

ATTAINMENT OF MATURITY IN POND-REARED KURUMA PRAWN *PENAEUS JAPONICUS* BATE

M. KATHIRVEL* AND V. SELVARAJ*
Central Marine Fisheries Research Institute, Cochin-682 031

ABSTRACT

Early juveniles of Kuruma prawn *Penaeus japonicus*, collected from wild, were successfully cultivated in an enclosed earthen pond at Mariculture Farm, Muttukadu near Madras on supplementary clam meat diet for a period of 6 months, during which period, they exhibited a growth of 11.2 mm/month. When a few specimens were reared further, females were found with developing ovary at the 11th month of culture. In the second trial conducted with the hatchery raised seeds of Kuruma prawn, the monthly growth was 15.4 mm and females became impregnated by the sixth month and matured by ninth month of rearing. The most significant observation in these trials is the occurrence of maturing female Kuruma prawns which has paved the way for the establishment of indoor broodstock for the first time in India and subsequent domestication of the species.

INTRODUCTION

It is well known that penaeid prawns belonging to the genera *Penaeus* and *Metapenaeus* migrate in their postlarval stages into coastal lakes, lagoons, backwaters and estuaries to spend their juvenile phase and move back to the sea for the attainment of maturity and subsequent spawning (Mohamed and Rao, 1971). However, in recent years, occurrence of matured penaeid prawns is reported from coastal lakes (Morris and Bennett, 1952; de Bruin, 1965; Muthu and Sampson Manickam, 1973; Lumare, 1984), backwaters (Rao and Kathirvel, 1971) and coastal ponds (Johnson and Fielding, 1956; Villaluz *et al.*, 1972; Racek, 1973; George, 1974; Pownall, 1975; Chen, 1976; Conte *et al.*, 1977; Lichatowich *et al.*, 1978; Rodriguez, 1981; Silas *et al.*, 1982; Yano, 1984; Kathirvel, 1985). As part of the field culture programmes on penaeid prawns at the Mariculture Farm of Central Marine Fisheries Research Institute,

Muttukadu near Madras, seeds of the Kuruma prawn *Penaeus japonicus* Bate, collected from the natural environment, were successfully cultivated during 1982-83 (Silas and Kathirvel, MS). Following this, two more field culture experiments were carried out between December 1983 and November 1985. During the course of these trials, matured *P. japonicus* were obtained. The results of culture experiments and collection of matured Kuruma prawns are presented in this account.

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MATERIAL AND METHODS

Two experiments were conducted, the first one with the stocking of 2000 early juveniles (size range : 35 to 81 mm ; average total length : 42.2 mm), obtained from wild, in a 0.4 ha pond

* Present address : M.R.C. of C.M.F.R.I., 141 Marshalls Road, Egmore, Madras-600 008.

from 6-12-1983 to 15-12-1984 and the second one with 2000 hatchery raised advanced post-larvae (size range : 9 to 27 mm ; average total length : 14.8 mm), stocked in the same pond, from 26-2-1985 to 12-11-1985. The second experiment was terminated due to damage of the culture pond by cyclonic rains and consequent complete escape of reared stock through breaches in the pond. The stocked prawns were fortnightly sampled for recording the growth and well-being. On each sampling, 50 to 60 prawns were caught by operating a drag net between 2000 and 2200 hrs and total length in mm (length between tip of rostrum to tip of telson) and total weight in gram were recorded for each prawn. Supplementary feeding was effected with the flesh of backwater clam *Meretrix casta* at a rate of 5% of body weight of stocked biomass. Each day, the clams were opened and spread on bamboo plates and kept submerged in 6 places at 1800 hrs and the shells were removed the following morning. The mature females collected from the pond during the first and second experiments were utilised for broodstock and spawning trials, the results of which will be published elsewhere. To determine the stage of the ovarian development, a few specimens were sacrificed. The ovary removed from the middle portion was preserved in Bouin's fluid for detailed histological studies. Hydrographical features such as surface temperature, salinity, dissolved oxygen and pH of pond water were monitored weekly.

ECOLOGY OF THE CULTURE POND

Topography : The pond under study, situated on the eastern border of the farm, was an enclosed one, thereby no exchange of water took place with the rest of the farm (Fig. 1). The bottom of the pond was sandy, having fine grains of 143 to 520 microns. The depth of loose sand was 20 to 35 cm. The water level in the pond was subjected to the seepage of water from the adjoining elevated sandy

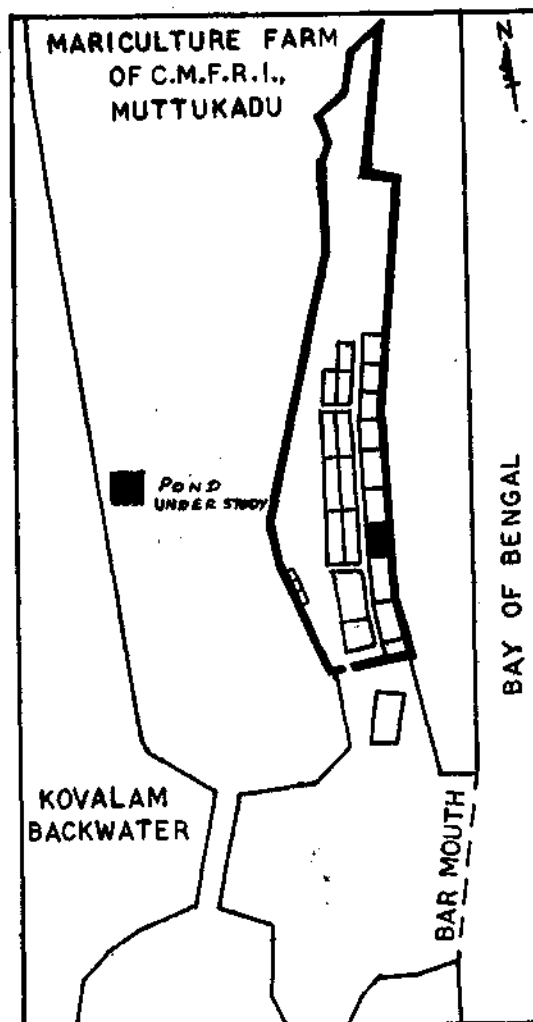


FIG. 1. Map showing the location of the culture pond in the Mariculture Farm complex at Muttukadu.

area during the monsoon months. The water level was 75 cm during the Northeast Monsoon months (October-December), which was reduced to 45 cm in the post and pre-monsoon months due to seepage and evaporation.

Water temperature : In the beginning of the experiment in December 1983, the average temperature was 26.8°C, coinciding with the prevailing winter season and reached a peak

(34.6°C) in April (Fig. 2). Afterwards, it gradually declined to 27.8°C in the winter season of 1984. The same pattern was observed during January to November 1985.

Surface salinity: In December 1983, the lowest value (16.07 ppt) was recorded due to the Northeast Monsoon rains and later, there was a gradual rise, reaching the peak in June (30.79 ppt). During October-December 1984, the values were lowered due to the monsoon and till November 1985, the same pattern that was observed in 1984 was repeated (Fig. 2). Thus, the pond water remained brackish from October to March/April and turned saline during the summer and pre-monsoon months.

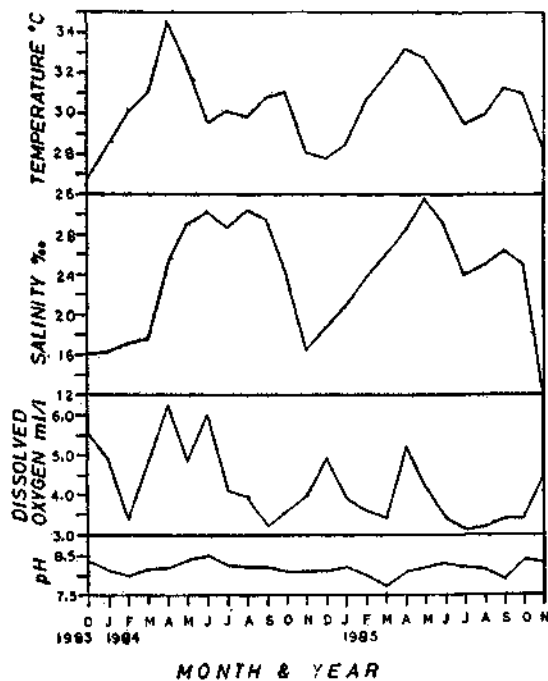


FIG. 2. Hydrographical features of culture pond during December 1983 to November 1985.

Dissolved oxygen: The values of dissolved oxygen were higher from December 1983 to July 1984 and after a slight fall during September-October, the values reached a peak in December 1984 and again in April 1985

(Fig. 2). Generally, the dissolved oxygen values were high due to the lesser depth of water in the pond, more penetration of sunlight and subsequent increased rate of photosynthesis and also greater mixing of atmospheric air.

pH: Though the normal pH values ranged from 8.1 to 8.3, lower values (7.7 to 7.9) were also recorded in some months (Fig. 2).

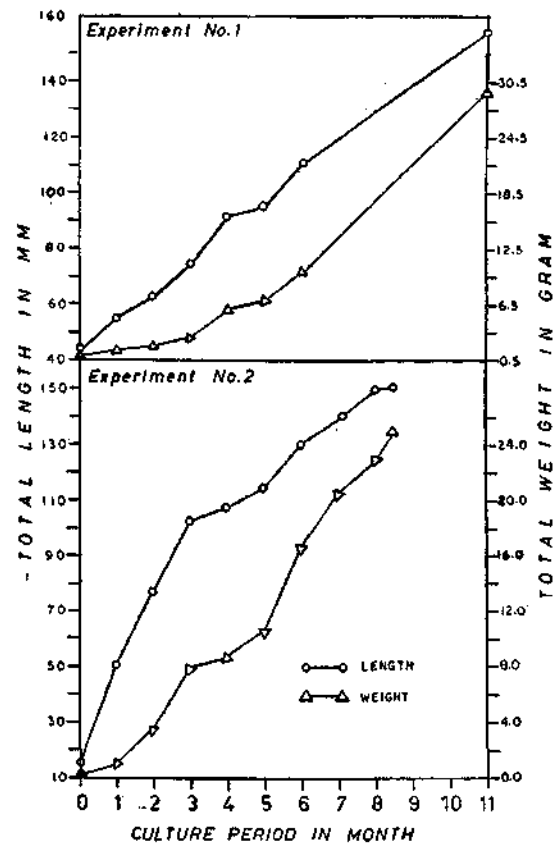


FIG. 3. Growth of cultured Kuruma prawns in the experiment No. 1 & 2.

FIELD CULTURE

The growth in terms of increase in total length (mm) and total weight (g) in cultured *P. japonicus* is given in Fig. 3.

Experiment No. 1: The early juveniles of *P. japonicus* with an average size of 42.2 mm

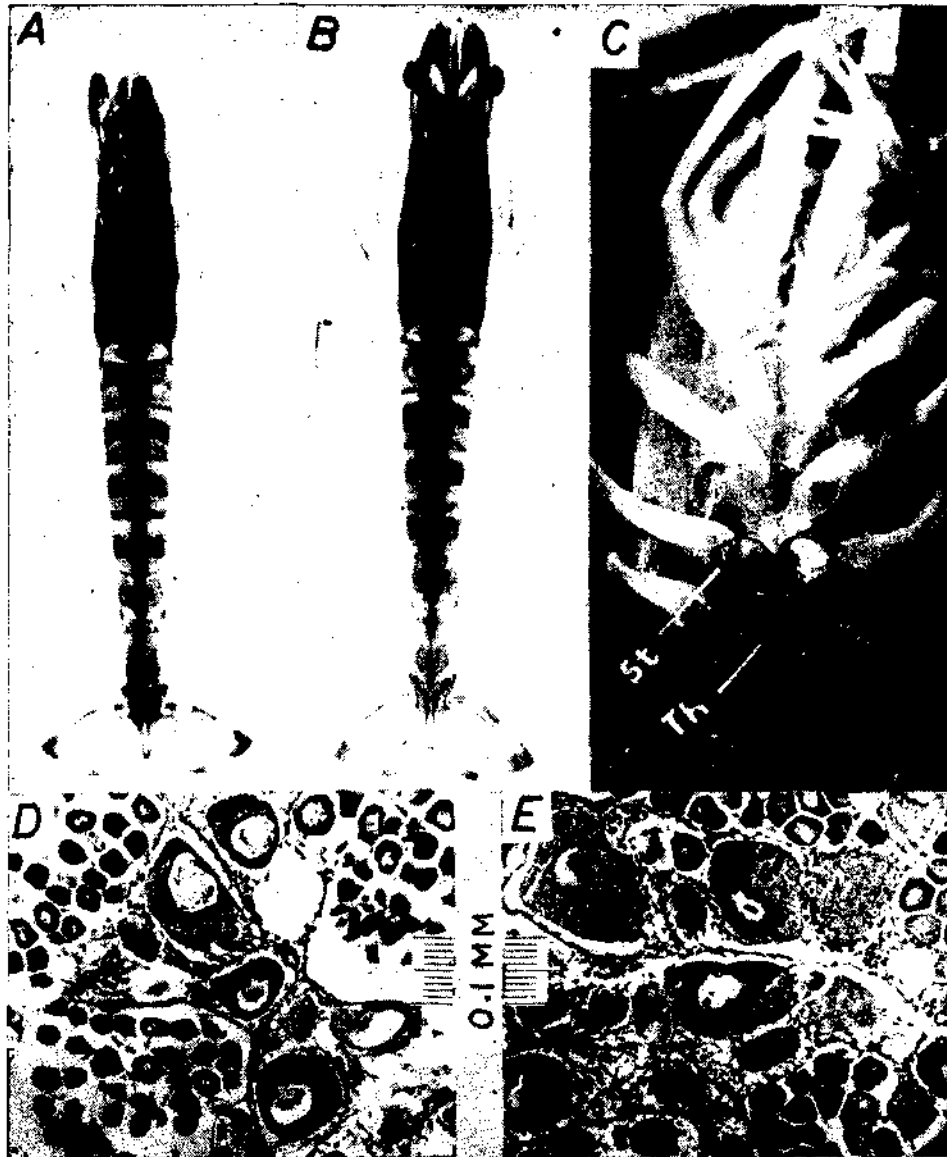


PLATE I. A. Female with developing ovary in Stage II, B. Stage III, C. Stopper in the thelycum, D. Cross section of ovary in Stage II and E. Cross section of ovary in Stage III (St. Stopper and Th : Thelycum).

(av. weight : 0.8 g) attained a size of 54.9 mm (1.4 g), 62.6 mm (2.0 g), 73.8 mm (3.2 g), 91.5 mm (6.2 g), 95.1 mm (7.0 g) and 109.7 mm (9.9 g) by first, second, third, fourth, fifth and sixth month respectively. Thus, an increase of 67.5 mm in length and 9.1 g in weight were attained in 180 days rearing. The rate of growth in length was 11.2 mm/month and 0.37 mm/day and in weight 1.5 g/month and 0.05 g/day. At the end of sixth month rearing, prawns were harvested and the number caught were 269 out of 2000 stocked, the rate of recovery being 13.4%. In spite of the low stocking density and supplementary animal diet, the growth and survival appeared to be low. Though the drag netting was carried out for 4 days during the night hours, the harvest was incomplete, as several specimens were seen swimming along the inner edge of the pond a few days after harvest. The left-over specimens were allowed to grow further. When the drag netting was carried out during the eleventh month of culture, 26 specimens ranging from 133 mm to 184 mm in total length were obtained. The average size for males and females caught was 152.0 mm (20.4 g) and 163.4 mm (38.1 g) respectively. Out of 15 impregnated females, 13 had ovaries in stage II and III (Pl. I A, B, D, E). The minimum and maximum size of females with developing ovary was 153.0 mm in TL (42.0 mm in CL) and 184.0 mm in TL (49.0 mm in CL). The impregnated females were clearly distinguished by the presence of a 'stopper' over the thelycum. The 'stopper', appearing like a pair of leaves in structure, was pale green in colour and in fact, is the distal end of spermatophoric mass, which has been deposited in the seminal receptacle during the course of mating (Pl. I C).

Experiment No. 2: The hatchery-raised advanced postlarvae (14.3 mm; 0.025 g) numbering 2000 were stocked first in a nursery area of 10 m², enclosed by velon netting material in one of the corners of the culture

pond and reared for 45 days, after which, the surviving prawns (1250 numbers) were transferred to the culture pond. The observed growth during the nursery phase and the following period is given below :

Period of culture (month)	Av. size (TL in mm)	Av. wt. (g)
Stocking	14.3	0.025
1.5	50.4	0.981
2	76.9	3.430
3	102.5	7.932
4	107.4	8.604
5	114.4	10.526
6	130.9	16.476
7	139.4	20.550
8	144.7	23.060
8.5	145.2	25.160

During the 8½ month rearing, the prawns registered an increase of 130.9 mm in TL and 25.135 g in TW. The rate of growth was 15.4 mm/month and 0.51 mm/day. As pointed out earlier, the rearing beyond 262 day was interrupted by severe cyclonic rains in the farm area during the second week of November 1985, resulting in the breach of the earthen bund of the culture pond and the subsequent escape of cultured prawns.

During the course of culture operation, the impregnated females were noticed at the end of the 6th month. The percentage of impregnated prawns among the sampled females of *P. japonicus* during 6th to 9th month of culture is depicted in Fig. 4. At the end of the sixth month, the percentage of impregnated females was 28.5, which increased to 53.7%, 56.3% and 100% in 7th, 8th and 9th month of culture respectively. The interesting observation is that 3 females obtained in the 9th month were having developing ovaries. The size of the impregnated females ranged from 128-153 mm in TL (CL : 29-40 mm) and that of females with developing ovary varied from 147 to 150 mm in TL (CL : 42-43 mm). Since this

brood has originated from the hatchery trials in January 1985, the exact age of the females at first maturity is 305 days (5-1-1985 to 6-11-1985).

DISCUSSION

In the present field culture experiments with *P. japonicus*, the monthly growth recorded during the six months of culture in the first trial was low (11.2 mm), while it was more (15.4 mm) in the second trial which lasted

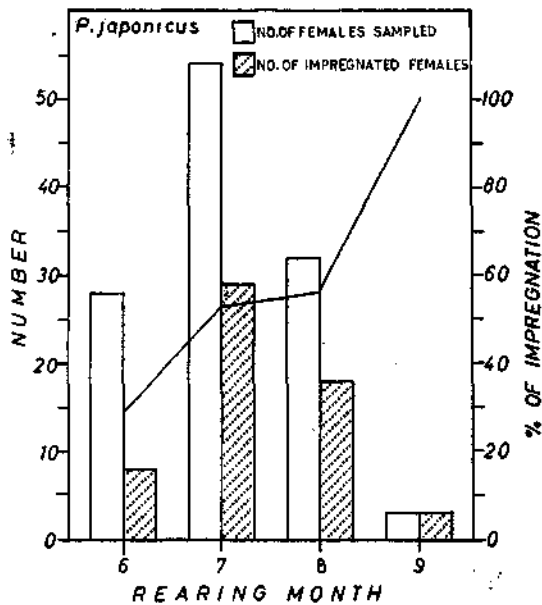


FIG. 4. Occurrence of impregnated females in the experiment No. 2.

for 9 months. Earlier observations on the monthly growth rate in *P. japonicus* were 29.6 to 34.3 mm (Hudinaga, 1969), 14.0 to 20.8 mm (Shigueno, 1975) and 19.8 to 23.3 mm (Silas and Kathirvel, MS) in 2-3 months rearing with supplementary feeding. However, when the culture operation extended upto 4-7 months, *P. japonicus* registered a monthly growth of 21.8 mm (Seno, 1910), 23.8 to 25.0 mm (Hudinaga, 1969), 21.7 to 26.5 mm (Liao and Huang, 1973) and 10.9 to 20.6 mm (Shigueno, 1975). From the size frequency analysis of the

juvenile Kuruma prawns caught from the wild, the maximum growth traced per month was 24.0 mm (Kubo, 1956), 31.2 to 48.0 mm (Lumare, 1984) and 22.7 to 46.1 mm (Kathirvel and Selvaraj, MS) in 2 to 5 months period.

In the present study, the most interesting observation is the occurrence of maturing females of *P. japonicus* in 11th and 9th month of culture during the first and second trials. The other penaeid prawns which attained maturity in the earthen pond culture systems are *Penaeus stylirostris* (Conte *et al.*, 1977), *P. kerathurus* (Rodriguez, 1981) and *Metapenaeus dobsoni* (Silas *et al.*, 1982) which took 14, 11 and 11 months respectively to attain maturity. However, when *P. latisulcatus* was cultivated in the same pond at Muttukadu farm in 1986, it took only 2½ months for females to attain maturity (Kathirvel and Selvaraj, 1987).

The salinity of the culture pond at the time of collection of maturing prawns was 12.04 to 16.5 ppt (present study) and 34.2 to 45.0 ppt (Lichatowich *et al.*, 1978; Rodriguez 1981; Silas *et al.*, 1982), indicating that the maturation of penaeid prawns can take place either in brackish, saline or hypersaline culture systems.

The minimum size recorded for *P. japonicus* females with developing ovary in the present study is 147 mm in TL, which agrees with the observation by Lumare (1984), who reported a minimum size of 144 mm (TL) at first maturity for the wild Kuruma prawns obtained from a saline lagoon on the southeast coast of Italy.

The collection of maturing females from the first experiment in November 1984 has paved the way for the establishment of an indoor broodstock for *P. japonicus* for the first time in India, in which, female Kuruma prawns were subjected to induced maturation by eye ablation. Consequently, ablated spawners released viable eggs and larvae were reared

successfully (Anon., 1986 a). The seeds raised from hatchery were successfully cultivated in the second trial of the present study, from which, impregnated females were obtained and utilised for indoor broodstock in October 1985 and subsequently postlarval production was achieved in November in that year. Thus, three generations (F 1 to F 3) were raised

between December 1983 to November 1985 (Anon., 1986 b). The present observation on the maturation of *P. japonicus* in enclosed ponds is significant in the context of meeting the requirements of mature prawns for hatchery production of seed prawns without depending on spawners from the wild.

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