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RECENT ADVANCES AND SCOPE FOR SEA FARMING IN INDIA

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ABSTRACT

Although brackishwater prawn and fish culture was traditionally practiced for a long time in the country, the efforts at sea farming are still in their infancy. During the past 15 years the Central Marine Fisheries Research Institute developed various technologies for sea farming of mussels, pearl oysters, production of cultured pearls, edible oysters, clams, prawns, lobsters, seaweeds and more recently sea cucumbers and top shells. The paper outlines recent developments in these areas as well as in others like sea ranching of marine prawns and pearl oyster, and scope for enlarging sea farming activities including development of artificial reefs in India.

INTRODUCTION

Sea farming is a new field which is still in its infancy in India. Although brackishwater prawn and fish culture was traditionally practiced for a long time in the country, farming the marine organisms in the sea has been taken up only recently by the Central Marine Fisheries Research Institute on an experimental basis. But in the last 15 years the Institute has made good progress in developing technologies for the sea farming of mussels, pearl oysters, edible oysters, clams, prawns, lobsters, seaweeds and more recently sea cucumbers and top shells. The concept of sea ranching the hatchery produced seed of marine prawn and pearl oysters to replenish the dwindling populations of these resources in the sea has also been developed by the Institute and implemented in a small way. All these programmes are aimed at augmenting the production of marine products from our seas for export as well as domestic consumption. The progress made in these areas and the scope for future development are discussed in this paper.

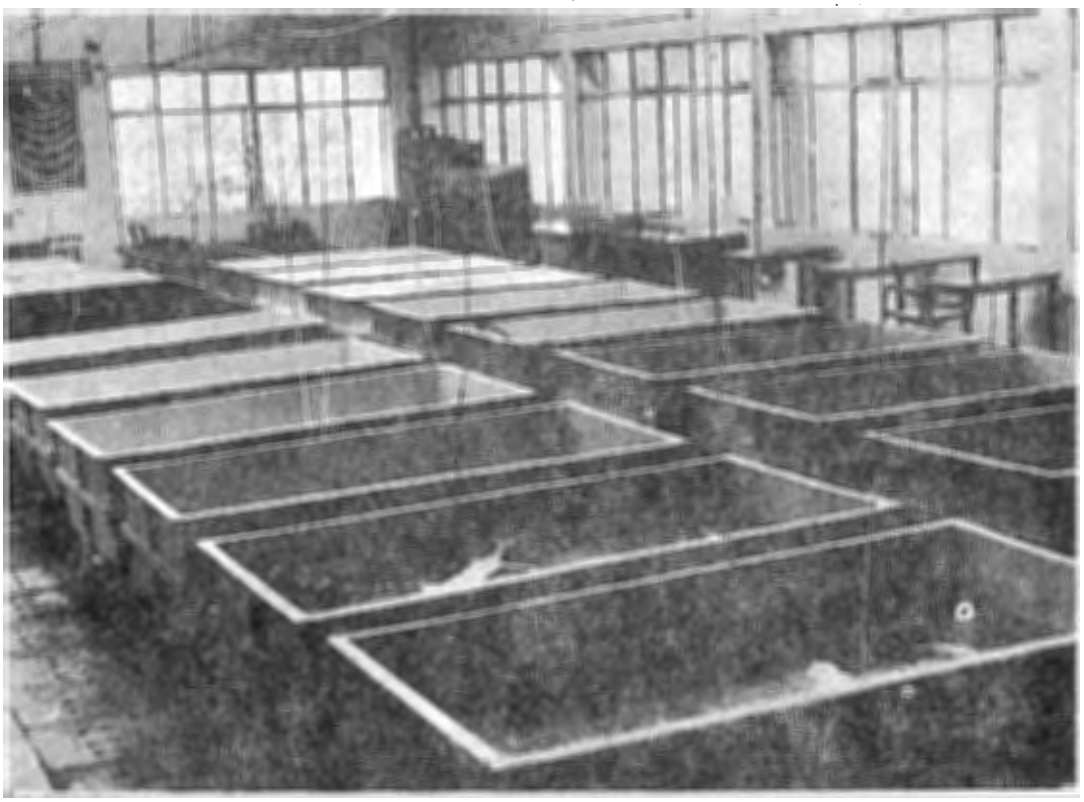

Fig.1: Inner view of pearl oyster hatchery

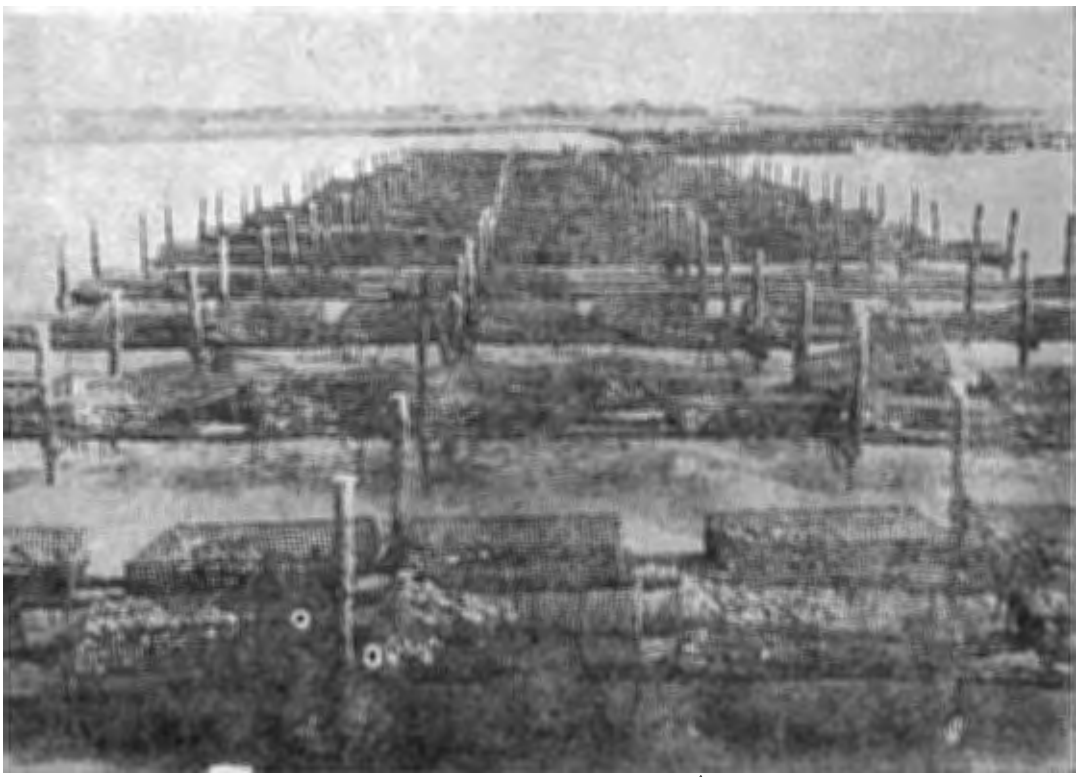

Fig.2 : Rack and tray culture of edible cyster

PEARL OYSTER CULTURE

Soon after the Indian pearl oyster *Pinctada fucata* was artificially induced to produce pearls at Tuticorin (Alagarswami and Qasim, 1974; Alagarswami, 1974) the need for growing the oysters under controlled conditions to supply the large number needed for artificial pearl production was realised and intensive research on open sea culture of pearl oysters was taken up by the Institute at Tuticorin. Culturing of pearl oysters in baskets suspended at various depths from floating rafts was developed (Chellam *et al*, 1987) for growing the oysters. The pearl oysters are atleast one year old before they are used for surgery and the post-operative culture period varies from 3-24 months depending on the size of the pearls required. Further, techniques of induced spawning of pearl oysters (Alagarswami *et al* 1983) and rearing of the larve to spat stage were developed (Alagarswami *et al*, 1983) and a pearl oyster hatchery to produce spat on a large scale was established at Tuticorin (Alagarswami *et al*, 1987). *Isochrysis galbana* was used as standard food for rearing the larvae. Spatfall occurred 24-32 days after spawning. Once the technology of hatchery production of pearl oyster spat was perfected, the possibility of populating the depleted pearl oyster beds of Tuticorin by sea ranching the artificially produced spat on the "Paars" was taken up (Chellam *et al*, 1987). The technique of artificial pearl production developed by the Institute is being tried on commercial lines by a joint venture of the Tamil Nadu Fisheries Development Corporation and the SPIC.

EDIBLE OYSTER CULTURE

Realising the potential for cultured edible oysters *(Crassostrea madrasensis)* as a luxury food, the CMFRI has been doing extensive research work on edible oyster culture at Tuticorin. In the Tuticorin Bay a pilot scale oyster farm was developed by the Institute using the rack and tray method (Nayar and Mahadevan, 1983; Nayar, 1987). From a 0.25 ha farm a production of 2.5 tonnes of shucked oyster meat was obtained after one year of growing period (Nayar *et al*, 1987). Depuration methods for purification of oysters before marketing have also been developed (Nayar *et al*, 1983; Rajapandian and Muthiah, 1987). The technology of hatchery production of edible oyster seed has been developed and a functional hatchery established at Tuticorin (Nayar *et al*, 1987) The technology includes induction of spawning under controlled conditions, larval rearing using pure cultures of algae *(Isochrysis galbana)* and spat production. Techniques of spat collection from

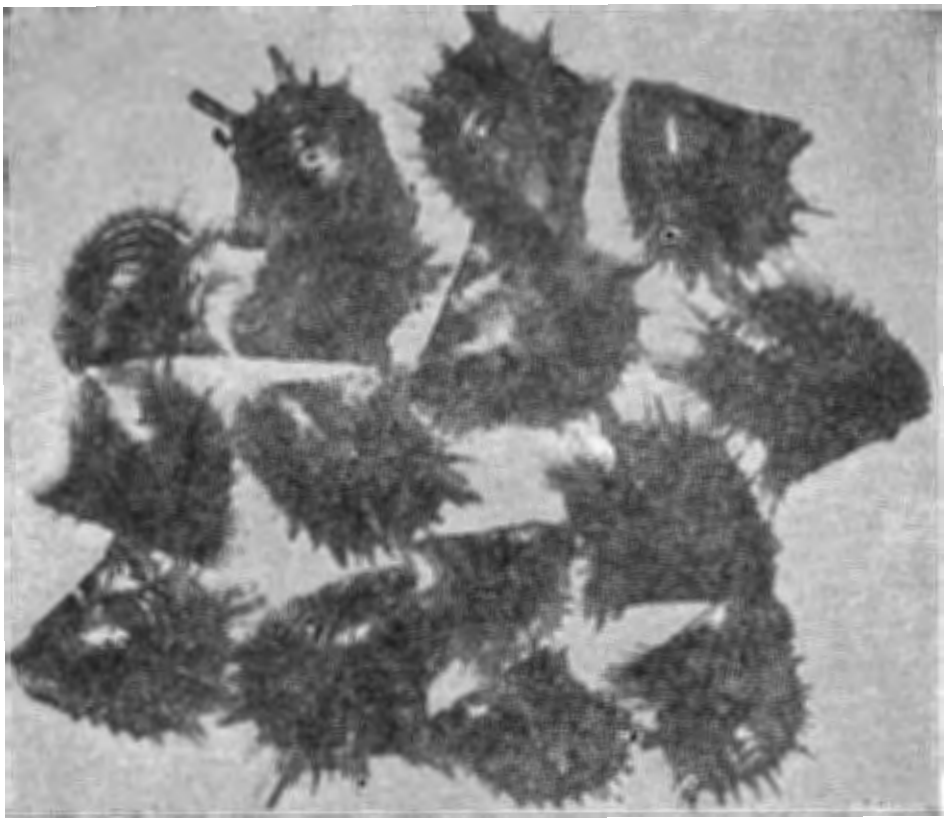

Fig.3 : Hatchery produced *Pinctuda Fucata* spat : 3 months old, 20mm(DVM)

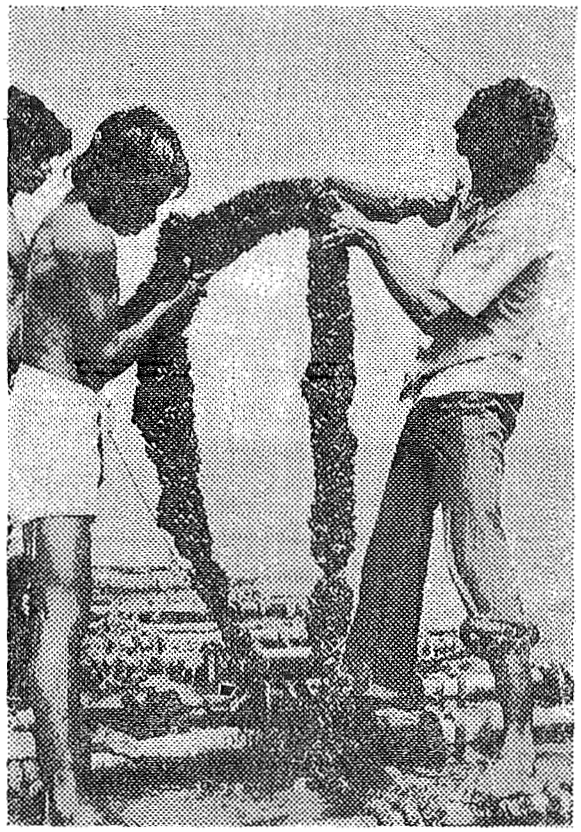

Fig.4 : Half grown mussels being examined

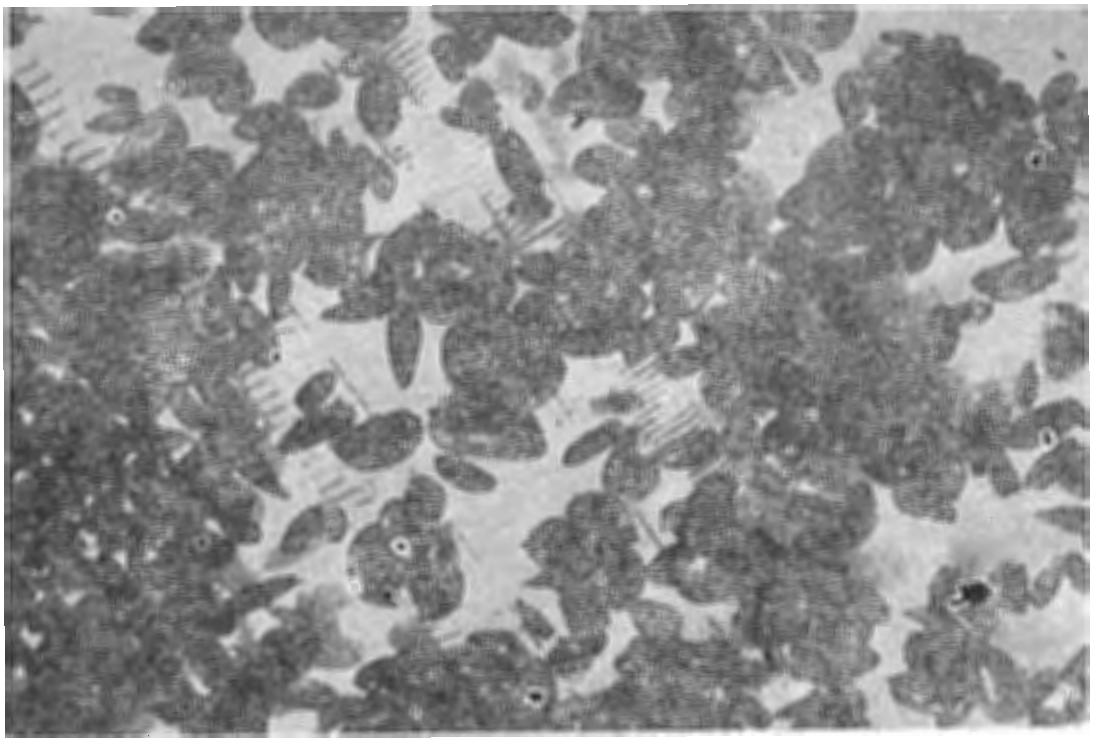

Fig.5: 2 month old spats of green mussel *Perna viridis* grown in the hatchery at Kovalam, Madras.

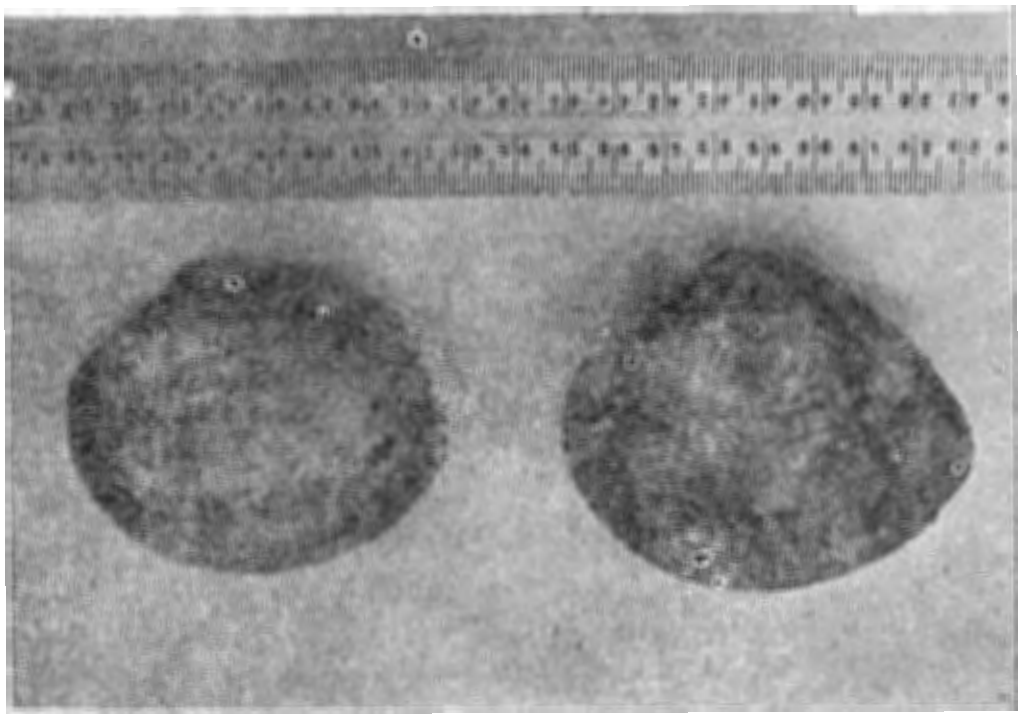

Fig. 6 : Giant backwater clam *Meritrix meretrix*

the wild have also been perfected (Muthiah, 1987).

MUSSEL CULTURE

The CMFRI has been conducting research on the raft culture of the brown mussel *Perna indica* at Vizhinjam and the green mussel *Perna viridis* at Calicut and Karwar (Kuriakose, 1980; Appukuttan *et al*, 1980; Kuriakose and Appukuttan, 1980).

Rafts of 6x6 or 5x4 m made of teak and bamboo poles, supported on 200 litre metal drums treated with anticorrosive paints were anchored in relatively sheltered bays where the depth was 8-10 m. The seeded ropes suspended from the raft were allowed to grow for 5-8 months. Production rates upto 15 kg per metre length of rope were attained.

Recently success has been achieved in hatchery production of green mussel seed at Madras (Sreenivasan *et al*, 1988).

CLAM CULTURE

Experimental culture of blood clam *Anadara granosa* has been carried out successfully in the Kakinada Bay. Experiments have shown that the site selected for clam culture should be such that it gets exposed for about 1-2 hours during the low tides. Screens made of bamboo interlaced with hemp twine are used in constructing the pen enclosure. Each screen is 5 m long and 0.3 m high, interspaced with six one metre long bamboo pegs which are driven into the mud to hold the screen vertically up.

Two experiments on culture of *Anadara* yielded 38,530 kg/ha and 40,000 kg/ha respectively in 5-5 1/2 months of culture (Silas *et al*, 1982; Narasimham, 1983). These experiments were conducted with naturally collected seed. But recently *Anadara granosa* has been bred in captivity and the larvae reared to the spat stage in the Institute's hatchery at Tuticorin. This will go a long way in providing seed clams for culture purposes.

Similarly, the backwater clam *Meretrix meretrix* another candidate species for culture has also been successfully bred and the larvae grown to seed size in the Tuticorin hatchery.

CULTURE OF ORNAMENTAL GASTROPODS

Recently, success has also been achieved at the Tuticorin Research Centre in breeding and seed production of the top shell *Trochus radiata*. The techniques evolved will pave the way for breeding and rearing of the large ornamental *Trochus* spp in the *Andaman Islands* which support the handicrafts industry.

CULTURE OF SEA CUCUMBERS

The sea cucumbers which are used for producing *Beche de Mer*, a product which is in high demand in the Far East have been overexploited from the restricted areas in which they are naturally found. There is need to culture them under controlled conditions to augment the production of this valuable export earning commodity. Preliminary pond culture experiments conducted in the Andaman Islands have given promising results. Now the sea cucumber *Holothuria scabra* has been successfully induced to breed for the first time in the country in captivity at the Tuticorin centre of the CMFRI by thermal stimulation and the eggs artificially fertilized to produce viable larvae which have been reared through the various stages such as dipleurula, auricularia, doliolaria and pentactula, to the postlarval stages. The postlarvae have been further reared to the juvenile stage in captivity and will be grown in sea water ponds to adult size. This is a major breakthrough in sea farming in India.

LOBSTER CULTURE

Culture of spiny lobsters has certain inherent difficulties. They have a very long larval life, the phyllosoma larvae taking 6-8 months to metamorphose into the puerulus stage. It is not economical to rear the larvae for such a long period in hatcheries.

At the Kovalam field laboratory of the CMFRI the puerulii of the lobster *Panulirus homarus* were collected in large numbers on tiles covered with coir rope and hung from rafts in the sea. They were then grown in large cement tanks filled with sea water. Clam and mussel meat was given as feed. They attained marketable size of 200 g in 18 months. To accelerate the growth of lobsters and reduce the duration of culture, bilateral eyestalk removal was experimentally tried (Silas, 1982; Radhakrishnan and Vijayakumaran, 1984). The treated lobsters attained the 200 g size in 6 months shortening the culture period by 1/3.

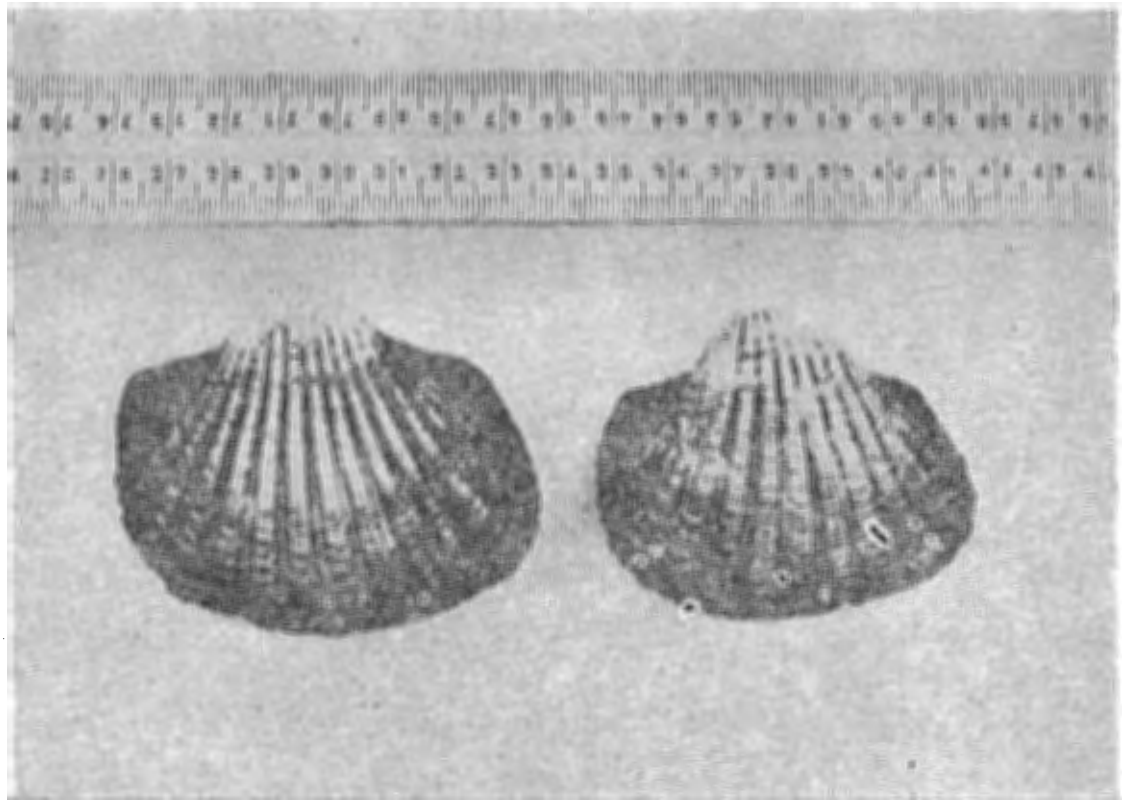

Fig.7 : The blood clam *Anadara granosa*

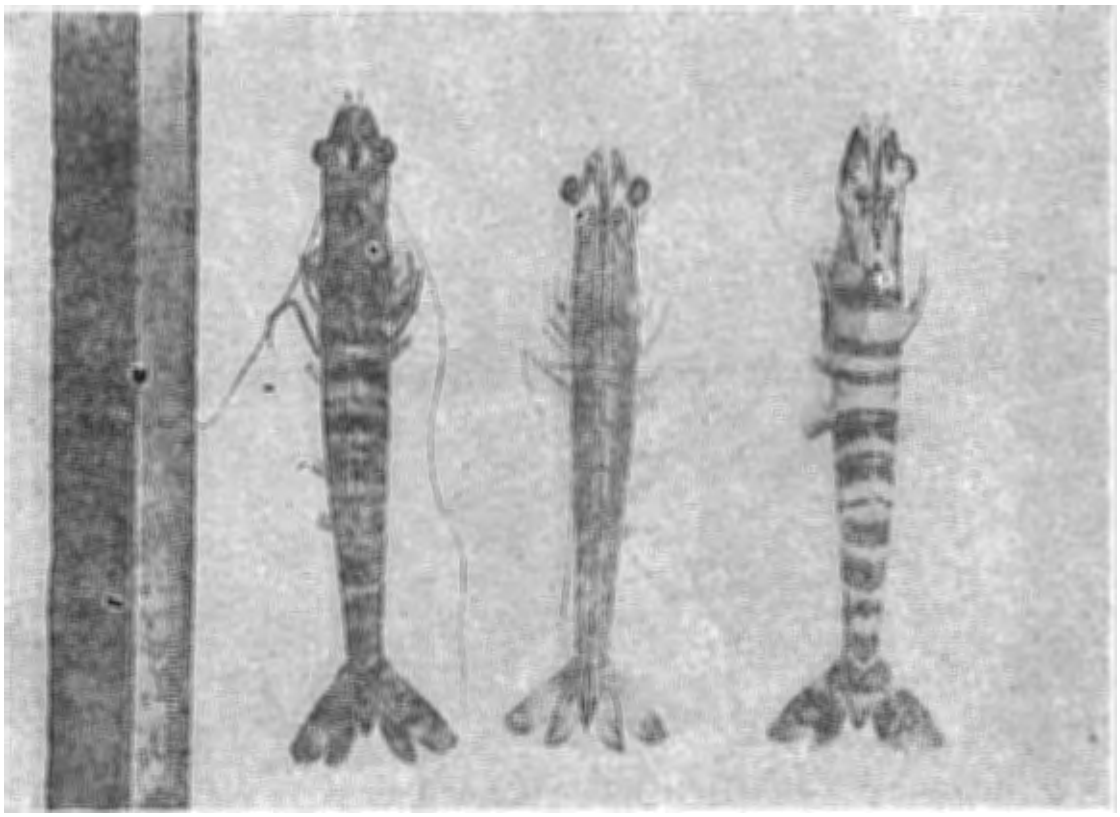

Fig.8 : Farm grown Kurumba prawn *Penacus japonicus*, king prawn, *P. latisulcatus* and witch prawn *P. canaliculatus*

The 200 g lobster doubled their weight in another 3 months i.e. a 400 g lobster could be produced in 9 months by eyestalk ablation. Similar growth enhancement by eyestalk ablation was obtained with *P. polyphagus* and *P. ornatus* also but this technique is not suitable for large scale culture as the mortality is quite high.

Collection of large numbers of puerulii from the sea for culturing is not easy. An alternative suggested is to culture the juvenile undersized lobsters that are caught incidentally in the bottom set gill nets operated for capturing the lobsters. However, better systems of growing lobsters in captivity should be developed to make lobster culture economically viable.

SEA RANCHING OF MARINE PRAWNS

The earlier success achieved by the CMFRI in the hatchery production of marine prawn seed (Silas *et al*,1985) paved the way for large scale production of the seed of almost all the species of marine prawns of commercial importance in India. Recently, seed of *P. japonicus* and *P. latisulcatus* have been produced at Kovalam through induced maturation and these two species have been "domesticated" in the sense that successive generations of these prawns have been maintained at the farm (Kathirvel *et al*,1987). These two species being burrowing and sedentary in habit are ideal for sea ranching as they will not move far away from the place of release.

A sea ranching programme for *P. semisulcatus*, a sedentary species which utilises the sea weed/see grass beds in the Palk Bay area as nursery grounds, has been implemented by the CMFRI at Mandapam Camp. Hatchery production of the seed of *P. semisulcatus* has been successfully achieved at the place. Under the project large quantities of hatchery produced seed will be released into the Palk Bay for replenishing the natural stocks of this prawn in the area.

SEA WEED CULTURE

Experimental culture of two agarophytes *Gracilaria edulis*, *Gelidiella acerosa* and one edible seaweed *Acanthophora spicifera* was carried out at Mandapam Camp by the CMFRI (Chennubhotla *et al*, 1977, 1978 and 1987).

The culture technology for *Gracilaria edulis* involves introduc-

Fig.9 : Adults of sea cucumbers Holothuria scabra

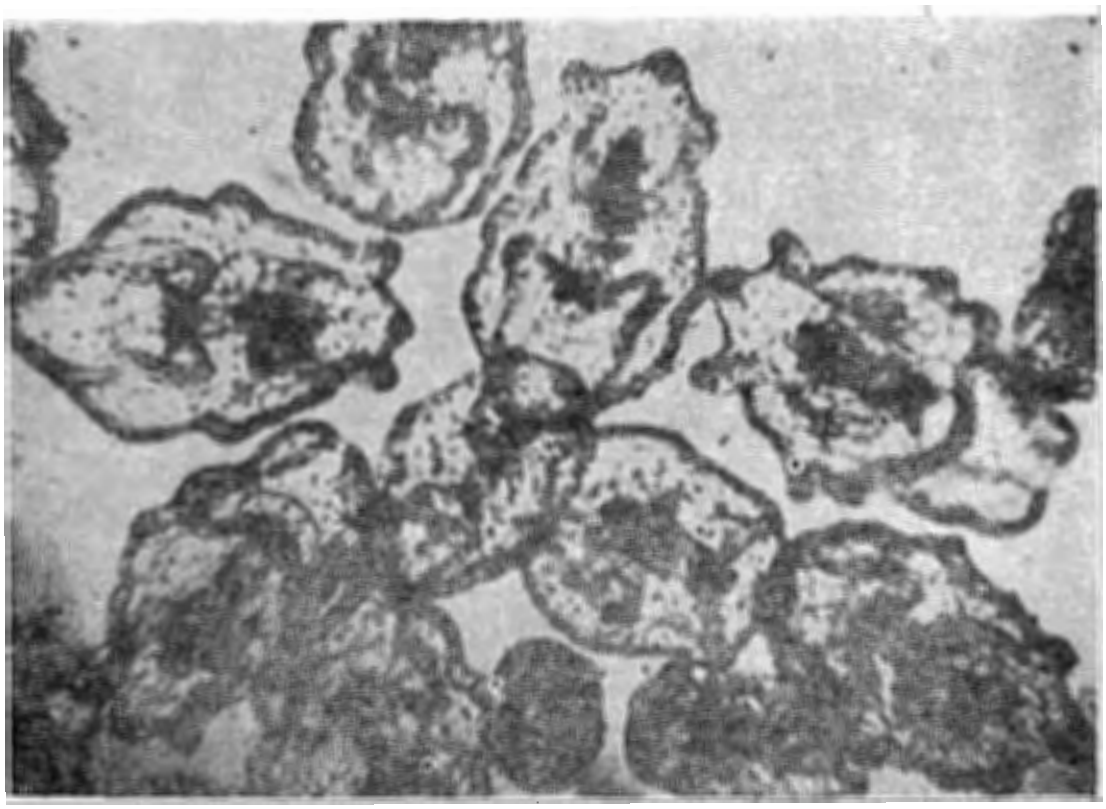

Fig. 10 : Auricularia larvae of sea cucumber reared in the hatchery at Tuticurin.

tion of fragments (4 cm in length) of the seaweed into the twists of the coir ropes which are fabricated in the form of 4x2 m nets tied to fixed poles in the inshore waters. A production rate of 34.3 Kg./8 m^2 in 80 days was obtained which is equivalent to 195 tonnes/ha/year.

Gelidiella acerosa was cultured using coral stones by fastening the fragments to a nylon string and wound round nails fixed on the coral stones. A production of 3.66 tonnes was obtained from one hectare in 180 days.

Cultivation of *Acanthophora spicifera* carried out with nylon nets (60x30 m) yielded 22.6 kg in 45 days. After harvesting, the remnants were allowed to grow for a second harvest and after 35 days another 14.4 kg were obtained.

OTHER AREAS RECEIVING ATTENTION

In the field of sea farming, development of artificial reefs to attract and concentrate fish and lobsters in a place so that they can be fished more easily is envisaged in the near future. Marine fish and prawn culture in floating net cages in suitable protected bays will also be tried. Culture of marine turtles in suitable marine enclosures is also a possibility which is being explored.

SCOPE FOR SEA FARMING IN INDIA

The very long coast line that India possesses is unfortunately and uncomfortably too straight for taking up sea farming in a big way. Countries such as Japan and Norway where sea farming has attained a high degree of perfection have a highly broken coastline with innumerable inlets and sheltered bays where the waters are calm and free from destructive waves even during stormy weather. Rafts for mussels, racks and trays for oysters, nets for sea weeds, floating cages for fish etc need sheltered areas for installation. An open coast subject to strong wind, and wave action during monsoons and cyclones in India poses many engineering problems for the establishment of sea farms. Since sheltered areas are limited, the scope for sea farming in India is also restricted. The prospective areas where sheltered bays are likely to be found are the landward side of the chain of Islands in the Gulf of Mannar, Goa, Konkan coast, Uttara Kannada coast, Gulf of Kutch and the Andaman and Nicobar

Islands and Lakshadweep. A detailed survey to locate such areas is urgently needed. The technologies developed by the CMFRI should also be tried out in such other areas where the conditions are favourable.

Apart from the physical features of the coast, there is no ready, lucrative market in India for sea foods such as the mussels, edible oysters and clams, which would naturally impede the growth of culture practices for these commodities. However, consumer education and market promotion drives will go a long way in creating demand for these products. There is already an export market for blood clams.

Sea weeds and sea cucumbers are in great demand and culture of these organisms is likely to expand if areas suitable for their culture are located soon. Suitable leasing policies should also be evolved by the State Governments (which have jurisdiction over territorial waters) to allot these areas for culture.

The scope for lobster culture appears to be limited unless cost-effective, intensive systems of culturing lobsters in captivity are developed. Sea ranching of the hatchery produced seed of marine prawns and pearl oysters has great potential under Indian conditions because these two resources are badly depleted by overexploitation. Massive sea ranching programmes can replenish these stocks and contribute to increased production of prawns and pearls. This should naturally be the responsibility of the Central and maritime State Goverments as no private agency can be expected to take up this work. Development of artificial reefs should also be under the government sector.

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