a higher flow nursery after removing the diseased branches.

Such a “coral hospital” was created at Bella’s Nursery during the workshop. Located near Cloud 9, the nursery is in the higher energy conditions of the outer reef yet protected from storm waves by the surrounding reefs. Bella’s Nursery was established in 2023 during a workshop with a group of Otterbein University students from Ohio. PIR boats were not available, so Dulcinea Tours provided considerable boat support to the group FOC. To create the coral receiving area, a rope nursery section on the original nursery was replaced with wire mesh, forming a flat table section ideal for placing tabulate, corymbose, and digitate corals which show signs of disease. While initially Bella’s nursery table will be populated with all the corals showing signs of disease from Bula Nursery, a quarantine section will in the future be created about 50 meters away, for receiving diseased corals which initially come in, with the corals graduating into Bella’s Nursery once they are shown to be disease-free. In this way we hope to develop a gene bank nursery of corals proven to be both heat resistant and disease resistant.



Scrubbing newly placed mesh for a “coral hospital” at Bella’s Nursery. *Photo by Leona Kustra*

Paradise Nursery Harvesting and Restructuring

Paradise Nursery was first constructed in February 2019 during an international coral workshop at PIR, with four sections of ropes and tables installed. The nursery was expanded during two subsequent workshops, in September and in February 2020. Additional sections were added in 2021 and 2022. The ropes were mostly planted with fast-growing staghorn corals and had to be trimmed annually to keep the nursery under control, while providing a source of corals for replanting to the reef and for the guest coral programme. When Bula Nursery was created, many of the over-mature ropes were used to fill in gaps in the nursery as we rushed it to completion.

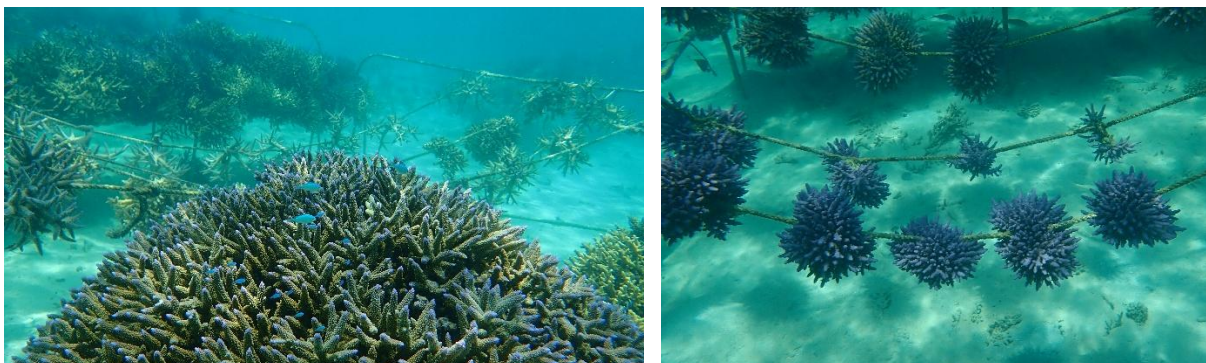
With the establishment of Bula Nursery, the workload of cleaning and maintaining Paradise Nursery became too much for the resort staff, and we missed the 2023 and 2024 out-planting seasons for many ropes and so many mature of the ropes became over-mature and very heavy. As some sections of the nursery had not been made with middle support bars, the ropes began to weigh the nursery down, and so some corals began to touch the sand. Attempts to elevate the ropes were made, but it has become obvious that the entire nursery needs to be downsized and rebuilt.

However, the large biomass of heat adapted corals that the Paradise Nursery represents is a valuable resource going into the intense CORDAP coral-focused research. During the

November workshop, ten overgrown ropes were removed from the nursery, with the entire untrimmed ropes used to create the first coral reef regeneration patch as our first CORDAP experimental replicate.

The goal now is to harvest the rest of the staghorn corals from the Paradise Nursery in February and March for use in the new experiments, and to rebuild a downsized version of the nursery once it is empty of corals. The new focus of Paradise Nursery will be the smaller, slower-growing, and brightly coloured digitate *Acropora*, *Stylophora*, and *Pocillopora* corals which can grow for at least five years before requiring replanting. The goal is to have Paradise Nursery become both strong and maintenance free, beautiful, and a striking complement to Bula Nursery.

The coral harvesting work to depopulate the nursery will be carried out in the workshops in February through March 2026, with rebuilding beginning in March, and with the replanting of the nursery delayed until it is properly reconstructed, replanting will start as soon as the waters cool off in June through August. All corals to be replanted within Paradise Nursery will be sourced from areas of extreme heat stress and moved into the cooler conditions at the nursery, which follows our Reefs of Hope assisted climate change adaptation strategy.



Paradise Nursery ropes of heat adapted corals. *Photo by Leona Kustra*

Establishing the First Coral Reef Regeneration Patch

The CORDAP scientific work will provide important data on several of the breakthrough Reefs of Hope strategies being developed and tested in the Malolo sites. An entirely new nature-based method of assisted coral reef recovery is being tested, via the creation of “regeneration patches” composed of staghorn corals. The corals are known to emit a smell that is irresistible to coral larvae and thus in theory the patches will attract coral larvae which settle around the patch and reboot natural recovery processes. The degraded backreef area of the outer barrier reef, including those near Cloud 9 are an ideal testing area, as are the reefs of the “West Nuku dead zone”.

To avoid the complication of COTS killing the corals of the patch, and to connect the work with improved coral reef tourism, our first regeneration patch was established near Cloud

9 between two degraded reefs that protect the patch from damaging cyclone currents and waves. The patch is located on a sandy coral-free area, surrounded by 12 stone and cement “fish houses”, placed at variable distances from the patch, which will serve as settlement structures for incoming coral larvae. The predicted results will be that the fish house settlement structures right at the patch will have the more juvenile corals settling on them than those 2m, 4m, and 8m away, which would prove the functionality of the patches.

As this first regeneration patch was put in during the spawning and coral settlement season, we may have some early data in January. We have obtained underwater UV torches which cause the tiny corals to glow brightly, enabling them to be counted at night or during the day under a dark tent created specifically for this purpose. As the coral larvae come in without their symbiotic algae and acquire them from the corals nearby, our hypothesis is that they will obtain heat-adapted algae from the corals of the patch, which can be tested once the juvenile corals grow bigger by the third year.

Another important source of data will be to record the fish population that develops within the patch. Coral growth will be recorded by photogrammetry starting in February. Regeneration patches established on both sandy areas and degraded rocky reef areas will be followed over a three-year period and beyond to determine their positive regenerative ecological impacts.



Four A-frame structures attached to create the new regeneration patch. *Photos by Leona Kustra*



Heat adapted staghorn coral placed on the Cloud 9 regeneration patch. *Photo by Leona Kustra*



Anchoring the patch, which will restore coral reproduction. *Photo by Tom Puchner*



Attaching overgrown ropes of heat adapted corals from the Paradise Nursery *Photo Tom Puchner*

Repair and Remodelling of the PIR “Underwater Museum”

The underwater museum area has become cluttered over time, with multiple new additions, some of which have failed. The most successful aspects are the table and chairs, and the wedding arch, which were repaired and enhanced. However, the least successful was determined to be the heart-shaped nursery, which did not look very much like a heart, and was too low so that re-suspended silt was making the corals sick, and some had died. We added a mesh tabletop to two underutilized metal structures that had been in the site since 2005, which had several *Acropora* corals thriving on them, indicating that the area is a good environment for corals, and we relocated the corals there, adding a few strong silt tolerant corals taken from Paradise nursery to create a nice nursery that the guests can view. Then with great difficulty, we broke the welds of the heart nursery and removed it to shore.

For future remodelling and maintenance, the bicycle ball needs to be elevated on U-bars driven into the sand to prevent COTS predation and to elevate it above the silt so that the corals thrive. The fish houses are also too many, and look cluttered, and so they might serve the project better if some were used as settlement structures for the new experiments. Purple massive *Porites* and yellow digitate *Porites* corals might be cemented to the tops of some of the fish houses that remain in the site so that they look much better, including the small *Bula* spelled out with fish houses, with could be written in massive *Porites* corals which can withstand the silty environment. The only corals that

can survive low down in the silty site are massive Porites. Finger Porites likes more elevation, and Pocillopora does well a meter or so higher, while Acropora only does well further out and elevated in the museum site, such as on the new coral table, which should continue to be monitored closely in the days and weeks after major rainfall and flooding events at the resort, as the water quality goes way down.



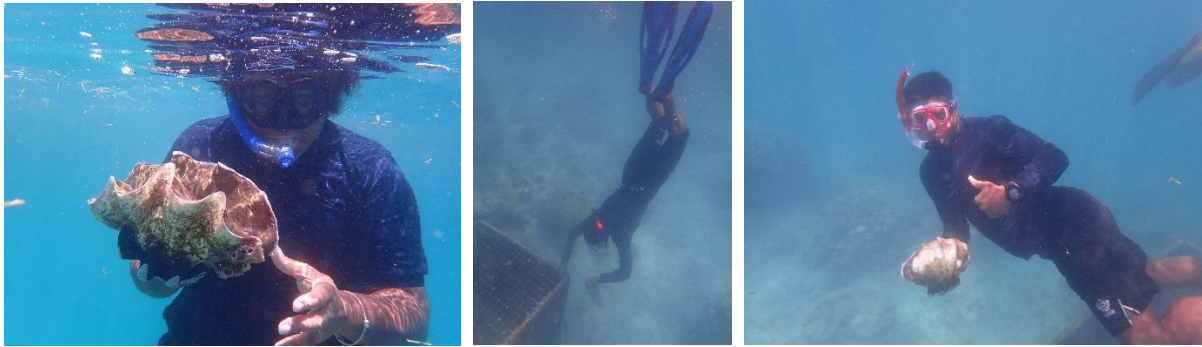
Repair and remodelling of the PIR “Underwater Museum”. Photos by Leona Kustra

Cleaning and Maintenance of the Four Giant Clam Cages

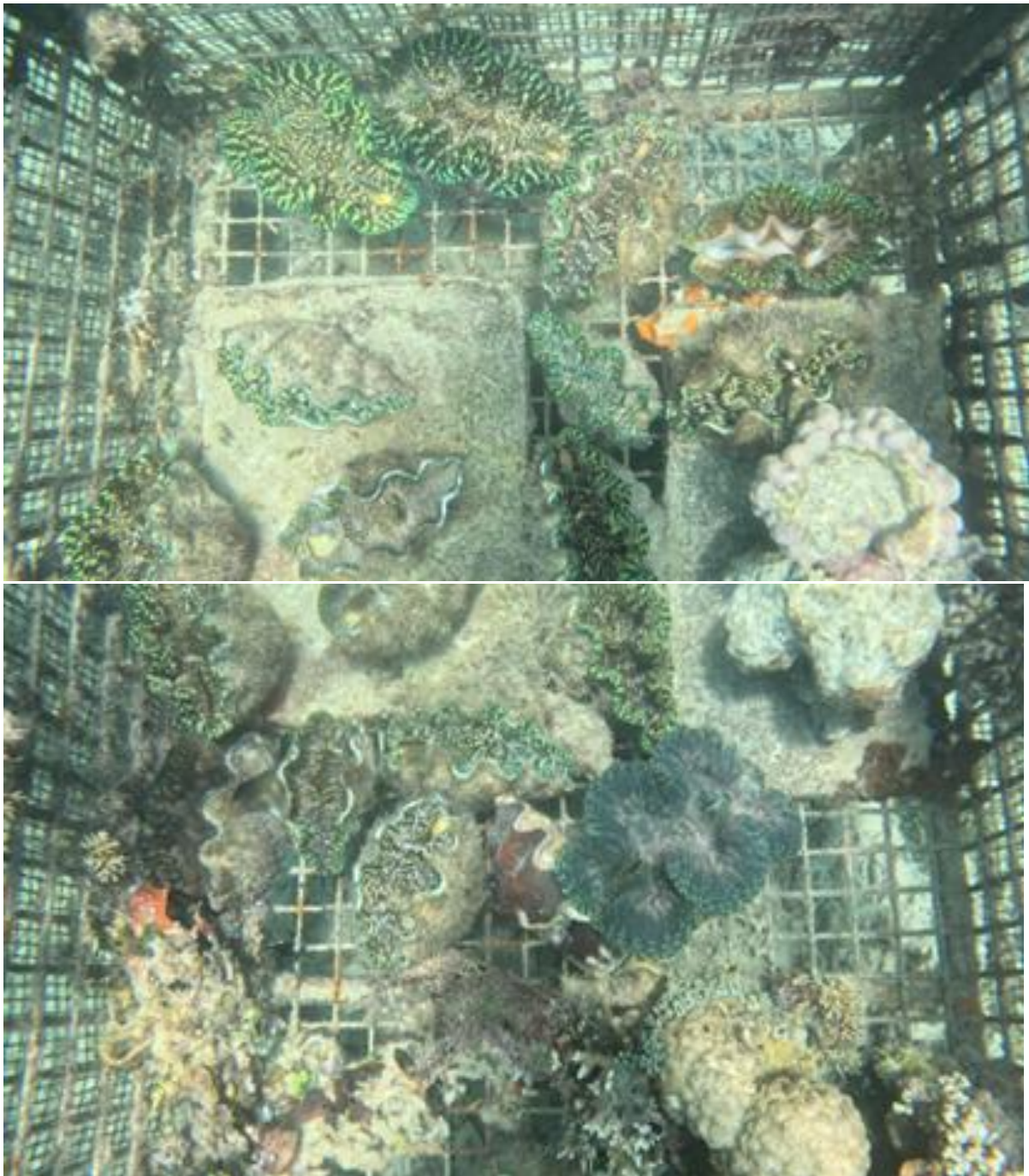
The clam cages have been in place for at least five years now. The clams presently are all healthy, although many dead empty clam shells were removed, indicating high mortality in the past, which is suspected to have been associated with the heavy rains and flooding the island experienced in 2024. One clam species that was in the past well represented in the cages, the teardrop clam, *Tridacna noae*, is now all gone. The three remaining species are all doing well, growing rapidly since last checked in May.

The major maintenance required was that that clam cages had been overgrown badly by the weedy coral *Pocillopora damicornis*, which tends to settle on iron structures. These corals had begun blocking the light to the clams, as the clams are photosynthetic just as corals are. The team cleaned each cage inside and out and rearranged some of the clams so that they would receive more light and be less crowded.

Better water quality would be helpful for the clams, which could be achieved by the redirection of the freshwater runoff from the resort as has been proposed, helping improve the entire reef system with the resulting better water quality. However, security is the reason the clams can not be moved to a better water quality site right now. Of four giant clams moved from the reef into Bula Nursery, only two remain due to theft.



Cleaning and maintaining the giant clam cages. *Photos by Leona Kustra*

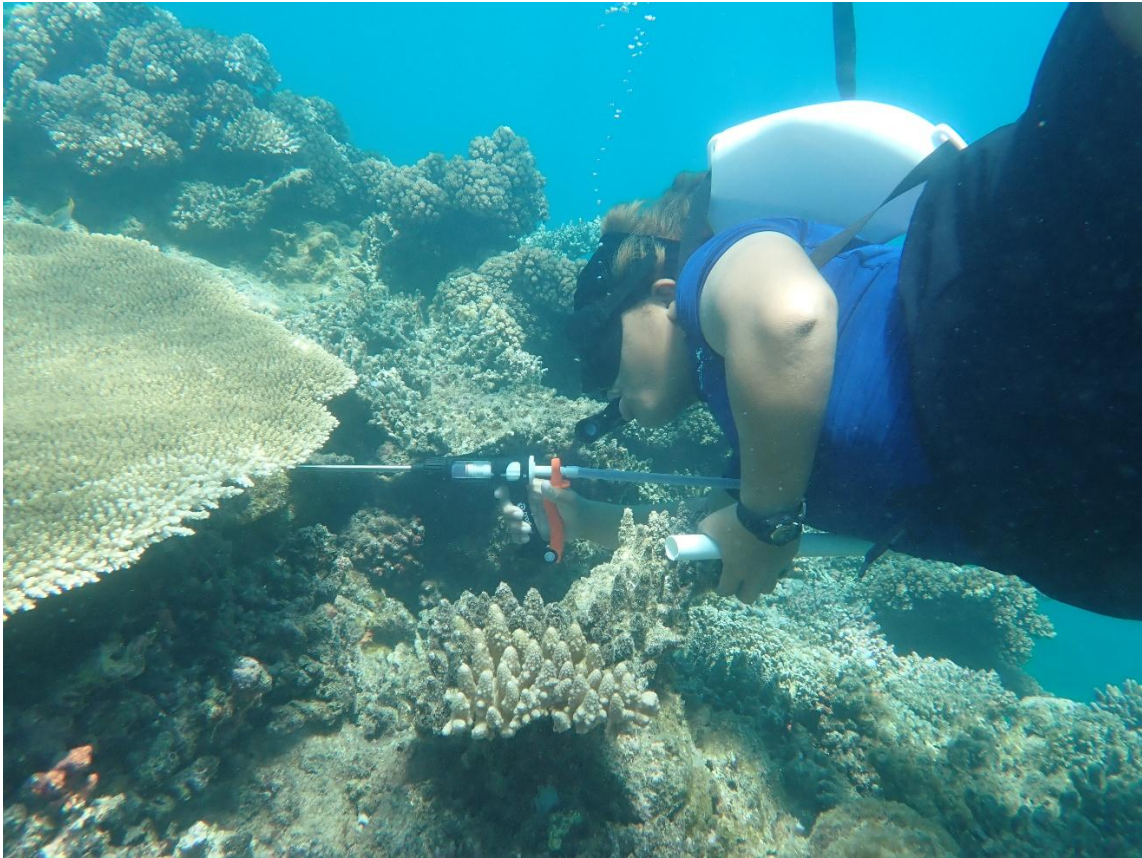


Cleaned Giant Clam Cages *Photos by Kelly Mammel*

Learning How to Use the New Vinegar Injection Guns for Killing COTS

Lessons were conducted on the use and care of the vinegar injection guns, which proved themselves very useful. Thanks to the Coral Conservation Society of Canada for providing the donation of the three guns.





Crown-of-Thorns Starfish removal and vinegar injection. *Photos by Leona Kustra*

COTS Removal from Nuku Point, Joe's Farm Reef, and Bula/ Paradise Surroundings

Removal was carried out using both hand removal using metal rods and with the COTS injector guns. The vinegar injector guns allowed for the killing of many more COTS in less time, and proved to be very efficient, especially where the COTS were strongly embedded into reef holes and crevices.

A total of 300 COTS were removed during the workshop activities.

Professional Snorkel Guide Training

Kelly Mammel, C4C volunteer from Hawaii, conducted a class for resort staff on how to interact with resort guests on the proper use of snorkelling equipment. This aspect is often neglected and assumption that everyone knows how to use a mask and snorkel, which can end up causing problems and distress for the guests. Becoming a snorkelling guide requires knowing the reef and learning how to interact with guests in the water.

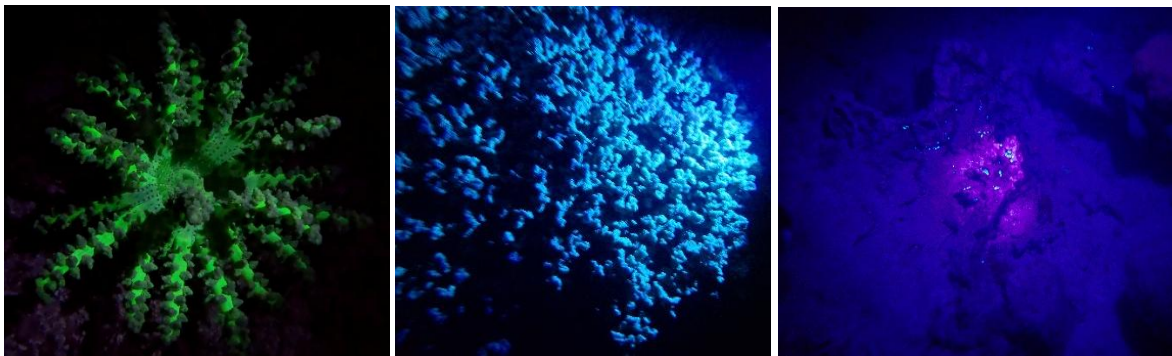


Snorkel guide training session. *Photos by Dr. Austin and Susana Vulawalu*

Nighttime Scoping with Under-water Ultra-Violet Torches

Directly off the resort, we did a nighttime snorkel using underwater UV torches and a blue light with yellow filter, in part to learn how to count newly settled and juvenile corals on the reef. However, many of the heat adapted corals were also seen glowing bright green and yellow, highlighted with glowing reds, blues, and violets. We plan to use the UV lights in the sorting and selection of corals for thermal resilience, to better understand how fluorescence imparts heat resilience to corals.

The sight of the glowing corals is rather amazing and so nighttime snorkelling with UV torches has immense potential as an advanced guest activity. Our original plan was to create a nursery for bleaching resistant corals at the old wharf, once the construction there is completed. This would be enhanced by the installation of UV lights, so that the nursery there would glow at night, being clearly visible from the wharf at low tides.



Coral spawning observations at PIR

The workshop took place during the time of the annual coral spawning. The specific days and times of spawning for each species are still being learned, but the predictions are becoming quite good, and we were able to see the early morning spawning of *Porites rus* in the area off the Museum during the workshop. This species is one of the few that spawn in the daytime, and that has separate sexes.

This spawning of corals represents resilience and hope for the future of coral reefs. The spawning of *Acropora* corals, which occurs in the dark of the early evening, can be quite spectacular, and future spawning events, once they are well known and predictable might become a nighttime snorkelling activity of high interest to guests.



Porites rus coral spawning at reef near PIR museum. Top photo is the male releasing sperm, and bottom photo shows eggs being released by the female. Photos by Tom Puchner



A big thanks to Plantation Island Resort for enabling the workshop to happen, and for continuing to nurture such a mutually beneficial partnership!