

Culture of Fishes in Cages and Pens Along the Coastal Waters of India

R. Marichamy, *et al.* *
Central Marine Fisheries Research Institute
Cochin, India

Designs were developed for experimental culture of a few culturable fishes, prawns and crabs in pens and cages. Fast growing species such as milkfish *Chanos chanos*, *Mugil spp.*, prawn *Penaeus indicus* and crab *Scylla serrata* were chosen for the present work. Large scale availability of the seeds of these species in this zone was another factor for choosing them. The results of culture attempts of the above species in enclosures of bamboo splits (thatti) fixed in shallow inshore waters at Tuticorin are summarized. Similar attempts affecting structural modification in pen to suit local conditions at Mandapam Camp gave satisfactory results. Double jacketed bamboo thatti enclosure fortified with a palisade of short casuarina poles strongly ribbed at intervals and driven to the bottom gave better stability to the structure. The growth rate of the stock was encouraging.

Culture of the green crab *Scylla serrata* employing (a) metal framed synthetic twine meshed rectangular and square type cages, (b) close woven cane ribbed cages and (c) soft wood rectangular box with compartments revealed that metal framed cages were preferable.

Introduction

In India, an awareness has developed in recent years on the need to carry out aquaculture, especially coastal aquaculture, on a scientific basis as a means to augment fish production and to provide greater job opportunities to the rural folk. This has become all the more important in the context of wide fluctuations in the landings of some of the major capture fisheries in India (Silas, et al 1976).

*Team members: Pen culture: G. Venkataraman, K.M.S. Ameer Hamza and P. Nammalwar - CMFRI Regional Centre, Mandapam Camp
S. Shanmugan and P. Bensam, CMFRI Research Centre, Tuticorin
Cage Culture: R. Marichamy, CMFRI Research Centre, Tuticorin

Realizing the immense potential of coastal aquaculture, which this country offers with its coastal lagoons, estuaries, backwaters and mangrove swamps, the scientists of the Central Marine Fisheries Research Institute initiated at the beginning of 1977 an intensive programme of cage and pen culture using cheap indigenous materials.

Cage Culture

In Tuticorin, culture of green crab *Scylla serrata* in cages was undertaken in the Tuticorin Bay and the Karapad creek during 1977-78. The cages are of three different types: basket type, box type rectangular cages, and metal framed synthetic twine mesh cages.

Basket type cages. These were made of cane splits closely woven in the form of a basket with a lid at the top. It was fastened to the basket by a binding wire. They measured 30 cm in diameter and 25 cm in height. These cages were found suitable for the culture of young crabs whose carapace width did not exceed 40-60 mm. However, it was found to be disadvantageous to culture bigger-sized crabs as they caused damage to baskets because of their wriggling activities. Cleaning the cages became a problem as they got clogged with algae over which a variety of worms, amphipods and other smaller organisms colonised. In due course these animals infected the cultured crabs.

Box type cages. These were made of soft wooden planks. Each cage was comprised of ten compartments with sufficient space in each of them to accommodate big-sized crabs. The dimensions of the cages were 2 x 1 x 0.3 m and that of the compartments were 0.3 sq m. Each compartment had a lid on the top with a hole at the centre for feeding. The cages were so constructed with planks as to leave sufficient space between them to allow free circulation of water. Tiny prawns and fishes which

entered through the slits accidentally became natural food for the crab. These cages on the racks was such that the upper edges of the cages remained exposed above the water surface during low tide. The cages were periodically cleaned with a stiff brush. Moulded shells and unutilized food were removed. Although this cage was suitable in many respects for the culture of crabs, some drawbacks were noticed, one being the deterioration of the planks from continuous soaking in the water and the other being the fouling of the planks by barnacles.

Metal framed synthetic twine mesh cages. Cages of two dimensions (1 x 0.6 x 0.2 m and 2 x 1 x 0.5 m) made of 6 mm mild steel rod knitted with synthetic twine were fabricated. The metal frames were coated with tar. The mesh of the slides and top portion of the smaller cage was 10 mm while that of the bigger cage was 15 mm. At the bottom, the mesh was much closer in order to retain the bits of food supply. The smaller cages were rested on the racks while the bigger ones were kept afloat by tying them to bamboo poles which served as floats. They were anchored with heavy stones. The smaller cages were stocked with 5-7 crabs and the bigger ones with 25-30 crabs. Care was taken to stock the crabs of the same size group to avoid cannibalism. The upper edge of the floating cage was about 0.3 m above the water surface and the bottom was about 0.5 above the sea bed. Unlike the other two types of cages the metal cages were free from fouling organisms.

Results

The Karapad creek with its coastal mangrove swamps and impoundments serves as a good nursery for the green crab, *Scylla serrata*. Seed crabs 45-60 mm in carapace width and weighing 15-40 g were collected mostly during February-March and introduced in the cane cages. The tip of the finger of the chelipeds of the crab was out to avoid possible damage to the basket. The grown up crabs were transferred and cultured in wooden or metal framed cages. The diet included trash fish, crushed bivalves and gutted wastes of the fish. Rate of growth was relatively fast in cultured crabs. Crabs in the size of 45-110 mm showed monthly average growth of 12-15 mm in carapace width and an increase of 45-60 g in weight. In the case of matured crabs measuring above 115 mm, growth rate was rather slow i.e., 5-6 mm per month. The crabs attained the marketable size of 145-160 mm (400-500 g) after a period of 9-10 months passing through 4 to 5 moults.

PEN CULTURE

A. Mandapam

A site in the Gulf of Mannar was selected for the erection of the pen as the sea forms a small bay at this place and is relatively calm. The sea bottom was mostly sandy and suitable for driving casuarina poles into the bottom. To strengthen the barrier, the vertical poles were supported with horizontal poles and braced cross-wise by bolts and nuts. Stones were also laid on the outer and inner sides of the casuarina barrier up to the same length for a height of 2.4 from the bed of the sea to give further protection to the pens from the action of waves and to prevent silting.

Bamboo pens designed to withstand the action of the waves and to last for a long period in the sea were made. It consisted of a double-layered thatti, an outer layer made of bamboo splits of 9 mm thickness and an inner layer of 5 mm thickness. These were firmly joined by iron straps. Each thatti was 3 m in length and 3 m in height. Three such thatties were joined to form one side. Altogether a single pen consisted of 12 thatties. The pen was square in shape and covered an area of 81 m². Tar was applied up to a height of 0.5 m from the bottom of the thatti and over it kriside was painted.

In order to strengthen the thatties country wood reapers of 3 m length, 0.2 m breadth and 13 mm thickness were fixed horizontally on either side of each thatti at 0.6 m interval. In addition to this, two runners of 9 m length and 0.1 m breadth were fixed to the thatties at 0.6 m intervals and these ran on all the four sides of the pen. The pen was supported on each side by casuarina poles and the reapers/runners, thatties, and casuarina poles were firmly attached to one another by bolts and nuts. These thatties were joined together at the corners with a wooden pole 4 m in height so that no gaps were left at the corners. The depth of water in the pen ranged from 1.2 m in low tide to 1.8 m in high tide. The bottom was mostly sandy. There was good flushing in and flushing out of the sea water through the minute crevices in the thatties.

Fingerlings of *Chanos* and *Mugil spp.*, were collected from creeks and tidal pools. Before the fingerlings were introduced in the pen, netting was done to remove any predators present inside the pen. The bottom of the pen was checked to ensure that there were no crevices below the water level through which fingerlings may escape.

The fishes were fed every morning with a known quantity of food equivalent to 1/10 of the weight of the fingerlings. It comprised equal proportions of minced fish meat and oil cake paste. The food was kept in an aluminum tray of the size of 0.5 x 0.5 x 0.2 m which was fixed at the centre of the pen in such a way that the tray was just above the low tide water level. The fish also fed on natural food like algae, phytoplankton and zooplankton available in the pen.

Altogether 3,288 fingerlings of *Mugil spp.* with a mean size of 32 mm were introduced in the pen in March, 1977. During a three month period (March to June) their size increased to 87 mm registering a growth of 18 mm per month. The average weight of fish increased from 0.8 g to 15 g.

In March 1977, 77 fingerlings of *Chanos chanos* whose size range 60-90 mm were introduced. In June, the mean size of fish increased to 277 mm.

Another batch of 80 milkfish fingerlings whose size range 46-108 mm was introduced in the pen in February, 1978. The mean weight increased from 4 g to 100 g from February to May. In the subsequent period of June to September the mean size increased from 226 to 380 mm registering a growth rate of 51 mm per month. The mean weight increased from 110 g to 448.

B. Tuticorin

Experimental culture of marine prawn and fishes in enclosures in the mud flats of Tuticorin was undertaken in 1977. Four pens were constructed each of 20 x 10 m (200 sq m) in extent. Each pen was made up of split bamboo screens, the split sticks spaced closely together and interwoven with synthetic twine. The screens were erected in the Bay supported by casuarina and teak poles.

Casuarina or teak logs of 3 to 4 m length were driven into the clayey bottom at regular intervals and the split bamboo screens were planted with support of the logs. The screens were driven to a depth of 10 to 12 cm into the substratum. In order to protect the pens from falling down due to strong winds and currents they were propped on all sides.

Results

Out of four pens, two were stocked with *Penaeus indicus*. One was stocked with the computed density of 75,000 seeds/ha the other with 40,000 seeds/ha.

The first pen was stocked with 1,500 seeds (75,000/ha) of *P. indicus* whose size range between 35 to 72 mm with a mean size of 54 mm and an average weight of 1.3 g. The prawns showed a growth of 7 mm per month and an increase in weight of 0.7 g per month for a period of about 5 months.

The second pen was stocked with 800 (40,000/ha) of the same species. In five months the individuals registered a growth of 12 mm and an increase in average weight of 1 g per month.

The third pen was stocked with 300 *Mugil spp.* whose size range of 14-33 mm with a mean size of 27 mm and weight of 0.2 g. In December, 1977 the mean size increased to 190 mm and the weight to 180 g.

The fourth pen was stocked with 200 milkfish in the size range of 26 to 66 mm with mean size and weight of 44 mm and 0.8 g. They were introduced in the pen in May, 1977. By October, 1977 the fish had increased an average increment of 51 mm and 48 g per month. One hundred *Mugil spp.* were also introduced in the same pen at about the same time as the milkfish. They grew from a mean size of 26 mm to 169 mm and from a mean weight of 0.2 g to 90 g over a period of 5 months.

Remarks

This is the first time that pens have been erected in the shallow bays in the Indian seas. This is an arduous task because the pens would have to face the hazards of the sea like the impact of tides and waves and withstand the attack of fouling organisms. Care was taken to erect the pens firmly in the sea. The materials used were treated with antifouling paints along their submersible portion.

The growth rates of milkfish and mullet introduced in the pens were very satisfactory. However, the growth of prawns in the first and second pens at the mud flats in the Tuticorin Bay was very poor. The poor growth can be attributed to the unfavourable slushy environment in which the prawns lived. Low recovery rate indicated high mortality of prawns in the pens. A fast growth of crabs was observed in the cages. Metal framed synthetic twine mesh cages were found to be more suitable for the culture of crabs from the point of view of durability and economy in the long run. Crab culture has been programmed to be carried out in the mangrove swamp area of Tuticorin Bay by rearing them in pens made of indigenous materials.

Some constraints were observed in the maintenance and operation of the pen. The bamboo screens did not last for more than a year in the sea due to fouling organisms like marine borers and due to wear and tear caused by the action of waves. However, the frame made of casuarina poles stored well in the sea except on the seaward side. Experiments are under way to construct pens made out of palmyrah leaf stem and sliced palmyrah wood to study their durability and cost factor.

One of the major problems encountered in the operation of the pens at the Mandapam Research Centre was the large accumulation of sea grasses in and around the pen during southwest monsoon months of the year. The hydrogen sulphide gas released by the decomposing sea grasses polluted the water and brought down the dissolved oxygen content. Blooms of the green algae *Trichodesmium* were also observed during the same monsoon months which also caused fish mortality. To overcome these difficulties culture work can be carried out in the Gulf of Mannar side of the Mandapam Research Centre over a period of seven to eight months starting from September and extending up to May when the sea is free from pollution caused by the accumulation of sea grasses and blooms of blue green algae. During this period the sea is calm. At Tuticorin Bay pen culture can also be done du-

ring the months following the southwest monsoon when the conditions similar to that observed at Mandapam Research Centre prevail.

Valuable experience has been gained on the design, maintenance and operation of the pens and cages in Indian seas. The abundance of seeds of mullets and milkfish (Tampi, 1973) and *Scylla serrata* and *Portunus pelagicus* shows that there is a great scope for the development of culture fisheries along the southeast coast of India.

References

- Bensam, P. 1974. The biology of the milkfish *Chanos chanos*, mullets (*Mugil spp.*) and pearl spot (*Etroplus sp.*) Summer Institute in Coastal Aquaculture, Cochin, CMFRI/SI/FC/T-3b.
- Silas, E.G., S.K. Dharmaraja and K. Rengarajan. 1976. Exploited Marine Fishery Resources of India: A synoptic survey with comments on potential resources. CMFRI Bulletin No. 27.
- Tampi, P.R.S. 1973. Culturable marine fish fry resources from brackishwater environment. *Proceedings of the Symposium on Living Resources of the Seas around India*. Special Publication, Central Marine Fisheries Research Institute, Cochin. pp. 390-399.