

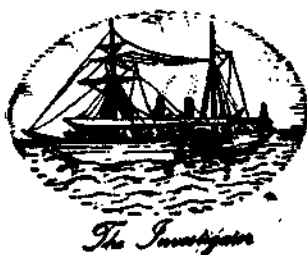
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PART 1: PRAWN CULTURE

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EXPERIMENTAL PRAWN CULTURE IN COASTAL PONDS AT MANDAPAM CAMP

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ABSTRACT

This paper deals with the experimental culture of *Penaeus indicus* and *P. semisulcatus* carried out in two coastal ponds at the fish farm of the Central Marine Fisheries Research Institute at Mandapam Camp for a period of 158 days during 1978 and 1979. Sea water was pumped into the culture pond daily to maintain water level at 0.75 m. Two experiments were carried out to study the growth rate of *P. indicus* at a stocking rate of five numbers per sq. m, one with supplementary food and the other with natural food elements produced by application of inorganic fertilisers. In the third experiment, *P. semisulcatus* stocked at the rate of three per sq. m were fed with pelletised supplementary food. Results of the above experiments are presented and discussed in the background of experimental culture operations carried out earlier.

INTRODUCTION

INCREASING interest is being shown at present for marine prawn farming operations in India owing to the export potential of prawns. Among the two methods of prawn cultivation in vogue, the extensive method has been practiced in India and south-east Asian countries involving natural stocking of prawns in tidal enclosures. The simplest form of semi-intensive prawn culture is practiced in Philippines by stocking *Penaeus monodon* post-larvae collected from estuaries in brackish water ponds, and in India, *P. indicus* and *P. monodon* are selectively stocked in salt pans at Manakkudy and Kakinada (Muthu, 1978). There are plenty of estuarine, coastal lagoon and brackish water area along south-east coast of India, which have not been put into proper utilisation for aquaculture practices (CMFRI, 1978 a). Earlier attempt to study the effective utilisation of a part of the saline lagoon on the Palk Bay coast near Mandapam Camp was carried out by Tampi (1960) by culturing the milkfish, *Chanos Chanos*. In the present report the results on the experimental culture of

P. indicus Milne Edw. and *P. semisulcatus* de Haan undertaken during 1978-79 in two coastal ponds in the same locality are reported.

The author expresses his grateful thanks to Dr. E. G. Silas, Director, C.M.F.R. Institute and Dr. P. Vedavyasa Rao, Senior Scientist for their keen interest, help and guidance in this work. I am thankful to Mr. P. Bensam, Scientist for going through the paper and for offering suggestions.

CULTURE PONDS

Tampi (1960) gave an account of general outlay of experimental ponds of CMFRI fish farm site along Palk Bay at Mandapam Camp. After the publication of the account by Tampi (1960) a cyclone had hit the farm area in 1964 and the ponds and sluices were partly damaged. In view of this, experimental culture operations were suspended, pending repair of the ponds. Subsequently in February, 1978 one of the culture ponds, previously named as VII by Tampi (1960) was excavated to one metre depth and the damaged bunds were streng-

thened for using it for prawn culture. In November, 1978, once again due to cyclone, tidal water entered the pond area and damaged the bunds. In February, 1979 one more pond was added in the site for prawn culture operations. Both these ponds were further deepened to a depth of 1 m and the bunds were strengthened by ramming up the earth. The former pond was 30 m long and 15 m wide, with a water area of 450 sq. m, and the latter pond was 28.0 m long and 14.5 m wide, with a water area of 406 sq.m.

The bottom soil of the ponds was admixture of sand and clay with shell fragments of marine molluscs. The soil condition of the lagoon area and the chemical nature of the lagoon mud have been dealt with by Tampi (1959) and Pillai (1954; 1956). As the sluice system was damaged completely, sea water supply to the pond was effected by pumping with the aid of a diesel engine of 6.5 H.P. capacity. The pumped water was filtered through a mosquito net in order to prevent the entry of unwanted organisms such as fish fry. Due to seepage and evaporation, about 25% of the water level went down per day in the ponds and hence sea water was pumped every day during day time and the water level in the ponds was maintained around 0.75 m.

Recording of environmental parameters such as salinity, temperature and dissolved oxygen of the water in the ponds were taken regularly. It was found during the progress of the experiments that surface water temperature did not show significant differences from one pond to another. The values ranged from 30° C to 32°C during April-May period of 1978 and 1979 and in June-September period temperature values varied from 29°C to 31°C. The average monthly salinity and oxygen values are presented in Table 1.

SEED COLLECTION

A good fishery for *P. semisulcatus* is existing off Mandapam (Nandakumar, MS) and the

seeds of this commercially valuable prawn are available during March-April and September-October periods in coastal waters of Palk Bay at Thonithurai particularly in the algal bed and at Devipattinam. Eventhough *P. indicus* does not contribute to the prawn fishery at Mandapam, the seeds of this species are available in estuarine, coastal and backwater area of this locality in February-April and July-November periods. The seeds of *P. indicus* and *P. semisulcatus* for stocking were collected from coastal waters of Palk Bay at Thonithurai, about 5 km south-east of Mandapam Camp by using a nylon mosquito net of 2 m × 1 m size. The collected seeds were transported in plastic containers of 47 litres capacity to the aquarium at the Regional Centre of CMFRI and acclimatised in plastic pools with running water facilities. They were kept for one week in this manner and transported to the farm site which is about 1 km from the Regional Centre.

EXPERIMENTS

Three experiments were conducted during 1978-79, one in 1978 and two in 1979.

Experiment I: This experiment dealt with the culture of *P. indicus* with food, minced clam meat and trash fishes in the pond of 450 sq.m. Before stocking the pond, netting operations revealed that it was devoid of any injurious organisms such as predatory fishes and crabs. *P. indicus* seeds were stocked in the pond at a rate of 5/m². The average total length of the seeds was 23 mm and the average weight, 0.11 gm (Plate I A). After stocking, the seeds were fed with clam meat and minced fresh trash fish at a rate of 10% of the body weight of the prawns and this rate was continued throughout the experiment. The salinity range of pond water was 33.08-35.19‰ and the oxygen content varied between 4.0 ml/l and 5.3 ml/l (Table 1). During first week of September, a slight discolouration of pond

water was observed. A plankton sample collected during the period was analysed and the occurrence of *Trichodesmium erythraeum* and *Thalassiothrix fraunfeldii* was noticed. This discolouration disappeared within a period of about three days and no adverse effects of this was observed on the culture stock.

of 231.53 kg/ha/5 months at a stocking rate of 50,000 prawn seeds/ha.

Experiment II: This experiment was also on *P. indicus* but without giving any supplementary food, but with application of inorganic fertilisers to the pond water. The pond used

TABLE 1. Average salinity (‰) and dissolved oxygen content (ml/l) for the months from April to September during the years 1978-79

Month	I Experiment—1978		II Experiment—1979		III Experiment—1979	
	Oxygen	Salinity	Oxygen	Salinity	Oxygen	Salinity
April	4.8	33.08	5.0	32.12	4.5	32.12
May	4.8	33.45	5.4	31.83	3.9	31.00
June	4.0	33.88	4.5	34.00	4.1	33.89
July	5.3	35.19	5.0	34.42	5.1	34.21
August	4.6	34.02	5.3	33.69	5.2	33.64
September	4.5	34.84	5.1	34.98	4.9	33.93

The mean weight increments registered during the culture period of 158 days are shown in Fig. 1. During the first month the weight increment was 2.49 gm at the rate of 0.083 gm/day. In the following month, the prawn showed only 0.70 gm weight increase showing a daily weight increment of 0.002 gm. From the third month onwards till the end of experiment (95 days), the prawns gained 8.20 gm in weight, at a rate of 0.086 gm/day. After 158 days of culture the prawns were harvested (Plate I.B). The average total length of prawns was 121 mm and the average weight, 11.5 gm (plate I.C), thus showing 98 mm growth in total length and 11.39 gm in weight in the course of the culture period. The overall rate of growth in total length and by weight per day were 0.620 mm and 0.072 gm respectively. The survival rate of prawns in the experiment was 44.05% (Table 2). Totally 10.42 kg of *P. indicus* was harvested indicating a production

for culture of *P. indicus* in 1978 was utilised for the experiment. The water was completely pumped out and predatory and competitive fishes such as catfishes, *Therapon* spp and *Tilapia* which entered the pond due to breaches of bunds in cyclone, were removed by operating nets and by handpicking. Due to continuous seepage of water into the pond from sea, it was not possible to dry the pond completely even for a short duration. Agriculture lime was applied at the rate of 400 kg/ha to absorb excess carbon dioxide and supply the calcium required by the prawns during their moulting periods. After fifteen days the inorganic fertilisers, urea and superphosphate in the ratio of 4:1 were added to the water at the rate of 100 kg/ha. Sea water was pumped into the culture pond and the water level was maintained at 30 cm for two days and 50 cm for next three days. A good amount of phytoplankton growth was noticed. The following planktons

were present in the water: *Rhizosolenia* sp, *Pleurosigma aestuarii*, *Thalassiosira subtilis*, *Navicula* sp. and a few filaments of blue green algae. There was no oxygen depletion below 2.78 ml/l due to more production of phytoplankton and when more water was pumped in, the oxygen value raised to 6.7 ml/l and the average pH value was 8.4. On the fifth day, the plankton produced settled at the bottom

During the culture period, the average monthly salinity range was 33.08‰ to 35.19‰ and monthly average oxygen content varied between 4.5 ml/l and 5.4 ml/l (Table 1).

During the first 78 days the prawns gained only 2.77 gms in weight thus showing only 0.036 gm increase per day. In the following 56 days, until the 134th day, the prawns

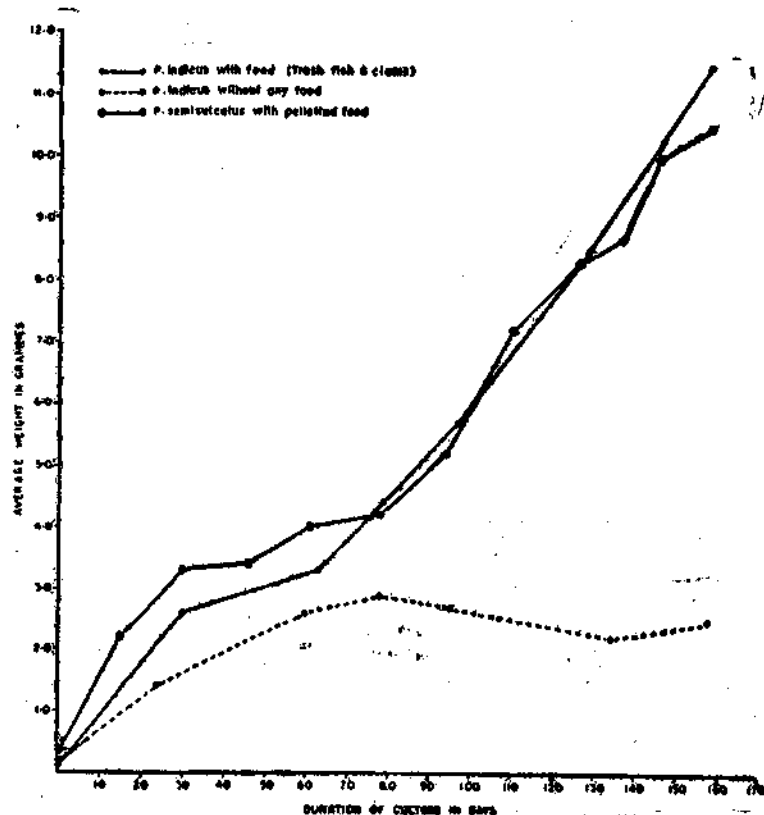


Fig. 1. Increase in average weight of prawns cultured in coastal ponds at Mandapam Camp.

of the pond. After seven days since the application of fertilisers, on 7-4-1979, *P. indicus* seeds with an average total length of 27.5 mm weighing 0.15 gm were stocked at the rate of 5/m². Inorganic fertilisers were added once in fifteen days and the water level in the culture pond was maintained at 0.75 m. The prawns were not provided with any supplementary food.

showed an average weight decrease of 0.74 gm at the rate of 0.013 gm/day (Fig. 1). During this period most of the prawns were observed to be rather lethargic with a soft body without the usual hardness of the exoskeleton. The cephalothorax appeared to be much larger for the abdomen and showed distinct disproportion when compared with

TABLE 2. Details of growth, survival and production of prawns cultured in coastal ponds at Mandapam camp during 1978-79

Number of experiment	Species involved, food provided and duration of experiment	Stocking density per sq.m.	Initial length (mm) at the commencement of rearing	Initial weight (gm) at the commencement of rearing	At the end of 78 days						At the end of following 80 days						At the end of experiment				Percentage of survival at the end of experiment	Production rate (kg)/hectare/5 months
					Average length (mm)	Average increment in length (mm)	Growth rate per day (mm)	Average weight (gm)	Average increment by weight (gm)	Rate of growth by weight per day (gm)	Average length (mm)	Average increment in length (mm)	Growth rate per day (mm)	Average weight (gm)	Average increment by weight (gm)	Rate of growth by weight per day (gm)	Average increment in length (mm)	Growth rate per day (mm)	Average increment by weight (gm)	Rate of growth by weight per day (gm)		
I.	<i>P. indicus</i> Food : clam meat and trash fish. Pond No. VII. Period : April-September, 1978.	5	23.01	0.11	84.2	61.2	0.776	4.40	4.29	0.054	121.0	36.0	0.450	11.50	7.10	0.089	98.0	0.620	11.39	0.072	44.05	231.53
II.	<i>P. indicus</i> . Without supplementary food. Pond No. VII. Period: April-September, 1979.	5	27.51	0.15	77.3	49.7	0.640	2.92	2.77	0.036	75.1	-2.1	-0.026	-2.52	-0.40	-0.005	47.6	0.301	2.37	0.015	37.24	47.78
III.	<i>P. semisulcatus</i> . Food : Pelleted artificial food. Pond No. VI. Period : April-September, 1979.	3	32.81	0.34	80.5	48.7	0.620	4.24	3.9	0.050	108.0	27.5	0.343	10.50	6.26	0.078	76.2	0.482	10.16	0.064	41.48	135.47

normal specimens of the same size. In the last 24 days, the prawns showed an upward trend in weight increase gaining 0.30 gm in average weight indicating 0.011 gm weight increment per day. On the 158th day the prawns were harvested. The average length and weight of prawns were 75.1 mm and 2.52 gm respectively. The average growth increment per day was 0.301 mm in total length with a daily weight increase of 0.015 gm during culture period (Table 2). The survival rate of prawns was 37.24% and the production rate was 47.78 kg/ha/5 months.

Experiment III: The third experiment was aimed at assessing survival and growth of *P. semisulcatus* in coastal ponds by providing with artificial pelletised food. After removal of unwanted fishes, agriculture lime and fertilisers were applied as done in the second experiment. In the first week of April, 1979 juveniles of *P. semisulcatus* with an average length of 32 mm and weighing 0.34 gm (Plate I, D) were stocked in the pond No. VI at a rate of 3 seeds/m². The prawns were fed on artificial pelletised feed compounded with fish meal (42%), tapioca powder (33%), rice bran (10%), black gram husk powder (9%), starmin powder (5%) and powdered yeast and vitamins (1%). Tapioca powder was boiled with water and other ingredients were mixed with the paste to make a dough. The pelletising was done by squeezing the dough through an ordinary hand squeezer and the product was sun-dried for three days. The analytical results of the feed were: (1) moisture 5.04%, (2) total ash 23.24%, (3) acid insoluble ash 5.77%, (4) protein 24.50%, (5) carbohydrate 22.50% and (6) fat 2.95%. The pellets retained their shape for about 45 minutes in the water. The monthly salinity range and oxygen content of the pond water during the experiment were 31.00‰ to 33.93‰ and 3.9 ml/l to 5.2 ml/l respectively (Table 1). Feeding was carried out at dusk and the prawns were observed to approach the periphery of the pond to pick the

pellets immediately after the supply. The prawns were fed with the pelleted food at a rate of 20-25% of body weight of prawns.

After 15 days, the prawns gained 1.824 gm by weight at a rate of 0.120 gm increment per day. During the second fortnight the weight gain was 1.12 gm showing 0.075 gm weight gain per day. In the following 48 days, the rate of weight increment came down to 0.020 gm per day and the average weight gain was only 0.96 gm on 78th day. From then onwards, the prawns showed 0.078 gm weight increment per day and gained 6.25 gm each within eighty days (Fig. 1). The experiment was carried out for 158 days and the prawns were harvested during the third week of September (Plate I E). The average total length of prawn was 108 mm and the average weight was 10.5 gm (Plate I F), thus showing an overall growth increment of 76.2 mm in total length and weight gain of 10.16 gms. The average growth rate per day was 0.482 mm and the average weight increase was 0.064 gm per day. The survival rate was 41.48% (Table 2). The harvested prawns weighed 5.25 kg which indicated a production of 135.47 kg/ha/5 months at the stocking rate of 30,000 seeds per hectare.

Harvesting

Drag net measuring 15 m in length and 2 m in height with a mesh size of 25 mm and weights added at regular intervals of 24 cm at the foot rope, was operated to harvest *P. indicus*. Only 50% of the prawns were caught by this method while the rest were found to bury themselves at the bottom. Hence the entire pond water was pumped out and the remaining prawns were hand-picked and gathered. However when the same net was operated to harvest *P. semisulcatus* 99% of the prawns were obtained, as they were found to cling to the meshes of the net during operation of the net. The entire water from the pond was pumped out to collect the remaining cultured stock of *P. semisulcatus*.

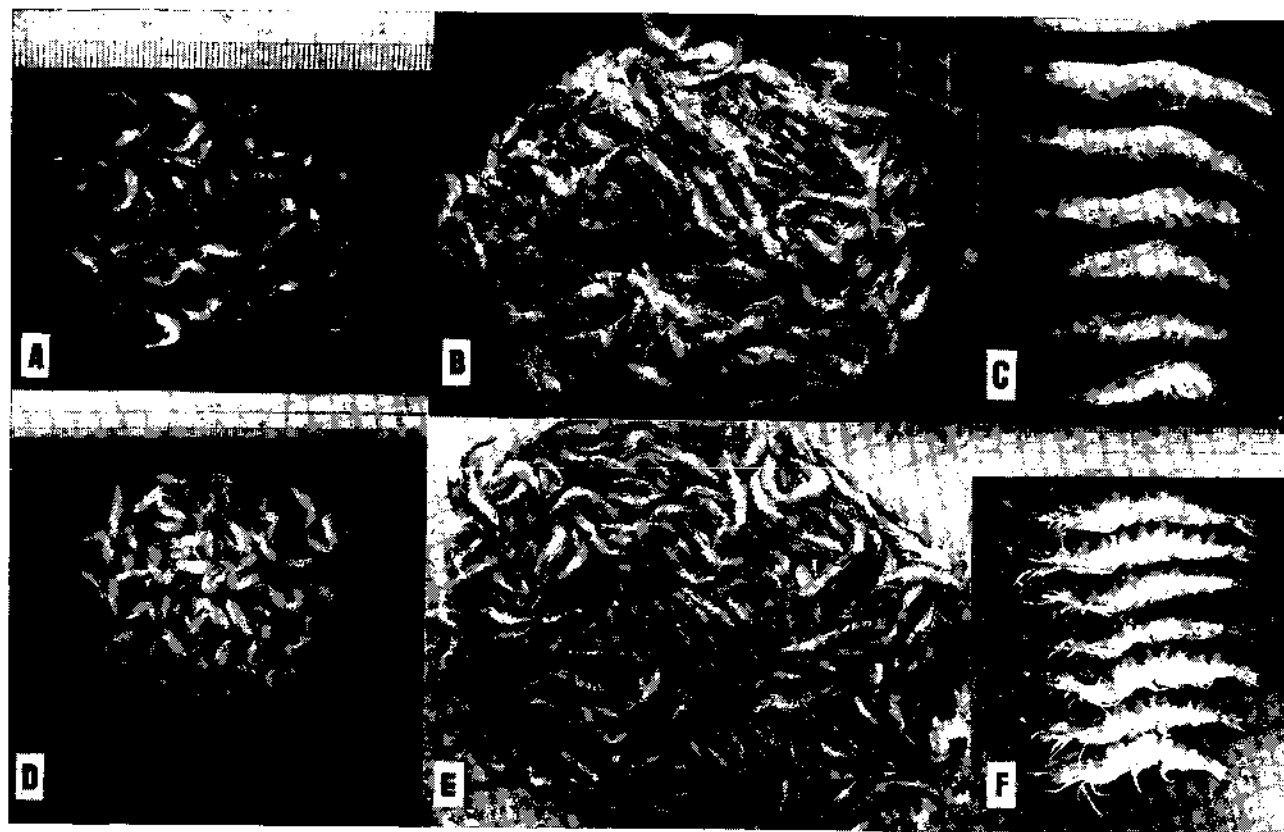


PLATE I. Stocked seeds and harvested prawns in the culture experiments at Mandapam Camp during 1978-79. A. A sample of seeds of *P. indicus* stocked in April, 1978 ; B. A sample of *P. indicus* harvested in September, 1978 ; C. Showing size range of *P. indicus* harvested ; D. A sample of the seeds of *P. semisulcatus* stocked in April, 1979 ; E. A sample of *P. semisulcatus* harvested in September, 1979 ; and F. Showing size range of *P. semisulcatus* harvested.

Competitors and Predators

Tilapia is now regarded as one of the pests in culture ponds since it is a prolific breeder and compete for space and food (Pillai, 1973). Even though *Tilapia* and other fishes were completely removed from the pond before commencing stocking operations, young ones of *Tilapia* in hundreds were noticed within a fortnight in the culture ponds. Males of *Tilapia* care their young ones in their mouth. While catching the adults, they immediately release them from their mouth. Attempts were made to eradicate this fish by operating gill nets and drag nets but without success. *Tilapia* posed a great problem as they were found to feed on the pelleted food provided for *P. semisulcatus* and on the plankton which developed as a result of fertilisation of the pond water in the second experiment. Although *Tilapia* was observed to consume crustaceans under crowded condition in the absence of vegetable food (Rabanal and Hasillos, 1957), when the gut contents of *Tilapia* of different sizes caught in the culture ponds on different days were analysed, they were not found to feed on prawns. Gobiid fishes of size range 10-25 mm were present in large numbers in the ponds and were observed to feed on plankton, thus competing for food with prawns. On some occasions, eagles, crows and gulls were found to pick up the prawns when they come near the edges of the ponds during morning and evening hours. Efforts were made to ward them off.

DISCUSSION

The growth rate of 0.620 mm per day in the first experiment for 158 days and 0.640 mm in the second experiment for the first 78 days for *P. indicus* indicates a faster rate of growth than those observations made by Hall (1962), Subramanyam (1968), George (1975) in the same species and compares well with the growth rate of *P. monodon* in prawn culture ponds at Phillipines (Delmendo and Rabanal, 1956)

and of *P. indicus* observed in cage culture (Rajendran and Sampath, 1975) and in Narakkal demonstration fields (CMFRI, 1978b). Sampath and Menon (1975) observed a growth rate of 0.99 mm/day in *P. indicus* during 95 days of cage culture with artificial feed. George (1961) recorded a faster daily growth rate of 1.39 mm in the brown shrimp *P. aztecus* from the estuarine environment of Louisiana (U.S.A.).

P. semisulcatus fed with pelleted feed showed 0.482 mm growth rate per day which compares favourably with those recorded by Hall (1962), Subramanyam (1968) and George (1975) for *P. indicus* and with the growth rate of *P. monodon* cultured in salt pan reservoirs at Kakinada. The rate of growth in total length and by weight of *P. semisulcatus* in this experiment are less than those of *P. indicus* cultured in the first experiment (Table 2).

The amount and quality of food required at various developmental stages are stated to have a direct relationship with growth of prawns (Kunju, 1978). The decrease in total length and weight after 78 days in *P. indicus* cultured in the second experiment without supplementary food may probably due to this factor, as environmental parameters such as, temperature, oxygen and salinity did not show any marked variation (Table 1 and 2). Slower growth rate due to non-availability of proper food after sixty days in *P. indicus* has been reported by Sampath and Menon (1975). The average daily growth rate of *P. indicus* cultured without feed were only 0.301 mm in total length and 0.015 gm by weight which works out to be only 48.54% of the growth rate per day and 20.83% in daily weight gain of the same species fed with trash fish and clam meat in the first experiment (Table 2). The survival rate is also higher in the first experiment than in the second experiment. These results confirm the necessity of supplementary feeding in prawn culture which has been dealt with earlier

(Zein Eldin, 1963). Rajendran and Sampath (1975) noticed better survival and growth rates and Sampath and Menon (1975) found faster growth in *P. indicus* which were given artificial feed in cage culture experiments in Kovelong backwaters. The slow rate of growth of *P. indicus* in the first experiment during the second month and of *P. semisulcatus* between 31 and 78 days of culture period may possibly be due to some physiological stress caused by the development of secondary sexual characters as there was no lack of food, and the environmental factors such as temperature, salinity and dissolved oxygen showed no significant differences.

Kurata and Shigueno (1976) observed higher survival rate in *P. japonicus* if large fry of

1.10–6.08 gm weight were stocked in the culture ponds. Mohanty (1974) recorded higher rate of survival in the experiment when advanced juveniles of *P. indicus* were stocked and lower rate of survival where early juveniles were stocked in the brackish water ponds. From the above facts, it appears that the survival rate of 44.05% in the first experiment and 41.08% in the third experiment can be enhanced by stocking fry weighing above 1 gm.

The present studies made in this experimental prawn culture in coastal ponds at Mandapam Camp indicate the possibility of developing intensive culture operations for *P. indicus* and *P. semisulcatus* on a commercial basis in such localities.

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