bombs could easily kill many of the reef organisms including giant clams.

We may never know what caused these great giants to disappear, but it is not too late to save the remainder from going extinct. The clean waters of the islands on the east coast of Peninsular Malaysia, as well as East Malaysia, are still conducive for the survival, growth and propagation of giant clams.

Ecotourism is becoming more important as the public realises the importance of conservation and a clean environment. Many of the coral reef islands in Malaysia are pristine and healthy. Research on giant clams has been conducted to improve the status of these islands and at the same time return a lost heritage to its natural home. In doing so, the public was educated on the value of conservation and ecotourism. The local language is interspersed with words describing giant clams. Conservation and tourism can co-exist and bring mutual benefit to both.

Figure 2. Giant clams were once so abundant that the shells were used as construction material.

SEAFDEC's stock enhancement programme

Wenresti G. Gallardo[1]

Background

The Aquaculture Department of the Southeast Asian Fisheries Development Center (SEAFDEC) has four regular programmes that focus on urgent aquaculture issues in Southeast Asia. One of the programmes, which began in September 2000, addresses stock enhancement. SEAFDEC/AQD first became involved in stock enhancement in 1991 through the Community Fishery-Management Project, undertaken in Malalison Island, Culasi, Antique (west central Philippines). The importance of stock enhancement was articulated as early as 1969 in the Kyoto Declaration on Aquaculture (Sections 17 and 18) and later affirmed in 2000 in the Bangkok Declaration and Strategy for Aquaculture Development (Sections 3.9 and 3.10), and then again in 2001 during the ASEAN-SEAFDEC Conference on Sustainable Fisheries for the New Millennium. One of the 10-point recommendations in the Millennium Conference is to: *Promote re-stocking activities (seed release programmes) from hatchery-produced stocks and/or wild collected sources in areas where they are considered to be feasible, particularly in localities operating within a regime of rights-based fisheries*.

Programme components

The stock enhancement programme of SEAFDEC/AQD has two research components:

1. Adaptation and refinement of breeding and hatchery production techniques of appropriate species for stock enhancement.

   The breeding component brings together previous works on the propagation of the abalone (*Haliotis asinina*), top shell (*Trochus niloticus*),

1. PhD, Program Leader for Stock Enhancement, SEAFDEC Aquaculture Department, Tigabuan, Iloilo, Philippines. Email: Gallardo@aqd.seafdec.org.ph

window-pane oyster (*Placuna placenta*), and seahorses (*Hippocampus barbouri* and *H. kuda*). Other species such as grouper and siganid, for which hatchery technologies have been developed, are being evaluated for their suitability for stock enhancement.

2. Development of strategies for release and stock enhancement of appropriate species.

   Research studies are aimed at determining the optimum release method, animal size, season, habitat and density that will result in high survival, growth and reproduction of the released animal.

The stock enhancement programme also has training and information components such as:

1. Seminars and training on stock enhancement for fishers, local government units and non-governmental organisations.

2. Production of information materials, such as flyers to enhance people's awareness of stock enhancement efforts.

Abalone

Abalone is a high value species of gastropod mollusc that inhabits rocky and coral reefs. Its large "foot" is one big muscle that is sold either frozen or canned and is highly prized in Chinese cuisine. Due to its high market demand, overharvesting from the wild could result in its depletion, thus, stock enhancement in protected areas is necessary.

SEAFDEC/AQD started its research on abalone in 1993 with the aim of developing and refining hatchery and grow-out culture techniques. With the development of hatchery technology, abalone juveniles can now be mass-produced. For stock enhancement purposes, juveniles are "diet-tagged" by feeding them with artificial diet for three to four weeks followed by seaweed feeding. The bluish-green shell band produced through artificial diet feeding serves as a permanent marker of hatchery-produced abalone when released to the wild. Efforts are also being made to produce and release first generation offspring of wild spawners from the release sites to maintain genetic integrity of natural stocks.

SEAFDEC/AQD researchers have evaluated potential stock enhancement sites in Panay and Negros Islands and have selected Sagay Marine Reserve in Negros Occidental as a pilot stock enhancement site. Preliminary releases of hatchery-produced abalone in Sagay Marine Reserve have produced encouraging results. This research aimed at determining the optimum release size, habitat, season and density, will continue with funding support from the International Foundation for Science (IFS).

Top shell

The top shell, *Trochus niloticus*, is another highly valuable gastropod mollusc. Its mother-of-pearl shell is used in the manufacture of buttons and other shell craft. The uncontrolled harvesting of top shell from the wild has resulted in the decline of natural stocks.

SEAFDEC/AQD started its research on top shell in 2000 with some broodstock obtained from Iris Marine Development Corporation, which operates a trochus hatchery in Palawan. SEAFDEC/AQD reared some broodstock and was successful in inducing it to spawn (see *SPC Trochus Information Bulletin* #9, p. 14). Thousands of juveniles have been produced and diet-tagged in preparation for release. In February 2003, more than 3000 top shell juveniles were brought to Palawan for release in a marine sanctuary in Binduyan, Puerto Princesa. The initial release was carried out by participants of the training course on Fish Sanctuary and Trochus Shell Resources Management conducted by the BFAR-Fisheries Resource Management Project (FRMP) in Palawan. SEAFDEC continues its efforts to refine seed production techniques to enable mass production of seeds for stock enhancement.

Window-pane shell

The window-pane shell, *Placuna placenta*, is a bivalve mollusc whose shells are used as lampshades and other shell craft marketed locally and internationally. The reported decline in natural stocks prompted SEAFDEC/AQD to resume its research on the species in 1990. SEAFDEC/AQD researchers have succeeded in propagating the species in the hatchery. Juveniles can be reared to larger sizes in tanks so that their survival rates in nature are increased once they are released. Initial attempts have also been made to restock the depleted beds along the Gulf of Panay by releasing both immature and breeding stocks collected from a neighbouring island. Close collaboration with the concerned local government has also resulted in the closure of the stock enhanced area to all forms of gathering so that a viable breeding population can be established. However, with the discovery of juveniles by fisherfolk, gathering was difficult to control. Closer cooperation of the fisherfolk and local government and the establishment of a permanent protected area are necessary so that a breeding population will always be available to repopulate the area.

Giant clams

SEAFDEC/AQD is collaborating with the Marine Science Institute of the University of the Philippines (UP MSI) in the restocking of giant clams *Tridacna* spp. UP MSI is distributing hatchery-produced giant clam juveniles to various parts of the Philippines in efforts to save and enhance the stocks of this endangered species. SEAFDEC/AQD received *Tridacna gigas* juveniles from UP MSI in October 2001 and these were reared in tank and ocean nurseries and then restocked in coral reefs in SEAFDEC/AQD's Igang Marine Substation in Guimaras Island. Restocked giant clams are growing well and the remaining giant clams in cages will be restocked in other protected areas such as Sagay Marine Reserve in Negros Occidental.

Seahorse

Commanding a good price either in live form for the aquarium trade or in dried form for traditional Chinese medicine, seahorse collecting in the Philippines and other parts of Southeast Asia is a good supplemental livelihood activity. However, because uncontrolled fishing will deplete natural stocks, seed production and stock enhancement techniques should be developed, coupled with other conservation measures.

Seahorse research at SEAFDEC/AQD started in 1996. Seahorse juveniles have been produced so that SEAFDEC/AQD now has at least second-generation, hatchery-bred animals in captivity. Sites are now being assessed where seahorse juveniles may eventually be stocked.

Commercial trochus button production in Hong Kong

Note from the Editor:

Head Crown Trading Limited is a Hong Kong-based company dealing in buttons and related trade, and is a key supplier of trochus buttons in Asia. Through the kind permission of Derek Put, we are able to reproduce a set of trochus button pictures produced by the company. Readers can get an e-copy of these button pictures by looking on the company website. Company details are given here for those who are interested.

Mr Derek Put
Marketing Research Executive (Asia-Pacific)
Head Crown Trading Limited
Room 1605, 16/F, Hewlett Centre
54 Hoi Yuen Road, Kwun Tong
Kowloon, Hong Kong

Telephone: +852 2763 1827
Fax: +852 2342 7481
Email: derekput@headcrowntrading.com
Web: www.headcrowntrading.com

PIMRIS is a joint project of five international organisations concerned with fisheries and marine resource development in the Pacific Islands region. The project is executed by the Secretariat of the Pacific Community (SPC), the South Pacific Forum Fisheries Agency (FFA), the University of the South Pacific (USP), the South Pacific Applied Geoscience Commission (SOPAC), and the South Pacific Regional Environment Programme (SPREP). This bulletin is produced by SPC as part of its commitment to PIMRIS. The aim of PIMRIS is to improve the availability of information on marine resources to users in the region, so as to support their rational development and management. PIMRIS activities include: the active collection, cataloguing and archiving of technical documents, especially ephemera ('grey literature'); evaluation, repackaging and dissemination of information; provision of literature searches, question-and-answer services and bibliographic support; and assistance with the development of in-country reference collections and databases on marine resources.

PIMRIS

Pacific Islands Marine Resources Information System