



# Guardians of the electric reef

In Bali's idyllic north-west corner, a unique community-driven marine conservation project is using electricity to rapidly regrow damaged coral reef and restore local livelihoods. Might this technology and its profound success be a route to helping save the Earth's vital coral gardens?

At Pemuteran, five hours driving north-west of Denpasar's action, the silhouettes of Java's massive volcanoes set the dramatic backdrop to a proud fishing community, its traditionally painted luggers pulled up on the beach.

Less than 10 years ago things weren't so good. The once thriving near-shore coral ecosystem which had supplied food and income to generations of families lay devastated by dual forces. Over-harvesting, cyanide poisoning and bombing by cash-poor fishermen, and then a massive bleaching event in 1998, had virtually destroyed the marine garden.

With its demise came the decline of livelihoods for the local people, many of whom had also relied on the flow-on benefits of diving tourism hosted by adjacent hotels.

It is a scenario common around

Indonesia's 17 500 islands. But, for Pemuteran, the confluence of two men's ideals, their simple marine electrical technology and the will of the villagers for change has yielded a better fate, setting a powerful example for global reef conservation.

Dr Thomas Goreau has dedicated most of his life to understanding and preserving coral reefs around the world, including Indonesia's. Together with research partner the late Professor Wolf Hilbertz, an architect, marine scientist and inventor, Dr Goreau developed the Biorock Process.<sup>1</sup> Based on mineral accretion technology invented by Professor Hilbertz, the process became an ingenious means of restoring healthy coral growth, supporting mariculture and protecting shorelines.

The method delivers safe, low voltage electrical currents via cables, and through

**A fisherman heads out at sunrise across Bali's north-western reefs.** James Porteous

seawater, to submerged metal reef structures. This causes dissolved minerals to crystallise out onto the structures as a white limestone substrate (similar to that which naturally makes up coral reefs and tropical white sand beaches), meanwhile accelerating the formation and growth of the skeletons of corals and other shell-bearing animals – at two to six times natural rates.

The structures eventually become rapidly colonised by a full range of coral reef organisms, including fish, crabs, clams, octopus, lobster and sea urchins. Species typically found in healthy reef environments are given an electrical advantage over the weedy organisms which often overgrow them in reefs stressed by humans. According to Dr Goreau, if the current is maintained, coral reefs can often be restored in areas

<sup>1</sup> Biorock® is a registered trademark of Biorock, Inc. The Biorock Process is owned by Biorock, Inc.

where water quality would prevent their recovery by any other method.

In 1998, fully aware of the significance of Pemuteran's reefs, Dr Goreau made attempts to start reef restoration there. But it was in the middle of the Asian Economic Crisis and coral reef destruction was 'totally out of control'.

By 2000, with rising concern about the deterioration of their reef and livelihoods, villagers had started action to prevent use of destructive fishing methods on their reefs, whether by locals or by outsiders, forming *de facto* marine patrol groups. Following a workshop in coral reef restoration in Bangkok in May that year, Yos Amerta, President of the Bali branch of the Indonesian Watersports Federation, invited Dr Goreau and Professor Hilbertz to start their restoration projects at Pemuteran.

'It took us two more years to find local support,' Dr Goreau reflects. 'But Pemuteran's "Karang Lestari" ("Protected Coral") community project has since steadily grown for eight years and is now the largest reef restoration project in the world.'

Scraping together funds from personal donors, and local hotels or businesses, the researchers led the construction and installation of 28 initial Biorock coral nursery structures along half a kilometre of what became the Pemuteran Village Marine Protected Area. With prospects of returning catches and dive tourists, they eventually had the cooperation of the entire community, including the fishermen, the Municipality of Pemuteran, local dive shops and hotels, and other local stakeholders and volunteers. Covering an area of nearly 10 000 square metres, this reef nursery and restoration site exceeds the combined sizes of other Biorock projects ongoing in the Pacific, Caribbean and Indian oceans.

Around 50 structures, of various geometric design, now stretch out offshore. More are being added each year as funds



**A diverse range of reef life has quickly colonised the electrified Biorock structures off Pemuteran.** Karang Lestari & Biorock

are raised, and the community is running the ongoing building, monitoring and maintenance. Cooperation and cross-support were the key.

The five or so hotels and dive shops that line the shore were instrumental in providing the power and cable facilities for the project, as well as promotion, fundraising, dive support, monitoring and education of workers and visitors. It's in everyone's interest to have the reef back.

Local businessman Agung Prana, who established the Taman Sari Hotel, was heavily involved in recent progress as part of his dedication to Pemuteran. He had worked to convince the community to rise to the challenge, to help turn the fishermen from poachers into conservationists, and now uses business funds to support the project's expansion.

His partner, Rani Morrow-Wuigk, helps run the hotel and is treasurer, co-ordinator and archivist for Karang Lestari. Together with Komang Astika, a dedicated young Balinese who qualified as a dive master and is now the project manager, Rani helps with day-to-day operations from a Biorock information hut on the foreshore.

'Things are going well,' Rani says, 'but we rely on a trickle of visitor donations through our "Sponsor a coral" scheme to run. Luckily, the goodwill is growing too.' For US\$35, donors get a project certificate and their name in wire fixed to a chosen structure, where it becomes new coral habitat. A photo of it *in situ* arrives by email later.

Komang is happy. His passion for the project is clear, and he's out checking the burgeoning corals and their fish tenants every day as part of a new career. 'They're my family,' he says. 'The fishermen respect me. There are many more fish available now, and there is pride.'

The Pemuteran Reef Gardeners Program, meanwhile, is training young people from the village to dive, and employs them to maintain and restore their coral reef resources. This is what Tom Goreau and Wolf Hilbertz foresaw. 'Such projects, giving the community the knowledge and skills to bring back their coral reefs and fisheries, are needed everywhere,' Dr Goreau emphasises.

'This project has transformed barren areas of dead coral with very few fish into lush reefs full of colourful and exceptionally rapidly growing corals swarming with fish – on the Biorock structures themselves as well as in the surrounding areas.

'Those who see it are absolutely amazed, because they did not believe it possible to restore such a complex ecosystem so quickly in places where little or no natural recovery was taking place. Those who have



**Rani Morrow-Wuigk (left), Komang Astika (centre) and a project colleague watch snorklers enjoy life on the Biorock structures from the project hut.** James Porteous

not seen these projects continue to deny that they are possible.

'We have already lost most of the world's corals and there is little time left to restore damaged reefs before they vanish. But the head-in-the-sand attitude of governments and funding agencies has resulted in denial – of both the problems and solutions – and blocking of funds by the international community to help coastal fishing communities in poor countries to grow back their rapidly vanishing living resources.

'It is now just a matter of the next record hot year for us to lose most of the little coral left,' he relays emphatically.

'When that happens, Biorock reefs may be all we have left in many places, because the corals we grow have 16 to 50 times higher survival from heat shock than surrounding reefs.'

Biorock projects can be powered by a wide range of electrical sources including renewable energy such as windmills, photovoltaic solar panels and tidal current generators. This means they can even restore the magic of reef ecosystems in areas where conventional electric power is unavailable.

● **James Porteous**

**More information:**  
Pemuteran's Biorock and Karang Lestari project, [www.globalcoral.org/pemuteran\\_coral\\_reef\\_restoration.htm](http://www.globalcoral.org/pemuteran_coral_reef_restoration.htm)  
Global Coral Reef Alliance, [www.globalcoral.org](http://www.globalcoral.org)