RAISING THE REEF

Reefs support 25 per cent of all marine species, but they are in danger from pollution, warming oceans and destructive fishing practices. Now scientists on the island of Bonaire have found a way to restore them – by breeding new coral colonies

Photography: **Lorenzo Mittiga**
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In the tiny island of Bonaire, scuba divers tend to an underwater nursery, slowly plucking off the algae that smothers young coral dangling from fibreglass trees. The island's entire coastline is a protected marine park and a major draw for tourists, but like elsewhere in the Caribbean Sea, coral cover has declined since the 1970s due to warming sea temperatures, disease outbreaks, coastal development and pollution. A team of scientists and volunteer divers are working tirelessly to restore the dying reef in the hope that it will serve as a model for the rest of the Caribbean.

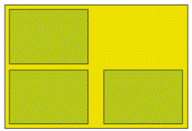
Above water, Bonaire has a semi-desert landscape dotted with giant cacti and low shrubs, which trap sediment and help prevent soil erosion. There is one problem, though: feral goats and donkeys, descendants of those once brought in by Spanish settlers, love to gobble up the scant vegetation. The loss of plant life, combined with powerful winds and hurricanes, increasingly pushes sediment and waste into the ocean, where it chokes the clear water.

As Bonaire is located outside of the hurricane belt, it provides a safe haven for boat owners to moor their vessels, but this can also have a negative impact on the coral. "We now have increasing number of boats mooring in the town area, very close to shore. They just release their waste water into the ocean, right there, on top of the reef," says Francesca Virdis, a marine biologist and project co-ordinator at Reef Renewal Foundation Bonaire (RRFB). Waste water introduces bacteria, viruses and disease to the shallow reef, as well as nitrogen and phosphorus that can fuel the growth of algae. As algae and corals both require sunlight to survive, they compete for space on the seabed.

Seven years ago, the RRFB started cultivating corals in underwater nurseries with the aim of outplanting them in areas that have suffered most from natural and anthropogenic threats. Today, the nonprofit takes care of eight nurseries with over 120 fibreglass "trees". The trees can hold between 100 and 150 fragmented corals each, which means a total of 15,000 corals can be grown at any given time. "We are trying to bring the reef back to what it was, not only by restoring the corals but bringing back the fish populations that live within the corals," Virdis says.

Each artificial "tree" is attached to the sea bed with sand anchors and is held up with floats that sit near the ocean surface. Coral fragments are hung from them by monofilament lines, out of reach of worms, snails, crabs and sea stars that all prey on the soft tissue of coral polyps. After six to eight months, the nursery-reared corals are ready to be moved to restoration sites. The main nursery is at Klein Bonaire, an uninhabited island about a 25-minute boat ride west from Bonaire. But some of the restoration sites are further offshore: once divers have harvested the coral fragments, they will transport them – 300 at a time – by boat to the new site.

When corals spawn, it means they are healthy and have survived long enough to reach sexual maturity. They only get one chance per year to spawn. For two or three nights after a full Moon, and for only 30 minutes at a time, an entire colony will eject capsules containing both eggs and sperm into the surrounding water. The capsules will float to the surface to mix with others along the length of the reef. The RRFB scientists believe they will be able to speed up the reef's recovery by collecting the capsules, mixing them together and releasing them back into the water, ensuring that a greater proportion of the coral eggs are fertilised.



Once common in shallow waters, staghorn and elkhorn corals are the two main species grown in the Bonaire nurseries. Staghorn corals (*Acropora cervicornis, pictured top left*) are branching, reef-building corals that can live for hundreds of years. Under the right conditions, they grow 10–20cm per year and form dense thickets reaching several metres across – providing many nooks and crannies for reef fish to hide in. Elkhorn corals (*Acropora palmata, pictured bottom right*) have thick and sturdy branches resembling elk antlers. Both species can reproduce asexually through fragmentation into smaller pieces. If a branch of coral falls from the reef, it can reattach to rock and form a new colony.

Each branch of staghorn coral is fixed on to square bamboo frames for structural support (*below, left*). The frames dissolve after a few years, leaving only a fused coral patch. The aim is for the corals to take root on the degraded site, build a reef structure, and spawn together.

Some 7,000 corals are "outplanted" each year, but Virdis and her team are aiming for 100,000 in the next five years. Genetic diversity is key ensuring the reef's long-term health. The RRFB has 50 genetic strains of staghorn and 50 strains of elkhorn coral. Different strains possess different strengths: some can better withstand diseases, others are more tolerant to heat or grow faster. In the nurseries, each tree holds a single strain of coral. "It's a way for us to track the diversity," says Virdis. To restore a degraded reef, a variety of coral species and strains will increase its resilience.

Each day, new algae is growing on the tree-like structures, but this can't be left unattended – if blooms of algae are allowed to grow, they will suffocate the living corals and kill them, so a large part of maintaining the nurseries is removing algae from the structures. The RRFB trains volunteer divers to support the weekly cleanups and monitoring at restoration sites. This involves checking for disease and damage to the coral fragments, and taking water samples, which are important in indicating reef health. Corals need clear water that lets sunlight through to the depths, and is free from sediment and nutrient runoff.