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HATCHERY PRODUCTION OF PENAEID PRAWN LARVAE FOR LARGE SCALE COASTAL AQUACULTURE

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The ever increasing demand for frozen penaeid prawns has given an impetus to culture these prawns in the tropical and sub-tropical regions of the world. One of the serious bottlenecks in the culture of prawns is the availability of seed prawns at the proper time for stocking purposes. The methods developed in countries such as Japan, Taiwan, Philippines and the U. S. A. for large scale hatchery production of penaeid postlarvae suitable for stocking are critically reviewed. The success achieved by the Central Marine Fisheries Research Institute at the hatchery in Narakkal in spawning and mass culturing the commercially important penaeid prawns such as *Penaeus indicus, P. monodon, Metapenaeus dobsoni, M. affinis, M. monoceros* and *Parapenaeopsis stylifera* from the egg stage to the postlarval stage is reported.

INTRODUCTION

Penaeid prawns have been traditionally cultured along with fish in many countries of the Indo-Pacific region in brackishwater ponds and impoundments (Bardach *et al.*, 1972; Hickling, 1970; Iverson, 1968; Milne, 1972). The postlarvae and juveniles that naturally occur in the backwater creeks and estuaries enter the ponds along with the high tide and are prevented from escaping during low tide by the screens that are inserted in the sluices. The prawns that are thus trapped grow rapidly in the ponds and are periodically harvested. The yield from these operations are greatly affected by the seasonal and annual fluctuations in the availability of the prawn seed in the backwater and estuarine systems. The ever increasing demand for frozen penaeid prawns has given an impetus to the development of brackishwater and coastal prawn culture in the tropical and sub-tropical regions of the world, on scientific lines. Instead of depending on the uncertain supply of natural prawn seed, there is a worldwide interest in the artificial propagation of the seed of fast growing species of penaeid pranws belonging to the genera *Penaeus* and *Metapenaeus*.

RESUME OF EARLIER INVESTIGATIONS

The technique of spawning the females of *Penaeus japonicus* in the laboratory and rearing the larvae to the late postlarval stage when they could be stocked in the ponds was perfected over a period of 30 years by Hudinaga and his associates in Japan (Hudinaga, 1935, 1942; Fujinaga, 1969; Hudinaga and Kittaka, 1966, 1967, 1975 and Hudinaga and Miyamura, 1962).

The method, as it is now practised in Japan, consists of spawning the ripe females and rearing the larvae from the egg to the "fry stage" in large concrete tanks of 60-200 tonnes capacity. The phytoplankton for the protozoea stages and zooplankton for the mysis and postlarval stages are developed in the concrete tank itself. The hatchery facilities and the rearing methods used in Japan are discussed in detail by Shigueno (1973). The use of large concrete tanks has also

been adopted in Taiwan to mass produce the postlarvae of *P. japonicus, P. monodon, P. semisulcatus, P. teroi, Metapenaeus ensis* and *M. joyneri* (Liao and Huang, 1973) and in the Philippines for producing the postlarvae of *P. monodon* and *P. indicus* (Villaluz *et al.*, 1969; Anon, 1975 *a* & *b;* Anon, 1976). This method has also been used for large scale production of the fry of *P. kerathurus* in Italy (FAO, 1972) and Spain (FAO, 1975);*P. duorarum* in Florida (FAO, 1969); *P. latisulcatus* in Australia (Pownall, 1974); and *P. orientalis* in Korea (Kim, 1967).

In the U. S. A. artificial propagation of *P. aztecus, P. duorarum* and *P. setiferus* has been successfully achieved by adopting slightly different techniques. Instead of using large concrete tanks, Cook and Murphy (1966, 1969) have used plastic or fibre glass containers (1-2 m^3 capacity) for spawning of the prawns. Cook (1969) has used inverted 19 l polyurethane carbuoys for rearing the nauplii to the postlarval stage. An air stone placed in the neck of the carbuoy circulates the water effectively. Pure cultures of diatoms and flagellates are given as food for the protozoea stage, and freshly hatched nauplii of brine shrimp are added when the mysis stage is reached. By this method, Cook (1969) has been able to produce 2000 postlarvae in 15 l of water in the carbuoy (i.e., 133 postlarva/l of water). In comparison, the Japanese method yields only 5-10 postlarvae/l of seawater.

To increase the survival rate of the larval stages and to reduce the cost of production, various substitutes for cultured diatoms and *Artemia* nauplii are being tried as food for the protozoea and mysis stages. In the Philippines bread yeast, washings of filamentous algae and juice of *Sargassum* (Anon, 1975 *a*) and fermented extract of vegetable refuse from kitchens (Anon, 1976) have been tried with varying degrees of success. In Japan, marine yeast (Farukawa, 1973) and finely powdered soyabean cake (Hirata *et al.*, 1975) have been successfully used. In Taiwan (Liao and Huang, 1973) and in the Philippines (Anon, 1975 *a*) the rotifer *Brachionus* has been used as food for the mysis stages.

A major bottleneck in large scale production of prawn seed is the difficulty in obtaining spawners throughout the year. To overcome this difficulty efforts are now being made in different parts of the world (Alikunhi *et al.*, 1972; Arnstein and Beard, 1975; Anon, 1975 *b* and 1976) to induce the adult prawns to attain full gonadial development under controlled artificial conditions.

PRESENT INVESTIGATIONS AT THE C. M. F. R. I.

At the Narakkal Prawn Culture Laboratory of the Central Marine Fisheries Research Institute, a very simple system has been evolved for rearing the larvae. Spawners are kept individually in 50 l plastic basins containing 35-40 l of seawater filtered through No. 21 plankton netting and aerated by an air stone. Spawning takes place in the night and the female is removed early in the morning. The eggs are allowed to develop undisturbed in the plastic basin. Just before the larvae moult into the protozoea stage, a suspension of phytoplankton is added so that a concentration of 10-15 $\times$ 10^3 cells/ml is present in the basin. The phytoplankton is not cultured separately in the laboratory but is collected from brackishwater ponds attached to the farm. Fresh collections of diatoms (mostly species of *Thalassiosira, Navicula, Pleurosigma* and *Nitzschia*) are added to the basins every day till the postlarvae are harvested. Along with the diatoms, tintinnids, rotifers and copepod nauplii occurring naturally in the pond are also introduced and form the food of the larvae in the mysid and postlarval stages. It was found that the larvae of *M. dobsoni* and *M. affinis* do not need any other food to complete the development upto the postlarval stage. But the survival of *Parapenaeopsis stylifera* and *Penaeus indicus* is better if brine shrimp nauplii

are given as food as soon as they attain the mysis stage. Throughout the rearing period the debris found at the bottom of the basin is siphoned out and fresh seawater added everyday. The water is continuously aerated.

Between December, 1975 and September, 1976 it has been possible to successfully spawn over 100 *M. dobsoni*, nearly 30 *P. indicus*, over 40 *P. stylifera*, several numbers of *M. monoceros* and *M. affinis* and one *P. monodon* at Narakkal. These have been spawned and reared in plastic containers of different sizes and the fry stocked in the farm as well as supplied to some local farmers for stocking in their fields. In the following table are given the results of a few of these experiments in which the 50 l plastic basins were used and larval counts maintained for determining the survival from the nauplius to the postlarval stage (stocking size).

Species	No. of experiments	Salinity range (‰)	Tem. range (°C)	Total no. of nauplii hatched	Total no. of postlarvae obtained after 25-30 days	Survival rate % Range (mean)
Metapenaeus dobsoni	6	32.8 to 37.3	25.0 to 29.3	2,10,550	38,346	2.3 to 37.0 (18.2)
M. affinis	4	31.6 to 35.6	25.8 to 29.1	4,40,670	25,320	4.2 to 8.8 (5.7)
M. monoceros	3	34.2 to 36.2	27.9 to 29.1	12,38,740	11,880	0.8 to 1.4 (1.0)
Penaeus indicus	3	33.8 to 36.3	25.1 to 28.9	1.52,000	3,740	1.5 to 8.9 (2.5)
Parapenaeopsis stylifera	2	33.8 to 36.2	25.0 to 28.9	91,300	10,060	10.6 to 11.5 (11.0)

It was found that *M. dobsoni* could be reared very easily by the method adopted here and a survival (from the nauplius to postlarval stage) of 18.2% was achieved on an average. About 10,000 to 12,000 postlarvae of *M. dobsoni* could be produced in 35-40 l of seawater. This yield of 300 postlarvae/l of water compares very favourably with 133 postlarvae/l obtained by Cook (1969) using much more sophisticated methods. The poor survival observed in the case of *P. indicus*, *M. monoceros* and *M. affinis* was mainly due to overcrowding and the accumulation of metabolites in the medium. Experiments are in progress at the laboratory to improve the survival rate of the larvae.

The rearing method adopted at Narakkal is distinguished by its simplicity and inexpensiveness. It involves very little capital investment and is not waste-

ful of larval food and seawater. This simple method is also need based so that it could easily be adopted by small scale farmers and fishermen who wish to take up prawn culture.

Experiments are also now being done at Narakkal to rear the larvae in large plastic pools (10, 20 and 50 tonnes capacity) where the problem of metabolities is solved by the diluting effect of the large volume of water and the addition of fresh seawater everyday to the rearing tanks after the larva attain the protozoea stage.

CONCLUSION

All along the Indian coast extensive areas are available for coastal aquaculture. Low lying coastal areas which are perennially innundated by the tides in Kerala and West Bengal are utilised for growing prawns in the traditional way either throughout the year or for part of the year (Gopinath, 1956; Pillay, 1954). Thus the basic infrastructure is already available in Kerala and West Bengal for developing large scale prawn culture on scientific lines.

In the Ernakulam and Alleppey Districts, nearly eleven thousand hectares of innundated areas are available for penaeid prawn culture. In the Vypeen Island near Cochin where Narakkal is situated, there are about 1170 ha of prawn fields yielding about 700-1100 tonnes of prawns annually by the traditional methods (George, 1974). There is considerable scope for improving the yield from these fields. One of the major constraints is the difficulty in getting the post-larvae of the fast growing species like *P. indicus* and *P. monodon* in large numbers. The methods that have been developed at the Narakkal Prawn Culture Laboratory will go a long way in increasing the yield of prawns from the prawn fields and in improving the rural economy of the coastal regions.

While the techniques of large scale culture of penaeid larvae are being improved at Narakkal, simultaneous arrangements are also being made to organise training programmes in prawn culture at the trainers level as well as for fishermen and farmers interested in taking up such culture practises.

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