ESTABLISHING AND MONITORING CORAL AND GIANT CLAM GARDENS

Coral and Marine Resources Management
in the Coral Triangle - Southeast Asia

CORAL TRIANGLE INITIATIVE
ON CORAL REEFS, FISHERIES AND FOOD SECURITY

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ABOUT THE PROJECT

The Asian Development Bank (ADB) and the Global Environment Facility (GEF)-funded Regional Technical Assistance Coastal and Marine Resources Management in the Coral Triangle-Southeast Asia (TA 7813-REG) operates in the Sulu-Sulawesi Marine Ecoregion, specifically in Indonesia, Malaysia, and the Philippines (or the CT3).

The project works with communities and local leaders to help them better manage their resources, become better prepared to face climate change effects, and adopt environment-friendly and sustainable livelihood options.

The project also aims to address natural resource degradation, poverty within coastal communities, and weakness in coastal and marine resources management policy implementation.

The project has three main outputs:

- Supporting CT3 governments in establishing an enabling environment for sustainable coastal and marine resources management;
- Addressing constraints to sustainable fisheries management and economic development in the coastal zone, such as illegal, unreported, and unregulated fishing, overfishing, and natural habitat destruction, among others; and
- Establishing a project management system to ensure effective project implementation.

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INTRODUCTION

Payment for Ecosystem Services (PES) is used to describe schemes in which the beneficiaries or users of ecosystem services provide payment to stewards or providers of ecosystem services.

The basic concept behind PES is that those who provide ecosystem services should be paid for doing so. PES is only one way among many for combatting ecosystem degradation.

PES provides an opportunity to put a price on previously unpriced ecosystem services like climate regulation, water regulation, and provision of habitat for wildlife.

Simply put, ecosystem services are benefits we get for the natural environment such as food and water and opportunities for recreation and ecotourism. Maintaining and enhancing ecosystem services and restoring them where they have been lost or degraded is increasingly being recognized as essential for sustainable economic growth and improved well-being of communities.

The training organized by the Coastal and Marine Resources Management in the Coral Triangle-Southeast Asia (TA 7813-REG), in partnership with the Western Philippines University (WPU), was designed for fisherfolk organizations, local government units (LGUs), and non government organizations (NGOs). The training combined lectures to provide the necessary knowledge and technical foundation and hands-on or practical activities with the participants actually doing the substrate construction, collection, and setting of coral fragments and giant clams.

The program was divided into six modules: **(i) training concept; (ii) coral reef restoration; (iii) marine stock enhancement; (iv) giant clam translocation; (v) collection of giant clams; and (vi) coral gardening.**

The training design and content were based primarily on the situation in the municipality of Taytay, Palawan where coral and giant clam gardens were pilot-tested in August 2015 and have since become a successful project. The basic training program is shown below.

Date	Suggested Duration (in hours)	Activity	Person(s) Responsible
Day 1	30 minutes	Registration	Secretariat
	1 hour	Opening Program Welcome Remarks and Message **Module 1: Training Concept**	Resource persons
	2 hours	**Module 2: Coral Reef Restoration**	Resource persons
	1.5 hours	Lunch Break	
	1.5 hours	**Module 3: Introduction to Marine Stock Enhancement**	Resource persons
	1.5 hours	**Module 4: Giant Clam Translocation**	Resource persons
Day 2	8 hours	**Module 5: Practicum and Fieldwork on Giant Clam Gardening** • Giant clam garden site selection • Giant clam translocation • Giant clam collection	Resource persons with trainees
Day 3	8 hours	**Module 6: Practicum and Fieldwork on Coral Gardening** • Coral platform construction • Underwater setting of coral platform • Collection of corals and giant clams	Resource persons with trainees
Day 4	8 hours	• Collection of coral fragments • Coral planting on platforms and reefs	Resource persons with trainees
Day 5	8 hours	Continuation of field activities Monitoring and Evaluation Closing Program	Resource persons with trainees

MODULE 1
Training Concept

LEARNING OBJECTIVE

At the end of this module, the participants will be able to explain the basic principles, guidelines, and methods on establishing coral and giant clam gardens.

KEY POINTS

The Coral and Giant Clam Gardening (CGCG) project is envisaged to be the best and most practical Payment for Environmental Services (PES) scheme that could be pilot-tested in a marine management area. CGCG, as a biological form of coral and associated habitat rehabilitation, basically involves the following activities:

- Identification of sites where coral fragments and giant clams will be collected;
- Training on coral and giant clam gardening;
- Establishment of coral nursery;
- Planting of coral fragments in selected substrates and/or transferring of giant clams to identified sites; and
- Maintenance, protection, and monitoring and evaluation (M&E) of coral and giant clam gardens.

Through coral and giant clam gardens, tourists will pay for and enjoy the experience of planting live corals and moving giant clams to identified garden areas, usually inside protected zones. Such activity is expected to generate interest and excitement among conservation-minded tourists and nature lovers in general. It is expected to become a viable and sustainable tourism attraction.

The gardens are expected to be managed by the LGU, which will provide the legislative framework for this tourism activity. Relevant ordinances will be passed to legally establish CGCG areas (including marine protected areas or MPAs and networks) and likewise ensure their protection and conservation.

MODULE 1 | Training Concept

A team of specialists will train a group of fishermen, who will be selected based on the recommendations of the Municipal Fisheries and Aquatic Resources Management Council (MFARMC) Chairman and the President of the Federation of Local Fishermen or other relevant local organizations, depending on the local situation. Trainees/ participants are preferably SCUBA divers or experienced fisher-divers, who can safely carry out underwater monitoring and maintenance of the CGCG.

MODULE 2
Coral Reef Restoration

LEARNING OBJECTIVES

At the end of this module, the participants will be able to gain knowledge on and discuss the following topics:

1. Economic value of coral reefs;
2. Rationale behind reef restoration activities;
3. Coral growth; and the
4. Ecological roles of giant clams in coral reefs.

KEY POINTS

On a global scale, the value of the total economic goods and services provided by coral reefs has been estimated at roughly $375 billion per year with most of this coming from recreation, sea defense services, and food production. This equates to an average value of around $6,075 per hectare (ha) of coral reefs per year (Edwards and Gomez, 2007).

In the Philippines, which has an estimated 27,000 km^2 of coral reefs (though with only about 5% in excellent condition), the reefs contribute at least $1.35 billion per year to the national economy from the combined value of fisheries, tourism, and coastal protection. Degradation of reefs means the loss of these economic goods and services, and the loss of food security and employment for coastal peoples, many of them in developing countries and many of them living in poverty (Edwards and Gomez, 2007).

It is estimated that 20% of the world's coral reefs have been effectively destroyed and show no immediate prospects of recovery, 24% are under imminent risk of collapse through human pressures, and that a further 26% are under a longer term threat of collapse (Edwards and Gomez, 2007).

Why carry out reef restoration?

Ecological restoration is the "process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed" (Edwards and Gomez, 2007). Coral reef systems have evolved to cope with natural disturbances and indeed these disturbances may be important in structuring reef communities. On the whole (if healthy and unstressed by man's activities), they tend to recover well from such acute disturbances.

However, full recovery of areas may take decades — a short time on an ecological or evolutionary time scale, but a long time on our time scale (Edwards and Gomez, 2007). The natural process of reef restoration may take a longer time; hence with the help of man facilitating the regeneration of corals and coral reefs, this ecosystem may be restored in a shorter period of time (Gonzales, 2012).

About coral growth

The Great Barrier Reef of Australia is over 2,000 km long and up to 320 km offshore. Drilling operations have run into a non-reef type of sediment at less than 200 m down (Stoddart, 1969), indicating that it is a very shallow structure that does not necessarily require a vast amount of time for development (Roth, 1979).

On the other hand, drilling operations on Enewetak (Eniwetok) Atoll in the Western Pacific have gone through 1405 m of apparent reef material before reaching a basalt rock base (Ladd and Schlanger, 1960). The rates of growth assumed by most investigators would dictate that at least scores of thousands of years would be required to grow a reef this thick (Roth, 1979).

For instance, *Acropora*, produces large complex structures within a very short time. *Acropora hyacinthus* tables can grow outward at up to 10 cm per year. Branching colonies also achieve rapid growth, like the fast-growing "staghorn" *Acropora* species increasing their branch lengths by up to 15 cm per year (Veron, 1986).

Smith and Kinsey (1976) used CO_2 analysis system in seawater and found coral growth rate to be 0.2 - 0.5 cm per year, while Chave et al. (1972) concluded the net rates of coral growth to be from 0.08 - 2.6 cm per year. Adey (1978) argues that Atlantic reefs should grow three times faster, and Odum and Odum (1955) suggest a growth rate of 8 cm per year.

The net growth rate of a reef is the combination of total carbonate production less carbonate losses by biological, chemical, and physical factors (Roth, 1997). The growth rate of corals can be temporarily nearly doubled by raising the temperature 5°C or by increasing the carbonate ion content of seawater (Roth, 1997).

In some corals, growth rates may be much faster than other coral species, given similar parameters as those observed from the authors' coral transplantation project in Bacuit Bay, El Nido and Taytay Bay, both in Palawan Province, Philippines. Transplanted staghorn coral fragments in Denot Island, Taytay, Palawan showed a 1.85-mm increase in average length within a month, ranging from 1 - 3 mm increase in length.

However, given the complexity and dynamics of the marine environment, there are many factors and various conditions which may facilitate and contribute to the growth and survival of either wild or transplanted corals. Hence, the need for condition- or locality-specific studies.

In measuring coral growth, one must also consider factors that contribute to the attrition of reefs. These include: (i) destruction by corallivores (boring organisms) (Macintyre, 1972); (ii) possible chemical breakdown; and (iii) mechanical destruction by waves and downslope movement along the edge of the reef (Roth, 1979).

It is sometimes useful to distinguish between "physical restoration," which centers on repairing the reef environment with an engineering focus, and "biological restoration," which focuses on restoring the biota and ecological processes. However, as corals, giant clams, and large sponges can provide both structural and biotic components, the distinction is sometimes blurred. In some situations, only biological restoration (either passive or active) may be needed; for others, a combination of physical and active biological restoration may be required (Edwards and Gomez, 2007).

Role of giant clams in a coral reef ecosystem

Neo et al. (2015) showed the ecological roles of giant clams in coral reef ecosystems: their tissues are food for a wide array of predators and scavengers, while their discharges of live zooxanthellae, feces, and gametes are eaten by opportunistic feeders. The shells of giant clams provide a substrate for colonization by epibionts, while commensal and ectoparasitic organisms live within their mantle cavities.

The study further explained that giant clams increase the topographic heterogeneity of the reef, act as reservoirs of zooxanthellae (*Symbiodinium* spp.), and also potentially counteract eutrophication via water filtering. Finally, dense populations of giant clams produce large quantities of calcium carbonate shell material that are eventually incorporated into the reef framework.

Unfortunately, because giant clams are sessile animals, they are easy to gather and are, therefore, prone to overfishing.

MODULE 3
Introduction to Marine Stock Enhancement

LEARNING OBJECTIVE

At the end of this module the participants will be able to understand and explain the definition, purpose, features, and functions of marine stock enhancement.

KEY POINTS

Stock enhancement is a coastal and fisheries management tool to increase and sustain the biomass of a certain population, especially in cases where the population is depleted or overexploited. Stock enhancement is also sometimes referred to as restocking (Gonzales, 2005) and is recommended as a follow through project for MPAs.

Most coastal management projects usually conclude with the management of MPAs and their network. Conservation/stock enhancement projects may answer the question "What happens after the establishment of MPAs?" MPA-based stock enhancement will restore marine resources faster; thus, it is more attractive to community members because they can bring quicker and more direct benefits to them. This intervention is relatively unique to Integrated Coastal Resource Management (ICRM) in the sense that it is seldom applied as an integral part of MPA management.

Because MPAs are protected and activities are regulated within these areas, they are ideal sites for stock enhancement. Thus, it is advantageous to promote MPA-based stock enhancement/conservation so that more communities are benefited.

Because of the popularity and success of many stock enhancement and restocking projects throughout the country, many MPA managers and local community stakeholders are adopting this strategy in their own protected areas in order to hasten the recovery of depleted species, which could then be a potential source of livelihood after the population is restored and becomes abundant.

Considering the importance of resource conservation in MPAs, this compilation is intended to provide ICRM projects, MPA managers, and community stakeholders with a guide on how to plan, implement, and manage resource conservation/stock enhancement projects like coral and giant clam gardens.

MODULE 4
Giant Clam Translocation

LEARNING OBJECTIVE

At the end of this module the participants will be able to identify and understand the requirements and procedures in establishing a giant clam garden.

KEY POINTS

1. **Requirements for a Giant Clam Garden for Ecotourism**

    a. **Site selection:** presence of a natural population of giant clams; accessibility to transportation, electricity and communication, preferably all year round;

    b. **Peace and order condition**: no poachers and other peace and security issues;

    c. **Substrate stability:** shifting sand and rubble can damage the garden;

    e. **Safety against strong wave action**: free-living clams can be moved and overturned by waves or be covered by shifting sand.

2. **Steps and Pointers in Giant Clam Garden**

    a. Only free-living clams (*Tridacna gigas, T. squamosa, T. derasa, Hippopus hippopus, and H. porcellanus*) are to be collected. Collection of boring clams like *T. crocea* might damage the coral substrate.

    b. Small or juvenile free-living giant clams have their byssus still attached to the substrate, and detaching these individuals by force can cause injury, stress, and eventual mortality to the corals and clams.

Figure 1:
Flushing Seawater Onto Newly Collected Giant Clams

Trainee flushing seawater onto newly collected giant clams to be transferred inside an MPA in Tecas Reef, Taytay Bay, Palawan (*R. G. Dolorosa*)

Figure 2:
Measuring Giant Clams

Trainees measure the size of giant clams in the garden in Tecas Reef, Taytay Bay, Palawan. (*R. G. Dolorosa*)

c. Collected clams can be kept out of the water during transport to the proposed garden site, but should be protected from direct sunlight or rain. Periodic flushing with seawater during transport is important **(Figure 1).**

d. The clams can be directly released at the site upon arrival. However, for inventory purposes, clams can be tagged and measured (shell length) before releasing. Measure the shell diameter of the clams with a large caliper. Record the number/tag of each clam and the size measurements **(Figure 2)**.

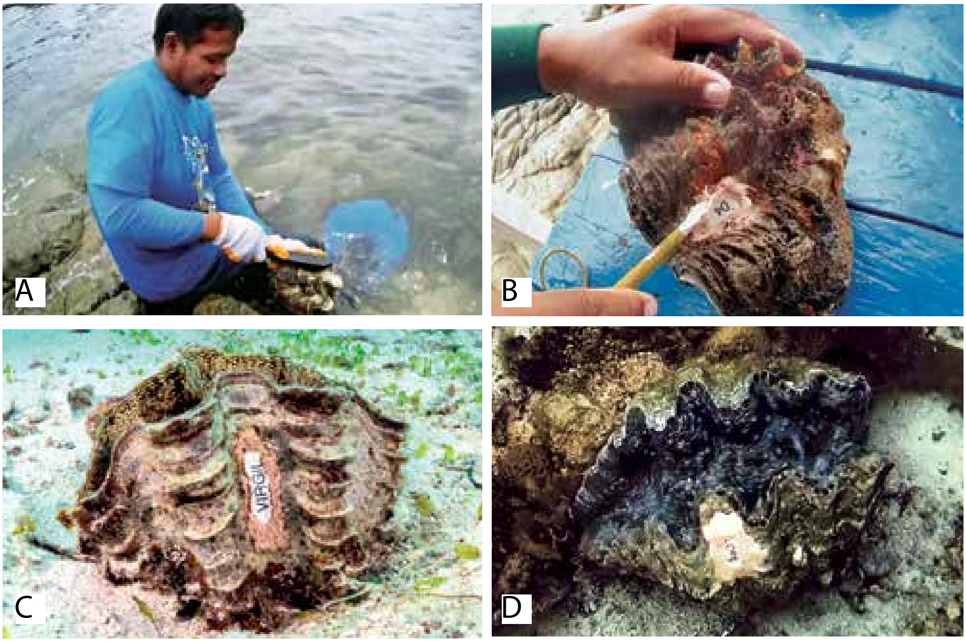
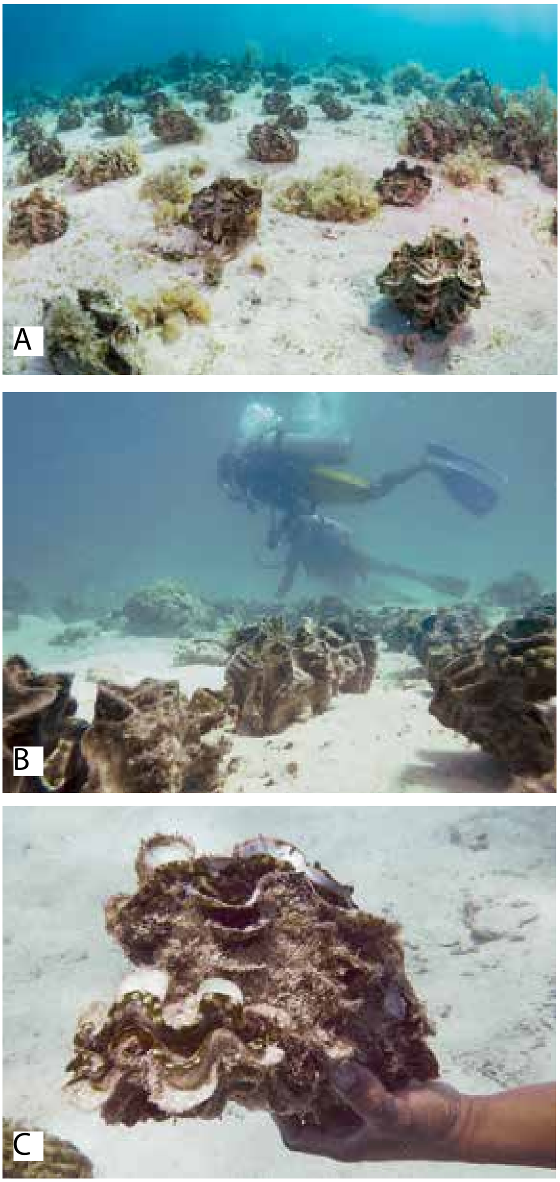


Figure 3:
Tagging Giant Clams

(A) Cleaning prior to tagging; **(B)** Placing the tag; **(C)** A close-up photo of newly released and marked *Tridacna squamosa* ; and **(D)** *Hippopus hippopus* (right). (*R. G. Dolorosa and E. Guevara*)

e. Steps in tagging **(Figure 3)**:
   - Clean a small portion of the shell with steel brush;
   - Wipe to dry;
   - Apply a small portion of marine epoxy;
   - Place a pre-numbered Dymotag;
   - Let the resin/epoxy dry for about an hour (keep the clam in shaded place);
   - Flush the clams with sea water.

f. Once the resin has hardened, transport the clams (onboard a boat) to the proposed garden site.



g. Deploy the clams in a suitable substrate between reefs. Arrange the clams either in circles or rows with a distance of about 1 - 2 ft between clams **(Figure 4)**.

h. Monitor the giant clam garden regularly. Some clams may lie on their sides or be partly buried in the sand. When this happens, the clams may be transferred to a more stable substrate. Monitor the clams for signs of bleaching, i.e., when the mantle loses its color and becomes pale.

Figure 4:
Newly Established
Giant Clam Gardens

Newly established coral garden at **(A and B)** Tecas Reef in June 2015 and **(C)** at Talacanen in November 2016. (*E. Guevara, B. J. Gonzales,* and *R. G. Dolorosa*)

MODULE 5
Practicum and Field Work on Giant Clam Gardening

LEARNING OBJECTIVE

At the end of this module, participants will have gained practical skills in the proper collection of giant clams from the wild.

KEY POINTS

Sites for actual coral and giant clam gardening must be identified using a basic set of criteria, guided by experienced specialists. The specialists must use a snorkel or SCUBA gear (when necessary) in conducting this survey. The identified sites should be depicted on a map with proper coordinates **(Figure 5)**.

Before the activity starts on site, specialists must give an orientation regarding the collection of giant clams. Only free-living clams are to be collected. Free-living clams with their byssus attached on hard substrate must be spared so as not to cause injury to the clams.

Collected clams are loaded on a boat and brought to the shoreline for tagging. Prior to tagging, a portion of the shell must be cleaned and wiped dry. A small amount of marine epoxy must be applied to glue a pre-numbered plastic tag (Dolorosa et al., 2014). Some giant clams can be tagged with the names of participants, instead of Arabic numerals as these are more easily identifiable.

The resin should be allowed to harden for about an hour while the clams are kept in a shaded area. The clams must be sprinkled with seawater from time to time to minimize stress. The marked clams are then released in a rubble-sandy area at a depth of 5 - 6 m where there is a natural population of *Tridacna* spp.

The clams must be arranged at a distance of at least 1 ft between the clams either in circular and triangular shapes or in straight lines. The point of release must be within the capacity of caretakers and law enforcers to regularly monitor and watch over.

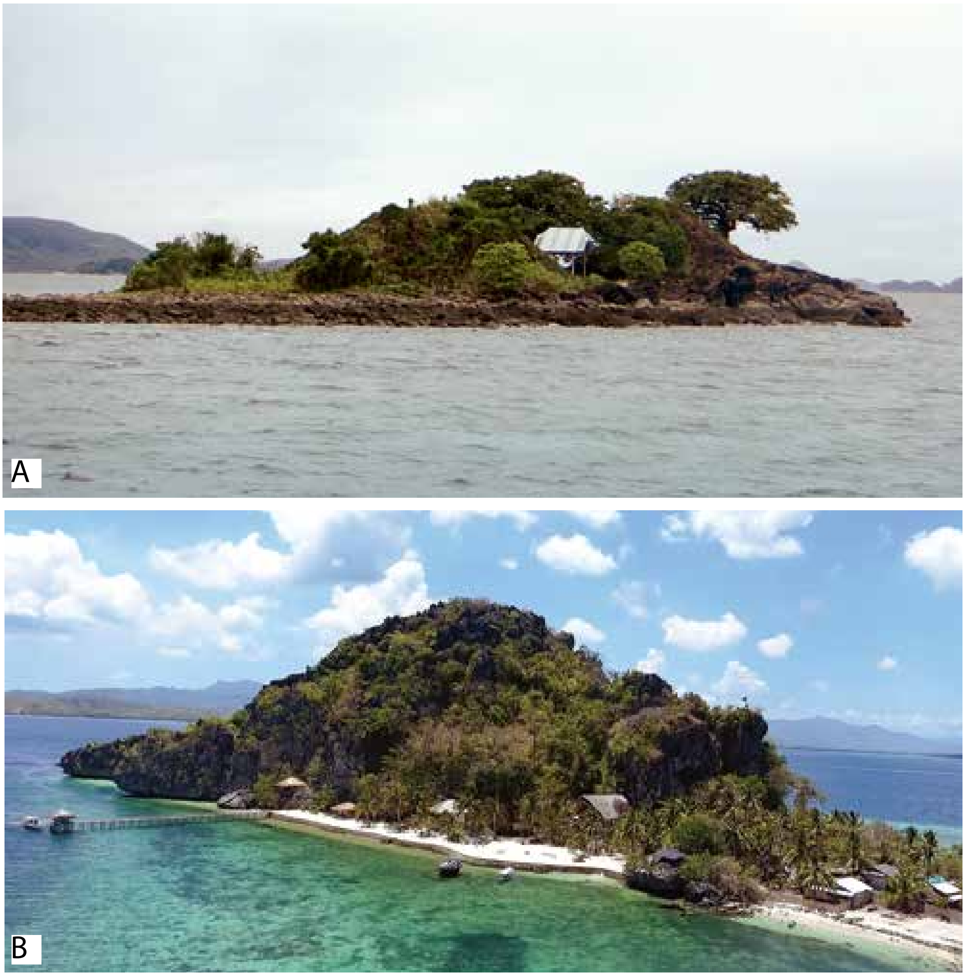


Figure 5: Denot Reef and Talacanen Islands

(A) Denot Island and (B) Talacanen Island in Taytay Bay, two of the selected sites for coral and giant clam gardening (*B. J. Gonzales* and *TA 8913-REG*)

MODULE 6
Practicum and Field Work on Coral Gardening

LEARNING OBJECTIVES

At the end of this module, the participants will be able to:

1. Enumerate and discuss the procedures in establishing a coral garden;
2. Identify the different substrates used for coral garden nurseries and grow out culture; and
3. List down and explain the steps in monitoring and evaluating a coral garden project.

KEY POINTS

A. CORAL NURSERY DEVELOPMENT

1. Platforms and Trays

There are two types of nursery platform techniques used by WPU in Palawan: pipe and screens. The pipe type consists of a tray made out of plastic screen supporting a series of pipes **(Figure 6A)**, where fragments of corals are being cultured (Edwards and Gomez, 2007; Gulayan et al., 2015).

The pipes function as the substrate for coral fragments or nubbins which are either inserted inside the pipe hole or attached to the side of the pipe. Pipes are usually arranged in rows and columns.

Figure 6A: Platforms and Trays

Prepared trays with systematically arranged pipes for coral fragments in Taytay, Palawan

On the other hand, the screen type features a tray with a screen made of combined polyethylene twines and wires (patterned from the University of San Carlos coral garden project), where coral fragments are directly attached (Figures 6B and 6C).

Figure 6B and 6C: Platforms and Trays

Screen trays being prepared in Cadlao Island, El Nido, Palawan. (*B. J. Gonzales*)

The number of coral fragments to be attached depends on the size of the platforms. The recommed distance between fragments is roughly 25 cm, as it is important to provide ample space for the growth of coral species (Figure 7). Branching corals need greater distances between fragments compared to foliose corals. Experience in different sites in Palawan has shown that the ideal depth for setting the platform is between 5 - 9 m. The location of the coral garden nursery should also be recorded and tagged in the map.

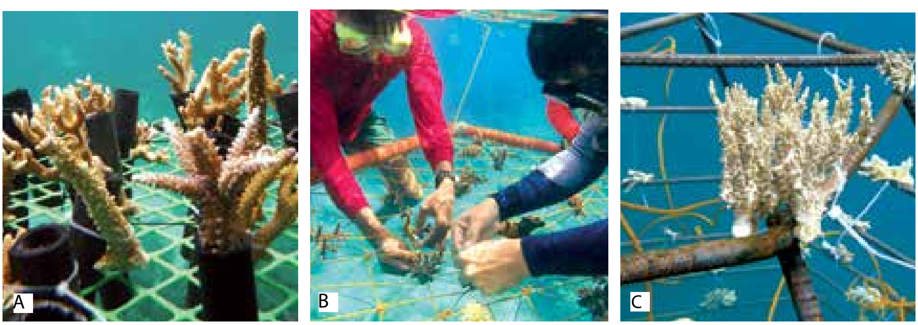


Figure 7: Coral Fragments Attached to Different Types of Substrates

Coral fragments attached to different types of substrates: (A) pipe-type on tray, (B) screen-type or platform, and (C) dome. (*B. J. Gonzales*)

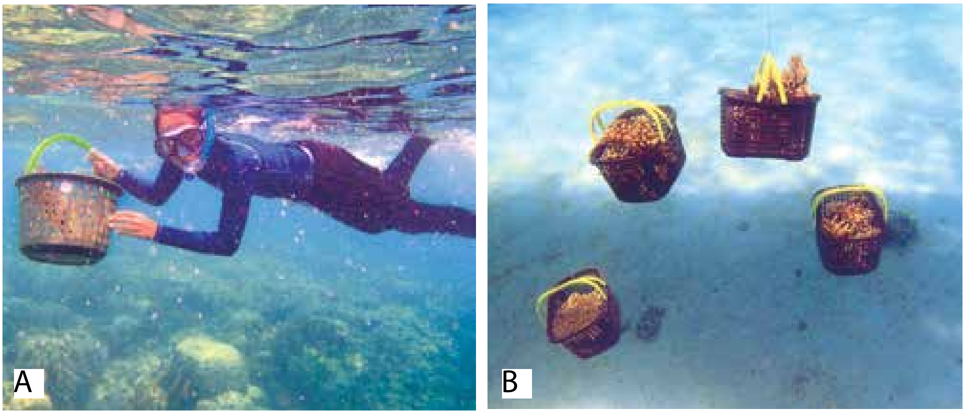


Figure 8: Collecting and Transporting Coral Fragments

(A) Collecting coral fragments, using baskets for transport and (B) hanging baskets with coral fragments before attaching to trays in Nogas Island, Antique. (*B. J. Gonzales*)

2. Collecting the Coral Fragment

"Corals of opportunities" are detached live corals found in rubble, usually just after storms or strong surges. These corals are collected to serve as fragments for the nursery.

As a rule, only 10% or less of the live coral heads should be taken and used as fragments for the coral nursery. Fragments are carried by snorkelers, from source to banca, inside a basket that should remain submerged until the fragments are attached to underwater substrates, e.g., tray or platforms (**Figure 8**).

3. Setting the Nursery Platforms

In nursery development, the platform type of substrate is preferred. Before setting the platforms underwater, the exact desired location of the platform should have been identified and agreed upon. The frames and platforms must be assembled (**Figure 9**), ensuring their stability against currents, wave action, and possible disturbance by large marine animals.

Some structures need to be secured and tied to nearby dead corals to add strength and stability, especially when set on an uneven or sloping bottom substrate. If possible, a flat area is preferable, although there are sites with limited width and a flat sea bottom.

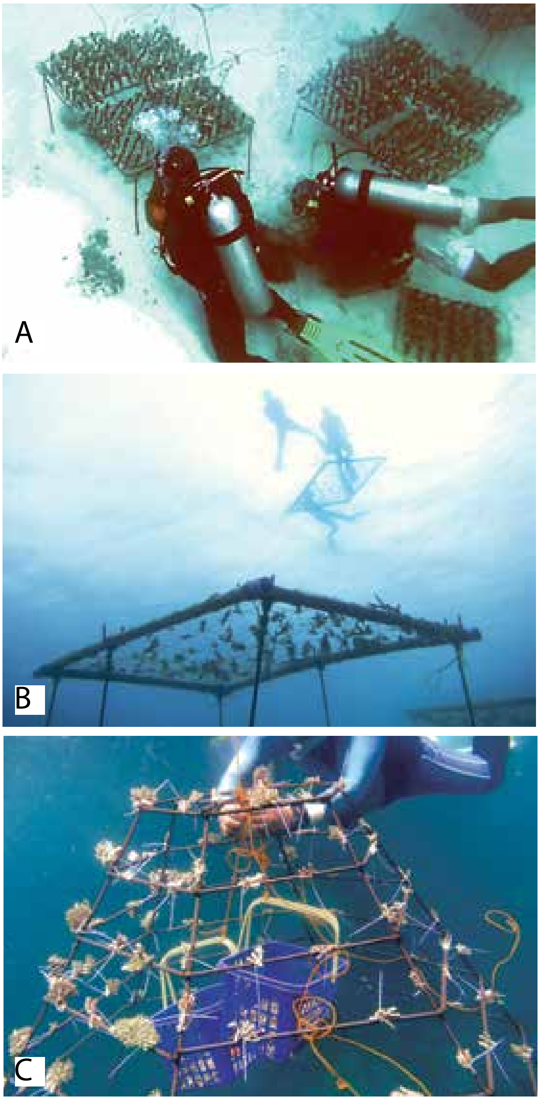


Figure 9: Setting Nursery Substrates

Setting nursery substrates: (A) pipe type; (B) screen type; (C) dome. (*B. J. Gonzales*)

4. **Attaching Coral Fragments to Trays/Platforms**

   The attachment of coral fragments to pipes or screens is done either in the shallow portions of the beach or on platforms hanging on the outrigger of a banca. After the platforms or trays are properly set, the coral fragments are ready to be placed on the platform.

   For screen platforms, coral fragments are tied, with more parts or surfaces of the fragments in contact with the tray.

   For pipe-type platforms, the fragments are placed inside the pipes, making sure that the fit is tight to prevent the fragments from falling out due to currents and other underwater disturbances. If the fragment diameter is larger than the pipe hole, the fragment can be tied to the vertical pipe by cable ties, making sure that the coral fragment is tied tightly to the pipe.

B. CORAL TRANSPLANTATION TO REEF

There are two coral transplantation methods based on the source of the coral fragments: direct planting and indirect planting. Direct planting uses coral fragments from natural coral reefs, which are directly planted on dead or degraded coral reefs (Figure 10).

The indirect planting method uses coral fragments grown from nurseries and transplanted to degraded reefs after a period of time. From experience, the nursery grow out period until the transplantation of corals is three months for fast growing species and nine months for slow growing species, depending on site suitability.

Direct transplantation involves the collection of coral fragments and planting these directly on degraded coral reefs. Direct planting is ideally done in natural crevices among reefs and rocks where coral fragments can fit. Some use a boring instrument to create holes for inserting the fragments.

When the natural hole is larger than the size of the fragment, a bamboo stick is inserted in the gap to adjust and tighten the fit of the fragment. The use of bamboo sticks for this purpose is more environment-friendly than other materials.

Figure 10: Using Bamboo Sticks for Attaching Coral Fragments to Degraded Reefs

Bamboo sticks and ties are used to firmly attach planted coral fragments to degraded reefs, Taytay Bay, Palawan. (*B. J. Gonzales*)

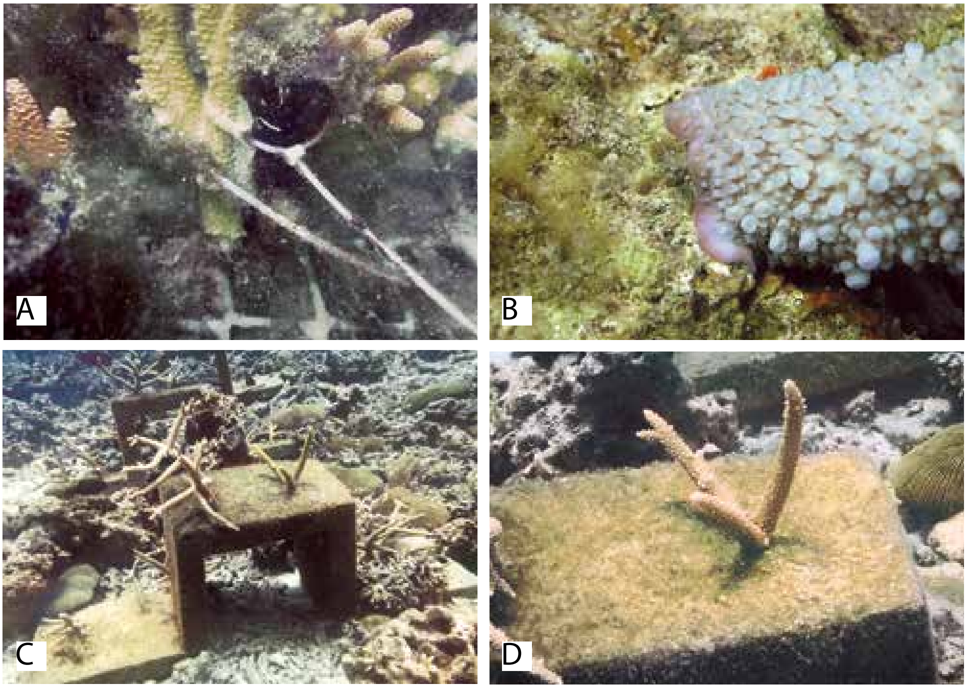


Figure 11:
Transplanted Coral Fragments Attached to Substrates

Transplanted coral fragments have settled on a pipe substrate **(A)** and directoly on reef surface **(B)** after 1 month in Taytay Bay, Palawan. Coral fragments planted on blocks in El Nido, Palawan. **(C, D)** (*B. J. Gonzales*)

C. MONITORING AND EVALUATION

After setting the platforms and transplanting the coral fragments, the site must be visited the following day to observe the general condition of the nursery. The sturdiness of the frames of the platforms and trays must be checked as some parts may not have been properly installed during the setting process. Cable ties must be tightened or additional ties used if there are loose fragments. The condition of the support ropes between platforms and adjacent rocks must be checked, and fragments added to empty pipes.

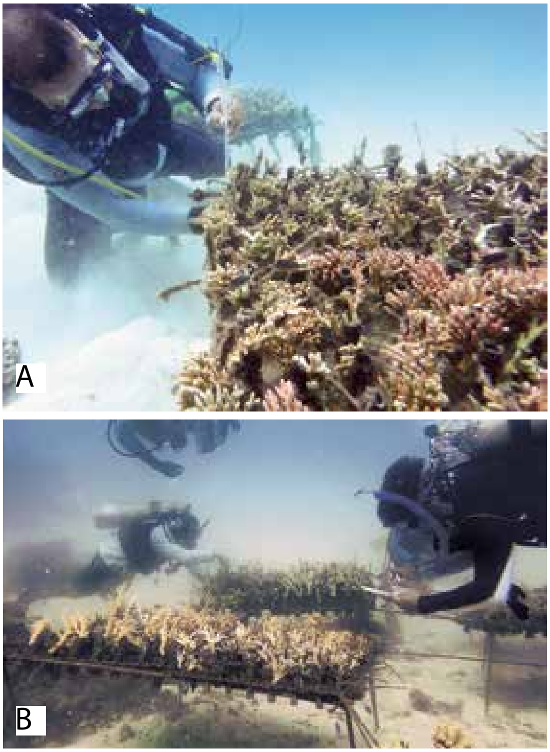


Figure 12:
Monitoring and Maintaining Coral Trays

(A) Monitoring and maintaining coral trays and gently brushing off algae. (B) Measuring the growth and survival rate of coral fragments after one month in Taytay Bay. (*B. J. Gonzales*)

During this visit, the baseline data of the garden/platform should be obtained, specifically the first measurements of the fragments. The length of the fragment must be measured at random to compute the average size at each platform.

The number of living coral fragments must be counted against the number of dead coral fragments per platform. If there are numerous platforms, random sampling should be carried out. Survival and growth rates must be expressed in percentages.

The next visit should be one week after the setting, but no counting and measurement of coral fragments need to be undertaken during this monitoring. The same routine parameters must be checked for the fragments, i.e., percentage of dead and live fragments and platform conditions. The attachment of corals to substrates should also be checked **(Figure 11)**.

The next monitoring visit will be done three months from setting **(Figure 12)**. During this visit, the growth and survival rate of the coral fragments must be measured using the same sampling methods as during the baseline data gathering.

The results of this sampling will be compared with previous sampling results.

This has to be done every three months for one year so that the evaluation of coral survival and growth is done on a yearly basis. During the three-month interval between monitoring visits, undesirable algae and fragments that have attached to the platform should be brushed off, while dead coral fragments should be continuously replaced. If desired, however, proper marking of fragments should be done so as not to complicate the collection of data on growth and survival of transplanted corals. Photo documentation is very effective in showing the "before and after" conditions of the growth and survival of the transplanted corals **(Figure 13).**

The materials needed for monitoring are the following: SCUBA gear, underwater slate with pencil, caliper or ruler, pliers, cable tie, underwater camera, and paint brush.

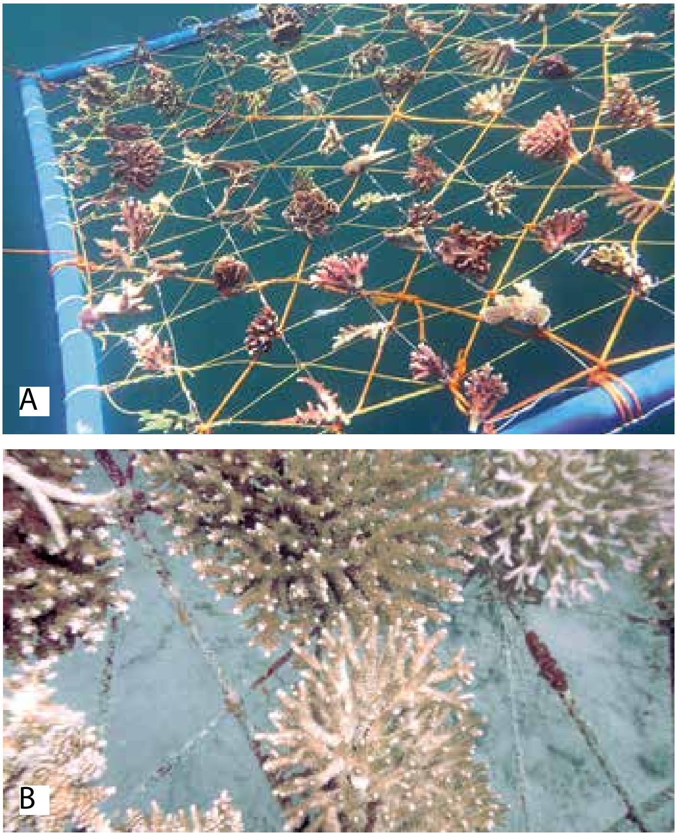


Figure 13:
Transplanted Coral Fragments

(A) Transplanted coral fragments in Pambato Reef, Honda Bay, Palawan; and **(B)** 9 months after installation. Take note of the distance between branches.
(*B. J. Gonzales*)

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ESTABLISHING AND MONITORING CORAL AND GIANT CLAM GARDENS

Residents in Taytay, Palawan are protecting corals and the vulnerable giant clams through the Coral and Giant Clam Gardening project. This initiative was designed to seamlessly combine reef restoration and sustainable financing through ecotourism. Since 2015, this nature-based initiative has changed the way local communities look at managing marine protected areas. This manual shows how reef restoration, so important for fishing communities, can be replicated in the country.