# Marine Fisheries Research and Management

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# 49 Mud crab hatchery technology

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**ABSTRACT**

*The portunid crab Scylla oceanica is preferred as a candidate for farming and fattening by virtue of its export potential. As wild seed stock is inadequate to meet the growing demand, there has been a concerted effort in countries like Taiwan, Japan and India to develop hatchery technologies for seed production not only for farming but also for sea ranching. Results of experiments on brood stock management, incubation, seed production through larval rearing, live feed production for larval stages, water quality management, crab culture and fattening conducted in tanks at Tuticorin are presented in this paper.*

## Introduction

Among the portunidcrabs *Scylla oceanica* is the largest species widely preferred for farming in the Indo-Pacific region. It commands a bright price due to international market acceptance. Intensive and indiscriminate fishing of mud crab together with poor management of its fishery have caused a decline in the population. Countries bordering the Bay of Bengal region have realised the immense potentialities of mud crab culture in recent years. Wild seed resources are inadequate to meet the demands of farmers. Commercial scale farming is possible only through the production of seed of this species through hatcheries. Taiwan and Japan have developed viable technology for the large scale production and aimed to replenish the wild stock through sea ranching programmes. The life history studies have brought to light informations on the details of larval growth, hatchery management and seed production. The hatchery techniques developed in Central Marine Fisheries Research Institute could easily be adopted to run a large scale seed production unit with relatively small capital expenditure or by converting the existing shrimp hatcheries suitably.

**Reproductive biology**

Among mud crabs, the most popular varieties are *Scylla oceanica* and *S. serrata*. The life cycle or reproductive and spawning behaviours are more or less the same in the two species of mud crabs. Juveniles up to 6 cm size live in sheltered areas of intertidal waters. The sub adults upto 11 cm are found in creeks as well as in open areas and exhibit extensive migrations up and down in the shore with tidal influence. The adults prefer deeper subtidal areas. Females migrate to deeper waters for spawning. Individuals of species do not mature at the same age or size. In natural environment, females could attain maturity and spawn within one year. *S. oceanica* attains maturity at 10-11 cm size and *S. serrata* at 9 -10 cm. Soon after the copulatory moult the abdomen of females becomes broad and dark green in colour. Mating takes place when the exoskeleton is soft and the copulatory act usually lasts 7 - 12 hours. In *Scylla* there is multiple spawning within a single mature instar and reproductive capacity is very high. Ovigerous females carry as many as 2 million eggs. Actual spawning and larval development are possible only in open sea where conducive environment prevails. There are five zoeal stages and when they attain megalopa stage they migrate toward coastal waters and often enter the estuaries mangroves and grow fast. After attaining maturity they migrate back to sea for breeding and the cycle is repeated.

**Brood stock and incubation**

Removal of large number of crab from wild stocks has adversely affected the crab fishery in recent years in India. This situation emphasises the need to evolve a hatchery system. Spawning occurs throughout the year especially in warmer countries. Spawners could be collected from the commercial catches in berried stages and maintained in hatchery as brood stock.

Spawner crab in berried stages are available from the commercial catches round the year with peak during March - May and September - October coinciding with the hot seasons. Such ovigerous females can be transported safely to hatchery and maintained in big rearing tanks. *Scylla* is known for multiple spawning and the same specimens could be used as brood stock for repeated production of larvae and seed in hatcheries. Maintenance of salinity around 33 ppt is a must for gonadial maturation in brood stock management.

Mud crab attains maturity at 90 - 110 mm carapace width (CW). Females of 7 - 8 cm gathered from commercial catches were stocked at 1 seed / $m^2$ for fattening in fenced grow-out ponds. The stock was fed intensively with clam meat as high as 15 - 20% of body weight. Loss of weight by frequent moulting was minimised by regulating the quality of water in culture site. The meat value in gravid females with fully developed gonads command significantly higher prices. Production of gravid females under fattening method aims not only to promote export trade but simultaneously helps to minimise the loss of natural stock of fully matured specimens from the wild. When gravid females are allowed to grow continuously together with matured males, particularly in a grow-out sytem having a salinity around 33 ppt, the mated females invariably spawn and become ovigerous or berried. Spawning is delayed for a few weeks after maturing and the sperm remains viable till the development of eggs for fertilization. Maturation of ovary and subsequent spawning takes place not only in sea but even in conducive water media of coastal ponds. Spawner crabs could be obtained by bilateral eye-stalk ablation under controlled laboratory conditions. Broodstock raised through this method are to be maintained in separate tanks for the consistent production of seed in hatchery system. Steady salinity close to 33 ppt, daily water exchange with a continuous flow through system, supply of nutritive clam meat as feed, maintenance of water temperature around 28 - 31°C are the essential technical programmes in management.

The reproductive capacity of *Scylla* varies from 1.5 - 2 million eggs. Temperature and salinity are the important factors in the embryonic development. The period of incubation varies from 8 - 13 days in Indian waters. The egg mass appears bright orange-yellow in the early days of incubation and gradually changes to greyish yellow, brownish and finally black with the development of chromatophores and eyes.The larvae hatch out in the morning hours around 5-6 AM and they swarm in the lighted area of the tank since they are strongly photopositive. The period of hatching is 8 - 10 days in summer when the temperature of the medium is more than 28°C, whereas in winter due to the fall in temperature hatching takes more days. Successful development and hatching of zoea becomes possible when the salinity is maintained at 31 - 33 ppt during incubation period. Most of the ovigerous females required for seed production in hatchery were collected from commercial fishing ground off Kayalpatinam, south of Tuticorin, besides those produced in coastal crab culture pond.

**Live feed production and hatchery management**

In the dietary regime, live feed organisms such as *Chlorella*, Rotifers, *Artemia* nauplii, copepods etc. play an important part for the optimum growth, survival and production of crab seed in hatchery system. A suitable technology was evolved to raise these stocks simultaneously at Tuticorin Research Centre of Central Marine Fisheries Research Institute. Large scale culture of *Chlorella* was developed in cement and FRP tanks by adding inorganic fertilizers in the filtered sea water at the rate of 100 g of Ammonium sulphate, 20 g of Calcium superphosphate, 5 g of urea and 3 g of metal mixes containing mainly Cobalt, Zinc and Magnesium per ton of water. In a period of 15 days the stock culture reaches to a maximum concentration of 20 million cells per $m^2$ under active aeration. The hydrological conditions required for the green water production are the following; water temperature around 20 - 25°C; pH in the range 8.20 - 8.50, ammonia ranges from 15 - 20 ppm, N between 2 - 5% and dissolved oxygen content around 9 ml/L.

The euryhaline rotifer *Branchionus plicatilis* is raised in the *Chlorella* media to reach the concentration of 100/ml in a week's time. Baker's yeast at 1 g/million cells promotes fast growth. Rotifers are measured in the size 150 microns and screened through 80 micron nylobolt filter compartment. The following formula is employed in the large scale production programme and management of rotifer culture.

$$\text{Volume of } \textit{chlorella} \text{ water} = \frac{\text{No.of rotifers in millions} \times \text{Std. rate of feeding 150000 Cell} \times \text{Density of } \textit{Chlorella} \text{ in rotifer tanks} \times 1000}{\text{Density of } \textit{chlorella} \text{ of stock tank}}$$

The consumption efficiency of rotifers is determined by the following method

$$\textit{Chlorella} \text{ density} = \frac{\text{No. of cells already present} + \text{Quantity of } \textit{chlorella} \text{ water added} \times \text{Density of stock } \textit{chlorella} \text{ water}}{\text{Total volume of water}}$$

Besides this live feed, *Artemia* nauplii and decapsulated *Artemia* embryos are kept ready to feed the larvae for the first three stages of zoeal stock in hatchery. Marine copepods such as *Trigriopsus, Acartia, Oithoma, Paracalanus* etc. are collected freshly in the morning hours and supplied to larval stock from fifteenth day onwards by which time the larvae reach advanced stages. Metamorphosis of larvae is influenced by the environmental conditions in the hatchery, besides the genetic control. There are five zoeal stages, running to 15 - 18 days and one megalopa stage which may last for 8 - 12 days depending upon the temperature and salinity. The active larvae are released at a density of 20 - 30/L in rearing tanks. Better growth and production of seed is attained by maintaining the quality of rearing media, particularly the salinity around 33 ppt and temperature between 28 - 31°C. The excess feed, dead ones, exuvia and faecal wastes are siphoned out daily while replenishing the water. Antibiotics are used when ciliates or bacteria are noticed in tanks. Brackishwater with salinity range at 22 - 27 ppt promotes the growth of megalopa for a quick metamorphosis into first crab instar in 7 or 8 days. The intermoult period is shortened in early crab stages when reared in low saline media. Cannibalism occurs from megalopa stage onwards.

**Larval rearing and seed production**

Heavy mortality occurs during the first, second and fifth zoeal stages, mostly due to unsuccessful moulting. Pollution of the water by dead larvae and infiltration of ciliates into moulting or soft larvae also appear to be the causes for mortality. In the early stages the zoeal stock are fed with *chlorella* mixed with rotifers at a concentration of 150 - 200/ml. *Skeletonema* and *Tetraselmis* are also mixed at 5000 cells/ml during the first 7 days. In the second week when zoea passes to stages III and IV, *Artemia* nauplii at the rate of 10 - 15 ml is mixed with rotifer and in addition to this BMC pellets (Japan product) of 100 micron size are also supplied. In later stages, as they grow bigger, they are fed with *Artemia* nauplii exclusively at 50/ml. Decapsulated embryo washed several times in clean sea water also constituted the feed at this stage. Megalopa develops prominant chelipeds to catch prey. Adult *Artemia* and fresh collections of copepods are supplied adlibitum to megalopa. Crab seed is attained after a rearing period of 27 - 30 days in the hatchery. It measures 3 - 5 mm in carapace width. It has to be reared in nursery till it reaches 15 mm size. Newly formed crab seed are fed with trash fish, prawns and clam meat twice daily. The supply of live feed organisms to larval stock is advantageous since it helps to maintain the water quality in rearing tanks. The trial experiments conducted envisage to increase the present production rate of 15% to several fold by resorting to improvised strategies in feeding and other hatchery management practices.

**Scope for crab culture**

Encouraging results have been attained in commercial scale production of mud crab through fattening methods in coastal ponds of Tamil Nadu, Andhra Pradesh. Large scale production of crab seed in hatcheries is the urgent need since the wild resources are not adequate for developing farming. A number of South East Asian countries have already developed hatchery system for seed production. A comparative account of the larval study indicates that the larvae of mud crab from tropical areas are more tolerant to high temperature and salinity than those from other regions. This advantageous factor will promote our efforts to concentrate and increase the production potentials in hatcheries. The infrastructure facilities developed for shrimp hatcheries could be suitably modified to this new venture. Water quality management and nutritional requirements of larvae in hatchery need further investigations. Microencapsulated diets hold promise in overcoming the nutritional deficiencies in existing live feed diets. Broodstock maturation by environmental manipulation and nutritional enhancement envisage to improve the technology for continuous supply of spawners. In order to realise the sustained yield, regulatory measures to control the fishing of fully matured gravid females become necessary.