

Mangrove-associated mollusc research at SEAFDEC/AQD

TERESA R. DE CASTRO-MALLARE

Southeast Asian Fisheries Development Center
Aquaculture Department
5021 Tigbauan, Iloilo, Philippines
<decastro@aqd.seafdec.org.ph>

Abstract

Mollusc research at the Aquaculture Department of the Southeast Asian Fisheries Development Center started in 1975 and focused on two commercially important mangrove-associated bivalves, the slipper-shaped oyster (*Crassostrea iredalei*) and the green mussel (*Perna viridis*). Studies conducted were on spatfall forecasting to increase collection of seeds from the wild; improvement of farming techniques; seed production in the hatchery; bivalve sanitation; and transplantation. These studies have led to the development of a suitable spat collector for oyster and mussel; promotion of the raft culture method for oysters and mussels to prevent siltation of growing areas, including a low-cost raft designed for this purpose; refinement of transplantation techniques to increase production and to grow oyster and mussel in suitable areas without natural populations; and design of a prototype low-cost depuration unit.

A socio-economic study of oyster and mussel farming practices in Western Visayas provided information on current farming practices and profitability. A study done on the use of green mussels as biofilter in a semi-intensive shrimp pond showed that shrimp stocked with mussels grew faster than those without.

A study on the biology and fishery of the "imbao" *Anodontia edentula*, another mangrove-associated bivalve, is ongoing. Spawning has been achieved in the laboratory and larval stages monitored were first polar body, 2-cell stage, morula, ciliated gastrula, trocophore, veliger, and pediveliger.

Introduction

Molluscs are considered cheap sources of protein. In 1996, world production of mollusc constituted about 32% of total world aquaculture production. Oysters and mussels together constitute 49% of world production of molluscs (FAO 1997).

The SEAFDEC Aquaculture Department started work on molluscs in 1975. Studies focused on two mangrove-associated bivalves, the slipper-shaped oyster (*Crassostrea iredalei*) and the green mus-

sel (*Perna viridis*=*Mytilus smaragdinus*) (Young & Yap 1984). Techniques were developed to: (1) increase collection of seeds from the wild, (2) improve farming techniques, (3) produce oyster and mussel seeds in the hatchery, and (4) improve sanitation and quality of bivalves (SEAFDEC/AQD 1983).

Another mangrove-associated mollusc studied is the brown mussel, *Modiolus metcalfei*, which is also widely distributed in the Philippines. However, a study on spat settlement showed that the brown mussel is not a good candidate for aquaculture because the spats do not settle on or attach to any type of artificial substrate except to adult mussels (Yap 1978).

Studies were also conducted on other species with high economic value, including the window-pane oyster or "kapis" (*Placuna placenta*), the Asian-moon scallop (*Amusium pleuronectes*), and the saddle-shaped oyster or "bay-ad" (*Placuna sella*).

At present, studies are being conducted on the broodstock management, seed production, grow-out culture techniques and artificial feeding of the donkey-eared abalone, *Haliotis asinina*. The biology and fishery of another mangrove-associated bivalve, *Anodontia edentula* are also being studied.

Oysters and mussels

SEAFDEC/AQD started the Mussel Research Project in 1976 with a grant from the New Zealand Government. The Project undertook a survey of the mussel farming industry in the Philippines to assess the status of the industry and to identify research gaps, and conducted studies on the biology and farming of green mussels (Tortell *et al.* 1978; Yap *et al.* 1977; Yap *et al.* 1979).

Oyster and green mussel farming are dependent on natural spatfall. To improve settlement success, a spatfall forecasting program for oyster was started in Himamaylan River, Himamaylan Negros Occidental in 1979 and for the green mussel in Batan Bay, Batan, Aklan in 1981. This program had two main monitoring activities: (1) daily counts of oyster/mussel larvae in the plankton and (2) actual settling of larvae on standardized collectors installed in oyster/mussel farm sites. Researchers from SEAFDEC/AQD developed a suitable spat collector for oyster and mussel which can also be used for grow-out culture (Figure 1). Observations showed that spatfall is imminent when the count of mature larvae exceeds 5/100 ml and persists for at least 3 days. For commercial farming operations, a good or substantial set of oyster seed should yield at least 15 spats/shell for a 40 m surface area, while for mussels, it would be a seed count of 200-500 spats/m of rope or 70-85 spats per 30 cm (Young & Traviña 1983; Young *et al.* 1981).

Oyster and green mussel farming in the Philippines makes use of bamboo stakes as cultch for settling oyster-mussel larvae and for grow-out. Fishfarmers using this method do not practice thinning or transplantation. The main problem with the prolonged use of bamboo stakes is siltation. To overcome this problem, researchers at SEAFDEC/AQD advocated the use of the raft method for mussel culture (Figure 2) which was also adopted for oyster culture (Yap *et al.* 1979; Sitoy *et al.* 1983). This culture method has several advantages: (1) mussels/oysters grow faster and have higher survival rate, (2) transplantation and thinning can be done easily, (3) production is higher, and (4) the hanging ropes do not accumulate silt and are thus more environment-friendly. The raft culture method has a potential return-on-investment of 74% and a payback period of 0.9 years.

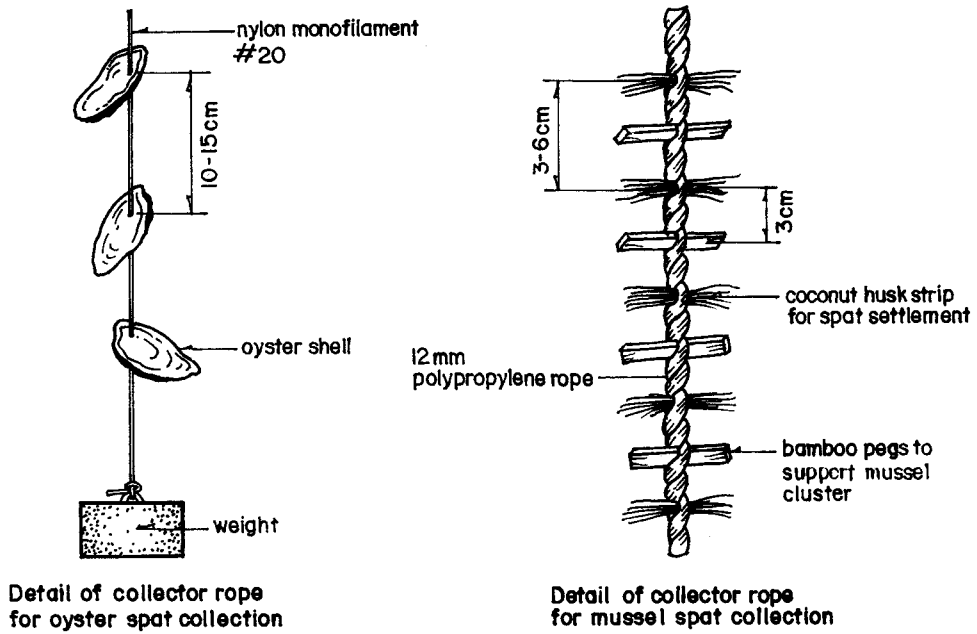


Figure 1. Details of collector ropes for oysters and mussel spat collection

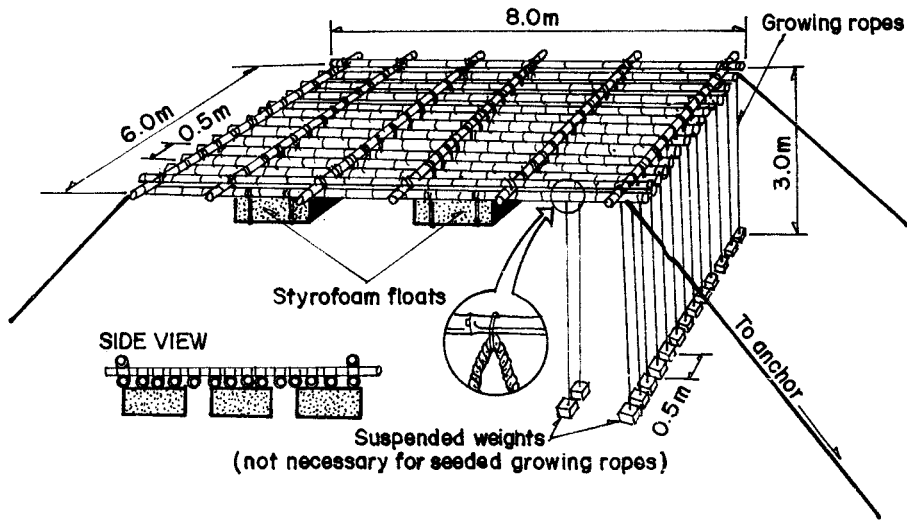


Figure 2. Details of raft for mussel and oyster culture (Yap *et al.* 1979; Sitoy *et al.* 1983)

In 1997, SEAFDEC/AQD started verification studies on the use of the raft culture method in commercial scale in three towns in Capiz and Aklan. Initial results have shown that it is commercially viable to culture oysters and mussels using the raft culture method.

To ensure continuous supply of seeds, SEAFDEC/AQD started seed production of bivalves in 1979. Young (1979) successfully spawned the green mussel in the laboratory. The slipper-shaped oyster was also successfully reared through its larval stages to metamorphosis and settlement (Ver 1986; Young unpubl.). Although there is available technology for the mass production of spats in the hatchery, oyster and mussel farmers still prefer to collect spats in areas with abundant natural spatfall because it is cheaper.

Oyster and green mussels can be transplanted or grown in suitable areas without natural populations. SEAFDEC/AQD in collaboration with the Philippine Council for Agriculture Resource and Research and private cooperators established mussel farms using transplanted mussel spats in Ticpan Bay and Calape Bay, Calape, Bohol and Balete Bay, Mati, Davao Oriental. These areas do not have natural mussel spatfall (SEAFDEC/AQD 1981).

Mussel spats for transplantation need a binding material to temporarily bind them to the new growing rope. Researchers from SEAFDEC/AQD found that medical gauze is effective. The gauze disintegrates just as the mussel spats have attached themselves to the new growing rope. Oyster spat collectors only need to be transferred to the new growing area.

The export market for oysters and mussels is quite attractive but public health concerns make it difficult for the Philippines to pass rigid standards for export. In 1983, SEAFDEC/AQD researchers devised a prototype low-cost depuration unit suitable for local conditions (Figure 3). Oysters were

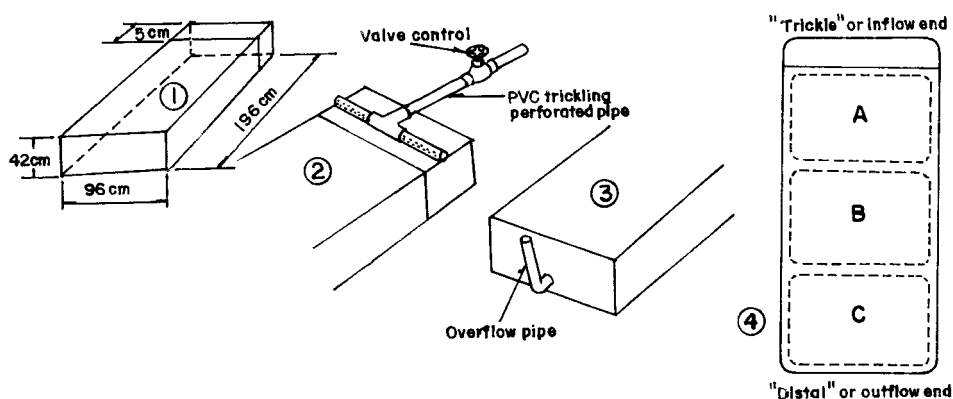


Figure 3. **Prototype low-cost depuration unit** (Gacutan *et al.* 1986): (1) depuration tank of marine plywood; (2) water trickles through this perforated pipe; (3) overflow of pipe where water is drained; (4) depuration tank areas (a, the inflow area nearest the water trickle; b, the middle area; c, the outflow end)

depurated using seawater sand-filtered in a flow-through system and seawater sterilized either through chlorination, ultraviolet radiation, ozonation, and treatment with polyvinyl-iodine-iodine. Ultraviolet-treated water was found to be 99% efficient after 48 h in terms of bacterial disinfection efficiency (Gacutan *et al.* 1986). UV radiation of seawater has no residual effect, is easy to use, and is comparatively inexpensive.

The increasing incidence of red tide in the country is cause for alarm. The first report on red tide occurred in 1983 in Western Samar and Leyte. The causative agent, *Pyrodinium bahamense* var. *compressa* can cause fatal Paralytic Shellfish Poisoning (PSP) in humans. SEAFDEC/AQD did studies to determine the toxicity of contaminated green mussels (Gacutan *et al.* 1984) and to test the use of ozone and PVP-iodine-iodine to inactivate the PSP toxin.

Studies on the socio-economics of oyster and green mussel farming practices in Western Visayas (Samonte *et al.* 1992) provided information on: (1) culture methods practiced by oyster and mussel farmers; (2) profile and social conditions of oyster and mussel farmers; (3) profitability of each culture methods; and (4) problems and constraints, and development potential of the oyster and mussel industry.

Another study made evaluated the use of green mussel as biological filter in semi-intensive shrimp (*Penaeus monodon*) ponds. Levels of suspended solids were lower while water transparency was higher in shrimp ponds with green mussels compared to those without. Shrimp grown in ponds with green mussel had significantly higher per cent weight gain and specific growth rate but survival and production were not significantly different (Corre 1997).

Imbao (*Anodontia edentula*)

A study on the biology and fishery of the "imbao" *Anodontia edentula*, another mangrove-associated bivalve, is now on-going. Field samplings revealed that "imbao" can be collected at mean depths of 25-30 cm (JH Primavera, pers. comm.). Monthly range of sizes of "imbao" was 42.8-51.1 mm mean shell length and 21.3-170.0 g total weight. Spawning and larval rearing in the laboratory showed that 0.3 ml of 4mM serotonin was effective in inducing spawning in female and male adults, but not temperature shock and ammonium hydroxide injection. Females that spawned ranged from 60 g, 57.4 mm shell length to 125 g, 73.1 mm shell length. The maximum eggs spawned by a 71 g female was 892,000. Developmental stages monitored were first polar body, 2-cell stage, morula, ciliated gastrula, trocophore, veliger and hatching of D-veliger.

Conclusions

Oyster and mussel farming is basically mangrove-friendly because it does not require the use of animal protein as feed. The raft culture method can be modified for shallower areas. Fishfarmers should be encouraged to use the raft culture method because it is environment friendly. Transplantation can be done in mangrove areas where natural oyster and mussel populations are scarce or absent.

References

- Corre KG. 1997. Growth, survival and production of shrimps (*Penaeus monodon*) with green mussel (*Perna viridis*) in semi-intensive ponds. University of the Philippines J. Nat. Sci.
- FAO. 1997. FAO Aquaculture Production Statistics, Data Series 1987-1996. FAO Fisheries Circular No. 815, Revision No. 10. 197 p.
- Estudillo RA and CL Gonzales. 1984. Red tides and paralytic shellfish poisoning in the Philippines. In: White AW, M Anraku and KK Hooi, eds. Toxic red tides and shellfish toxicity in Southeast Asia. Proceedings of a consultative meeting; 11-14 September 1984; Singapore. SEAFDEC, IDRC. p 52-79
- Gacutan RQ, MY Tabbu, TR de Castro, AB Gallego, M Bulalacao, L Arafiles and F Icatlo, Jr. 1984. Detoxification of *Pyrodinium*-generated paralytic shellfish poisoning toxin in *Perna viridis* from Western Samar, Philippines. In: White AW, M Anraku and KK Hooi, eds. Toxic red tides and shellfish toxicity in Southeast Asia. Proceedings of a consultative meeting; 11-14 September 1984; Singapore. SEAFDEC, IDRC. p 80-85
- Gacutan RQ, M Bulalacao, HL Baranda Jr. 1986. Bacterial depuration of grossly-contaminated oysters. In: McLean JL, LB Dizon and LV Hosillos, eds. Proceedings of the First Asian Fisheries Forum; 26-31 May 1986; Manila, Philippines. Asian Fisheries Society, p 429-432
- Gonzales CL. 1989. *Pyrodinium* blooms and paralytic shellfish poisoning in the Philippines. In: Hallegraef GM and McLean JL, eds. Biology, epidemiology and management of *Pyrodinium* red tides. ICLARM Conference Proceedings 21. p 39-47
- Samonte GPB et al. 1992. Socio-economics study of oyster (*Crassostrea iredalei*) and mussel (*Perna viridis*) farming in Western Visayas, Philippines. AFSSRN-SEAFDEC-AQD Team. Southeast Asian Fisheries Department Center, Aquaculture Department, Tigbauan, Iloilo, Philippines
- SEAFDEC/AQD. 1981. SEAFDEC/AQD 1981 Annual Report. p 21
- SEAFDEC/AQD. 1983. A decade of aquaculture research and development: a review. 15 p
- Sitoy HS, AL Young, and MY Tabbu. 1983. Raft culture of mussels. Extension Manual No. 8. SEAFDEC Aquaculture Department, Tigbauan, Iloilo, 12 p
- Tortell P, CE Orano and MY Tabbu. 1978. Mussel culture has good prospects as protein source. *World Fish*. 27 (2): 49
- Ver LMM. 1986. Early development of *Crassostrea iredalei* (Faustino, 1932) (Bivalvia: Ostreidae), with notes on the structure of the larval hinge. *Veliger* 29: 78-85
- Yap WG. 1978. Settlement preference of the brown mussel, *Modiolus metcalfei* Hanley and its implication on the aquaculture potential of the species. *Fish. Res. J. Philipp*. 3(1): 65-70
- Yap WG, C Orano and MY Tabbu. 1977. Biology and farming of the green mussel *Mytilus smaragdinus*. SEAFDEC *Quarterly Res Rep*. 1(2): 5-7
- Yap WG, AL Young, CEF Orano and MT de Castro. 1979. Manual on mussel farming. Extension Manual No. 6. SEAFDEC Aquaculture Department, Tigbauan, Iloilo. 17 p

- Young AL. 1979. Larval rearing of bivalve molluscs. Proceedings of the technical consultation on available aquaculture technology in the Philippines; 8-11 February 1979. SEAFDEC/AQD Tigbauan, Iloilo. p 247-251
- Young AL and RD Traviña. 1983. On predicting the settling season of the oyster *Crassostrea iredalei* in Himamaylan River, Negros Occidental. *Kalikasan, Philipp. J. Biol.* 12 (1-2): 107-114
- Young AL and WG Yap. 1984. *Perna viridis* (L.) 1758 as the correct name for the Southeast Asian green mussel (Bivalvia: Mytilidae). *Philipp J. Sci.* 113 (1/2): 1-9
- Young AL, E Gargantiel and RD Traviña. 1981. Preliminary studies on predicting the setting season of oysters for the benefit of shellfish farmers. SEAFDEC *Quarterly Res. Rep.* 5(2): 19-23