EXPERIMENTAL CULTURE OF *CHICOREUS VIRGINEUS* (RÖDING, 1798)

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ABSTRACT

Spawning and an experimental larval culture studies were carried out for 170 days with an economically important muricid gastropod, *Chicoreus virgineus*. Spawning occurred during February and March. The vasiform capsules were laid in clusters. Capsule structure and fecundity were compared with other muricid gastropods. Larvae hatched out 22-25 days after spawning, mostly as non-pelagic juveniles. The size ranged from 1.21 to 1.34 mm. The juveniles were fed with both live and non-live feeds. Bivalve spats and newly settled barnacles were found to be more suitable for a period of about 90 days, and bivalves, *Meretrix* sp. were given for further culture as a regular diet.

INTRODUCTION

With regard to molluscan culture in India much attention has been devoted to the culture of some bivalves. Gastropod culture is still ignored, though they have great commercial value. The recent demand for gastropod meat and operculum has motivated the fisherfolk along the southeastern coast of India to go for regular fishing of gastropods. There is increased exploitation of economically important gastropods. Bearing this in mind an attempt has been made to culture the muricid gastropod *Chicoreus virginius* as it is regularly exploited all along the southeastern coast of India for shells, meat and operculum.

MATERIALS AND METHODS

Sample collection

Samples of *Chicoreus virgineus* (Röding, 1798) were collected from the littoral region of the coastal environment of Cuddalore (11°42'N; 79°46'E) by trawl netting. The animals were scrubbed and washed in sea water. Groups of different sizes were maintained in a cylindrical plastic tank of 60 litre capacity filled with filtered sea water, salinity 32 ppt, temperature 27±3°C, and pH 8. The standing water was well aerated and replenished every day. The bivalves *Meretrix meretrix* and *M. casta* were given to them as regular diet till spawning was observed.

Maintenance of the capsule

The capsule clusters, laid on the walls of the tanks, were carefully removed using a stainless steel scalpel and placed in a circular plastic tank 60 litre capacity filled with filtered sea water, salinity 32 ppt, temperature 27±3 °C and pH 8. The water was gently aerated and replenished every day.

Rearing of larvae and juveniles

The hatched out larvae were separated and placed in a circular plastic rearing tank of 20 litre capacity filled with sand-filtered sea water (salinity 32 ppt; temperature 27±3°C and pH 8). 100 larva were introduced in each tank. The water was replenished every day in the early hours. The larval size and the characters were noticed once every ten days. Survival rate was also calculated.

Feeding

Trial feeding was conducted in circular plastic tanks of two litres capacity. 50 larvae from the hatching tanks were introduced in each tank and different food items such as boiled egg yolk, boiled clam meat, frozen *Artemia* naupli and the naturally collected spats of bivalves and newly settled barnacles were given to them. The water was gently aerated. After 92 days, bivalves *Meretrix meretrix* and *M. casta* of a small size were given as food, as the juveniles can drill and feed on the bivalves.

RESULTS

Spawning

In the laboratory, *C. virgineus* laid egg capsules from February to May. The capsules were deposited in clusters on the sides of the tanks. Each cluster containing 42 to 98 egg capsules. The spawning generally lasted for 36 to 45 hours.

Structure of egg capsule

C. virgineus egg capsules were irregularly arranged in a cluster. The newly laid capsules were vasiform, opaque and creamy white in colour and they changed into pale yellow after 2-3 days. The mean length and width of the capsule was 1.11 cm and 0.64 cm, respectively (Fig.1). The capsules were broad at the top, and narrower towards the base. The narrower basal region was connected to membranous branches (adhesive disk) by a small peduncle. One side of the capsule was concave, and the opposite side slightly convex and smooth. Two distinct ridges were found at the concave side.The ridges became united at the basal region. At the apical region, between the two ridges, a groove like structure was present. The apical region of the capsule was elliptical in shape and had a central "exit hole" covered by a thin transparent membrane. The mean size of the exit hole was 1.34 mm.

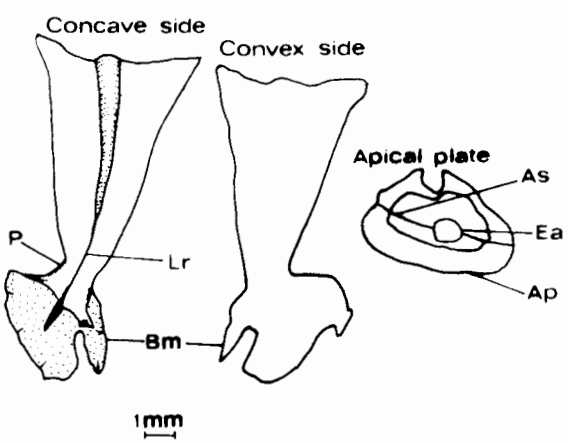

Figure 1. *Chicoreus virginius* egg capsule.
Ap = Apical plate, As = Apical suture, Lr = Lateral ridge, Bm = Basal membrane, P = Peduncle, Ea = Escape aperture.

Fecundity

C. virgineus eggs were round, white and were floating in a colourless mucus-like fluid. Their size ranged from 192-210 µm. 534-596 eggs were observed in each capsule.

Hatching

Hatching was observed in *C. virgineus* about 26 days from the day of spawning. The hatching period lasted for about 10 hours and 10-22 larvae were released from each capsule. On an average 15 larvae per capsule.

Feeding

The newly hatched *C. virgineus* fed actively on live food *viz*., bivalve spat and newly settled barnacles. Larvae would rarely feed on the other food sources like boiled egg yolk, boiled clam meat and frozen *Artemia* naupli, and the water was also quickly polluted. Hence live feed was given as a regular diet for culturing *C. virgineus* for a period of 92 days.

Development of *C. virgineus*

The hatched larvae were non-pelagic with four distinct lobes, a well developed siphon, foot and tentacles bearing eyes. The shells were brown with one whorl. The average length was 1.28 mm. The young ones were found to be creeping at the bottom and on

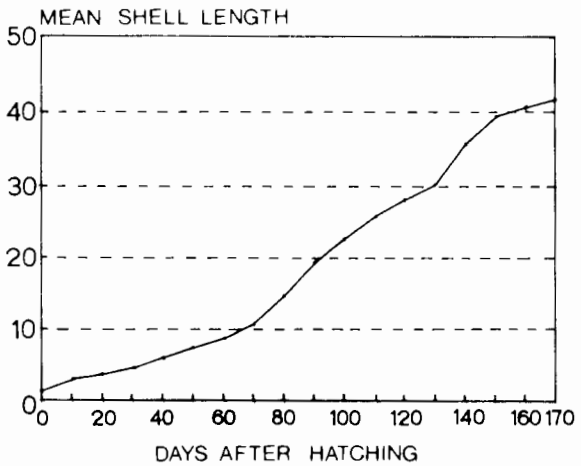

Figure 2. Growth of *Chicoreus virginius* juveniles reared in the laboratory.

the side walls of tanks. However, a few larvae were rarely found swimming and they quickly attached themselves to any part of the tank. The following observations were made over 170 days (Fig. 2).

10th day. Two whorls and six spiny outgrowths were found in the outer lib region. Mean length: 2.52 mm.
20th day. In addition to the outer lib spines, two spines were also found in the siphonal canal region. Mean length: 3.82 mm.
30th day. The juveniles were found with three whorls. Mean length: 4.6 mm.
50th day. Four whorls were observed and a band of light brown colour also appeared in the middle region of the body whorl. Mean length: 7.2 mm.
70th day. Varices started developing in the juveniles. Mean length: 9.2 mm.
80th day. Five whorls and three varices were clearly visible. Shell length: 10.7 mm. After that no remarkable changes were observed except in the increase in shell length of juveniles and shell thickening.
170th day. The mean length of the juveniles was 41.6 mm and the shell was dull white in colour, and had five whorls and three varices with spines. A band brown in colour was found in the middle region of the body.

Survival rate

During the experimental culture of *C. virgineus* survival rate was only 2% at the end of the observation period. High mortality was observed during the earlier days, *i.e.* 83% and 53% respectively during the first 10 and 20 days. No mortality was observed after 60 days.

DISCUSSION

The shell surfaces of most of the wild collected *C. virgineus* were found to have egg clusters during February and March. Similar observations were also made in *C. virgineus* by Natarajan (1955) in Mandapam coastal waters of the Gulf of Mannar region.

C. virgineus egg capsules resembled capsules of other muricids like *C. ramosus* (Bussarawit and Ruangchua, 1991; Xavier Ramesh *et al.*, 1992) and *M. florifer* (D'Asaro, 1970). However their height was less than that of *C. ramosus* and higher than that of *M. florifer.*

The number of 10-22 larvae released from each capsule was similar to observations by Natarajan (1955) in laboratory spawning of *C. virgineus* collected from Mandapam coastal waters.Though about 600 eggs were found in a newly laid egg capsule, the hatching was poor. According to Natarajan (1955) only a few eggs of *C. virgineus* developed into embryos and the rest into nurse eggs. Utilization of nurse eggs by the developing embryos is the characteristic feature of this species which has direct development. The present hatching is comparable to findings of D' Asaro, (1970) in *Murex florifer* and *M. pomum*. Both species have direct development.The hatching was 5 and 13 larvae respectively in *M. florifer* and *M. pomum*. Natarajan (1955) reported that *C. virgineus* has larvae of the planktotrophic type for a short time. Though we found four elongated velar lobes, a characteristic feature of the veliger larvae, we never noticed prolonged swimming, except in some which occasionally swam. In Muricidae, non-pelagic development has been also reported in *C. brunneus* (Risbec, 1932); *M. quadrifrons* and *M. sengalensis* (Knudsen, 1950); *M. torrefactus* (Cernohorsky, 1966); *M. pomum* and *M. florifer* (D'Asaro, 1970). However recent observations by Middelfart (1992) revealed that *C. brunneus* and *C. torrefactus* have distinct pelagic development in Thailand. During the 170 days of culture of *C. virgineus,* growth was observed to the average size of 41.6 mm. In general, slow but steady growth was observed up to 70 days and thereafter growth was significantly faster up to the 150th day (Fig.2). The growth was notably slower after 150 days. Wildly collected bivalve spats and newly settled barnacles were used as diet for 92 days. Live food was collected from the estuarine region, and ceramic plates were used as substrate. Many unwanted fouling organisms and heavy accumulation of detritus were noticed on the substrate. When introducing the ceramic plates with the settled feed in the rearing tanks, production of H_2S was noticed in the space between the bottom of the tank and the ceramic plates. A similar observation

was made by Steenfeldt and Bussarawit (1992) when culturing *C. ramosus*. According to Chen (1984) H_2S is known to be toxic to juvenile abalone and retarded their growth even at concentration as low as 0.05 ppm. Hence the slower growth in the period of 70 days might be due to poor water quality or insufficient food. The growth was significantly faster when the juveniles were fed with live bivalves. However, we could not definitely conclude whether the *Meretrix* species alone provide all the essential nutritional requirement for their normal growth. But in *C. virgineus* cultured for 170 days this rate of growth was 3 fold higher than that of *C. ramosus* cultured in the laboratory (Nugranad, 1992).

The probable reason for high mortality during the earlier periods might be either due to insufficient food or failure of some juveniles to find the food source. Another notable reason for high mortality was the crawling behaviour of the juveniles. They crept out of the culture medium which lead to death of many juveniles. In addition, the big ones preyed upon the smaller juveniles.

CONCLUSION

C. virgineus culture should be possible and easy if some important technical problems like suitable substratum, and live feed could be solved. However, from the economical point of view *C. virgineus* culture might not be as encouraging as that of other organisms. Bivalves were provided as regular diet for the growing juveniles and the cost of the feed was higher than that of the marketable size of *C. virgineus*. It is necessary to reduce the cost of production by identifying a low cost suitable formulated feed or to find some live feed, other than bivalves with economic importance. More studies should be conducted to ascertain the nutritional requirements of *C. virgineus* for their successful growth.

REFERENCES

Bussarawit, N. and T. Ruangchua. 1991. The production and morphology of egg capsules and veliger larvae of *Chicoreus ramosus* L. *Phuket mar. biol. Cent. Spec. Publ. no.* **9**: 70-74.

Cernohorsky, W.O. 1966. The Radula, egg and young of *Murex (Chicoreus) torrefactus* Sowerby (Mollusca: Gastropoda). *The Veliger,* **8**(4): 231-233.

Chen, H.C. 1984. Recent innovations in cultivation of edible molluscs in Taiwan, with special reference to the small abalone. *Haliotis diversicolor* and the hard clam *Meretrix lusoria. Aquaculture*. **39**: 11-27.

D'Asaro, C.N. 1970. Egg capsules of Prosobranch molluscs from South Florida and the Bahamas and notes on spawning in the laboratory. *Bull. Mar. Sci.* **20**(2): 414-440.

Knudsen, J. 1950. Egg capsules and development of some marine prosobranchs from Tropical West Africa. Sci. Res. Dan. Exp. coast of Trop. West Africa. *Atlantide Rep.* 85-128.

Middelfart. P. 1992. Early life stages of muricid gastropods *Chicoreus ramosus, C. torrefactus* and *C. brunneus* from Phuket Island, Thailand. *Phuket mar. biol. Cent. Spec. Publ.no.* **10**: 113-122.

Natarajan, A.V. 1955. Studies on the egg masses and larval development of some gastropods from the Palk Bay and the Gulf of Mannar. M.Sc. dissertation, Annamalai University, India.

Nugranad, J. 1992. Intensive culture of *Chicoreus ramosus* at the Prachuab Khiri Khan hatchery. *Phuket mar. biol. Cent. Spec. Pub. no.* **10**: 65-71.

Risbec, J. 1932. Note sur le ponte et le development de mollusques gastropods de Nouvellele Caledonia. *Bull. Soc. Zool. Franc.* Tome **LVII**, No. **4**: 358-75.

Steenfeldt, S. and N. Bussarawit, 1992. Culture of *Chicoreus ramosus* at the PMBC. *Phuket mar. biol. Cent. Spec. Publ. no.* **10**: 53-64.

Xavier Ramesh, M., J.K. Patterson Edward, and K. Ayyakkannu. 1992. Reproductive Biology of *Chicoreus ramosus* from Mandapam coastal waters, southeast coast of India. *Phuket mar. biol. Cent. Spec. Publ. no.* **10**: 80-85.