The Problem

Did you know that every square kilometer of healthy reef can feed up to 500 people in one year? Despite our dependency on these reefs as a major source of protein, continuous reef destruction has reached a critical stage. Over 30 million acres of damaged reef have been reported in 93 out of 100 countries. The Philippines is part of the rich Coral Triangle in South-East Asia. Yet in the Philippines alone, it has been shown that 95% of the reefs are already critically damaged due to overfishing, destructive fishing practices (cyanide and dynamite fishing), and lack of protection. At this rate, 70% of the world's coral reefs will disappear within our lifetimes. In the International Reef Symposium in Okinawa (2004), it was declared that “We are now challenged to come up with more innovative solutions to these urgent issues.” Coral reefs are often referred to as ‘rainforests’ of the ocean due to their high biodiversity. The same way that we reforest denuded mountains that used to contain acres of trees, we are faced with the challenge to replace the denuded seaboards that are constantly being destroyed!

The Solution

Present attempts at reef rehabilitation using different artificial reef technologies (such as reef balls, layered rocks, or sunken tires and structures) all rely on larval settlement before the structure becomes a living reef ecosystem that can deliver sustainable production. Without human intervention and because of nature’s slow processes, these structures will most likely become fish aggregating devices rather than catalysts in the rehabilitation of the coral ecosystem.

This project offers a new approach to artificial reef development that interconnects the social, political, economic and scientific factors toward a sure success in reef restoration. It explores the possibilities of human intervention going past the inherently slow and passive process of reef restoration by means of natural colonization to a more dynamic approach involving farming and transplanting of coral fragments. Farming and transplanting plus the utilization of the Acanthus module leads to “Compression in Time”—shortening the waiting period to within five years instead of decades natural processes require. How then can we undertake massive economic coral reef rehabilitation when sourcing of healthy coral fragments from the wild can not be sustained by destructed coral reefs? Our project, “Concrete Substrates for Accelerated Coral Restoration” addresses this need by establishing Acanthus modules in marine protected areas. These modules become coral nurseries and can be donors of coral fragments every two to three years or as the need arises.

A Work in Progress

Six modules of Acanthus were constructed in mid-2004 and deployed in the Duka Bay Resort Marine Sanctuary for research observation. Three modules were transplanted with coral fragments and the other three were not and were used as the control group.

Results from research show the planted structures developed and grew healthy coral colonies that can be donors of coral fragments within two years. With proper planning, production can be timed as needed for establishing other Acanthus nurseries or massive outplanting programs. For outplanting, suitable designs of cement substrates are currently being studied and evaluated for its adaptability to different environs needing rehabilitation (rubble areas, degraded reefs, and sandy bottoms, etc.).
ACCELERATED CORAL RESTORATION

STAGE 2.
The Acanthasia Module - A Coral Nursery

This stage involves the planting or placing of the coral fragments onto the Acanthasia structure which serves as a coral nursery. This stage provides the coral a venue for growth and protection from the elements.

- Corals are brought to the Acanthasia module for propagation.
- Fragments are securely tied and cemented into the Acanthasia legs.
- Branching coral fragments are monitored regularly. After 2 years of successful growth, these corals will serve as permanent donors for outplanting.

STAGE 3.
Enhancing Area Spread Through Outplanting

After 2 years of growth, this stage (currently a work in progress) involves the harvesting of coral clones from the Acanthasia coral nursery for "outplanting" or spread outside of the nursery. With this stage we can attain coral reef restoration in a period of 5 years.

- After 2 years, coral clones from Acanthasia donor are harvested and brought to the outplanting area.
- Coral clones from Acanthasia are securely cemented in outplanting area blocks.
- Outplanting serves to rapidly rehabilitate a wide area of barren or damaged reef.
QUANTUM CHANGE AND TRANSFERABILITY

Simple adoptable technology

Simplicity is inherent in the design of the module. Simplicity coupled with the low level of technology requirement is effective and this promotes replication.

Simple onshore manual fabrication

Materials are all sourced locally and can be assembled on any open area near the shore.

Stable underwater LEGO-type assembly

Standardized snap-on pieces that do not require heavy equipment is important for adoptability and affordability.
ETHICAL STANDARDS AND SOCIAL EQUITY

Increases participatory implementation

The community has seen the benefits of participating in the project because in the context of a marine protected area, there will be “spillover” of fish from the project site to traditional fishing grounds hence the promise of sustaining their livelihood.

Provides alternative livelihood

Aside from fishing, increased potential for tourism as well as providing the labor in setting up the modules are some of the anticipated sources of livelihood.

Increases knowledge and awareness

The community’s involvement, as well as the project’s research activities, all serve to increase the knowledge of the marine environment and conservation.
ECOLOGICAL QUALITY AND ENERGY CONSERVATION

Provides shelter for fish and other marine life

The quality of the reef as a habitat for both fish and corals is seen to be improving as evidenced by the generally increasing numbers of species of fish and invertebrates as well as increase in total weight (biomass).

Absorbs wave energy

Reefs are natural breakwaters. They protect coastal communities.

Is a stable structure and a suitable substrate for coral growth

The structural stability of the Acanthia modules provide a substrate where corals can grow rapidly as shown by the graph below where coral branch length has increased by more than 100 percent.

Acts as a catalyst for a self-sustaining reef ecosystem

The fast-growing coral fragments on the Acanthia modules will provide a steady supply of coral clones for the establishment of new coral ecosystems that can rehabilitate barren or damaged reef areas.
**ECONOMIC PERFORMANCE AND COMPATIBILITY**

**Increases fish abundance**
Enhanced habitat increases fish population. This directly impacts fisheries production.

Change in total fish abundance (fish/100 m²) within an area around the modules containing transplanted coral colonies over 5 sampling periods.

Nearby communities will benefit from “spillover” of fish from the project site to nearby traditional fishing grounds.

**Increases fisheries production**
The project acts as a breeding ground for marine life - where life cycles are nurtured - thus sustaining the environment’s natural productivity.

<table>
<thead>
<tr>
<th>Date/Sampling</th>
<th>Replicates</th>
<th>Total No. Fish Species (species/100 m²)</th>
<th>Total No. Fish Families (families/100 m²)</th>
<th>Fish abundance (fish/100 m²)</th>
<th>Estimated Fish Biomass (kg/100 m²)</th>
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<tr>
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<td>3rd SAMPLING</td>
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**Requires low cost technology**
The simple prefabricated designs are affordable and has low installation and maintenance costs.
CONTEXTUAL RESPONSE AND AESTHETIC IMPACT

Increases potential in tourism

This project is a showcase of an innovative and effective approach to a common problem of the coastal area. Investors, conservationists, and tourists will be drawn to the site to witness and be a part of the project's success.

Allows for a wide area of rapid rehabilitation

Outplanting or Stage 3 of this project effects the wide area for rapid coral ecosystem rehabilitation. The growth and spread in extent of corals in the reef is a slow process. Through outplanting, “Compression in Time” is achieved because it has been shown that with this technology and human efforts, a reef can be rehabilitated within five years.

Is a catalyst for coral/fish diversity

Enhancing the reef habitat promotes an increase in the number and types of marine life. Biodiversity is high since 16 types of branching coral species were used for transplantation and had a high success rate in growth and survival. A diverse and healthy coral community attracts diverse and healthy marine life!