Farming the giant clam

By **MB Surtida** and **RY Buendia**

Aquaculture and enhancing stock density along reef coasts: hitting two birds with one stone. That's what the culture of giant clam promises.

The Philippines is home to seven giant clam species (*Tridacna gigas, T. derasa, T. squamosa, T. croces, T. maxima, Hippopus hippopus* and *H. porcellanus*).

In 1983, *T. gigas* and *T. derasa* were included in the list of endangered species during the convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) to regulate its commercial trade. In 1985, all the other species of giant clams were included in the list (the so-called Apppendix II) to eliminate problems in identifying giant clam derivatives of the different species. As signatory to the convention, the Philippines has banned the exportation of all giant clams.

The Fisheries Statistics of the Philippines has reported harvests of giant clams to be 243 tons in 1976, 11,930 tons in 1980, 7 tons in 1983, and 68 tons in 1984. This decline has been attested to by Dr. Hilconida Calumpong, Director of the Silliman University Marine Laboratory (SUML) in Dumaguete City when she said that when she was in Cuyo Island in 1978, she could walk on wide areas of giant clams in the intertidal areas. Ten years later, the giant clams were gone. A distribution study by Calumpong and Cadiz in 1993 (five of 6 sample sites are protected areas) again showed that no *T. gigas* and *T. derasa* were found while *T. crocea* and *T. maxima* populations were stable. The last two are boring clams (they embed in coral heads) and are thus more difficult to harvest; it is safe to assume that the other three species are endangered.

What are giant clams?

Giant clams are slow growing, long living organisms, and the largest living bivalve shells in the world. They are found in tropical waters (in clear water, barrier protected lagoon environments) of the Indo-Pacific like Papua New Guinea, Indonesia, Malaysia, Palau, Northern Australia, and the Philippines. They reach sexual maturity in 4-5 years. Experts refer to them as unique because they manufacture their own food through the algae that live on them, similar to corals. The algae supply food to the clams through photosynthesis which supply sugars and nitrogen-rich compounds. Referred to as "built-in food factories," giant clams need only sunlight, water, and carbon dioxide in order to make their food. This is considered an advantage because in culture, feeding is entirely omitted.

When sexually mature, clams continuously release millions

The breeding tank at Silliman University (SU) contains breeders of two species. Drs. Hilconida Calumpong, Director, and Janet Estacion, Assistant Director of the SU Marine Laboratory with Ms. Agnes Apao and Mrs. Jacinta Lucanas, both study leaders, explain the breeding habits of the giant clams being studied

The giant clam culture project in the Philippines

The giant clam culture project in the Philippines started in 1984 with a joint collaborative project of eight Indo-Pacific countries spearheaded by Australia and supported by the Australian Center for International Agricultural Research (ACIAR). The objectives of the project were to develop culture techniques for giant clams for food and for restocking of depleted reef areas. Collaborating institutions were the Silliman University - Marine Laboratory in Dumaguete City, and the University of the Philippines - Marine Science Institute in Diliman, Quezon City. Today, after many scientific studies and conferences, culture techniques are nearing perfection, and hopefully would be picked up by an industry to supply a growing market and continue what has been initiated in the restocking of depleted reefs.

The institutions working under the ACIAR collaboration are willing to extend information and technology to interested parties. *-- MBS*

of eggs in a day, spawning being triggered by diurnal, lunar, and environmental cues. However, mortality in the wild is high during this period. Lucky survivors settle on hard substrate, transform into juveniles, attach their byssal threads on reefs for anchor, and arrange themselves so that their mantles face the sun. Until 2.5 years, clams are vulnerable to predation. Growth during this period is fast, about 2.5 cm per yr in ideal reef flats. In degraded coasts, clam survival at this point is almost nil.

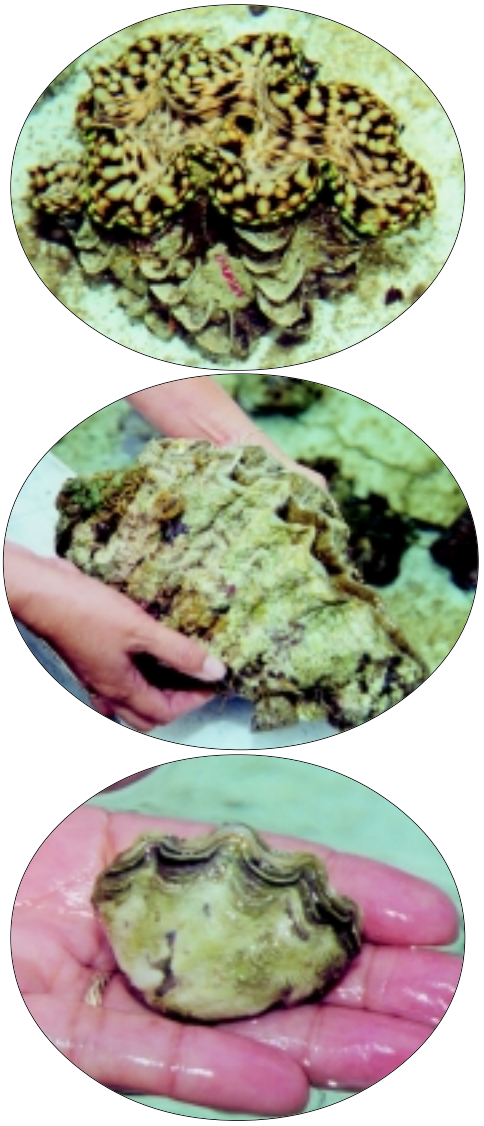
Until clams become adults, they undergo several development stages much like other bivalves: egg, gastrula, trocophore, veliger, juvenile. Fertilized eggs undergo gastrula to trocophore stages in 12 hr. After this, they become trocophores, by which time, they are still incapable of ingesting food particles. When the digestive system is complete (the veliger stage), they can now take small phytoplankton, three days after fertilization. In SUML, they are fed *Isochrysis galbana*. Veligers then metamorphose to juvenile clams 2 weeks after fertilization. Juveniles can be harvested 3-4 months after fertilization when they range from sizes 1-10 mm. From egg to juvenile, mortality is 99%.

How may clams be farmed?

Transfer of juveniles to the ocean environment can be done in intertidal areas with clear water, high salinity (away from freshwater runoffs), and good circulation. Clams are placed in trays, cages, enclosures or a combination of either on or without substrates. These areas would ensure that there is less fouling of cages, predation on clams is less severe, and human access for farm management is easier. For a cage size 1 x 5 x 0.3 m, approximately 100 juveniles (30-40 mm) can be stocked. For bigger juveniles, (70-80 mm), fewer clams should be stocked (30 ind).

By this time, clams are now relatively ready to survive by themselves. After 12-18 months in the nursery, giant clams of size 20 mm may be transferred to the growout phase. The site must first be considered with regard to the species used.

Tridacna squamosa *(top), has ruffles on its shell, well distinguishable from* H. hippopus *(middle) and the rest of the giant clams which have none while* T. crocea *(bottom) is the smallest giant clam. These are the three giant clam species now being studied at SUML. The T. squamosa photo shows the ruffles on its shell and an open colorful mantle. Giant clams close shells when taken from the water.*



T. gigas and *H. hippopus* are suited to intertidal zones while *T. derasa* and the others are grown best in shallow subtidal sites. By this time, protective cages are no longer necessary. A nylon netting atttached to floats (similar to a floating fence) may be helpful in excluding large predators and marking the farm area. The clams may be left in these areas for several years until harvest.

It is best to refer to a paper from SUML by Calumpong and Solis-Duran about constraints to restocking. The paper showed that of 26 sites restocked (more than half were marine sanctuaries, two were resorts, and one seaweed farm), the coral reefs yielded highest overall survival, followed by sandy areas and seagrass beds. Growth rates were comparable in these areas. The study also showed that restocking can be successful especially if the areas are protected from typhoons and poaching, and careful handling of clams is practiced. Survival is as much as 60%. But restocking must be measured not in terms of survival but on the recruits that have been traced to the restocking, thus, the necessity for markers.

Adult giant clams can grow to over 1 m length (*T. gigas*) making it the world's biggest bivalve mollusc. According to Tisdell, this species is sometimes referred to as the killer clam, arising from the reputation for closing on divers, thus preventing them from returning to the surface. *T. derasa* is the second largest while *T. crocea* is the smallest. In SUML, 8-9 year old *T. crocea* are about 20 cm length.

The market for giant clams

In the Philippines, giant clam meat is popular to coastal dwellers, especially if typhoons and monsoon rains prevent the fishers from going farther out to sea to fish. In 1987 (clams must still have been plentiful), fresh clam meat cost ranges were ₱7-25 in Guiuan, Samar; Naic, Cavite; Polillo, Quezon; and Alaminos, Pangasinan. In Bongao, Tawi-Tawi, giant clams cost ₱5 per bunch.

In Cebu and Negros Oriental, live *T. squamosa*, *T. maxima*, and *H. hippopus* 7.5 - 40 cm long cost ₱2-50 per pc. These are usually sold for the marine aquarium industry.

In Palawan, dried adductor muscle cost P70-120 per kg reportedly sold offshore to Taiwanese and Japanese vessels while in Cagayancillo Island, shells of giant clam (paired and unpaired) 7.5 - 13 cm long cost P0.60-14/kg. Adductor muscles of large

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The United States has grown to become the single largest pearl jewelry consumer, purchasing US$1.47 billion, or 36% of the global pearl jewelry sales. Europe, which accounted for only a small fraction of the pearl market five years ago, is seeing its market share expand at a tremendous pace, with wholesalers reporting substantial growth year after year. The European pearl jewelry market is estimated at US$700-900 million. Meanwhile, Tahitian cultured pearl exports are expected to exceed 7,000 kg in 2000. Annual reports of Tahitian pearls were about 5,000 kg in 1996 and 1997; and more than 6,000 kg in 1998 and 1999. The Philippines, on the other hand, continues to establish itself in the international pearl market with exports increasing 22.8% to 586,665 g or 156 kg in 1999 compared with 1998.

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Lucinidae) that harbors symbiotic bacteria. This shell family has also been observed to live in hydrogen sulfide-rich habitats such as sewage outfalls, seagrass beds, mangrove swamps, and in organically rich sediments.

This means, researchers say, that *imbao* harbors symbiotic sulfur-oxidizing bacteria in its gills and has the mechanism within itself to use up sulfide. This capability would make *imbao* useful if raised in polyculture with shrimp. It is a fact that brackishwater pond sediments contain plenty of sulfide, particularly where the cultured animals are fed protein-rich diets. *Imbao* can very well answer this problem – and make aquaculture more environment-friendly.

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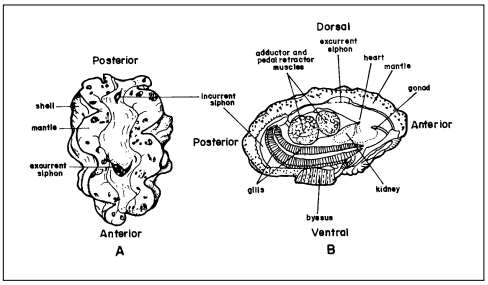
clams are popular for export. But it is important to note that in order to produce meat biomass and supply the adductor muscle/mantle markets, time for which capital and resources are tied up prior to sales is lengthy, thus quick returns are not possible.

In Australia, farm-gate price of fresh clam meat ranges from $A3 to 7. In 1986, it was reported that Taiwan demand for adductor muscle of 100 ton/yr was at $US 7.50 - 21.25/kg.

The giant clam life cycle shows its stages of development



The parts of the giant clam shows the adductor muscle which is the most valuable part of the clam for export purposes. The adductor muscle is highly priced in Japan for sashimi and fetches a good price

Conclusion

Experts say that the giant clams (nearing extinction in most parts of the world) are attractive to farm for economic, social, and ecological reasons because of their innate characteristics - selffeeding, sedentary habit, adult resistance to predation. Besides, technology for its mass production from breeding to harvest has been proven successful in many parts of the Indo-Pacific. But its development as an industry is difficult to appreciate considering the duration that capital is tied up to production. Perhaps its importance lies not so much on its promise for immediate profits but on its ecological importance to coasts worldwide. Resembling big trees in primary forests, their importance cannot be measured immediately but their contribution is far-reaching and simple, one fails to see it. As in most ecological issues, the profit is promised for the coming generations. ###