Donors

The construction and operation of the CAC since its inception have been financed by numerous donors and with limited dependence upon core support from ICLARM. The major contributors have been:

- Australian Centre for International Agricultural Research
- Australian International Development Assistance Bureau
- Overseas Development Administration of the United Kingdom
- Australia and Pacific Science Foundation
- International Centre for Ocean Development
- Commonwealth Fund for Technical Cooperation
- United States Agency for International Development
- United States Peace Corps
- Volunteer Service Overseas
- New Zealand External Aid Division
- South Pacific Commission

1995

Coastal Aquaculture Centre

#496

P.O. Box 438, Honiara, Solomon Islands
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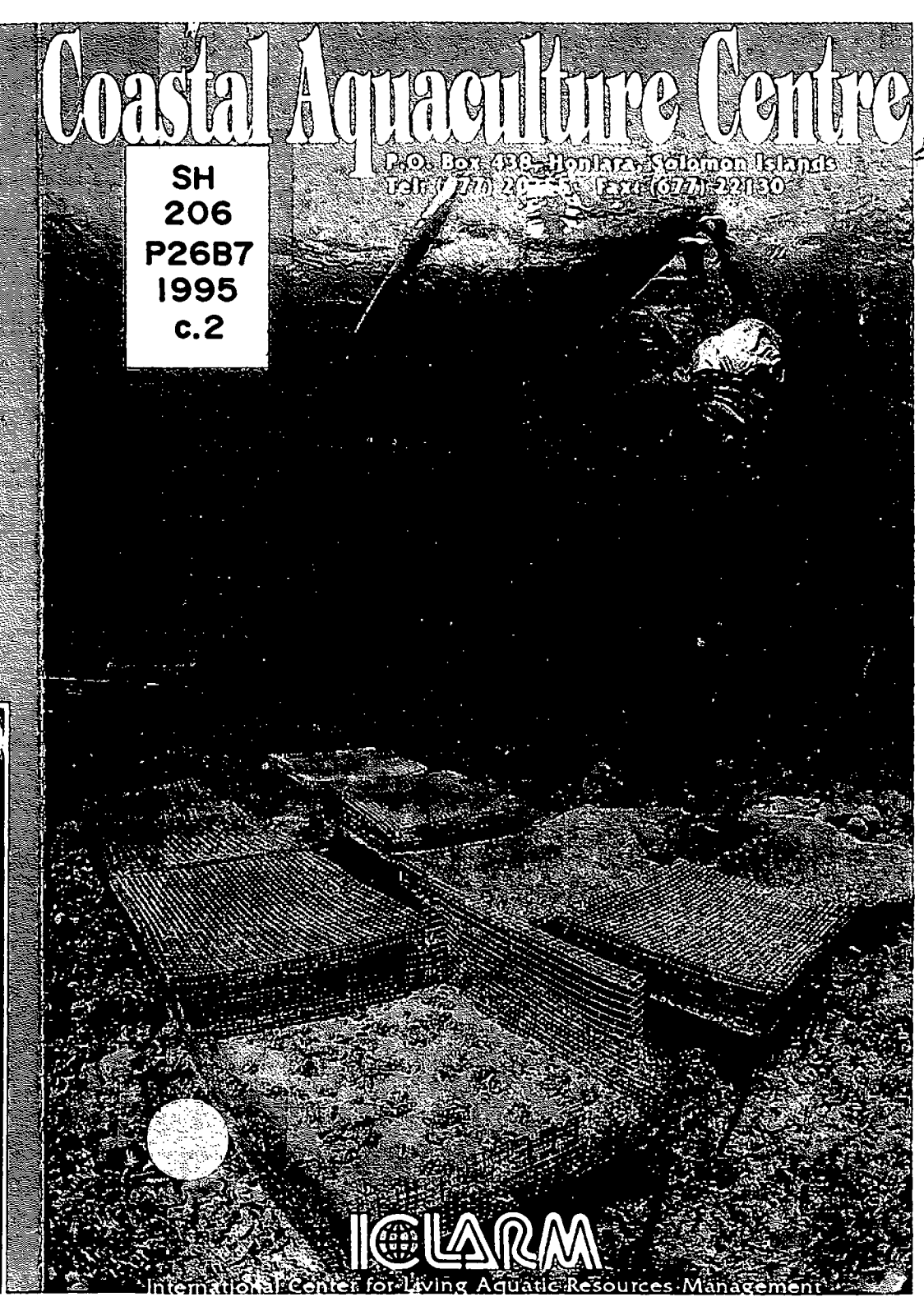


ICLARM
International Center for Living Aquatic Resources Management

Importance of Coral Reefs

The Coastal Aquaculture Centre

Apart from rainforests, coral reefs are the most diverse ecosystems on earth. Coral reefs are found in 109 countries and support a rich variety of animals of value to human societies, including fish, spiny lobsters, sea cucumbers, giant clams, pearl oysters and shells such as trochus, conch and green snail. Traditionally, these animals were harvested at subsistence levels. More recently, development of lucrative export markets has also provided coastal villagers with opportunities to earn money from coral reef species. These earnings are now an important source of income for many coastal communities.

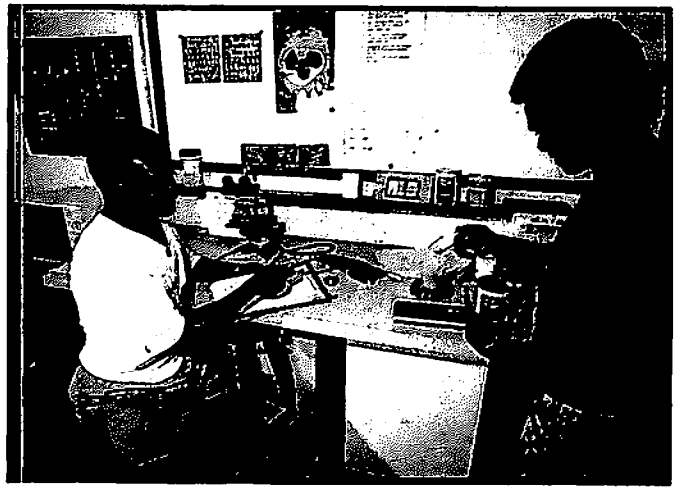
Rudie Kuiter

Unfortunately, the transition from a subsistence to a market economy has usually been far from ideal: chronic overfishing has often occurred and, on many reefs, there are now too few of the most prized animals to sustain reasonable harvests. Destructive fishing methods have compounded the problem by degrading some reefs to the point where they cannot support valuable species. Tragically, many coral reefs in developing nations no longer provide benefits to the people who live near them.

ICLARM established the Coastal Aquaculture Centre (CAC) to redress this problem by developing ways to enhance the productivity of coral reefs, and by transferring the technologies to communities living on coralline coasts in developing countries throughout the world.

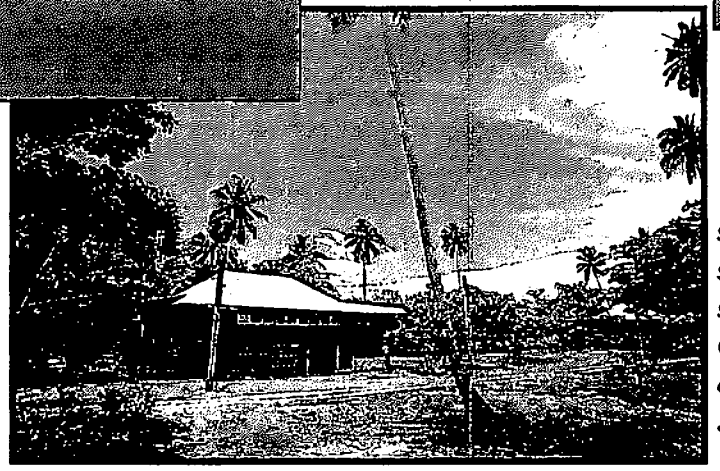
The specific aims of the CAC are to develop simple methods for producing and growing selected species of coral reef fish and invertebrates. The production of juvenile coral reef species will benefit coastal communities in two ways; the juveniles can either be grown to market size in culture or released onto coral reefs to enhance wild stocks.

Research at the CAC is directed at culturing species which are cheap to grow and easy to market. In developing village-based aquaculture methods, the CAC strives to ensure that the techniques fit within social and legal frameworks. Results are reviewed by scientific peers and then passed on to developing countries by training their key staff at the CAC, and through the publication of manuals and newsletters.

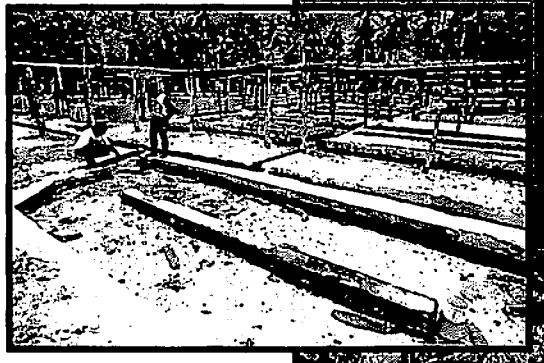


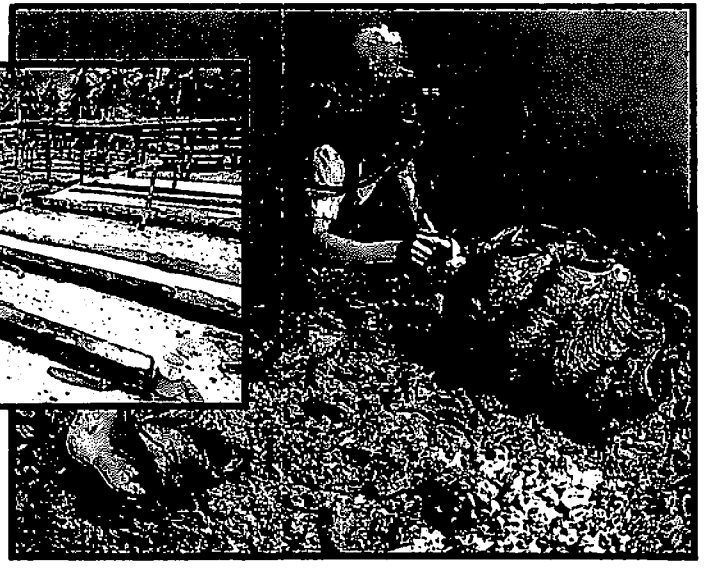
Systems for the enhancement of wild fish and invertebrate stocks appear to offer excellent possibilities for increasing harvests but major research efforts are needed to translate these prospects into increased or stabilized harvests.

Location and Facilities

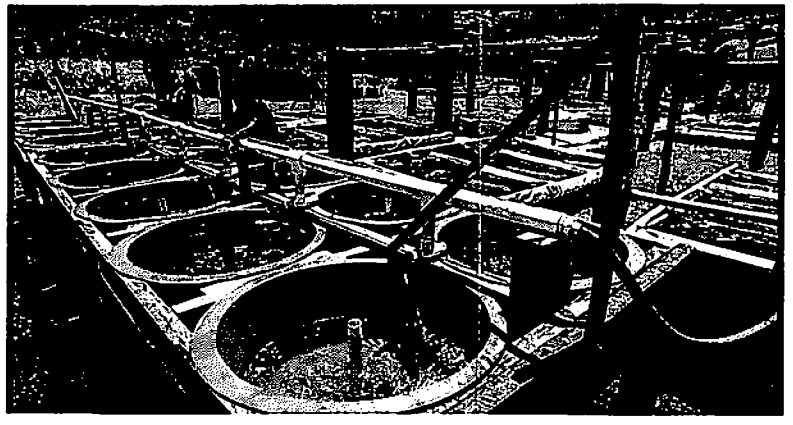


The CAC is located 25 km west of Honiara, Solomon Islands. The site covers 4.8 ha of waterfront land and 4.0 ha of protected fringing coral reef. The Solomon Islands' environment is pristine, most of the highly prized coral reef animals of the Indo-Pacific are readily available, and it is easy to organize farming trials in villages because of the traditional marine tenure system. However, the emphasis is on developing farming systems which are highly transferable to more needy developing countries.





The CAC has wet and dry laboratories, a library and a computer room. On-site accommodation is available for the scientific staff and for visiting scientists and trainees. The aquaculture facilities include a hatchery, and sufficient nursery tanks of various sizes to do well designed experiments and to produce juvenile bivalves for pilot commercial-scale farming trials. The CAC's protected coral reef provides a venue for marine biological and ecological studies and for experimentation with ocean farming systems.



Giant Clams

Research on giant clams in New Guinea and Micronesia had, by 1985, confirmed that these unique phototrophic bivalves could be cultivated. Attributes of the various species, such as high prices of the meat, particularly for sashimi and aquarium markets, their preference for shallow water, and their cost-free mode of feeding (giant clams get their food from organic compounds produced by the minute zooxanthellae algae within their tissues, and by filtering plankton from the water), suggested that the largest species, *Tridacna gigas*, would be most suitable for farming near coastal villages. The CAC's first task was to develop farming systems which would enable giant clams to be produced cheaply and on a large scale by village-based producers.

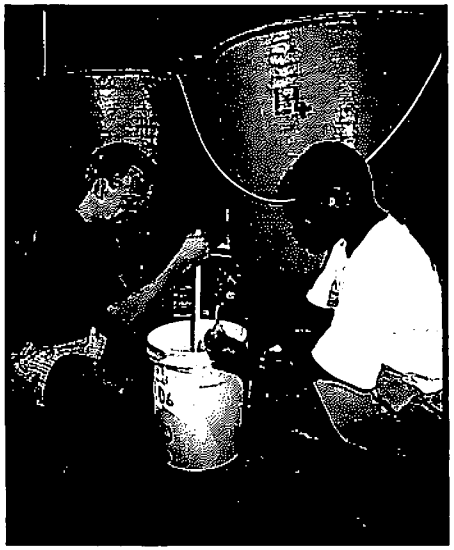
The CAC acquired its first batch of giant clam broodstock in July 1987 and the first cultured juveniles were placed in villages in October 1988. During the following five years, the CAC distributed more than 60 cohorts (batches) of giant clams to 40 villages. Trials identified cultivation systems and habitats which yielded promising rates of growth and survival, and CAC staff are now working towards improving returns for village farmers. Current experiments aim to further reduce the cost of juveniles, increase growth and survival at village sites and to find better ways to transport giant clams alive to distant markets. Similar experiments on five other species of giant clam are now in progress.

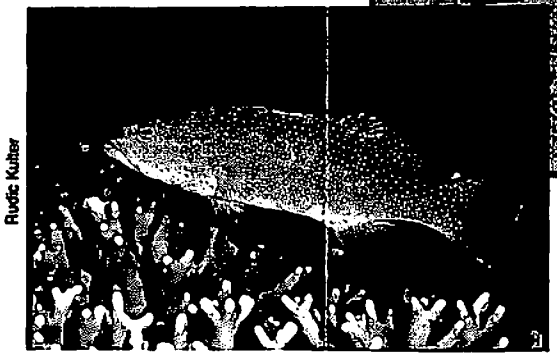
The CAC also operates a field station at Nusa Tupe, near Gizo in the Western Province of the Solomon Islands. This facility is used principally for experiments to solve ocean nursery problems encountered by village-based giant clam farmers, and to rear selected cultured juveniles as future broodstock. The station's leasehold extends over 17 ha of protected coral reefs, sea grass beds and reef flats and is an excellent study site for many aspects of coral reef ecology. It has limited accommodation for trainees and visiting researchers.

The CAC also produces juvenile giant clams for re-establishing populations where overexploitation has extinguished stocks. Shipments have been sent to the Philippines and Western Samoa and the first batch sent to the Philippines is now approaching reproductive maturity. Staff from the CAC have been instrumental in developing protocols for such shipments to ensure that genetic diversity is maintained and that the risk of transmitting disease is minimized.

Collaboration

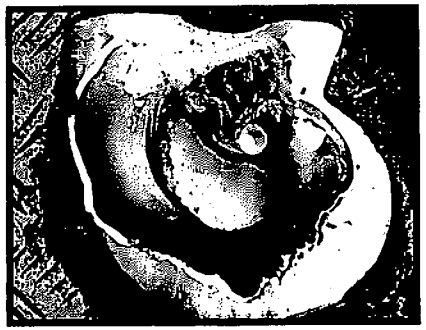
The CAC relies on collaboration with advanced scientific institutions, and governmental and non-governmental agencies to discover how to increase the productivity of coral reefs and manage them for the sustained benefit of coastal communities. The CAC provides a venue for research on aquaculture and fisheries enhancement, but is also available for use by collaborators seeking to understand and develop other ways to achieve these goals, e.g. by the use of marine protected areas and the application of traditional knowledge to modify catch rates. Future development of the CAC will center around increasing the capacity for research and training by constructing additional experimental facilities and accommodation for visiting scientists, postgraduate students and trainees.





Rudie Kuiter

Other Species



Forum Fisheries Agency

The CAC is committed to developing simple, low-technology aquaculture systems for a wide variety of species of fish and invertebrates which are associated with coral reefs. Recent initiatives with other species include spawning and rearing various species of sea cucumbers to determine whether they will be suitable for farming or restocking wild populations, and testing systems for the collection of larval blacklip pearl oysters caught in various coastal habitats which might enable viable pearl oyster farms to be established in coastal villages. The CAC will also be assessing the cost-benefit of enhancing populations of trochus, green snail and selected species of reef fish with juveniles produced in simple hatcheries.

as locations of nurseries and egg depositions, improved fisheries monitoring systems, environmental education programs, and wider and better options for alternative livelihood available to fishers.

- Marine protected areas (MPAs). MPAs may enhance local adjacent fisheries by acting as a source for movement of fish from unfished to fished areas. A potentially more important role for MPAs is protection of spawning stocks (fish stocks that may produce eggs). In the long term they may be the only viable solution to the problem of declining size of spawning stocks, and thus act as an insurance policy against fishery collapse. Development of tourism in or near MPAs is another potential benefit to local communities.
- Mariculture ventures. Raising of organisms such as algae, giant clams, grouper and shrimp in ocean pens or enclosures has potential and is best approached at the community level.
- Fisheries enhancement programs. Fisheries enhancement, the augmenting of natural stocks with hatchery raised seed, now appears to be a viable option provided that the fishery is properly managed, e.g., the Japanese now rear and release juveniles of 86 marine species back into the sea. The Chinese have recently established a viable shrimp fishery where one previously did not exist.

For more information and/or assistance regarding artificial reefs in the Philippines, you may contact:

- The Director, Marine Research Division
  Philippine Council for Aquatic and Marine Research and Development
  Los Baños, Laguna 4030
  Tel/Fax 0973 782886

- The Chief, Coastal Resources Management
  Bureau of Fisheries and Aquatic Resources
  Arcadia Bldg.
  860 Quezon Avenue, Quezon City
  Tel 965465, 965444
  Fax 988517 or 991249

- The Program Leader
  Aquatic Environments Program
  ICLARM, Bloomingdale Bldg.
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  0718 Makati City
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  Fax 816 3183

Details on the negative and positive features of artificial reefs, an inventory of artificial reefs deployed in the Philippines, and alternatives to artificial reefs can be found in the proceedings of a workshop on artificial reefs in the Philippines* published by ICLARM and the German Development Service.

*Munro, J.L. and M.C. Balgos, Editors. 1995. Artificial reefs in the Philippines. ICLARM Conf. Proc. 49, 56 p.

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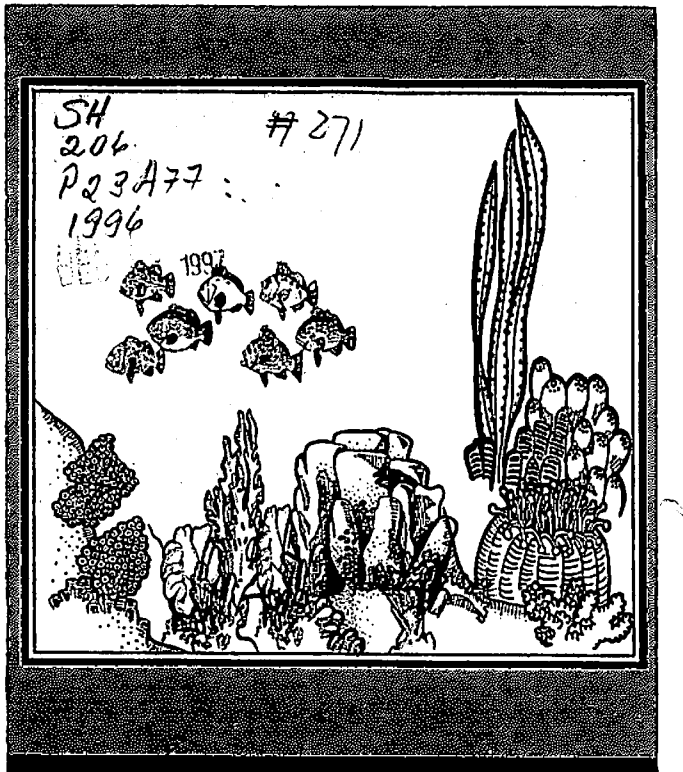

Artificial reefs in the Philippines: are they the best solution?

What are artificial reefs?

Artificial reefs are sets of any hard structure or material placed on the seabed to provide dwellings for fish and other marine organisms. The word module is used to refer to a single standardized structure that is a part of an artificial reef. Modules can be combined in various arrangements to form an artificial reef.

What are they used for?

Artificial reefs are believed to have some or all of the following ecological and socioeconomic functions which they share with natural reefs:

- habitat or shelter for fish and other marine organisms
- substrate or base on which corals may form new colonies and on which other marine organisms grow anew
- feeding, breeding or nursery area
- deterrent to trawling
- eco-tourism and other recreational purposes
- recycling scrap materials
- mariculture or sea farming
- fishing ground
- entry point for coastal management initiatives
- focus for propaganda purposes of vested interest groups
- providing a known and easily located fishing area.

All of the ecological functions of artificial reefs mentioned above are generally beneficial. The impact may be positive through increased survival if there are limited coral reefs in the area on which young fish may take refuge and if no fishing is done on the artificial reef. It can also provide substrate for settlement of fish and growth of algae and other marine organisms on which other organisms feed. However, artificial reefs are generally too small in comparison to natural reefs to have any significant impact on total fish production. For example, the area covered by all the artificial reefs deployed in the Philippines since 1977 (~50 000 modules) is approximately within 0.1-2.0 km^2, less than a hundredth of 1% of the country's total coral reef area.

Why are artificial reefs popular in the Philippines?

Artificial reefs have become popular as a fisheries management tool with the rise in coastal management efforts in the country. Artificial reefs have become instrumental in drawing coastal communities together bound by common concerns for fisheries resources protection and restoration. Artificial reefs help to show that coral reefs and other marine ecosystems are invaluable and must be protected from destruction. Moreover, artificial reefs aggregate fish rapidly, making fishing more effective. However, artificial reefs may not be the best solution to fisheries management problems.

What problems constrain the usefulness of artificial reefs as resource management tools in the Philippines?

- There are no clear-cut policies on the construction, use and management of artificial reefs. Most of the reefs have been put up without clear objectives or purpose, e.g., whether for fishing or habitat enhancement.
- Artificial reefs have been deployed or set up without compliance with guidelines on module construction and deployment; most of the reefs deployed since 1977 have been washed away or have disintegrated.
- There are no management plans in place that govern the use of artificial reefs such that overfishing and ownership of artificial reefs have become unresolved issues.
- There are no monitoring systems to determine the status of artificial reefs.
- Most of the fish harvested on artificial reefs come from adjacent ecosystems which are already overfished. Thus, they add to the overfishing problem.
- Sustainable, cost-effective fishing on artificial reefs is difficult to attain because of the low harvest attributable to the artificial reef itself and the high cost of enforcing fishery regulations.
- Adding to habitat space does not generally improve fish yield in areas which are already overfished, and therefore have excess fish habitat available already.
- In areas where coral reefs have deteriorated, it is more important to halt the source of deterioration and permit natural recovery rather than to replace degraded habitats with costly artificial structures — in fact, the same deterioration may limit the viability of the new habitats.

What are some alternatives to artificial reefs for resource management?

- Better environmental management programs, with greater emphasis on lessening environmental problems which threaten the sustainability of coastal zones, e.g., deforestation, mining, road construction and poor land use leading to erosion and siltation; sewerage and garbage disposal.
- Better fisheries management programs. The bases for such programs could include greater involvement of village fishing communities in fisheries management, e.g., development of local fishing cooperatives as a means for effort control, taking greater account of local knowledge of the stocks, such