

About Tropical Marine Science Institute (TMSI) research

ENHANCING SINGAPORE'S CORAL REEF ECOSYSTEM IN A GREEN PORT

BACKGROUND

This project was initiated in collaboration with the Maritime and Port Authority of Singapore (MPA) to focus on the development of protocols on coral relocation and restoration. Through coral transplantation, new reefs will be established and degraded reefs will be rehabilitated and the concepts and principles developed through this programme can be applied to support the sustainable development and management of coastal cities.

SIGNIFICANCE OF THE RESEARCH

Reef restoration is necessary to prevent loss of coral reefs and their associated marine biodiversity in cities with rapid coastal development. This project involved the establishment of coral nurseries to facilitate the propagation of coral fragments, which are then transplanted to A) create new reef habitats and B) rehabilitate degraded reefs.

The science of reef restoration is relatively in its infancy especially for urbanised coastal areas. Many restoration projects depended on fast-growing coral species and the response of other species to restoration has yet to be systematically tested, especially on heavy sediment reefs such as that of Singapore.

This research has four strategic directions:

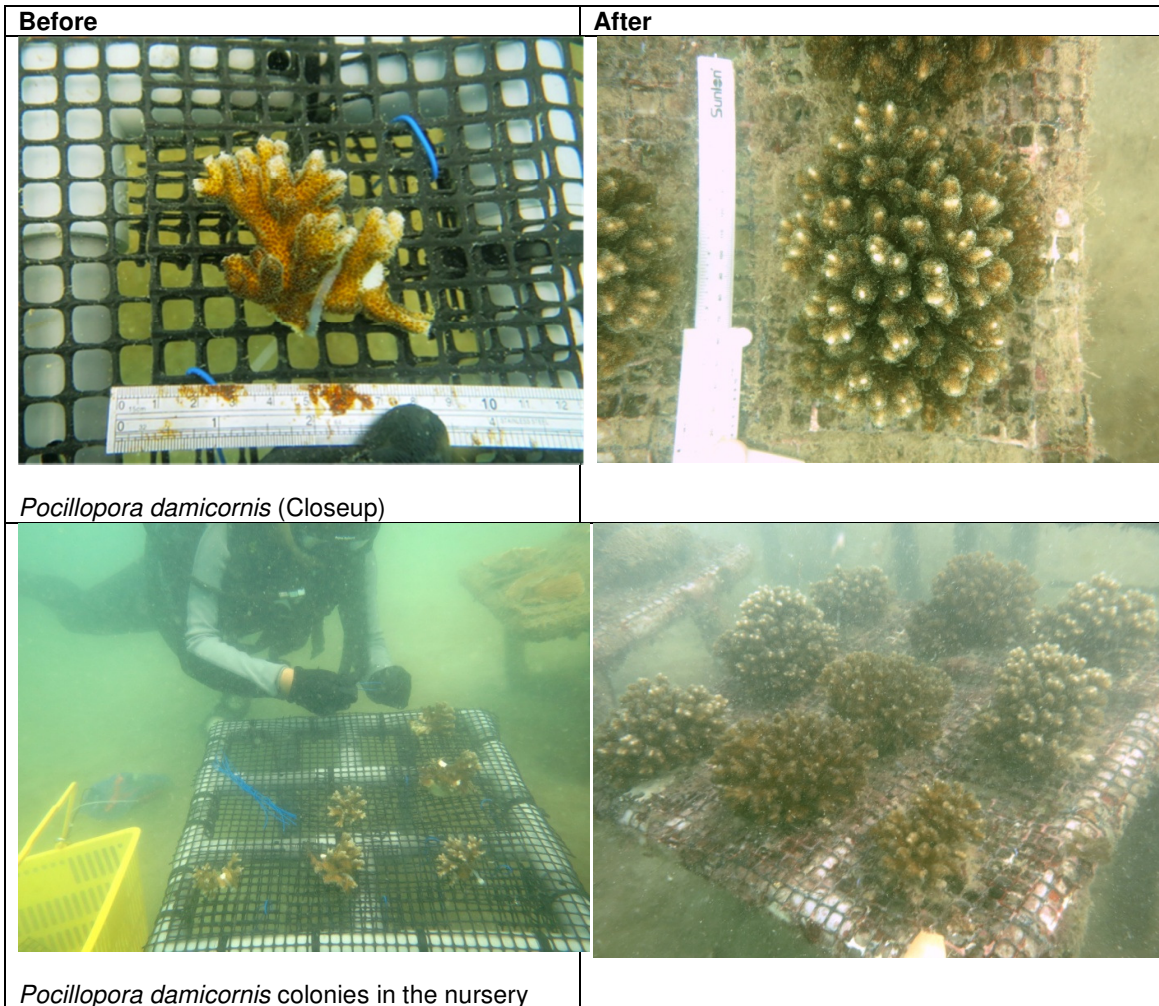
1. Optimising the methods for establishing coral nurseries and transplantation to augment growth and survivorship of the coral fragments
2. Assess the suitability of coral species for rearing in the nurseries and for transplantation
3. Engage volunteers in the coral rearing and restoration efforts and to examine the efficacy of citizen science in reef restoration
4. Assess the changes in reef community assemblages following coral transplantation

This research program is among the few in Singapore to include coral nurseries as part of the reef restoration effort. The development and optimisation of coral rearing and transplantation protocols can be applied for future restoration of urban marine habitats and can be used to support Singapore's coastal management initiatives.

RESEARCH HIGHLIGHTS

A) Optimising methods for coral nursery establishment and coral transplantation in high sediment environment.

1. Nursery efforts
 - Identification of 3 nursery sites.
 - 1251 coral fragments (from 22 coral genera) collected from Sultan Shoal and reared in coral nursery.
 - 92% survived after 1 year, and have increased in size by up to twice the original diameter (range of 1.05 to 1.91 times).



2. Different slope orientation of coral nurseries
 - Fixed horizontal nurseries were more suitable for Singapore's marine environment.
 - Enhances growth and survival of most coral transplant species.

3. Coral relocation efforts can mitigate the effects of thermal stress events.

Demonstrated that coral relocation (by transferring to nurseries or transplantation) can accelerate coral recovery if the relocation site has more favourable conditions (e.g. stronger currents and lower sea surface temperature). This is a potential mitigating approach to reduce stress on corals and lower mortality in times of sea temperature rise.

B) Reef rehabilitation efforts and public outreach.

- 1) Reef Rehabilitation effort
 - Restored a total of 300 m² of reefs through the projects (150 m² new reefs, 150 m² degraded reefs) using 420 nursery-reared corals
 - Of these, volunteers assisted with the rearing of 216 corals in the nursery in 2014, which were subsequently transplanted to Lazarus in 2015
 - Total estimated area transplanted restored by volunteers: 80 m².
 - Total participants 52 (25 in 2014, 27 in 2015).

- 2) Discovery of uncommon coral species in Sultan Shoal

- 2 colonies of *Echinopora horrida* were found on the Sultan Shoal reef, limited to a relative small area. This species was not recorded in the 2009 coral survey and museum specimens were last collected in 1980. Tissue has been collected for DNA barcoding.
- Part of one colony was fragmented and the fragments currently reared in the coral nurseries for reintroduction to other reefs to ensure species survival.



Echinopora horrida in the nursery.