

TECHNIQUES OF REARING *MACROBRACHIUM ROSENBERGII* (DE MAN) LARVAE

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Spawning, rearing and maintenance of larvae under controlled conditions for the regular supply of seeds are the necessary pre-requisites in prawn culture on a commercial scale. *Macrobrachium rosenbergii* (de Man) was selected for this purpose because of its large and attractive size bringing high prices in the local and foreign markets and the short duration of 9 months in which it reaches a marketable size. Gravid females of this prawn, collected from nature were allowed to breed in the laboratory. The larvae were mass cultured in glass tanks of 74 × 30 × 34 cm, 90 × 45 × 45 cm and 108 × 45 × 45 cm capacity upto the 7th zoea stage in 26 days. One of the important results achieved is in the feeding of the larvae for getting proper survival rate with cheaper prepared feeds instead of the expensive food item *Artemia*. The detailed techniques of rearing the larvae and maintaining them in the laboratory under optimum conditions of growth and survival are discussed in the paper.

INTRODUCTION

The giant prawn *Macrobrachium rosenbergii* found in the Indo-Pacific region, is distributed in waters connected with the estuaries along both the east and west coasts of India (Raman, 1964 and George, 1969). At present most of the commercial catches come from the natural sources, which, however, are not sufficient to meet the increasing demand. In addition to this, a declining trend in the fishery of this prawn has been recently noticed in several areas. Therefore, the only way to increase the production of this commercially important species is by adopting methods of aquaculture. Amongst fresh and brackishwater species, *Macrobrachium rosenbergii* is found most suitable for culture because of its large size and the short period of nine months in which it grows to marketable size.

There are two distinct phases of culturing this prawn. The first includes spawning and rearing of the larvae in the laboratory and the second, rearing juveniles to the adult stage in the ponds. On a commercial scale however, seed supply by collection from nature cannot be regular because of the low natural population densities characteristic of this species (Bardach *et al.*, 1972). The only way to grow substantial crop is by rearing prawn right from egg to the adult stage in captivity. Efforts have already been made in many parts of the world and success achieved in Malaysia (Ling, 1962) and in Hawaii (Fujimura, 1966). In Hawaii, the initial brood stock was transported from Malaya and the culture developed to a commercial scale (Fujimura and Okamoto, 1970 and Ochida, 1972). The reported yield is about 4,000 Kg/acre/yr. Wickins and Beard (1974) made observations on the breeding and growth of this species. Dugan *et al.* (1975) developed a combined rearing technique in which early stage larvae are reared in conical tanks attached to a separate biological filter. By using their methods, Hagood and Willis (1976) determined a total production cost of \$ 3.56 for 1000 juveniles of *M. rosenbergii*. Meeran and Sebastian (1976) described tanks made of perspex sheet walls and grey slate bottom yielding better survival of the

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larvae. Joseph and Sadanandan (1976) found elongated half cylinder containers showing better results than glass tanks.

Larval stages of some penaeid prawns from Indian waters have been reared under laboratory conditions as cited by Silas and Muthu elsewhere in this volume and Rao and Kathirvel (1973) and Thomas *et al.* (1974). However, so far not much work has been done on culturing the larval stages of *M. rosenbergii* on a mass scale. Hence, the present work, as a part of the project on aquaculture in the National Institute of Oceanography, was taken up to mass culture *M. rosenbergii* larvae in the laboratory and the results are presented herein.

EQUIPMENT AND METHODS

Glass tanks of 45 × 23 × 30 cm size were used for maintaining brood stock and 74 × 30 × 34 cm, 90 × 45 × 45 cm and 108 × 45 × 45 cm sizes for mass rearing the larvae. Seawater was filtered through nylon netting of 50 μ mesh size and was sterilized (8 - 12 hr) by a pair of ultraviolet light tubes of 20 matts. Before using, the required salinity of the water was adjusted from this seawater by adding 2-3 days old tap water.

COLLECTION AND MAINTENANCE OF BROOD STOCK

Gravid *Macrobrachium rosenbergii* females were obtained from Durbhat, situated at the upstream region of Zuari river. Berried animals were available here from the month of July to September. Four to eight females were brought at a time to the laboratory, in big plastic buckets of 32 l capacity by filling half of it with water from the same locality and covering with a perforated plastic lid. On reaching the laboratory the berried females were immediately transferred to tanks of 45 × 23 × 30 cm size, filled to half of its capacity with aerated seawater of salinity 4-6‰, at the rate of 1-2 females per tank. The larvae usually hatched within a week and were transferred to the bigger rearing tanks.

METHODS OF TRANSFERRING LARVAE

Various methods of transferring larvae as described by Ling (1962), Fujimura (1966) and Dugan *et al.* (1975) were tried. The quickest and most suitable method least injuring the larvae was the following. All the tube lights of the room were switched off and only a corner of the tank illuminated by a table lamp. The larvae were allowed to concentrate there for a few min and then siphoned out in plastic buckets of 15 l capacity. Meanwhile, rearing tanks were kept ready by filling them to 2/3 of their capacity with sterilized seawater of 12-16‰ salinity at the room temperature, 27.5°C. The water was continuously aerated with the help of an air stone at the rate of 2-8 bubbles/sec depending upon the size of the tank and the number of the larvae. The larvae are then netted from the buckets and transferred into these tanks with a hand net made of nylon material of 25 mesh/cm. This method saved time without injuring the larvae and also avoided incoming of water and undesirable substances from the hatching tank.

REARING OF THE LARVAE

The larvae were reared up to the 7th stage in 26 days. During this period proper care was taken to maintain optimum water conditions, to avoid fouling of water and to give appropriate quantity and quality of food. Optimum water conditions were daily maintained by cleaning the tanks 2 to 3 times and by partial change of water. Depending upon the size of the tank and the number of larvae, total change of water was done within 2-4 days.

FOOD AND FEEDING

A variety of food items like phytoplankton *Tetraselmis* sp., *Skeletonema costatum*, mixture of zooplankton, copepods, *Artemia* nauplii, scrap fish powder, boiled potatoes, boiled egg, corn flour, maize flour, yeast, powdered hen egg custard, powdered mangrove leaves, boiled peas, etc were tried. Trials were also made to grow larvae in green water having a mixture of phytoplankton, without giving any supplementary food. It was noticed that larvae could not survive more than 2-3 days after hatching in such circumstances or when given only *Tetraselmis* sp. and *Skeletonema* sp. as food. In these initial days the larvae can survive even without any food because of the presence of embryonic yolk material. It seems that the green water of Fujimura (1966) might be helping only in maintaining good water conditions like green plants in the aquaria but early larvae do not feed on phytoplanktons as such. This has recently been confirmed experimentally by Cohen et al. (1976).

Mixture of zooplankton consisting mainly of copepods was accepted as food but due to the difficulties involved in getting sufficient quantities to supply for large scale culture this was given only as supplementary feed whenever available. Larvae easily accepted *Artemia* nauplii also, but, in the present experiments efforts were made to avoid the use of *Artemia* because of their high cost.

Prepared foods were found much cheaper and most practical. Hen egg custard and scrap fish flesh made in powdered form were used as food throughout the experiments. Egg custard was prepared and graded into various sizes following Ling (1962) and then oven dried at 37°C. Similarly, fish flesh food was prepared following Fujimura (1966) and Dugan et al. (1975) and later oven dried.

Feeding was started from the 3rd day of hatching onwards. On 3rd day food was given only two times per day, thereafter the number of feeds was increased to 3-4 times a day. During the feeding operation the larvae were induced to concentrate on one side of the tank by illuminating it with a table lamp and gradually fed by slowly spreading the food in the form of a suspension on the upper surface of water with the help of a medicinal dropper. Extra food, excreta, dead animals and any undesirable substances were removed 2-3 times per day.

OPTIMUM CONDITIONS OF SURVIVAL

The rate of survival was greatly affected by factors like water conditions, photoperiod, cleanliness of the tanks, rate of stocking, aeration control, depth of water, size of the food particle and method of feeding.

The present experiments showed salinity of 12-16‰ at the room temperature 26-27°C and photoperiod of 12-14 hr to be optimum. The water conditions were maintained by cleaning the tanks 2-3 times a day. Overcrowding was avoided as it resulted in oxygen depletion and also lead to cannibalism from third stage onwards. So the larvae were stocked at the rate of 150-200/l of water during the first two stages and thereafter, at the rate of 20-50/l. Aeration was controlled at the rate of 4-8 bubbles/sec which was sufficient to keep the water saturated with oxygen, to keep food particles in circulation and to avoid deaths due to turbulence of water.

Trials with different volumes of water indicated a minimum depth of 16 cm in the tanks suitable. The larvae get better opportunities to catch food while swimming and so are fed better and show a better rate of survival. To a certain extent mortality of the larvae occurs by getting entrapped in the debris at the

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bottom of the tank and consequent starvation and infections. As experienced by Fujimura (1966) a suctorian protozoan infection was encountered many times, causing high mortality. Antibiotics like Pencillin and Streptomycin single and in combination were ineffective to control this infection. Copper sulphate solution (0.4 ppm) as suggested by Fujimura (1966) was not found suitable. However, the infection could be controlled by very dilute formaldehyde (0.2 ml/l of water). Ling (1969) suggested formalin treatment for protozoan infections. During the present experiments, the mean percentage of survival was very high (90-100%) in the earlier stages and decreased from stage 6th onwards due to infections (40-50%).

REMARKS

The present experiments have been successful in developing a basic technology of mass culturing *Macrobrachium rosenbergii* larvae through the delicate early stages up to the seventh zoea. One of the important results achieved is in the feeding of the larvae for getting proper survival rate. Instead of using the expensive food item *Artemia*, other cheaper feeds could be successfully used and can later be commercialised.

ACKNOWLEDGEMENTS

We are grateful to Dr. S. Z. Qasim, Director, NIO, Goa, and the project leader for his continuous encouragement and suggestions. Thanks are due to Dr. M. J. George for help and for critically going through the manuscript.

REFERENCES

- BARDACH, J. E., RYTHER, J. H. AND McLARNEY, W. O. 1972. *Aquaculture, the farming and husbandry of freshwater and marine organisms*. Wiley Interscience, New York.
- COHEN, D., FINKEL, A. AND SUSSMAN, M. 1976. On the role of algae in larviculture of *Macrobrachium rosenbergii*. *Aquaculture*, **8**, 199-207.
- DUGAN, C., HAGOOD, R. W. AND FRANKS, T. A. 1975. Development of spawning and mass larval rearing techniques for brackish, freshwater shrimps of the genus *Macrobrachium* (Decapoda: Palaemonidae). *Florida Marine Research Publications*, No. 12, 1-23.
- FUJIMURA, T. 1966. Notes on the development of a practical mass culturing technique of the giant prawn *Macrobrachium rosenbergii*. *Indo-Pac. Fish. Council. Proc.* 12th Session, 1-4.
- FUJIMURA, T. AND OKAMATO, H. 1970. Notes on progress made in developing a mass culturing technique for *Macrobrachium rosenbergii* in Hawaii. *Indo-Pac. Fish. Council.* 14th Session, 18-27.
- GEORGE, M. J. 1969. Genus *Macrobrachium* Bate 1868. Ch. VII in prawn fisheries of India. *Bull. Cent. Mar. Fish. Res. Inst.*, Mandapam Camp. No. **14**, 179-216.
- HAGOOD, R. W. AND WILLIS, S. A. 1976. Cost comparisons of rearing larvae of freshwater shrimp *Macrobrachium acanthurus* and *M. rosenbergii* to juveniles. *Aquaculture*, **7**, 59-74.
- JOSEPH, K. S. AND SADANANDAN, R. 1976. Notes on larval rearing experiments of *Macrobrachium rosenbergii* (de Man) in captivity using prepared food. *Bull. Dept. Fish. Kerala*, **1**, 37-40.
- LING, S. W. 1962. Studies on the rearing of larvae and juveniles and culturing of adults of *Macrobrachium rosenbergii* (de Man). *IPFC Current affairs bulletin* No. **35**, 1-11.

- LING, S. W. 1969. Methods of rearing and culturing *Macrobrachium rosenbergii* (de Man). *FAO Fish. Rep.*, **3**, 607-619.
- MEERAN, N. K. AND SEBASTIAN, M. J. 1976. On rearing the larvae of the giant freshwater prawn — *Macrobrachium rosenbergii* (de Man). *Bull. Dept. Fish. Kerala*, **1**, 33-36.
- RAMAN, K. 1964. On the location of a nursery ground of the giant prawn *Macrobrachium rosenbergii* (de Man). *Curr. Sci.*, **33**, 27-28.
- RAO, P. V. AND KATHIRVEL, M. 1973. On the breeding of a penaeid prawn *Metapenaeus dobsoni* in the brackish water medium. *Indian J. Fish.*, **20**, 228-230.
- THOMAS, M. M., GEORGE, K. V. AND KATHIRVEL, M. 1974. On the spawning and early development of the marine prawn, *Parapenaeopsis stylifera* (H. Milne Edwards) in the laboratory. *Indian J. Fish.*, **21**, 266-271.
- UCHIDA, R. N. 1972. Review of recent progress in coastal aquaculture in the United States. In: Pillay, T. V. R. (Ed.). *Coastal Aquaculture in the Indo-Pacific Region*. pp. 84-104. Fishing news (Books) Ltd., London.
- WICKINS, J. F. AND BEARD, T. W. 1974. Observations on the breeding and growth of the giant freshwater prawn *Macrobrachium rosenbergii* (de Man) in the laboratory. *Aquaculture*, **8**, 159-174.

DISCUSSION

- TIWARI : Do all the eggs in a gravid female hatch simultaneously or is there a considerable time-lag between the hatching of the first and last egg?
- USHA GOSWAMI : All the eggs hatch within a period of 6 hr; many hatch at the same time.
- BOSCHI : Did you use green water for the culture of the larvae? How many larval stages are there and what is the total period of metamorphosis?
- USHA GOSWAMI : Green water was used for the experimental purposes in small scale and it did improve the water conditions. However, in large scale culture, this was not found practical in the laboratory, as many unwanted ciliates and other protozoans were coming up now and then.

There are 8 morphologically distinct larval stages described but there are 11-12 moults. The period of metamorphosis is 32-40 days.