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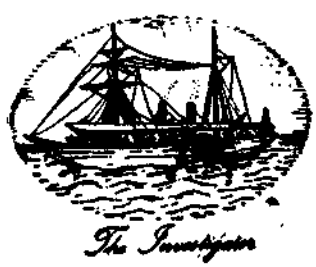

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EXPERIMENTAL CULTURE OF PRAWNS AND FISHES IN COASTAL PENS AT TUTICORIN DURING 1976-'78

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ABSTRACT

The paper gives an account of experimental culture of prawns *Penaeus semisulcatus*, *P. indicus* and fishes *Chanos chanos* and *Mugil* in split bamboo screen pens, constructed in the shallow bay at Tuticorin during 1976-'78. The problems encountered in the maintenance of the pens in the locality in the context of tidal conditions, winds and waves, as well as the growth of the culture stocks in relation to the hydro-biological conditions prevailing in the area in the course of the work are recounted. Suggestions for a more effective approach of pen culture in the light of the practical experiences gained in the work are given.

INTRODUCTION

THE PRACTICE of culturing organisms in artificial enclosures implanted at the substratum, called pen culture, appears to have originated in Japan (Felix, 1975) and is in vogue for over fifty years in Cambodia, Thailand and Indonesia, (Devaraj, 1974). Pen culture exercise might have originated in the form of some kind of impoundment of fishes or prawns in artificial enclosures in seas, estuaries, lakes, rivers, and using palisades, hedges of tree branches, split bamboo, as is practiced even today in the Adriatic. However, adequate attention to make use of this method of culture to increase fish production appears to have been bestowed only in recent years including some affluent countries obviously in the wake of increasing demand for seafood (FAO, 1970, 1972 a, b, 1975 ; Devaraj, 1974 ; Felix, 1975 ; Mane, 1975). A distinct advantage with pen culture is that pens could be installed in estuaries, bays, swamps, loches, derelict water masses and coastal areas. And, with the recent advent of synthetic fibres for making durable nets, Synthetic tubes as well as scaffolding frame works for making supporting structures and new formula feeds for sustaining culture stocks, pen culture is assuming increasing importance in different parts of the world (Joyner, 1970; FAO, 1972 b).

In India, with the immense potentialities for coastal aquaculture along the extensive coast of about 6,100 km, dotted with many estuaries, creeks, backwaters, and with the availability of many-a-valuable culturable fish and shellfish, there is great scope for developing pen culture on a viable basis. This becomes much more important while considering the availability of the seeds of culturable marine fishes and prawns (Tampi, 1973) in abundant quantities. Realizing these facts, an experiment on pen culture was taken up at Tuticorin during 1976-78 by the Central Marine Fisheries Research Institute and the experience gained as well as the results obtained therefrom are reported in the present paper, indicating the problems faced and the ways and means of overcoming them.

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Marine Fisheries Research Institute for suggesting the work and for the encouragement and guidance given in the execution of the project. They are indebted to Shri K. Nagappan Nayar, Officer-in-charge, TRC of CMFRI for the keen interest shown in this work.

NOTE ON CULTURE SITE

The site selected for undertaking the experiment was in Tuticorin Bay, about 2 km south of Tuticorin town and adjoining the mouth of Karapad creek (Fig. 1). The substratum in the site was mostly muddy, becoming sandy towards the shore. Depth of water in the area ranged from 0.75 m to 1.75 m and sinking range of the muddy substratum varied from 25 to 50 cm. Tidal amplitude in the locality fluctuated from 0.75 m to 1.5 m. Patches of sea grasses and small plants were also present in the region.

Atmospheric temperatures in the locality increased from January onwards (23.5°C) reaching the peak during July-September (30.9°C) followed by a declining trend (27.8°C). Sea water temperatures in the pen culture site also registered a similar pattern (24.4, 28.8 and 27°C respectively). Mean values of low tides showed three peaks in an year, one during March-April (83.1 cm), another during August-September (90 cm) and the third during December-January (90.3 cm). On the other hand, mean values of high tides showed only a single peak, usually during April-May (160.8 cm). Rainfall was recorded almost all round the year, although of slight intensities, with the main rainy seasons during April-June and October-December, of which the latter period was more intensive than the former, with peak rainfall of 463.9 mm. Wind velocities usually ranged from low values of 3-13.5 km/h to high values of 37-73.1 km/h. Strong westward winds prevailed from May to middle of September and strong northern or northeastern winds blew from middle of November to April. From September to November, directions of the winds were not constant.

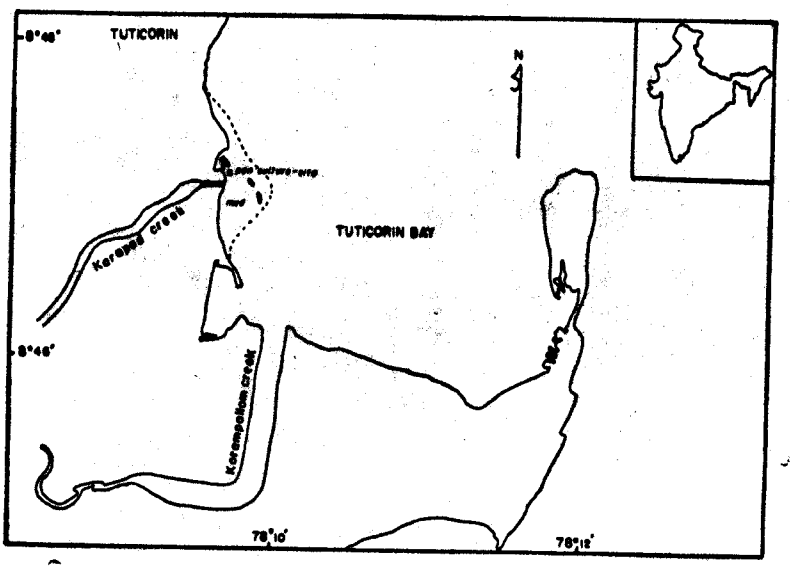

Fig. 1. The pen culture site at Tuticorin.

Hydrobiological Conditions

Salinity values in the culture site during the period 1976-78 ranged from mean figures of 31‰ to 37‰. Lower values were recorded during the months of rainfall and higher values during the summer months (April-June). On rainy days the salinity values became as low as 10-15‰. This was also the case on days when there were influx of fresh water from Karapad creek into the bay. Dissolved oxygen contents in the region varied from 7 to 8 ml/l and pH values fluctuated around 8. One litre samples of sea water collected from the locality and analysed usually contained 1 ml of edible organisms for culture stocks, such as filaments of *Oscillatoria, Pleurosigma, Nitzschia, Navicula,* copepods, nauplii, gastropods and bivalves. Also, epiphytic organisms were found thriving well on the blades of sea grasses and other plants growing in the region. It may be seen from these facts that hydrobiologically the area is quite suitable for the survival and growth of most of the culturable species such as *Chanos, Mugil* and *Penaeus.*

Construction of Pens

Six culture pens were constructed during 1976-78, each of 20m × 10m in extent (Fig. 2). The pens were made up of split bamboo screens, the sticks each measuring about 3 metre long and 20 to 25 mm thickness which were spaced closely together and interwoven with synthetic twines at an interspace of about 30 cm. The screens so made were implanted at the slushy substratum to a depth of about 15 to 30 cm and were supported by vertically planted casuarina or teak wood poles of 3 to 4 m height spaced at a distance of about 3 metres. Horizontal poles of about 3 to 4 m length were fastened to the vertical poles by nails as well as with synthetic ropes, for giving additional

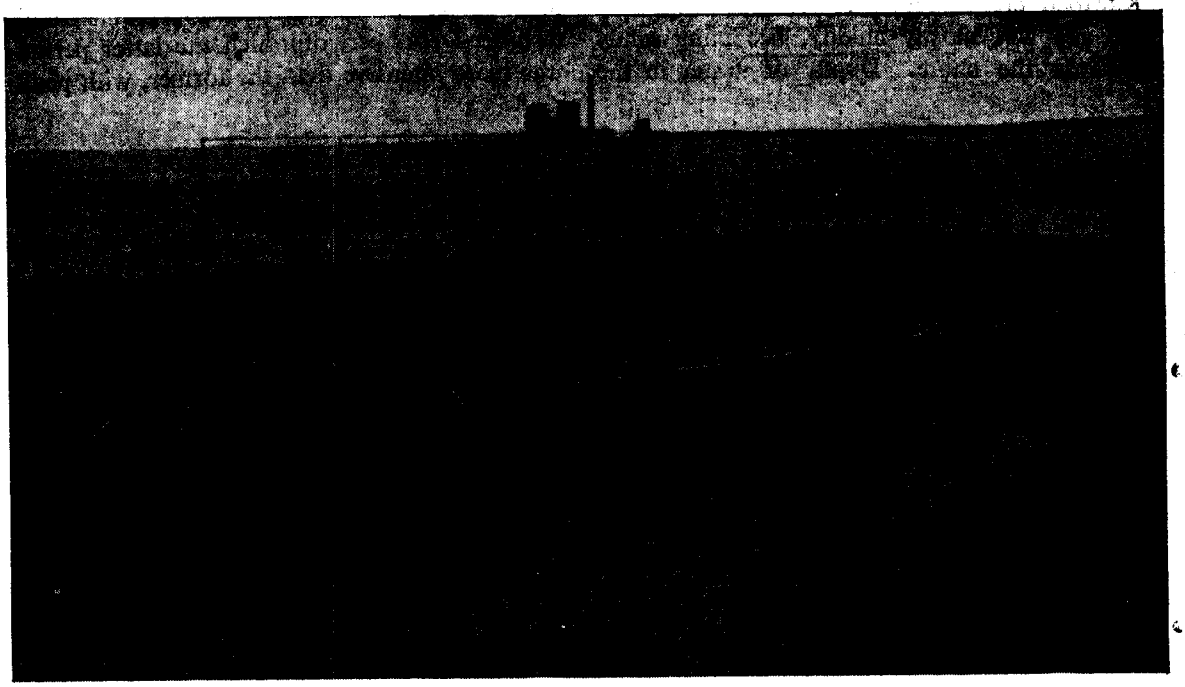

Fig. 2. Coastal pen made up of split bamboo screens with the extent of 20 m × 10 m at Tuticorin.

support to the structure. Obliquely planted props were provided on the outside as well as inside of the pens in order to make them strong enough to withstand the prevailing winds and waves. Within a couple of months of constructing the pens bryozoans, barnacles, algae and oysters were observed to grow on the screens and wooden structures upto a height of about 0.5 to 0.75 m from the bottom, marking the levels usually submerged. Each pen was provided with a small door of about 0.75 × 0.75 m size to facilitate workers and scientists to enter the pens for releasing seeds and taking care of the pens.

TABLE 1. *Results of pen culture conducted at Tuticorin during* 1976-78

Pen No.	Species	Rate of stocking (per ha)	Size range (mm)	Av. weight (g)	Size range at harvest (mm)	Av. weight at harvest (g)	Monthly growth rate	
							Length (mm)	weight (g)
1.	*P. semisulcatus** Dec. 76	75,000	35-100	—	—	—	—	—
2.	*P. indicus* Apr. 77-Sep. 77	75,000	35-72	1.30	61-135	4.7	7.0	0.7
3.	*Chanos, Mugil* May 77-Nov. 77	10,000 15,000	23-36 14-33	0.35 0.20	155-225 69-365	41.0 180.0	27.0 23.0	7.0 26.0
4.	*Chanos*	10,000	44.00 (mean)	0.80	301.00 (mean)	240.0	51.00	48.0
	Mugil May 77-Oct. 77	15,000	26.00 (mean)	0.20	169.00 (mean)	90.0	29.00	18.00
5.	*P. indicus* June 77-Apr. 78	75,000	48.79	1.54	46-130	2.6	—	—
6.	*P. indicus* Apr. 78-Sep. 78	75,000	36-75	1.2	51-150	8.2	—	—

* The prawns escaped due to the damage caused to the pen.

RESULTS AND DISCUSSION

The experiments undertaken and results obtaind in the six pens are given in Table 1.

The negative results obtained in some of the experiments on the culture of prawns in the pens at Tuticorin appeared to be due to changes in environmental conditions as well as due to damages caused to the pens resulting in the formation of holes serving as passage for prawns to move out. From the condition of the first pen as well as judging the environmental conditions, it appears that the disappearance of *Penaeus semisulcatus* was caused by one or both of the above factors. Due to heavy rains in the months of October (221.6 mm) and November (178.9 mm) 1976 and discharge of large amounts of freshwater from Karapad creek into the bay, the salinity values were brought down to as low as 5-10% in December and January. In May 1977 there was a rainfall of 150.4 mm; and it is possible that a major proportion of the population of *P. indicus* in the second pen might

have been killed due to this reason. Similarly, in the case of the fifth pen the sudden changes in salinity conditions caused by rains during October (151.8 mm) and November (463. 9 mm) 1977, might have resulted in heavy mortality of *P. indicus*. The small size of prawns harvested in this pen, after a culture period of ten months indicated that the original seeds stocked were completely lost and that the stock harvested belonged to a subsequent stock seeded naturally. In the sixth pen, there was better growth during April-September 1978 period amounting to an average weight increase of 8.2 g. This period was also coincided by scarce rainfall ranging from nil condition in the months of June and August 1978 to 1 mm in May, 1.5 mm in July and 5.5 mm in September. These facts strongly suggest that if natural mortality has taken place on a large scale inside the pens, it might have been caused by sudden changes in salinity conditions.

Another factor which might have contributed to poor growth, survival and production of prawns in coastal pens at Tuticorin appears to be the slushy condition of the substratum. When compared with soil particles in a firm substratum, those in a slushy bottom have the tendency to absorb and fix some of the vital elements in sea water like calcium rather than releasing, resulting in a medium deficient of these vital elements. It is needless to stress that a culture medium deficient in such vital elements as calcium is not at all conducive for the survival and growth of prawns, particularly at the time of their moulting for the formation of shell. It appears quite probable that such deficiencies prevalent in coastal areas where pens are constructed would result in such unsatisfactory growth of prawns as has happened in the sixth pen in which only an average weight increase of 8.2 g was recorded over a culture period of ten months, whereas *P. indicus* is known to register weights upto 15 to 25 g within a culture period of six months in coastal ponds.

As against the poor growth of prawns, *Chanos* and *Mugil* have registered impressive growth increases amounting to 48 g per month for the former and 26 g per month for the latter. The culture medium deficient in vital elements like calcium might not have affected these fishes because their calcium requirements are not so high as the periodically moulting prawns. This clearly indicates that fin-fishes can be cultured with profit and without much difficulty in coastal pens, once the question of affording adequate protection to the stock inside the pens is solved.

The most difficult problem encountered with regard to the present pen culture operations at Tuticorin was the maintenance of the pens for a fairly long period in terms of the investments made and in the context of boring and fouling organisms damaging the split bamboo screens within about three months of their construction. Wood-eating crustaceans, boring molluscs, bryozoans barnacles and oysters have considerably weakened the screens making them highly susceptible for further damage by the prevailing waves, currents and winds. The slow and steady action of waves accompanying the high and low tidal amplitudes has caused wear and tear of the screens already weakened by boring and fouling organisms. These factors were observed to result in the formation of holes particularly at levels at which waves have caused wear and tear of the bamboo. The condition was further aggravated by winds prevailing almost throughout the year. Wind velocities ranging from 45.3 km/h to 73.1 km/h were recorded. The cumulative effect of all these factors was the reason for the brief durability of the pens and their failure to serve as effective structures for culture operations.

It is obvious from the above considerations that for ensuring successful operations, the pens should be constructed in such a way that they are free from the impact of boring and fouling organism. For this purpose, it is essential

to treat the materials with anti-fouling agents at least along the portion of the screens that is submerged in water. Alternatively, it is essential to construct coastal pens with galvanized weld mesh or synthetic fibre nets which cannot be damaged by boring and fouling organisms. Synthetic nets made of polyethylene, nylon, kuralon, vinylon, tetron, etc. are useful in this regard (Milne, 1972). In fact, coastal pens in most of the countries including even those in southeast Asian region are constructed with synthetic fibre nets and not with undurable structures like bamboo (Milne, 1972).

While constructing coastal pens, it is essential to do so with strong supports to enable them to withstand strong winds, waves and currents (Milne, 1970). For this purpose, the substratum of the locality selected should be of firm clay or mud so that poles or wooden posts could be driven sufficiently deep inside for affording adequate support to the pen even during rigorous weather conditions. In localities where such net enclosures are likely to be damaged by organisms like crabs, it is desirable to provide an outer predator net covering also. And, in cases where wear and tear of nets are likely to be caused by wave action, a solid barrier consisting of logs of wood may be erected across the way of waves and currents in order to reduce their impact on the pens considerably. It is obvious in this connection that locations such as saline swamps, lagoons, and bays free from strong waves and currents as well as sheltered from rigorous weather conditions are the best locations for resorting to pen culture operations.

Culture of *chanos* in pens in Philippines taken up recently (FAO, 1972 a ; 1975) has proved to be successful and according to Felix (1975), three months old fish have grown to 30-49 cm long, 2 to 3 fishes weighing one kg and after eight months of culture they measured 65-80 cm, each fish weighing 2 to 3.5 kg. Felix (1975) further reports that pen culture of *Chanos* has brought in so much profits that the area of operation was increased from a few ha in 1971 to 7,000 ha in 1974. Mane (1975) states that as much as 10 tonnes of *Chanos* could be produced in one ha. In the present pen culture experiments at Tuticorin, a growth of 48 g per month for *Chanos* and 26 g per month for *Mugil* is recorded, thus pointing out that pen culture operations could be made profitable in India also by paying adequate attention for selection of sites, construction of culture facilities in such a way as to ensure their sound maintenance against winds, waves and currents. There is no dearth of such localities in the coastal regions of India ; and the experience gained in the present experiment points out positively that by utilizing such areas, it is certainly possible to develop pen culture of marine finfishes as a viable industry. Also, by selecting sites with firm substrata suitable for prawn culture operations and by undertaking some soil preparation procedures, it would be possible to develop prawn culture operations also in pens as a profitable venture.

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