

**Description of repairing / restoring an eroding beach in Pemuteran, Bali, Indonesia  
with Biorock reefs which were NOT designed for shore protection  
but for ecotourism diving and snorkeling.**

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When Tom (**Thomas J. F. Goreau, PhD / President, Global Coral Reef Alliance / President, Biorock Technology Inc.**) began the project 20 years ago in 1997, the entire coral reef in front of the beach had just died from bleaching caused by global warming. There was no beach at all at high tide, one had to either walk in the water, or on top of the seawall built to prevent shoreline trees (whose roots were exposed by beach erosion) and hotel dining areas from falling into the sea. An erosion scarp lined the shore in front of the seawall.

All along the 150 meter long eroded beach we built many Biorock about 100 meters from the high tide mark. **These Biorock reefs increased the live coral cover of the dead fringing reef from about 1% to about 99% in 10 years (for before and after video see: <https://www.youtube.com/watch?v=Rx8TV9KdOns&t=332s>).**

**The Biorock reefs were designed for ecotourism diving and snorkeling, not for shore protection.** None of the Biorock reefs reach the high tide mark, most are at least 5 meters deep, so none are visible from shore. None contains rocks or gabions like the previous example, and they are shaped like abstract art sculptures, in the shape of marine life (fishes, sharks, crabs, sea stars, nudibranchs, cuttlefish, etc.), or in the form of the Balinese Gods..

The beach along the entire 150 m length of the property has grown upwards by about a meter, burying the power cables deep in the sand (the amount of power used by the entire project is around 2 Kilowatts, or about an air conditioner worth), and the beach has grown outward by about 10-12 meters width at high tide. The original sea wall, over which one had to climb up or jump down to the beach, is now almost entirely buried under the beach sand and invisible for most of its length.

Even more remarkably, the beach sand itself has changed color! When we began this was a black sand beach of basalt lava grains, sprinkled with white shells. You could not walk on it barefoot when the sun was out because it was so hot, so everyone walked in the sea, or on top the seawall to get past. We had to run full speed across the beach with our SCUBA tanks on our backs to avoid painfully burning our feet.

Now the beach is half white, and no longer painful to walk on in the full sun. **The reason is that the Biorock process, which stimulates growth of all forms of marine life, has grown dense mats of white limestone beach sand producing Halimeda algae. These were not present before the project, are clearly localized under and around the Biorock reefs, and rare or absent further away.**

The beach continues to grow, 20 years later. In 2016 there was a lot of physical damage to the corals from the largest storm waves anyone in the village could remember, but the beach continued to grow.

**The Biorock process has therefore grown the beach by, 1) reducing the energy of waves passing through the Biorock reefs, and 2) by creating a vast new supply of sand.**

***We can go almost anywhere with suitably designed structures.***

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