Indian J. Fish., 35 (3): 171-177, 1988

EXPERIMENTAL FIELD CULTURE OF WHITE PRAWN, *PENAEUS INDICUS*, IN THE POLYETHYLENE FILM - LINED PONDS USING PELLETISED FEED

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ABSTRACT

The results of two experiments on the culture of *Penaeus indicus* conducted during the year 1982 are given. A high survival rate of 99.2% was obtained for the prawns which were stocked at a mean size of 15.8mm. Maximum production rates obtained per hectare within a period of 83 days mono-culture under stocking densities 4, 5, 7 and 10/m2 were respectively 355, 253, 431 and 398 kg. The size of prawns at harvest ranged from 90.8 to 119.3 mm mean length and from 4.4 to 12.3 g mean weight. The instantaneous growth rate varied from 0.0211 to 0.0251 for length and from 0.0591 to 0.0720 for weight in the different ponds. The pelletised feed used in these experiments gave a good feed conversion ratio of 2.62 in one of the ponds.

INTRODUCTION

Eventhough the possibility of aquaculture in the different ecosystems in India has been reported by many authors, the possibility of utilizing the fallow sandy sea shore for mariculture was investigated only very recently (Mohan and Nandakumaran, 1980, 1981 and 1982, and Lazarus and Nandakumaran, 1983,1985, 1986, 1987a, 1987 b and 1988 and Lazarus *et al.* 1986). Following these, two prawn culture experiments were conducted at the Calicut Fish Farm of the Central Marine Fisheries Research Institute during the year 1982 with an idea to study the efficiency of the system for prawn culture and also to find out the optimum stocking density and stocking size of prawn needed for this culture system. In addition to the above, attempts were also made to study the conversion efficiency of the feed used for the experiment and the instantaneous growth rates of prawns in the different ponds. The first experiment was conducted in 8 ponds from January to March covering a total water area of 1361 m' and the second one in a pond having 714 m^2 water area from March to June.

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MATERIAL AND METHODS

Seed

Penaeus indicus seed produced at the Narakkal Prawn Culture Laboratory of CMFRI were used for the present experiments. Before stocking, the young ones were acclimatised to the new environment for about an hour by keeping them in fibreglass tanks containing well aerated water drawn from the stocking ponds. Then the healthy ones were counted and stocked.

Pond Preparation, Stocking and Management

Ponds were prepared as described by Lazarus and Nandakumaran (1987a) and nine ponds thus prepared ranging in size from 78 to 714 m* water area were used for the present experiments. The prawns were harvested with cast nets and drag nets after reducing the water level as much as possible. Harvesting was done 79-84 days after the date of stocking. In order to find out the optimum density of stocking, the prawns were stocked at different densities varying from 3 to 10 nos/m* as given in Table 1. Since salinity is an important factor of the environment in culture practices, efforts were made to maintain the salinity at particular levels by pumping fresh water.

Feed and Feeding Method

Compounded and pelletised feed developed at the Narakkal Prawn Culture Laboratory of CMFRI for penaeid prawns was used in the present experiment. The feed was compounded using dried mantis shrimp, prawn head waste, fish meal, groundnut oil cake and tapioca and prepared as dry pellets of 3 and 5 mm diameter. The proximate composition of the pellets was: Protein 24.5%, Lipids 8,2%, Carbohydrates 32.1%, Ash 14.7% and Moisture 5.1%. Vitamins and mineral contents were not seperately estimated. The feed was given at the rate ranging from 20% of the body weight in the beginning of the experiment to 4% of the body weight towards the end of the experiment. The prawns were fed once daily. The feed conversion ratio was calculated using the formula:

$$\frac{\text{Total dry weight of feed given}}{\text{Increase in biomass of the stocked prawns (wet. wt.)}}$$

Feed conversion ratio was calculated for the time intervals between each sampling and for the entire culture period.

Monitoring of the Environment and Growth

Environmental parameters such as salinity, dissolved oxygen and pH were recorded weekly twice around 0600 hrs and on days of biological sampling. Temperature was noted twice daily at 1000 hrs and 1400 hrs. To monitor the growth of the stocked prawns, samples were collected every 10 days with a cast net and the length and weight of the prawns in the sample were measured. In addition to the above aspects, observation was also made on the growth of green vegetation in the ponds

RESULTS

Environmental Conditions

The environmental data are summarised in Table 2. The mean temperature fluctuated within a narrow range of 31.0-32.8°C in the ponds during the first experiment whereas in the second experiment, because of summer conditions, a slight increase was noticed, the range being 31.5-33.2°C. It was possible to maintain the salinity around the value planned for each pond for most of the period except towards the end of March when the evaporation was very high due to intense solar radiation and higher temperature. Dissolved oxygen value normally ranged between 3.2 and 4.8 ml/1, but touched a low level of 1.7 and 2.9 respectively in ponds B and H towards the end of the experiment. The pH value ranged between 8.1 and 9.3. The green vegetation was found to develop in the form of a mat on the bottom and sides of the ponds and after a few days they got detached bit by bit and floated on the surface of the water. The algal forms normally found were a mixture of *Cosmarium* sp., *Oscillatoria* sp., *Nostoc* sp., *Hyalotheca* sp., *Chordafilum* sp. *Chroococcus* Sp., *Cyclotella* sp. and pennate diatoms. The algae were found more in ponds A, B, C, G and H.

Growth

Growth rate of the prawns in the different ponds was studied by following the progression of the mean size of prawns sampled at different dates and also at the time of harvest. The trend of growth observed in the different ponds are given in Fig. 1 and the calculated daily length and weight increments for the ponds are given in Table 1.

TABLE 1. *Stocking and harvest details of P.* indicus *in the first and second experiments*

Particulars	A	B	C	D	E	F	G	H	I
					PONDS				
Area of pond (m^2)	84	78	88	135	246	210	420	100	714
Date of stocking	5-1-82	5-1-82	5-1-82	5-1-82	5-1-82	5-1-82	5-1-82	5-1-82	17-3-82
Date of harvest	29-3-82	25-3-82	29-3-82	29-3-82	29-3-82	29-3-82	26-3-82	29-3-82	9-6-82
Duration of the experiment (days)	83	79	83	83	83	83	80	83	84
Mean length at stocking (mm)	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8	18.4
Mean weight at stocking (mg)	32.5	32.5	32.5	32.5	32.5	32.5	32.5	32.5	33.0
No. stocked	840	780	616	405	1,230	1,050	2,020	700	2,837
Stocking density (nos./m^2)	10.0	10.0	7.0	3.0	5.0	5.0	5.0	7.0	4.0
Nos. harvested	416	330	540	28	761	1,042	1,832	204	2,726
Survival rate (%)	49.5	42.3	87.7	6.9	61.9	99.2	90.7	29.1	96.1
Count per kg	125	104	142	81*	214	205	135	108	107
Production rate* (kg/ha)	398	399	431	25	141	253	305	178	355
Salinity originally planned (ppt)	10	20	10	20	20	30	20	20	30
Mean length at harvest (mm)	106.2	114.6	102.3	119.3	90.8	93.2	105.6	110.9	110.1
Mean weight at harvest (g)	7.6	9.6	7.0	12.3	4.4	4.9	8.1	9.1	9.2
Daily length increment (mm)	1.08	1.25	1.04	1.24	0.90	0.93	1.12	1.14	1.07
Daily weight gain (mg)	9	11	8	14	5	5	9	10	11
Total feed given (kg)	18.34	17.84	17.20	—	27.7	24.8	38.8	17.18	100.8
Total biomass produced (kg)	3.343	3.103	3.643	—	3.703	5.083	14.813	1.683	23.963
Feed conversion ratio	5.49	5.75	4.72	—	7.48	4.88	2.61	10.21	4.85

* Estimated

The instantaneous growth rate was calculated following the formula:

Instantaneous growth in length or weight

$$= \log_e \left(\frac{\text{Final length or weight}}{\text{Initial length or weight}}\right) \Big/ \text{No. of days}$$

The instantaneous growth rate values obtained for the different ponds are given in Table 3.

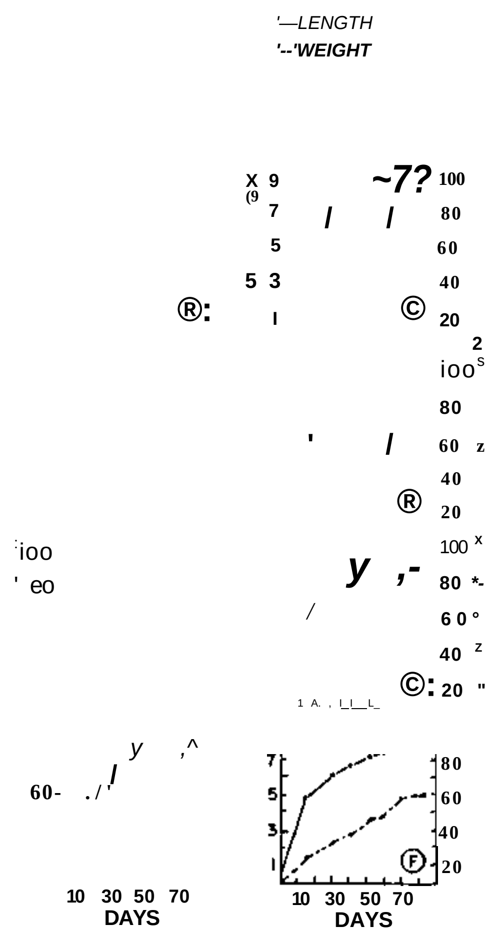

Fig. 1. Growth trends of *Penaeus indicus* in the different ponds.

Better growth rates were observed in ponds A, B, C, D, G and H in the first experiment and in pond I during the second experiment. Excepting pond D, all the other ponds, in which better growth rates were observed, had good growth of algae in them.

Growth rates were higher in ponds B, D and H where the survival rates were low (Table 1). In pond B a daily growth increment of 1.25 mm and weight increment of 0.11 g were recorded with an instantaneous growth rate of 0.0251 for length and 0.0720 for weight. As mentioned earlier, this was one of the ponds in which better growth of algae was seen. At the same time a comparatively low survival rate (42.3 %) was seen for this pond. Similarly in pond H also the better growth rate was attributed to the presence of algae and low survival rate. In pond D the algal growth was less. But because of the very low stocking rate (3 nos/ m^1) good length increment of 1.24 mm/day and weight increment of 0.14 g/day were noted and the size at haivest (plate I) was also the maximum for this pond (119.3 mm/ 12.3 g). The daily growth increment observed in the pond upto 6-3-'82, ie. five days before the mortality was 1.5 mm. This showed that the growth in the pond was faster right fiom the beginning of the experiment.

Survival Rate

Ponds C, E, F, G and I gave good survival rates of 87.7, 61.9, 99.2, 90.7 and 96.1% respectively. In ponds E, F, and G the stocking density was $5/m^1$ and in C and I it was $7/m^2$ and 4/m' respectively. In all the above ponds the salinity ranged from 20-30 ppt except pond C in which it was 10 ppt. Though in pond D the stocking density was low (3/m») and the salinity was 20 ppt the survival rate was poor (6.9%). This was probably due to the mortality which was observed on 11-3-1982, that is, on the 65th day after stocking. However, the poor survival rate observed in Pond H with a stocking density of 7/m' could not be attributed to any reason. The ponds in which the stocking density was 10/m* exhibited

TABLE 2. *Environmental data collected during the experiments*

Paiameters		PONDS A	B	C	D	E	F	G	H	I
Temperature (°C)	Range	31.0-32.3	31.2-32.3	30.7-32.3	31.3-32.5	31.3-32.8	31.2-32.8	31.5-32.8	31.5-32.3	31.5-33.2
	Average	31.7	31.9	31.6	31.8	32.1	32.1	32.1	31.9	32.4
Salinity (ppt)	Range	7.3-22.6	13.7-30.2	9.8-18.1	14.3-23.2	18.3-36.8	11.8-32.1	21.3-30.2	14.9-29.2	22.6-33.8
	Average	11.3	21.3	12.5	18.2	22.6	28.2	23.9	21.4	30-3
Oxygen (ml/1)	Range	3.3-4.4	1.9-4.4	3.8-4.2	3.3-4.8	3.2-4.3	3.3-4.6	3.1-4.4	2.9-4.3	4.1-4.8
	Average	3.9	3.8	4.0	4.1	3.7	3.9	3.8	3.8	4.4
pH	Range	8.3-9.1	8.3-9.1	8.1-9.3	8.1-8.9	8.2-9.1	8.7-9.2	8.1-9.1	7.9-8.7	8^ 8.9
	Average	8.5	8.6	8.6	8.4	8.8	8.9	8.7	8.4	8.8

poor survival rates. In general an inverse relationship was found between increased stocking density and survival rate in this culture system.

Production

Pond C with 7 nos/m* stocking density gave the maximum production of 431 kg/ha in 83 days. Ponds A and B in which the prawns were stocked at a rate of $10/m^1$ gave comparatively better production of about 400 kg/ha in this culture system. Among the ponds which had a stocking density of 5/m', pond G gave a production of 305 kg/ha. Pond I which had 4/m' gave 355 kg/ha. Among the above five ponds which gave better production, the first four ponds had a salinity regime of 10-20 ppt and the last one 30 ppt. The above results show that production was more or less the same in all the stocking densities and salinity regimes used in these experiments.

Feed Conversion

The average feed conversion ratio obtained in the present study from ponds A, B, C, E, F, G, H and I were 5.49, 5.75, 4.72, 7.48, 4.88, 2.62, 10.21 and 4.85 respectively (Table 1). The ratio for pond D was not calculated as the survival rate was very poor (6.9%). As seen in Fig. 2, in general, the feed conversion ratio gradually increased as the prawns grew larger in size, except in pond C, in which the initial feed conversion ratio was higher than the feed conversion ratio at the end of the experiment, and in pond G, in which the feed conversion ratio almost remained constant throughout the

TABLE 3. *Instantaneous growth rate of* P. indicus

Ponds	Length	Weight
A	0.0230	0.0657
B	0.0251	0.0720
C	0.0225	0.0647
D	0.0244	0.0715
E	0.0211	0.0591
F	0.0214	0.0604
G	0.0237	0.0694
H	0.0234	0.0679
I	0.0214	0.0670

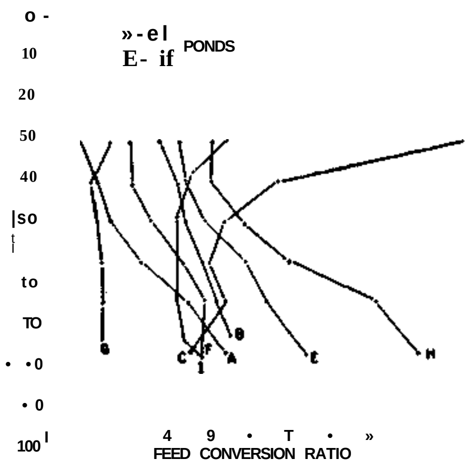

Fig. 2. Feed conversion ratio observed in the different ponds.

experiment. Among the experiments conducted in different ponds, the average feed conversion ratio obtained in pond G was the best (2.62) followed by the ratios in ponds C, I, F, A, B, E and H. The average feed conversion ratio obtained in pond H was very high. This was mainly due to poor survival. Eventhough the feed was kept in trays at the bottom of the pond, the actual quantity of the feed consumed by the prawns in each case could not be accurately determined, since the prawns have the habit of carrying away the pellets from the tray while feeding. The feed conversion ratios calculated were thus apparent values only. There is greater scope for improving the feed conversion ratio by periodically assessing the actual biomass present in the pond and regulating the quantity of feed given accordingly.

DISCUSSION

Mohan and Nandakumaran (1980) have reported a production rate of 500 kg/ha for 112 days with a survival rate of 48% in an experiment conducted in the same culture system for *P. indicus* which was stocked with seed having an average size of 42 mm at the rate of 18.5/m'. In another experiment they have reported a production of 1,600 kg/ha for 110 days with a survival rate of 98 % when the prawns were stocked at 42 mm mean size and a stocking density of 19/m^{1}. In both the experiments artificially compounded feed of ground wheat preparation was given to the prawns. When these results are compared with those obtained during the present experiments, some interesting facts emerged. Even after stocking 42 mm juveniles, the above authors could get only 48% survival rate in the first experiment, whereas in the present experiments a maximum survival of 99.2 and 96.1 % was obtained when stocking was done with seed of 15.8 and 18.4 mm mean size respectively. By rearing the stock for 112 days the above workers could get an average size of only 97 mm at the time of harvest for the prawns which were stocked at the rate of 18.5/m^{J}. In the present experiments the prawns attained an average size of 110.1, 105.6, 110.9 and 114.6 mm respectively when they were harvested after about 83 days, at stocking densities of 4, 5, 7 and 10/m' respectively. This shows that for getting better growth in a shorter time, the stocking density should be limited to one of the densities mentioned above. Apart from shortening the culture period and enhancing the size at harvest, which will give better economic returns, reducing the stocking density will also avoid wastage of seed as well as feed. Lazarus *et al.* (1986) have also reported good survival rates (86.7 and 89.8 %) in this culture system when the stocking density was 6.4/m^{1} and 7.1/m' and poor survival rates of 7.9 and 3.6% when the stocking density was 30.5/m' and 38.0/m' respectively.

In the normal course when the prawns are stocked at a larger size, the survival rates are expected to be good. Mohan and Nandakumaran (1980) got only 48% survival rate for the prawns which were stocked at an average size of 42 mm. This poor survival rate may be attributed to the higher stocking rate (18.5/m). The higher survival rate reported by Lazarus *et al.* (1986) for the prawns which were stocked at a mean size of 46.6 and 84.0 mm but at a low stocking intensity (6.4 and 7.1/m*) lend support to this. From the above, one can see that stocking density plays an important role in the growth and survival of prawns in this culture system.

The main advantage of this culture system over the other systems is that there are no predators in the pond since the water is filtered at the time of pumping and hence mortality due to predation is nil. This also makes it possible to stock the ponds with early stages of seed. Since there are no competitors as well, the feed supplied to the prawns is not being eaten up by other animals. Further, because the ponds are dewatered at the time of harvesting a 100% recovery is also possible.

The only disadvantage with this culture system is the non-permeable nature of its bottom. Because of this, the excreta of the prawns and other waste materials accumulate at the bottom and make it uncomfortable for the prawns to live at the bottom. Such deterioration of the pond bottom was prevented to some extent in the present experiments by periodically pumping out the bottom water containing organic matter.

The increase in the feed conversion ratio as the prawns grow larger in many of the ponds may be due to excess feeding as the quantity of feed was determined based on the original number stocked. This can be avoided by feeding the stock after periodically assessing the actual biomass present in the pond. However, the results obtained in the present experiments with *P. indicus* are almost in agreement with the results of Elam and Green (1974) on *P. setiferus* using two different feeds in nursery and grow-out ponds. They obtained production rates of 224 to 667 kg/ha, with feed conversion ranging from 1.8 to 2.3. In the present study 305 kg/ha was obtained in 80 days period with a feed conversion value of 2.62 in pond G by the use of pelleted feed.

ACKNOWLEDGEMENTS

We wish to express our sincere thanks to Dr. E.G. Silas, former Director and Dr. P.S.B.R. James, Director, CMFR Institute, Cochin for the encouragements and to Shri K.H. Mohamed, retired Scientist of the same Institute for the suggestions.

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