CAN-102-Coral Restoration-World's Oceans

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Coral Restoration Out planting Summary:

Coral reefs provide food and livelihood to millions of people and their ecosystem services (e.g. tourism, fishing, coastal protection) are valued at $30B/year globally and $100M/year in the U.S.

Preserving the critical socio-economic functions that corals reefs provide necessitates a multi-pronged approach that ranges from actions at the global to local level. Globally we need to dramatically and rapidly abate ocean warming, and locally we need to manage overfishing and pollution, while at the same time repopulating target reefs with resilient, genetically diverse, and reproductively viable populations through active restoration.

Active coral restoration has been occurring in the Caribbean basin for 15 years, and due to the dramatic decline in coral reef health and extent, has been growing globally as both a conservation management strategy and a method to promote tourism. Corals for repopulation can originate from existing nurseries where they are fragmented, or millions of naturally produced eggs and sperm can be brought to a lab or nursery and reared. Either way the corals must be grown in land-based or in-water nurseries until they are large enough to "plant" on a reef. While some biological questions remain, the obstacles to achieving restoration at scale are primarily in the realm of increasing efficiency and drastically reducing the amount of time it takes to deploy corals to the reef.

We need to scale up from deploying thousands of corals at a time to hundreds of thousands or even millions of corals at a time. The primary method of coral restoration for the past several decades has been fragmenting existing corals (primarily branching corals), growing them to a larger size in in-water nurseries, and then transporting them and "outplanting" them to appropriate reef sites for restoration.

This technique has been used for several decades, primarily with Elkhorn and Staghorn coral in the Caribbean. The structures used for in-water nurseries have evolved over the years and vary in cost, ability to withstand currents and hurricanes, minimize biofouling, and other factors. Some methods include small concrete or ceramic tile "plugs" screwed into cinder blocks, and fragments of branching coral tied with fishing line to cinder block and rebar "apartment blocks", PVC "trees" anchored to the shallow seabed, or "clotheslines". So far the most optimal designs have involved floating structures that minimize biofouling.

However, even the most optimal designs are designed to repopulate small-scale restoration projects that are perhaps 100m^2 and the biggest bottleneck of all is the "outplanting" phase. It is estimated that over 150 organizations globally are engaged in coral restoration, with at least that same number showing interest in beginning restoration work. Coral restoration is a growing segment in the non-profit, for-profit, coastal protection, government mitigation, and tourism development space.

The highest cost for performing restoration currently is associated with diver and vessel time. The industry is currently lacking a design for an efficient in-water floating nursery structure that can be coupled with an equally efficient method to collect corals off of the nursery structure and ”outplant” a reef restoration site. The coral nursery structure should accommodate a minimum of 1000 coral fragments of Caribbean Elkhorn coral (~4 cm at deployment to nursery and growing to ~20cm at outplanting). The structure should be deployable by two divers in a single one-tank SCUBA dive (~1 hr). Structure should feature a simple and rapid method for coral attachment / detachment, be stable when exposed to heavy weather, minimize/eliminate biofouling, be reusable for at least five years, and cost less than $250 when deployed at scale. The re-attachment to reef method should be such that 3000 ~20cm Elkhorn corals can be “outplanted” to a reef restoration site and the nursery structure can be re-stocked with ~4cm coral fragment in less than one day. Such new technology that radically decreases diver-coral interaction time, will increase the number of corals that can be deployed per unit time, and would be readily paid for by the many large and small scale organizations using these techniques.

Project Goals: Coral reef restoration is expanding rapidly and globally. There is a broad ecological and socio-economic need for coral restoration, and there is an untapped market for efficient coral nursery structures that are affordable, easy and quick to set up, and allow for the rapid deployment of grown corals onto the reef. There are many slight variations and modifications but the basic current methodology is:

• A nursery structure is erected underwater in a shallow, easily accessible environment.
• Coral fragments are attached by tying individual coral fragments with fishing line to the in-water nursery structure.
• The structure is cleaned of biofouling organisms during the coral growth period
• When the coral is ready to be planted it is untied from the structure, placed in a bucket and moved to the reef restoration site.
• At the reef restoration site, the coral is glued onto the reef with underwater epoxy. The overall project goal is to increase the efficiency of coral restoration by improving the design of both in-water nursery structures and the “outplanting” of corals from the structures to the reef restoration site. The nursery structure should be designed to:
• deploy in ~1 hr by 2 SCUBA divers
• hold 1000 ~4cm Elkhorn coral fragments that can grow to ~20cm each
• attach and detach corals rapidly (such that structures can be restocked and ~3000 ~20cm diameter Elkhorn corals can be planted in one day)
• cost $250/unit, given mass market fabrication, and a 10 unit minimum purchase Prefabricated, inexpensive, but sturdy structures, with simple attachment/detachment sites, and a method for getting these corals onto the reef rapidly would change this industry entirely. Using snaps or small cement or ceramic tiles that could be wedged onto the reef could increase efficiency by >10 times.

If the SBC technology is successful and affordable, communities/localities world-wide that rely on coral reefs as their economic engine through recreation and tourism will pay for this, as will large-scale coral restoration NGOs, and government agencies that engage in mitigation.

For additional reading see The WFCRC Document Gallery for articles about:

- Public Service Announcements (PSA)
- Coral Alert Network (CAN)
- Emergency Reporting Reports (ERR)
- Call to Action (CTA)
- Marine Protected Areas (MPA)
- Marine Life Alert (MLA)
- Seismic and Oil Production Threats
- Natural Science Reports (NSR)
- Oil Spill Alerts (OSA)
- And other miscellaneous documents