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DEVELOPMENT OF A SMALL SCALE SEMI-INTENSIVE PRAWN HATCHERY AND ITS ROLE IN THE DEVELOPMENT OF BRAKISHWATER PRAWN FARMING IN ORISSA

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ABSTRACT

To develop a continuous seed production technology, particularly of *Penaeus monodon*, which has maximum demand in brackishwater culture system, a small scale hatchery was designed at Puri Centre in 1984-'85 under a semi-intensive system and operated using recirculated water through a biological filtration system. The details of hatchery lay out, tanks, filters, water and air systems, maintenance of breeders, and feeds are given. The system is semi-intensive in the sense that developed feeds were used and salinity and pH were controlled to suit the hatchery needs. The problems encountered in the hatchery such as spawner availability, transportation stress, impact of environmental factors, water quality etc are discussed. The system and its cost of management are brought out with a view towards its suitability as a small scale operation under Indian conditions.

INTRODUCTION

The development of a hatchery system for penaeid larvae in India has commenced in the late 1970's following the broad principles of design laid down under the extensive large tank Japanese system (Shigueno, 1975) or the intensive small tank American system (Cook, 1957; Cook and Murphy, 1969). These systems are capital intensive involving the use of *Artemia* nauplii as larval diet in addition to diatoms. In India, the prawn hatchery technology developed by national institutes has dispensed with the use of *Artemia*, instead diatoms and suspension diets are used as larval diets (Hameed *et al.*, 1982; Silas and Muthu, 1985)

The non-availability of the seed of desired species of prawns all round the year is one of the reasons for the slow growth of prawn culture industry in our country. In the context of the recent development of brackishwater prawn farming the importance of prawn seed production need not be overemphasised. In order to meet the needs of the Indian farmers, a small scale semi-intensive hatchery was designed and operated at Puri, particularly for *Penaeus monodon*. The details of the hatchery and its management and relevance in the context of the rapidly developing prawn farming sector in Orissa are presented in this paper.

THE HATCHERY TECHNOLOGY

Hatchery lay out

The small scale hatchery developed at Puri consists of a 20m x 10m shed roofed with Asphalt sheets. Apart from the outer brick lined wall, an inner lining of plywood covers the entire shed on all sides. Windows are provided at intervals of 2.5 m at a height of 1.5 m from floor level.

The larval rearing tanks are made of FRP. These are two 2.5 t tanks (3.7m x 1.3m x 0.6m) and four 0.4 t tanks (1.3 m x 0.7m x 0.6m) presently under use in the hatchery for production and experimental purposes. Seawater is stored in 10-12 diameter plastic pools with a total storage capacity of 30 t. The rearing tanks have

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tube lights (4 in each tank) fixed at 1.7 m interval and 25 cm above the tank surface. Air supply system is arranged at a height of 2m from floor level while the water supply is 1 m above floor level.

The air system consists of one diesel (5 HP) and two electrical (2 HP) compressor units. A generator (5 HP / 3 KV) is installed as a stand-by unit. The air is supplied through GI pipes (16 mm dia) which form the main distribution system and valves are taken from this with control taps. The air passes through 5 mm PVC air lines with regulators and air stones. In each large FRP tank three pairs of air lifts are provided at an interval of 1 m.

The biological filtration system

Water management is the principal technique developed in the present study. The water filtration system is a 2m high, circular concrete unit (1m diameter) with a perforated false bottom 15cm above the base level where filtered sea water collects. The biological filter consists of 4 layers *viz.*, 25 cm of large pebbles, followed on top by 25 cm oyster shells, followed by 20 cm coarse sand and topped by a 15cm layer of activated charcoal retained in a large net bag. Water is pumped to the top level to fall on the charcoal from where it trickles down to the reservoir. The filtered water is taken into the hatchery tanks through PVC pipes connected to the 15 cm long GI outlet (16mm dia,) provided at the base of the filter. The rate of flow of water from the filter is 10 litres/minute.

Backwashing of the filter is done after each rearing cycle. The water in the rearing units is exchanged, at least 30% every day, during larval rearing run. The used water is taken back to the storage tank, buffered with oyster shell powder and allowed to age over 7-10 days and then recycled into the hatchery tanks through the biological filter.

Feeds

The prawn larvae are given progressively, baker's yeast (N_6—Z_1) at a rate of 0.3g/1 ton of water, *Chaetoceros* or *Skeletonema* or mixed diatoms (Z_1—M_1) at a rate of 20×10^3 cells/ml, suspension feeds (150-200 U particles) prepared out of mysids, *Tubifex* and *Artemia* ($M_1 - P_6$). The feeds are given twice a day at 1000 hrs and 1800 hrs.

Diseases and control

To avoid disease incidence, prophylatic treatments with antibiotics are followed using hostacycline or terramycin at the rate of 0.01 ppm. If any ciliate attacks are observed, the entire larvae are discarded and a thorough cleaning of the rearing system is undertaken.

Collection and transportation of brood stock

Breeders of *P. monodon* are collected from trawler catches from Paradip and / or from catamaran catches from Puri. The transportation of brood prawns from Paradip to hatchery takes 6 hours excluding the time taken from trawling site to base.

Spawning and Hatching

The brood prawns ranged in size from 225mm/107 g to 296mm/250 g. If the ovary is fully ripe, as judged from its diamond shaped side-wise extension in the first abdominal segment the prawn is kept overnight in a plastic drum (70 l) containing 50 liters of filtered water for spawning under strong aeration. EDTA at the rate of 10 ppm, is added into the spawning container. Spawning takes place late night or early morning. The mother prawn is removed the following morning and also the spawning debris and the eggs are washed and kept for hatching.

The fecundity varied from 2-8 lakhs. The hatching time ranged from 8-14 hours, subject to the prevailing temperature. The hatching rate varied from 10-80%. The details of spawning and larval development are furnished in Table-1. The nauplii are then siphoned out into rearing tanks and stocked at a density of 50-100 per litre. Aeration was given mildly during nauplius and zoea stages and more vigorous during mysis and post-larval stages. The water level was maintained at 40 cm in the tanks and daily 30% water was exchanged using *fresh*, filtered *sea water*. The larvae were examined daily for their stage of develop-

Table-1. *Details of spawning and hatching of Penaeus monodon at Puri hatchery 1984-'85.*

S.No.	Size of mother prawn (mm/g)	Source	Date of spawning	Nature of spawning	No. of eggs released	No. nauplii hatched	Hatching rate (%)	Remarks
1.	275/170	Offshore	18.2.1984	Full	7,35,000	1,00,000	13.6	Larvae died at Z^1 stage
2.	225/107	Offshore	18.2.1984	Full	3,00,000	2,40,000	80.0	Larvae died at Z^1 stage
3.	228/110	Induced matured	19.10.1984	Partial	1,50,000	30,000	20.0	Complete mortality at Z^1 stage
4.	220/100	Offshore	21.10.1984	Partial	2,00,000	1,00,000	50.0	Motality at Z^1 stage due to overcrowding.
5.	296/250	Offshore	23.10.1984	Full	6,00,000	2,40,000	40.0	Produced 2500 P_5 larvae
6.	240/135	Offshore	12.11.1984	Full	4,00,000	80,000	20.0	Ciliate infection and larvae weak. Discarded at Z_1 stage
7.	236/131 267/179	Offshore	24.1.1985	Partial Full	6,00,000	56,000	9.3	Produced 17 P_5 larvae.

ment, feeding efficiency and general health. Sampling was done daily to estimate their density. The larvae were harvested at P_5 stage.

Salinity, temperature and pH

For normal development and successful hatching of eggs, the salinity and temperature of the water should be in the range of 28-35 ppt and 28-32°C. Below and above these limits, the hatching and development of larvae were either slow or very poor. pH of the rearing water was maintained between 8.1-8.4, which is found to be optimal for normal development. All stages for the larvae showed heavy mortality below 26°C, 25 ppt salinity and 7.8 pH.

DISCUSSION

The hatchery operation of tiger shrimp mainly depends on the wild-caught brood stock from catamaran or trawler catches. The breeders caught in catamaran takes 6-8 hrs and the trawler caught ones takes 7–8 hours to reach the hatchery. Thus the catch are subjected to severe stress during transportation and often the poor maintenance on board the vessel leaves them half-dead. By frequent change of water and constant aeration, transportation stress can be minimised with proper facilities and trained man power. At times, egg loss was also observed due to transportation stress.

In prolonged unusual rainfall season (as observed in 1985-86) the near shore waters show reduced salinity status due to heavy discharg into the sea, and thereby affect the general condition of the prawns. Further, high incidence of prawns with bopyrid parasites (particularly males) was noticed in the catch during this period. The prime spawning season of *P. monodon* in Orissa coast is from August-December with peaks in October and December (Rajyalakshmi *et al.*, 1984). This coincides with the monsoon and post monsoon (winter) period when there is drop in sea salinity and also of ambient

temperature. Thus, both selection of spawners and operation of hatchery are within a narrow range of option.

A fully mature female normally releases all eggs overnight in a single spawning. However, a few instances of non-release of eggs were observed even after keeping them consecutively for 2–3 days for spawning. Sometimes partial spawning was observed and the remaining ovary regressed subsequently.

Out of the seven total spawnings occurred in 1984-85, rearing was completed in two spawnings only. Though this is a low production level, it has shown that this hatchery system has capacity to produce 0.25 million postlarvae per rearing cycle, if the brood prawn is in prime condition and the ambient temperature and salinity are in the range of 28-32°C and 28-34 ppt, respectively. The survival rate from nauplius to postlarvae varied in the two instances, while it was 1.04% in the first, it was 0.03% in the second. Maximum mortality occured between N_6–Z_1 stages. The low survival in the two completed trials is due to low diatom feed and adverse environmental factors.

According to Silas and Muthu (1977) a major bottleneck in large scale prawn seed production is the non-availability of spawners throughout the year. Elsewhere (Rajyalakshmi *et al.*, 1987) it is shown how the development of a suitable maturation system of immature *P. monodon* can develop into a dependable broodstock for continuous supply to a hatchery, thus linking both system to each other as is needed under well managed programme.

The ever increasing trawl fishing off the Orissa coast during the peak breeding season of *P. monodon* (post monsoon and winter months) and the recently started prawn culture activities since 1983 are adversely affecting the recruitment of postlarvae into the estuaries and in turn, the offshore capture fishery stock. The seed produced from this hatchery technology can also be used as a management tool for large scale stocking of coastal waters including the Chilka lagoon (Rajyalakshmi, 1986) as a conservation measure and also to support the inshore capture fishery of tiger prawns as is being done particularly of *Penaeus japonicus* in Japan (Kurata, 1981).

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