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Coral Gardening: Issues and Challenges

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CORAL GARDENING: ISSUES AND CHALLENGES

Executive Summary

Coral gardening is the process of restoring cover of a damaged reef by affixing live coral fragments. This method of reef rehabilitation has been gaining popularity in the Philippines, and while it has its applications, it should be the last option for bringing a reef back to a healthy state. Proper management of reef resources through marine protected areas, removal of stressors, and easing of fishing pressure provides a broader and more holistic approach while allowing the reef to recover by itself. If coral gardening is the only viable option available for rehabilitating a certain reef, careful consideration must be put into site selection, coral species to be utilized, and the management of transplantation sites. All national and local government permits required for operating a coral gardening initiative should also be obtained, and a monitoring plan formulated to assess its effectivity in the long run.

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Reef Restoration

Coral reefs in the Philippines are in a state of decline, either due to natural (e.g., typhoons) or man-made (e.g., pollution, coastal development) causes. While there is generally little that can be done about natural stressors at the local level, managing man-made sources of reef stress is a feasible goal.

Restoration is defined as aiding the recovery of a damaged ecosystem (Rinkevich, 2014). Passive reef restoration relies on the ability of corals to naturally recover and grow, and is often limited to managing human activities near reefs and eliminating identified anthropogenic causes of reef damage (e.g., dynamite fishing; Rinkevich, 2005). Restoration is potentially most effective where reef stressors are acute or short-term (Yap, 2003), such as the ship grounding in the Tubbataha Reefs Natural Park or Typhoon Yolanda damage in the Sagay Marine Reserve, which both protected areas recovered well from. Active reef restoration, on the other hand, involves direct actions such as modifying the reef with natural or artificial structures (Rinkevich, 2014). Coral gardening is one form of active reef restoration.

What is Coral Gardening?

Coral gardening is currently a popular method used to help speed up the recovery of coral cover on reefs. It involves transferring coral fragments or whole colonies from a donor reef to a damaged one, either directly or after going through a period in a nursery where they are grown to a certain size before being transplanted. Some coral gardening efforts use live fragments that have been naturally broken off by waves or storms and already scattered on the reef (called “corals of opportunity” or COPs), while others use corals actively broken from live colonies.

Transplantation and gardening methods have been studied intensively over several decades. These methods often involve the use of ties or wires (e.g., Maragos, 1974), marine epoxy (e.g., Yap & Gomez, 1985), and nails (e.g., van Steveninck & Breeman, 1987) for attachment of coral fragments, as well as the use of frames and ropes (e.g., Maragos, 1974) as grow-out units.

Coral Gardening in the Philippines

Coral gardening in the Philippines boomed in 2012 with a government-funded project that was rolled-out in several provinces. Since then, almost half a million coral fragments in more than 500 coral nursery units have been deployed all over the country. Small-scale coral gardening activities, such as those funded by non-governmental organizations and individuals, continue across the country and are apparently still gaining popularity. Given the number and diversity of stakeholders that rely on coral reefs, coral gardening projects have had both positive and negative reactions from different sectors in the Philippines.

Environmental Implications

Reef restoration through coral gardening and transplantation can be challenging and complex since many ecological factors must be considered before undertaking such an endeavor.

The first challenge is that donor sites must have enough COPs for transplantation; and that these COPs are gathered while they are still alive and viable. A study done on 20 Philippine coral reef stations showed an average of only 0.6–4.5 COPs per square meter (Feliciano et al., in prep.). Based on these numbers, the goals of some transplantation efforts (usually several tens of thousands of fragments) may be unrealistic from both the supply and cost-of-effort standpoints and may pose the risk of participants having to supplement insufficient COPs with fragments broken off from intact colonies. If fragments are broken off, donor sites need to have high coral cover to help ensure that they can recover. However, a recent study covering 166 coral reef stations all over the Philippines found an average of 22% hard coral cover, 10% lower than was reported in the 1990s (Licuanan et al., 2017). Most local reefs may therefore not tolerate the further loss of corals from harvesting for gardening.

The second challenge is that corals typically chosen for transplantation tend to have high mortality rates. Branching *Acropora* species, with their delicate growth form and tendency to become COPs, are commonly used for coral gardening (Edwards & Gomez, 2007). This is despite the fact that *Acropora* species typically have higher mortalities in the initial stages of transplantation, and have slower growth and lower reproductive rates than corals left intact in their natural habitats (Yap et al., 1992). They are also more prone to mass coral bleaching (Marshall & Baird, 2000; McClanahan et al., 2007), a now widespread consequence of climate change that has decimated a large portion of the Great Barrier Reef (Hughes et al., 2017).

The third challenge is that it is difficult to ensure that the transplants will be compatible with the conditions at their transplantation site. Target or recipient sites need to meet certain requirements, not the least of which is similarity to the donor site (Edwards & Gomez 2007). The underwater environment is highly variable (Drury et al., 2017) — no two sites are ever exactly alike — and corals, being sensitive, might not survive in the transplantation site.

In cases where the environment proves unsuitable for a particular coral species, the use of transplants can result in a costly, damaging, and unproductive restoration effort. Also, more specific criteria need to be set for determining whether sites are in need of transplantation to enhance natural recovery. It is not enough to say, for example, that "all reefs that have less than xx percent cover are in need of transplantation." Different sites can support different levels of coral cover based on specific environmental conditions (Yap, 2003).

Legal Implications

The Implementing Rules and Regulations of Republic Act 10654 (2015) amending the Fisheries Code state that all coral farming and propagation activities require an Aquatic Wildlife Farm Permit issued by the Department of Agriculture. Gathering of corals for any other reason outside of scientific and research purposes is illegal. However, most coral nurseries and rehabilitation initiatives in the country operate without the proper national government permit. This permit should be obtained from the Bureau of Fisheries and Aquatic Resources to ensure proper documentation and tracking of these activities.

Economic implications

The cost of coral gardening activities can be highly variable. A 2016 estimate by V. Hilomen ranged from PHP500,000 to PHP5 million per hectare (Ranada, 2015). Factors that affect cost include materials and restoration method used, the distance of the relocation site from the donor site, nursery or grow-out costs, and human resource requirements.

To illustrate this, computations show that 280,112 COPs of 5-cm radius are needed to increase hard coral cover in a hectare of reef from 0% to 22% (Feliciano et al., in prep.), which is the current national average (Licuanan et al., 2017). Based on the average availability of 0.6-4.5 COPs per square meter of healthy reef, this means 6 to 47 hectares of reef need to be searched to be able to gather enough COPS to make a significant change to a hectare of damaged reef (Feliciano et al., in prep.). A prior study estimated the total cost of gardening and then transplanting a colony to be USD 0.3-0.4, or approximately PHP15 to P20. Multiplying this amount with the 280,112 COPs needed, and the total restoration expense would be PHP4.2 to PHP5.6 million per hectare.

Compare the cost of coral gardening to the cost of investments in an island-wide management and protection for Olango Island in Cebu, which is PHP5.2 million per year, and the cost of expenses in administering a single well-managed marine protected area such as Gilutungan Island (also part of the Olango Island group), which is PHP1.6 million per year (White et al., 2000; values adjusted for inflation). Based on these numbers, investing in marine protected areas appears more cost-effective than coral gardening.

Conclusions

There is high variability of success in previous coral gardening initiatives, with good survival for some areas and very high mortality for others. Successful endeavors have generally been on the small scale of only tens to hundreds of square meters, and the increasing cost of upscaling suggests that large-scale efforts are best be avoided in favor of other management options. Target areas must be chosen carefully, with sufficient biological and ecological information about the transplant species and sites. However, seeing that the Philippines has approximately 26,000 square kilometers of coral reefs, with most having suffered a marked decline in overall reef condition over the last four decades (Licuanan et al., 2017), it will be difficult for coral gardening projects to achieve a significant improvement in reefs on a national scale.

In addition, coral nurseries require extensive maintenance and costs, which become prohibitive when we consider the person-hours and underwater operations expenses that go into finding, gardening, and transplanting enough COPs to make a substantial change.

In cases where natural or man-made stressors cause damage to reefs, passive restoration or letting the reef recover by itself is recommended. Institutional-level regulation is necessary to ensure that careful deliberation goes into determining 1) if active restoration is needed, and 2) if it is viable, likely to succeed, and sustainable, before allowing such activities to proceed. Although there are some instances where coral gardening or transplantation is the only viable option, better management and protection provides a more multi-dimensional and cost-effective approach to conserving reefs.

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