

Utilizing 3D Printing to Revitalize Coral Reefs

Monica Ratnaraj and Eric Stack

According to the National Oceanic and Atmospheric Association (NOAA), coral reefs rank among the “most diverse and valuable ecosystems on Earth.” Reefs support more species per unit than any other marine environment and, therefore, are vital to the health of our oceans. Additionally, healthy coral reefs directly impact the economy by supporting commercial and subsistence fisheries, as well as local investment through recreation and tourism. Arguably most important, coral reef structures buffer shorelines against 97 percent of the energy from waves, storms, and floods, helping to prevent loss of life, property damage, and erosion (NOAA, 2013). Unfortunately, reefs are vulnerable to natural threats like rising water temperatures and predators and human threats like pollution, unauthorized fishing, and deep water trawling. In fact, it is estimated that the planet has lost half of its coral since 1950 (Wetzel, 2021) and one in five remaining coral are damaged beyond repair (Handwerk, 2021).

In Enric Sala’s 2018 TED Talk titled Let’s Turn the High Seas into the World’s Largest Nature Reserve, he shows us how quickly a marine ecosystem can regenerate when allowed to flourish without human interaction. It is mesmerizing to see the time lapse video of a desolate seascape become a vibrant underwater ecosystem in no time. In its simplest form, his argument is that if we protect ocean waters, and deep ocean waters in particular, the ocean will regenerate itself and we will all benefit from eliminating the unnecessary and harmful industrial aspects of our relationship with the ocean. This seems to be true and is a valuable path forward, but it could prove difficult to eliminate these practices and protect ocean waters at the scale needed to see real improvement. Instead, we propose a combination of this practice and leveraging available technology to restore our coral reefs and improve the health of our oceans and our planet.

One exciting technology is the emerging use of 3D printing to counteract coral reef loss. This approach takes many forms and has a variety of applications. Researchers in Hong Kong have used 3D printed clay tiles to create an artificial reef that organic coral and other nesting marine life can attach itself to (Cairns, 2021). Australia-based Reef Design Lab has used 3D printing to design molds for artificial reefs made from marine-concrete that have successfully increased biodiversity in a Maldives lagoon (Cairns, 2021). The reef structure was printed and cast, then filled with concrete and dropped seven meters below the surface. Live coral was then transplanted into the artificial reef, where it will grow and colonize the artificial structure, forming a new, living reef.

Even further, in a 2020 study published in Nature Communications, scientists were able to create “bionic” synthetic corals using 3D bio-printing technology. This 3D bio-printing is able to produce “optically-tunable photosynthetic material that mimics coral tissue and skeleton morphology with micron-scale precision” (Wangpraseurt, 2020). This artificial tissue is capable of growing microalgae, as well as photosynthesizing. These processes are vital to the role of coral reefs in the broader marine ecosystems that they support. Bio-printing has the potential to speed up the regeneration of reefs and marine life that flourishes around it, without having to wait for these living organisms to grow and develop on their own.

While preservation of existing coral reefs and marine life should be our first priority, this technology has exciting potential to revitalize marine biodiversity in areas affected by pollution and climate change. This ties in strongly to **Sustainable Development Goal #14: Life**

Below Water, the goal to “Conserve and sustainably use the oceans, seas, and marine resources for sustainable development.” A strategy that combines preservation of existing underwater life with technologies that can grow new environments for coral to thrive can help us towards the goal of marine conservation.



A bleached section of the Great Barrier Reef near Heron Island. Stop Adani via Flickr



An artificial reef cast from 3D printed molds. Image courtesy of Reef Design Lab.

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