Coral Reef Rehabilitation and Restoration: Experience of Malaysia

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Abstract

After the event of mass coral bleaching in 2010 and the ever vulnerability on the marine environment due to climate change, the Department of Marine Park Malaysia starts to look at ways to address the future of coral reefs through coral reef restoration. Approaches such as mitigation, adaptation and resilience need to be enhanced in Malaysia marine protected areas (MPAs). A coral restoration project was initiated in 2011 in collaboration with stakeholders such as Reef Check Malaysia. It takes about three years to reach maturity and two pilot sites had been established with encouraging result. The design of the coral frame structures goes through three different stages of which the present *Cores 3* frame hopefully will enhance the spatial coverage for the project. The first two frame's design can hold about 24 coral fragments (nubbins) whereas the present *Cores 3* can holds up to 70 coral fragments. A breakthrough of improved survival rates after the transplanted coral sources had been substitute using the "coral of opportunity" as a "seed" and increasing the size of each of the coral seed fragments to more than 10 cm length. Suitable site selection is an important factor in determining the success of the project. At the moment the genus from *Acropora spp*, and *Pocillopora spp*, are used for the coral transplant.

Keywords: climate change, coral reef restoration, marine protected areas, coral transplant.

Introduction

Malaysian coral reefs are mostly fringing type, and the country has more than 540 species of hard corals (Reef Revisited, 2012). Sipadan Island is an oceanic island of Malaysia encircled by corals. Although Malaysian sea waters could be about 566,285 km², at the moment only 9% of the country's coral reefs (**Fig. 1**) are protected through the establishment of marine protected areas of MPAs (CT Atlas.WorldFish, 2012).

Fig. 1. Malaysia's coral reefs

Moreover, considerable portion of Malaysia's live coral cover had been reported to be beaching. In an effort to address such concern, Malaysia had implemented since 1998 coral rehabilitation program (**Table 1**) in many locations shown in **Fig. 2**. There had been many cases of coral bleaching starting in 2010, such as in Renggis Island off west central Tioman in Pahang where coral bleacing was reported at depth of 12 m and temperature of 31°C (**Fig. 3**), and in Lima Island east of Redang, Terengganu at depth of 10 m and temperature of 30-32°C (**Fig. 4**).



Fig. 2. Locations of Malaysia's Coral Reef Rehabilitation Program

Table 1. Malaysia's Coral Reef Rehabilitation Program (1998-2014)

Year	Sites	Activities	Stakeholders	Status
1998	Sarawak	Installation of Reef Ball ARs	Sarawak Forestry Corporation	Conservation
2003	Semporna Island, Sabah	Coral transplantation	Islamic Financial Services Board	Commercial
2005	Sabah	Coral transplantation	Tropical Research and Conservation Centre	Semi- conservation
2006	Layang-Layang, Sabah	Coral transplantation	Department of Fisheries Malaysia (DOFM)	Conservation
2009	Gaya (off Kota Kinabalu)	Electrophoresis for DNA/RNA analysis	Gayana Eco Resort	Conservation
2011	Buhay Dulang, Sabah	Coral transplantation	DOFM/Sabah Park	Conservation
2011	Tioman, Pahang	Coral transplantation	Department of Marine Parks Malaysia (DMPM)	Conservation
2012	Perhentian, Terengganu	Coral transplantation	DMPM	Conservation
2014	Bidong, Terengganu	Coral transplantation	DOFM	Commercial

Also in 2010, coral bleaching was reported in Teluk Bakau, Redang Island (**Fig. 5**), and in Batu Malang, Tulai Island, Tioman, Pahang (**Fig. 6** and **Fig. 7**). In 2014, coral bleaching was

observed in Pinang Island off Redang, Terengganu at 3-5 m deep waters and temperature of 31-32°C (**Fig. 8**).



Fig. 3. Coral bleaching in Renggis Island, off west central Tioman, Pahang, Malaysia



Fig. 4. Coral bleaching in Lima Island, east of Redang, Terengganu, Malaysia

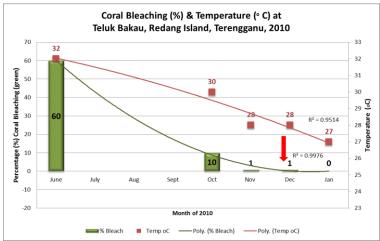


Fig. 5. Percentage of coral bleaching in Teluk Bakau, Redang Island, Terengganu, Malaysia



Fig. 6 Coral bleaching in Batu Malang, Tulai Island, northwest of Tioman, Pahang, Malaysia

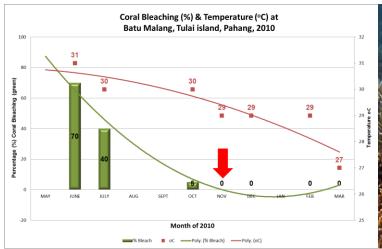


Fig. 7. Percentage of coral bleaching in Batu Malang, Tulai Island, northwest of Tioman, Pahang, Malaysia



Fig. 8. Coral bleaching in Pinang Island, off Redang, Terengganu, Malaysia

Analysis

Many factors threaten the health of coral reefs. These include climate change, pollution, habitat loss, invasive species, coral disease, and illegal fishing. It is therefore necessary to develop mitigation and adaptation measures as well as resilience. Efforts have been made by various

agencies in Malaysia to restore its corals, such as coral transplantation carried out by DMPM (**Fig. 9**) in Tioman Island, Pahang (**Fig. 10**) which had achieved positive results (**Fig. 11**), and in Perhentian Island, Terengganu (**Fig. 12**).





Fig. 9. Coral transplantation carried out by DMPM in Tioman Island, Pahang, Malaysia





Fig. 11. Development of transplanted corals in Tioman Island, Pahang, Malaysia





Fig. 13. Development of transplanted corals in Perhentian Island, Terengganu, Malaysia

Lessons Learnt

Although the coral transplantation carried out by DMPM, there are lessons that should be shared for the benefit of countries that might embark on a similar activity. Firstly, the sites should have moderate current and unobtrusive sunlight. The

Benefits of Coral Restoration

Many benefits could be gained from coral restoration through transplantation. These could include increased live coral cover, hastened

Risks of Coral Restoration

While there are benefits from coral restoration, there could also be risks that come with it. As experienced by DMPM, the transplantation sites could be destroyed by freak weather, while infestation of predators could occur, *e.g.* oysters.

Concerns on Coral Restoration

Some concerns had been raised regarding coral restoration, which should be taken into account if countries intend to carry out such activity. These are: possible alteration of donor reef ecosystem especially is collection of fragments to be transplanted is unsustainable; could create false

Further Studies Needed

In order to demonstrate the viability of coral restoration, it is necessary that relevant studies should be conducted. These could include: fish population at restored coral reefs; other marine biotic populations on site; biodiversity abundance and species richness (for conservation purposes);

fragments of corals to be transplanted must be more than 10 cm. In addition, sites should not be too close and adjacent to natural reefs. Finally, maintenance of the installations is necessary immediately after the transplantation.

recovery of target coral reefs, increased biodiversity, re-established ecological balance, stabilized surrounding environment.

High man-hour is needed for the maintenance of the installations. There could also be inadequate coral fragments that are available in nearby donor reefs. High mortality could also be encountered during the transplantation.

sense of hope among the stakeholders; transplanted corals could compete with local recruits; low diversity due to selective coral species transplanted; and could create unintentional species dominance with monospecies mix distribution.

choice of massive coral or non-branching species (for resilience purposes), among others. Moreover, it is also necessary to conduct capacity building of stakeholders on new handling methods of transplantation.