

Production of Giant Freshwater Prawn Postlarvae in Penaeid Prawn (*shrimp*) Hatchery : An Experience

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A pilot scale penaeid prawn (shrimp) hatchery was established at the National Institute of Oceanography, Goa in 1996 with an installed production capacity of 2 million postlarvae (PL 20) as part of the Technology Project in Mission Mode Semi-intensive Penaeid Prawn (shrimp) Aquaculture, funded by the Department of Biotechnology, New Delhi. The hatchery facilities were designed and developed for production of PL of penaeid prawns (shrimp) and for conducting research for improving larval rearing and related techniques. A report on the subject entitled "Design and Specifications of a Pilot Scale Prawn Hatchery" was submitted to Union Department of Biotechnology (DBT) in March 1997 (NIO/SP-5/97).

For the last two years, PL 20 stages of *Penaeus monodon* and *P. merguensis* have been produced at the hatchery and supplied to the local farmers for stocking. Besides, various types of experimental studies have been carried out for optimising larval rearing conditions and related aspects. Training courses have been organised for user community in water quality management and in penaeid prawn (shrimp) seed production techniques and management. Several graduate and post-graduate students of Goa University have also been making use of the facilities for their research work.

Genesis

During the south-west monsoon season (June-September), all penaeid prawn (shrimp) hatcheries along the west coast of India have to be shut down due to sudden drop in salinity which is not suitable for rearing penaeid prawn larvae. However, salinity and other climatic conditions during this season are

conducive for rearing larvae of the giant freshwater prawn *Macrobrachium rosenbergii*, commonly known as "scampi". Therefore, a successful attempt was made during the monsoon season of 1997 to rear PL of *M. rosenbergii*, making use of the facilities developed for penaeid prawns (shrimps). This enabled the hatchery to carry on with production during the monsoon season and also earn additional revenue.

M. rosenbergii is a commercially important farmed species of freshwater prawn. The life history of this species is quite interesting because, while the adults inhabit the freshwater bodies, the gravid females migrate to the low saline estuarine region for spawning and the postlarvae migrate back to freshwater areas for growth and maturity. The catadromous behaviour of this species facilitates its spawning and larval rearing in low saline waters in the hatchery. Therefore, the salinity reduction occurring during the monsoon season in the coastal waters and estuaries along the west coast of India can be beneficially used for rearing the PL of this species under captivity. In the inland areas, on the other hand, saline water has to be prepared by adding common salt or brine to freshwater, or sea water has to be transported over long distances.

In Goa, adults of this species are caught in small numbers in the middle and upper reaches of the estuaries mostly during the monsoon season when they move downstream for reproduction and spawning. Farming of this species has not been considered all along to be a viable venture in Goa and consequently no serious efforts have been made all along in this direction. Seed availability has been a major constraint for farming

this species in other parts of India too because only a few hatcheries have so far been established for the production of freshwater prawn seed.

In this report, the endeavour is to describe the various steps involved in rearing the larvae of the giant freshwater prawn based on the experience gained in the pilot scale penaeid prawn (shrimp) hatchery at NIO so that other commercial shrimp hatcheries can also follow the protocols and earn additional revenue from sale of freshwater prawn seed during the monsoon season.

Protocols for rearing

M. rosenbergii larvae

Brood stock collection and

Maturation : Healthy adult females and males are collected from the wild or from farms. They are disinfected in aerated freshwater containing 15-20 ppm formalin for half an hour before transferring into the maturation tanks. Berried females (carrying orange or grey coloured egg mass) are kept for incubation or hatching (depending on colour of eggs). Artificial shelters are provided at the bottom of the maturation tanks.

Female:Male ratio of 4:1 is maintained in a 1000 L rectangular FRP tank (maturation tank) and usually 8 females and 2 males are kept for maturation. Dechlorinated and aerated freshwater is used in the maturation tanks. Before introducing the animals, conditions are created for rich natural algal bloom (mostly *Chlorella* spp.), rotifers and zooplankton to grow as they provide a healthy environment and food for the brooders. In addition, the prawns are also fed on feed of about 5% of body weight every morning consisting of an assorted variety of fresh food consisting of mussel meat,

lam meat, worms, small shrimps, pieces of potatoes, formulated feed, etc. The tank bottom is cleaned by siphoning out very morning unconsumed food, faecal matter and moults. About 20-30% of water is exchanged to compensate for the loss. Occasional sprinkling of freshwater or rain water speeded up the maturation process.

Spawning occurs within 8-12 hours after mating. The extruded eggs get deposited on the ventral side of the abdomen and the egg mass is firmly held by the pleopods. Under captivity a female matures 2-3 times in a season. The interval between two successive puberty moults is about 20-30 days. In some females the next maturation process may start while the eggs are still incubating and in such cases the puberty moult occurs within 10 days.

Incubation, Hatching and fecundity: Initially, the egg mass is range in colour. The berried female is transferred into a 1000 lit FRP tank containing 8 psu water for incubation, Feeding, cleaning of tank and exchange of water are done as mentioned earlier, Artificial shelters are provided for protection and 3 to 4 females are kept in each tank for incubation. The incubation period is 18-20 days at 26-28°C. During this period, the colour of the egg mass gradually turns to grey/dark grey. Extreme care is taken while handling the incubating females so as not to cause damage to eggs or loss of eggs. The females remove dead eggs and extraneous materials with the first pair of pleopods and they periodically ventilate by vigorous movement of pleopods.

Females carrying dark grey egg mass are carefully transferred into a dark coloured cylindro-conical FRP tank (110 lit) containing aerated 8 psu water for hatching of eggs. Only one female is kept in one tank. Feeding is not done at this stage as the female avoids food. This helps in maintaining good water quality, hatching normally occurs in the night and may last for 2-3 days. This results in having 2 or 3 different stages of larvae form a single spawn. The maximum hatching occurs in the second day. The

newly hatched larvae are dispersed by the mother prawn with the help of its pleopods.

The spent females are transferred directly into the maturation tank containing freshwater having thick algal bloom. Abrupt exposure to freshwater enhances re-maturation process. The larvae are removed by opening the ball valve provided at the bottom of the tank after two days.

A 25 g female produces >3,000 eggs in the first brood. It increases with the size of the female and a 60 g female carries about 25,000 eggs. The fecundity, however, decreases in subsequent broods.

Larval rearing: Larva undergoes 11 distinct zoea stages before metamorphosing into a postlarva. Each stage can be recognised by certain distinct morphological characters. (For larval identification, see Rao, K.J. and Tripathi, S.D., 1993. A manual on giant freshwater prawn hatchery. CIFA, Vol. 2, p.50).

Microscopic as well as visual observation of the larvae is made every day to assess the quality of larvae, health, survival, growth stage, size, deformity (if any), gut state, ectoparasitic infestation, swimming behaviour, etc. Moulting sometimes gets delayed in zoea stages III, V and VIII due to protozoan infestation. This can be overcome by application of ~20ppm formalin for 6 hours for 2-3 consecutive days.

Type and size of the rearing tanks have to be changed according to the stage of the larvae. The freshly hatched zoeae are grown in the hatching tank itself for 2 days until they reach zoea I or II and no feeding is done. Later they are shifted to rectangular or circular FRP tanks of 500 or 1000 lit capacity depending on the density of larvae. They are stocked @ 60-80 larvae/lit. Water depth in the tanks is maintained around 70 cm. Feeding is done from this stage onwards. It takes 2-3 days for one stage to moult to the next stage. They are reared in these tanks until they grow to Mysis VI-VII stage. Since synchronised growth is lacking, 2 or 3

stages may exist in the tank at a time. From stage VII onwards, they are reared in large oval shaped LRTs of 2000 lit capacity made of FRP or in plastic pools (4' diameter, 2' depth) until they attain postlarval stage. Water depth of 70 cm is maintained in LRT and in pool around 60 cm. The stocking density is reduced to 30-40 lit. After attaining PL stage, they are transferred to 20,000 lit concrete nursery tanks containing dechlorinated freshwater to grow for a further period of 15 to 20 days before supplying to farmers. Rich algal growth and zooplankton will improve the health and enhance the growth of postlarvae. Weaning of postlarvae from brackishwater to freshwater is done gradually and with care as sudden change will cause mortality. Salinity reduction is done by 1 psu at a time and brought down to freshwater condition over a period of 12-15 hours. Vigorous and uniform aeration is given in all LRTs and nursery tanks to keep the feed in suspension for the larvae and to maintain dissolved oxygen level high and uniform. Survival rate improves by providing artificial floating shelters in LRTs. Artificial shelters are placed at the bottom of nursery tanks which increase the surface area for the postlarvae to settle and also act as hiding places for PL.

Salinity: Zoea I to early stages of PL survive and grow faster in 12 psu water. Sudden and wide variations affect the survival rate. Dechlorinated freshwater only is used for dilution. Sea water passed through a sand filter and cartridge filters improves the water quality.

pH: Wide variations in pH are not conducive for larval growth. They will affect moulting and growth. Extreme levels cause mortality. An optimum range of 7.3-7.8 is conducive for larval growth.

Temperature : Growth is adversely affected if the temperature of water drops <26°C. Lower temperatures delay metamorphosis and cause mortality. Sudden changes in temperature is avoided while exchanging water as they affect the survival rate.

Light : Larvae are phototactic and exposure to sunlight tends to aggregate them to the brighter part of the tank

resulting in cannibalism and poor survival. Even in well aerated tanks, clumping of larvae occurs in the area with sunlight. Therefore, tanks are kept in shaded area away from direct sunlight.

Aeration : Survival is high if the aeration is uniform and vigorous. Vigorous aeration keeps the food particles in suspension and helps in dispersion of larvae in the tank besides providing the much needed dissolved oxygen. Aeration is stopped only for short durations while cleaning the tanks and observing larvae.

Nutrition : Nutrition is an important criterion for larval survival and growth. For the first 2 days no feeding is done as the zoeae survive on the yolk. From 3rd day onwards, freshly hatched brine shrimp nauplii (BSN) and formulated feed are given. Feeding is done seven times a day. The first and the last feeding are exclusively on BSN. Quantity of feed given for different larval stages is worked out based on visual observation of the gut content as well as feed utilisation by the larvae. Larvae feed continuously. However, excess feeding is avoided to reduce feed cost and to maintain good water quality.

Depending on the larval stage, the feed is sieved through appropriate mesh as shown below:

Larval Stage	Mesh Size (mm)
Zoea II-III	0.1
Zoea IV-V	0.15
Zoea VI-VIII	0.2
Zoea IX-X	0.3
Zoea XI-PL1	0.4
PL1-P15	0.5-1.0

A combination of three prepared feeds (adjacent table) and BSN yields the best survival and growth. PL stage is attained within 21-28 days with a survival rate of >60%.

Water Quality Management : Maintenance of a high quality water in the hatchery is very important for the successful rearing of the freshwater prawns. Freshwater is dechlorinated before use. Sea water is filtered through a sand filter to eliminate all abiotic and biotic particles >50µm. Since the hatchery requires saline water of 8 and 12 psu

besides freshwater, it is prepared in advance and stored in overhead tanks after treating with 1.5 mg of free chlorine or 15-20 ppm formalin to eliminate all microorganisms and parasites. The tank bottom is cleaned before the last feeding so that the quality of water remains good during the night when the moulting and metamorphosis actively take place. Daily water exchange of 30-50% ensures good quality water.

Strict adherence to the following criteria will help in successful larval rearing:

- i) Maintenance of salinity, pH and temperature at the optimum range and avoidance of sudden variations.
- ii) Avoidance excess feeding.
- iii) Observation of health, growth, gut

and deformity regularly.

- iv) Checking for protozoan infestation and treatment in time.
- v) Checking for contamination and quality of feed.
- vi) Cleaning and disinfection of all implements and equipments.
- vii) Maintenance of general hygiene in and around the hatchery.
- viii) Cleaning of tank bottom every day evening.
- ix) Cleaning sides of tanks once in 3 days and rotating (change) tanks every week.
- x) Maintaining uniform and vigorous aeration.
- xi) Replacement of 30-50% water every day.

The following tables give the feed formulation and feeding schedule:

Feed formulation	
Egg Custard (EC)	Egg (97%) +Yeast (3%)
Egg-Prawn Custard (EPC)	Egg(85%) + Prawn(12%)+Yeast(3%)
Formulated Feed (FF)	Egg (35%) + Soyameal (25%) + Mussel Meat (25%) + Skimmed Milk Powder (12%) + Yeast (3%)

Feeding Schedule (at hourly intervals)						
0600	0800	1000	1200	1400	1700	1900
BSN	EC	EPC	EPC	FF	FF	BSN
<i>(Feeding rate of BSN and feed varies with growth stage as shown in the Table below. The quantity of feed shown is for 10,000 larvae per feeding).</i>						
Larval Stages		BSN per Larva		Feed (g) per 10.000 Larvae		
Mysis II-III		12		3		
Mysis IV-V		28		5		
Mysis VI-VIII		44		6		
Mysis IX-X		54		8		
Mysis XI-PL1		64		11		
PL1-PL5		16		15		

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