Experiments on shrimp polyculture in fixed cages in Vellar estuary

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ABSTRACT

Investigations on shrimp (Penaeus indicus, P. monodon and P. semisulcatus) polyculture in a fixed cage (5 x 4 x 1m) were conducted to assess the increase in sustainable biomass production in an unit area in Vellar estuary using an economically viable low cost technology. The shrimps were grown for 90 days covering the premonsoon and monsoon seasons by feeding them at the rate of 15 % of their body weight per day. The length-weight relationship of the individual was calculated and the 'r' values were 0.98, 0.97 and 0.93 for P. indicus, P. monodon and P. semisulcatus respectively. The average total length increase/day of the different species was found to be 0.90 mm for P. indicus, 0.78 mm for P. monodon and 0.64 mm (in 2 months) for P. semisulcatus. The environmental parameters were also monitored. The rainfall recorded was 500 mm in October and 320 mm in November. A total of 5 kg was harvested out of which the actual stocked shrimps weighed 2.865 kg (P. indicus : 2.339 kg and P. monodon : 0.526 kg) and the remaining 2.135 kg was contributed by the autoentrants. After 60 days 100 % mortality of P. semisulcatus was noticed, indicating their preference for higher salinities.

Introduction

The steadily increasing cost of operations in the aquaculture practices has necessitated to develop more economically viable methods of cultivating the shellfishes and finfishes. The method using cages or pens is considered as a productive culture system (Isaac Rajendran and Siddharaju, 1983). Eventhough in Mung Dung Lake, Indonesia floating bamboo cages have been in use since the early 1920s (Reksagleora, 1979) only during the last decade this system spread to the United States and the Europe (Pantulu, 1979; Cohe, 1979). Recently this technology was introduced in India especially in Tamil Nadu. Research on cage culture was carried out in Kovalam backwaters of Tamil Nadu since 1973 (Isaac Rajendran and Sampath, 1975) and Killai backwaters (Victor Chandra Bose, 1982; Maruthupandian, 1987) for culturing shrimps to commercial size. Apart from these Uma Maheswari (1983) and Sundararaj and Krishnadas (1990) cultured also the shrimps in cages and floating pens. But so far no work is recorded on cage culture in estuaries
and hence the present study was undertaken in the Vellar estuary to (1) examine the feasibility of cage culture for the shrimps (P. indicus, P. monodon and P. semisulcatus) and (2) to assess the effect of the formulated feeds on the growth, survival and yield.

Materials and methods

A fixed cage (5 x 4 x 1 m) made of knotless synthetic velon webbing with 16 p mesh size was fabricated and placed in the Vellar estuary with two third of the cage immersed in the water. The cage was made in such a way that the bottom did not touch the substratum (Krishnan et al., 1983). Provision was made inside the cage for the shrimps to hide during the moulting period by putting some stripes of polythene sheet. The seeds were collected from wild and kept in a separate floating hapa for 2 days for acclimatization before stocking them in the cage.

The most active seeds nearly of same size were selected visually, measured and stocked in the cage at a density of 12 seeds/m² (1,20,000 seeds/ha) (180 seeds of P. indicus, 30 each of P. monodon and P. semisulcatus). The average initial length and weight of the seeds of P. indicus, P. monodon and P. semisulcatus were 39.0 mm & 0.41 g, 66.2 mm & 1.95 g and 53.5 mm & 1.41 g respectively. The shrimps were fed with the pelleted feed. The feed (M/s Ruminant Feeds, Salem) was kept in a specially designed plastic plate at the rate of 15 % of the body weight per day in two instalments at dawn and dusk.

Fortnightly sampling was done during the culture period of 90 days (from 20th August to 17th November 1990). After measuring the length and weight of the shrimps, which were used for the study of the length-weight relationship, the samples were returned to the cage without any damage. The hypothetical cube law \( W = CL^2 \), modified as \( W = aL^b \) (LeCren, 1951) was used to study the length-weight relationship. The data were also subjected to the analysis of correlation coefficient.

The environmental parameters of salinity, dissolved oxygen, temperature and hydrogen ion concentration (pH) were estimated at fortnightly interval. After 90 days the shrimps were harvested. The autoentrants were identified by the difference in their size and weight at the time of harvest.

Results

Growth (Figs. 1 to 3)

At the time of harvest the average length and weight were found to be 120 & 136.4 mm and 13 & 17.6 g for P. indicus and P. monodon respectively. Total mortality was observed in the case of P. semisulcatus. But at the end of 60 days the final average length and weight of P. semisulcatus were 92.0 mm and 5.99 g respectively. Thus the length increase/day was 0.9 mm for P. indicus, 0.78 mm for P. monodon and 0.64 mm for P. semisulcatus.

![Fig. 1. Rate of increase in length(mm) and weight (g) of Penaeus indicus in relation to salinity and oxygen.](image-url)
Shrimp culture in fixed cages

Fig. 2. Rate of increase in length (mm) and weight (g) of *Penaeus monodon* in relation to salinity and oxygen. Explanations to graphs and histograms as in Fig. 1.

Environmental parameters

The salinity fluctuated from 1.2 to 34.1‰ during the culture period. A sudden fall in salinity was noticed from 15th October to 5th November when it remained below 5‰. The dissolved oxygen concentration in the surface water varied from 3.2 to 5.0 ml/l while the mean was around 4.02 ml/l. The surface water temperature fluctuated between 25° and 32°C. The pH value ranged from 7.8 to 9.1. The total monthly rainfall for October and November was found to be 500 and 320 mm respectively.

Production

Out of the total 5 kg biomass harvested (2.5 tonnes/ha), the stocked shrimps weighed 2.865 kg while the others were autoentrants (2.135 kg). Among the stocked shrimps, *P. indicus* weighed 2.339 kg and *P. monodon* 0.526 kg.

Autoentry

The autoentrants (2.135 kg) included both shrimps (1.885 kg) and finfishes (0.250 kg). The shrimps belonged to *P. indicus*, *P. monodon*, *Metapenaeus* sp. and *Macrobrachium* sp., while the autoentered finfishes belonged to *Ambassis* sp. and gobiid fishes.

5. Length-weight relationship and correlation coefficient

The length-weight relationships for the individual species were:

- *P. indicus*: Log \( W = -3.2531 + 3.1280 \cdot \log L \) \((r = 0.98)\)
- *P. monodon*: Log \( W = -3.0060 + 2.9518 \cdot \log L \) \((r = 0.97)\)
- *P. semisulcatus*: Log \( W = -2.7450 + 2.8400 \cdot \log L \) \((r = 0.93)\)

Discussion

Studies made on the growth of the shrimps *P. indicus*, *P. monodon* and *P. semisulcatus* in cages and pens by Sundararaj and Krishnadas (1990) in Tuticorin have shown a very low survival rate ranging from 20 to 37%, but in the present study *P. indicus* and *P. monodon* showed 100% survival.

The growth rate was found to be more in cages than in ponds. This is due to the circulation of water inside the cage during the tidal flux and water movement which brings in natural food and periodically washes out the accumulated
metabolites as reported by Subramanian (1972).

In the fixed cage culture at Kovalam, carried out by Krishnan et al. (1983), P. monodon was stocked at the rate of 10/m² for a period of 120 days and the average production was 216.5 g/m², while in the present study the P. monodon was stocked at the rate of 12/m² for a period of 90 days and the average production was 237.5 g/m² thus giving a better yield at a shorter interval. The maximum individual weight of P. monodon was 33.7 g at the density of 4/m² in 120 days; while in the present study it was found to be 25.2 g at a higher stocking density of 12/m² in 90 days.

According to Kunju (1978) the density of the population and availability of space for individual may have direct impact on the growth of shrimps. The present observation shows that 240/20 m² stocking density of P. indicus (180 nos.), P. monodon (30 nos.) and P. semisulcatus (30 nos.) is ideal in the cage culture practices, the size of the cage being 20 m².

Compared to dry feed, wet feed generally favours the growth of P. monodon than P. indicus (Maruthupandian, 1987). In the present study by using M/s Ruminant pelletised feed the growth rate in P. indicus was found to be more than in P. monodon. In general the growth rate and survival rate were good. The length-weight relationship was linear with that of the growth of shrimps.

In the length-weight relationship the exponential value was found to be nearer to 3 in all the three species cultured and the correlation coefficient values (r) for length and weight of P. indicus, P. monodon and P. semisulcatus were 0.98, 0.97 and 0.93 respectively. Sriraman (1978) observed 'n' value for P. indicus to be 3 and as the 'n' value observed for the three species studied is nearer to '3', the result obeys the cube law.

Further the present study shows that P. semisulcatus is not a suitable candidate species for the cage culture during monsoon season as the result indicated total mortality. Thus it is clear from the investigation that polyculture excluding P. semisulcatus in cages is a feasible venture in Vellar estuary.

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References


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