CMFRI

Course Manual

Winter School on

Recent Advances in Breeding and Larviculture of Marine Finfish and Shellfish

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PRESENT STATUS OF MUSSEL FARMING

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Introduction

The green mussel (*Perna viridis*) is also referred as the green lipped mussel or the Asian green mussel. The shell of *P.viridis* tapers to a sharp, down turned beak and has a periostracum that is dark green to dark brownish green. The ventral margin of the shell is straight or weakly concave. The beak has interlocking teeth, one in the right valve and two in the left. The wavy posterior end of the pallial line and the large kidney-shaped adductor muscle are diagnostic features of this species.The native range of the green mussel is along the Indian coast and throughout the Indo-Pacific. It occurs naturally and is widely distributed along the intertidal coasts of India.

Sexes in this species are separate and the fertilization is external. Spawning is closely related to the monsoon seasons and occurs twice a year during March-April and October-November. Sexual maturity typically occurs at 15-30 mm shell length (corresponding to 2-3 months). The life span of *P.viridis* is typically 2-3 years. Growth rates are influenced by environmental factors such as temperature, food availability and water movements. First year growth rates vary between locations and range from 49.7 mm/yr in Honk Kong to 120 mm/yr in India.

Spawning is initiated by either sex of the green mussel with each releasing two streams of gametes into the water. Spawning has also been induced by the presence of other spawning individuals in the area and a drop in salinity. Females release about 5 lakh eggs. Seven to eight hours after fertilization, the zygote is completely transformed into mobile, trochophore larvae. After 16 to 19 hours the veliger larval stage is reached with the larval shell covering the internal body parts and developing a strong ciliated velum. The straight hinge D shaped larvae metamorphoses to pediveliger with a pedal organ, the functional foot and descends to the bottom. The larvae completely metamorphosize in eight to twelve days. In 10-12 days the larva secretes the initial byssal threads and attaches itself. Changes in organ system takes place and the post larvae with characteristics of adult mussel called spat are formed. *Perna viridis* has the greatest growth rate of the mussels studied to date. Maximum growth of the green mussel occurs 2m below the surface because of the increased productivity of the water at that depth and a narrow area of temperature and salinity fluctuation.

P. viridis is a suspension feeder. This species is an efficient filter feeder, feeding on small zooplankton, phytoplankton and other suspended fine organic material. The high growth rate of the green mussel is related to high salinity and an abundance of phytoplankton. The green mussel has a high tolerance for reduced salinities, increased survival during atmospheric exposure, and high survival rates in turbid water.

Mussel culture Techniques:

The world mussel production (FAO data) during 2006 was 1.89 million tons valued at 1.2 billion US dollars. The world production of *Perna viridis* during 2006 was 305,321 tons valued at 2.74 million US dollars. The total production of green mussels in India (2008) is about 15,000 tons. Many culture techniques are used for growing mussels worldwide. Some of these are described below:

Bouchot or Intertidal Pole Culture

In Europe, mussel culture is believed to have started in 1235, when an Irish sailor survived a shipwreck on the Atlantic coast of France. He found that the poles he had kept for trapping birds attracted mussel spat settlement. This became the basis for Bouchot method which is the oldest and the main method utilised in France. In this method, ropes with spat attached are wound around large vertical poles *(bouchots)* in the intertidal zone. A mesh netting is used to cover the mussels to prevent them being detached and lost. A barrier is placed at the bottom of the pole to prevent predators such as crabs from reaching the mussels. This method of culture requires large tidal ranges, in order to supply the densely packed mussels with food.

On-Bottom Culture

This method is widely used in Netherlands, Denmark and Germany. The culture is based on the principle of transferring seeds from areas of great abundance where growth is poor to culture plots in lower density to obtain better growth and fattening of the mussel. The culture plots must have a firm substratum and less of drifting sand and silt particles. In Netherlands, the seeds are dredged from Waddenzee. The seeds are laid in intertidal areas to produce mussels with thick shells and strong adductor muscle. In the subtidal areas higher meat yield and thinner shells are produced fit for processing industry. The production is about 22 tonnes per acre. The whole process is highly mechanized from collection of seeds to harvesting and marketing.

Long line culture

This method is becoming very successful in open sea mussel farming. A rope is stretched horizontally near the water surface and maintained 1-2 m from the surface with buoys. Mussels are grown on vertical ropes known as 'droppers' which hang from the horizontal rope for a length of 4m. Mussel seeds are collected from natural beds and transplanted onto the ropes into a continuous sock-like cotton tube, which is approximately 17.5 cm in width. Small mussels stripped from the collection ropes are inserted. This cotton sock is then wound around the dropper. The mussels grow and attach to the ropes using their byssal threads and the cotton sock slowly disintegrates and falls away. The droppers are placed a minimum of 0.5 m apart and have at least 4 m of free space from the bottom. In deeper waters the gap between the bottom of the line and the sea floor is greater. Anchor ropes extend from each end of the horizontal rope to anchors buried in the mud of the bottom. As the ropes are kept taut, there is no movement around the anchor to disturb the bottom as occurs when boats are anchored.

The density at which mussels can be cultured on long lines could be about 300 per meter, but depends on the food availability, which varies from site to site. Mussels grown on longlines can become smothered by naturally settling juvenile mussels and other fouling organisms. For this reason, most farmers prefer to position their farms away from heavy spat settlement areas to avoid layers of spat attaching to larger mussels.

Raft Culture

The basic principle of raft culture is similar to long line culture in that the mussels are suspended on droppers but these are suspended from the raft instead of the long lines. The raft itself is anchored to the seabed removing the need for several anchoring systems. Long line culture however, creates less of a visual impact, and the droppers can be spaced farther apart to maximize the use of the available phytoplankton. Raft culture is more suited to areas of dense phytoplankton and to smaller operations, as there is less scope for mechanical harvesting. This method of culture is used in the Galician Bays in Spain, Saldahna Bay in South Africa but has been abandoned by the New Zealand industry in favour of long lines.

Fixed suspended culture

This is the simplest of the rope method used for green mussel cultivation in India and Philippines. The main purpose of the pole is to support the structure. In between these poles, ropes are suspended either vertically or kept horizontally where the depth is a limitation.

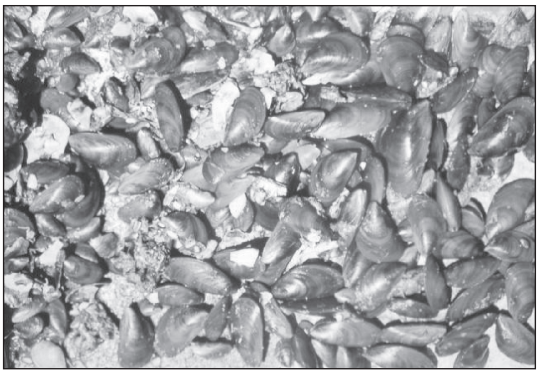
Indian experience

Mussel culture is fast becoming popular in the Malabar area since 1997 following the success achieved by CMFRI in rearing green mussel by rack culture in the backwaters and popularizing through involvement of progressive farmers who took up its culture in the backwaters and found it as profitable venture. As a result demands came from new entrepreneurs for training, and mussel farming spread from Kasaragod to Ponnani. Backwaters Mussel culture in Kerala was started first in Padanna and Cheruvattur Panchayats in Hosdurg Taluk of Kasaragod district. Later it was taken to Elathur in Calicut district and Vallikunnu and Ponnani in Malappuram district. Initially the low cost technology developed by CMFRI was transferred to five groups with 15 to 21 members at Cheruvattur and Valiyaparamba and provided financial assistance through North Malabar Gramin Bank and Cheruvattur Farmers Co-operative Bank. A loan of Rs.2,60,200/- was provided with a subsidy component of 50%. These groups harvested 67.4 tonnes of mussels during May-June 1997. A portion of the harvested and shucked meat (2000-Kg) was sold to the Integrated Fisheries Project, Cochin at a rate Rs.45/kg. and the rest was sold in the domestic market. The groups could realize Rs.3,34,555/= from the harvest with a net profit of Rs.1,04,455/= within a period of 6 months.

Fig1. Typical mussel farm at Padanna

Fig 2. Mussel culture training at Elathur

Fig.3. Collected seed of Green mussel P.virdis



Major areas of Mussel culture

1. Kasaragod district: The culture is done in the Padanna backwater systems in the Hosdurg Taluk. Major producing areas are Thekkekad, Badakekad, Ori, Kavunchera, Valiyaparamba, Koyambaram, Padanna kadapuram and Madakkal. The total production from this area during this year is 11,000 tons.

2. Cannanore district: Culture is restricted to Koduvalli and Dharmadom area. The total production is 1,900 ton.

3. Malappuram district: TTC training was given to 45 trainees at Vallikunnu panchayat during September1999 by CMFRI. Subsequently, during January 2001, training was imparted to 60 trainees of Malappuram district under the self-help group (SHG) training programme of the State fisheries Department. This training was conducted at Balathurithi. The total production from this area during this year is 1500 tons.

4.Kozhikode district: Mussel culture is being done in the Korapuzha estuarine system. Initially training was imparted to 20 persons under the self-help group (SHG) training programme of the State fisheries Department. The total production is about 2,000 tons.

Constraints

1. Availability of seed:

The seeds required for culture is presently collected from traditional fishing areas and these are often causing conflicts between farmers and mussel fishermen. This year has seen more conflicts than previous years. Hence it is essential that additional spat collectors have to be established along the coast to ensure supply of seeds to the farmers.

2. Marketing:

The harvesting seasons of cultured mussels is mostly during April – May months and farmers are forced to sell their crop before the onset of monsoon to avoid mass mortality of mussels due to freshwater influx into the backwater system. At present only a few processing plants purchases cultured mussels from the farmers and as a result the local market are flooded with cultured mussels during these months resulting in fall in the prices and thereby affecting the profitability of the operation.

3. Depuration system:

The main constraint in the export of cultured mussels is the lack of proper depuration techniques. Depuration plants are needed at regular intervals along the coast so as to depurate the cultured mussels for export processing.

4. Storage facility:

If sufficient cold storage facility is provided, cultured mussels can be depurated, shucked and stored not only for export market but also for local market throughout the year. This will increase the profitability of the culture operation.

5. Post harvest technology:

Value added products of longer shelf life need to be developed from mussel meat to increase the revenue realization from cultured mussels. Mussel fry, mussel pickle etc. are some of the best examples for value added products. More studies are needed to develop ethnic cuisines with longer shelf life.

6. Siltation of backwaters:

Some areas in the backwater system have very high siltation levels especially during rainy season. This often results in mortality of mussels in the farms. Hence scientific feasibility studies are required to demarcate potential culture sites. Silting of the bottoms where culture is done may induce a problem for the benthic communities located underneath. This should be solved by strong policies directed towards correct management of the fouling and silt accumulated by the hanging ropes.

Prospects:

1. Backwater mussel culture is a decade old phenomenon along the Malabar coast and opens immense potential for resource and employment generation among coastal communities especially women living below poverty line.

2. Mussel culture is a low investment activity with very good returns. If promoted properly, mussel farming can be used as a tool for women empowerment in the coastal areas and can stimulate a healthy socio-economic development in the area.

3. Better post harvest technologies can develop attractive value added products. Since very good export markets are available for mussels, they can be taken up as a challenging opportunity by technicians and scientists.

4. In the western countries, mussel is considered as poor man's oyster. But in India, mussel can be considered as tool for the upliftment of the poor people living in the coastal areas especially along the Malabar Coast.