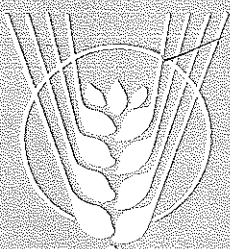


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समुद्री मात्स्यिकी सूचना सेवा

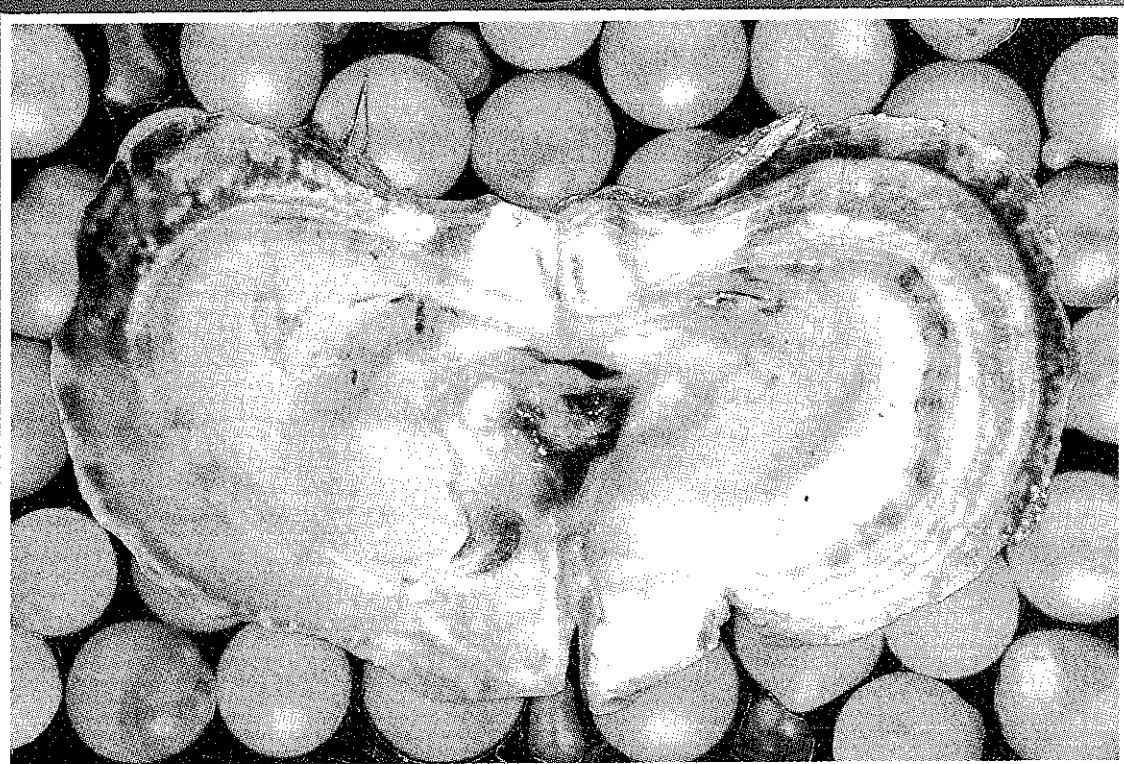
MARINE FISHERIES
INFORMATION SERVICE

No. 143

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JUNE, JULY, AUGUST 1996



तकनीकी एवं TECHNICAL AND
विस्तार अंकावली EXTENSION SERIES

केन्द्रीय समुद्री मात्स्यिकी CENTRAL MARINE FISHERIES
अनुसंधान संस्थान RESEARCH INSTITUTE
कोचिन, भारत COCHIN, INDIA

भारतीय कृषि अनुसंधान परिषद
INDIAN COUNCIL OF AGRICULTURAL RESEARCH

समुद्री मात्स्यिकी सूचना सेवा : समुद्री मात्स्यिकी पर आधारित अनुसंधान परिणामों को आयोजकों, मत्स्य उद्योगों और मत्स्य पालकों के बीच प्रसार करना और तकनोलजी का प्रयोगशाला से श्रमशाला तक हस्तांतरित करना इस तकनीकी और विस्तार अंकावली का लक्ष्य है।

THE MARINE FISHERIES INFORMATION SERVICE : Technical and Extension Series envisages dissemination of information on marine fishery resources based on research results to the planners, industry and fish farmers and transfer of technology from laboratory to field.

Abbreviation - *Mar. Fish Infor. Serv. T & E Ser.*, No **143**: June, July, August 1996

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Front cover photo : A pearl oyster with a fully formed pearl inside. Seen in the background are the pearls produced under onshore culture

मुख्य आवरण चित्र : पूर्ण विकसित मोत्ती के साथ एक मुक्ता शुक्ति। पृष्ठ भूमि में — तटीय संवर्धन द्वारा उत्पादित मोत्ती।

Back cover photo : X-ray graph of pearl oyster with *insitu* implanted nucleus and natural pearls before extraction

पृष्ठ आवरण चित्र : मोत्ती निकालने के पहले रोपित केन्द्रक और प्राकृतिक मोत्ती के साथ मुक्ता शुक्ति के एक्स-किरण ग्राफ।

PROSPECTS OF LARGE SCALE ONSHORE MARINE PEARL CULTURE ALONG THE INDIAN COASTS

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Central Marine Fisheries Research Institute, Cochin - 682 014

Introduction

Marine pearls are precious gems which are one of the most attractive objects of adoration. The occurrence of natural pearls, also called oriental pearls, in the wild pearl oysters is very rare. Although they generally lack proper shape, the natural pearls command very high price even today. The technology of pearl culture was developed by Japan followed by other countries including India. In India the raft culture technology for pearls was developed and perfected in the Central Marine Fisheries Research Institute (CMFRI) at its Tuticorin Research Centre in the Gulf of Mannar coast. World production of cultured marine pearls from different species, mainly from Japan and China, is estimated to be 75 t, against the projected demand of over 100 t. This gap indicates vast potential for the worldwide production and marketing of pearls. In spite of a sound technology, India has not yet attained the status of a commercial pearl producing country. Although India is endowed with a long coastline, the locations suitable for pearl culture in sea farms are quite limited, and consequently, entrepreneurs have not shown much interest in pearl culture.

In the past five years shrimp farming has taken considerable lead in India, particularly in the states of Andhra Pradesh and Tamil Nadu. However, this industry suffers frequent setbacks due to outbreak of diseases and other problems. This situation has created a great deal of awareness among the entrepreneurs about the need to diversify the species base of Indian mariculture and also the techniques. Against this background, the CMFRI attempted the development of a technology for cultured marine pearls in onshore tanks like any other pond systems under controlled conditions. The results of the experiment, first of its kind, are presented and discussed here.

Procedure for culture experiments

The Indian pearl oyster (*Pinctada fucata*) numbering about 1,200 were transported by

train from Tuticorin to Kakinada on 20-01-1995 over a distance of 1,600 km covering 48 hours of journey with 12 hours of halt at Madras for change of sea water. Among the oysters there were 400 implanted oysters and 800 spats. All the implanted oysters suffered mortality within a few hours after reaching Kakinada. About eighty per cent of the spats also suffered mortality. The remaining spats numbering about 140 formed the material for this experiment. Sixteen spats were kept in a cage and suspended beneath the finger jetty of the Kakinada Bay fisheries harbour at a depth of about 80 cm below the surface of water. The remaining spats were spread over the bottom of a cement tank (10 x 5 x 1.2 m) situated in a private shrimp hatchery at Konapapapet (Fig. 1). The tank was provided with a seawater intake, bottom aeration and an outlet drainage. The depth of seawater in the tank was constantly maintained at 30-40 cm (Fig. 2) and the water was changed twice a week. Water pumped from the sea was filtered through slow sand filters and rapid sand filters, and then allowed to pass through chlorination and dechlorination process before letting into the tank. The oysters were fed with a mixed diet of 80% *Chaetoceros* sp. and 20% *Isochrysis galbana* at a density of 10,000 cells per ml two times a day at 0800 and 1800 hrs.

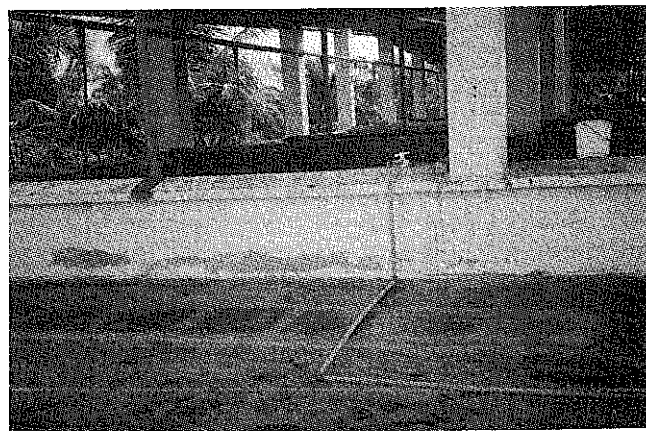


Fig 1. Onshore cement tank used for pearl oyster culture.

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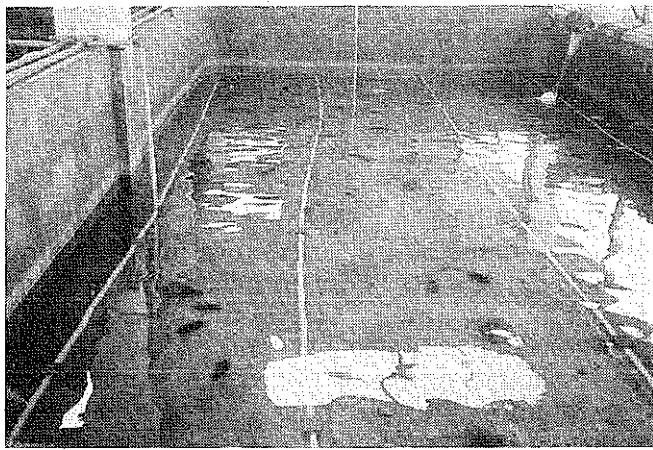


Fig 2. Onshore cement tank with aerator lines. Pearl oysters and green mussels on the bottom

The oysters from the finger jetty of fisheries harbour were transferred to the cement tank in April, 1995 to facilitate implantation. Nucleus implantation with 3 mm beads was carried out on 80 oysters by following the standard procedure in the 2nd week of June 1995. The pearl oysters were later shifted from Kakinada to the shore laboratory of the CMFRI at Visakhapatnam, in the last week of September 1995 and kept in a plastic pool, in order to facilitate better monitoring. At the shore laboratory unfiltered seawater from the Visakhapatnam outer harbour was brought and stored in a plastic pool (3 t capacity) and allowed to settle for about one week before use, by which time most of the fouling organisms like barnacles and serpulids got settled in the plastic pool. These two foulers in turn were able to remove some of the other foulers. At the shore laboratory also food consisting of 80% *Chaetoceros* sp. and 20% *Isochrysis galbana* was given daily at a density of 75,000 cells per ml, two times a day at 0800 and 1800 hrs.

Faecal matter from the pearl oyster tank was siphoned out at regular intervals of 12 hours and an equal quantity of seawater replaced in order to maintain the depth of water at 30-35 cm in the tank. X-ray technique was used to separate the oysters retaining the implanted nucleus from those which rejected the nucleus.

The pearl oysters kept in the Kakinada bay were regularly cleaned to remove the foulers till they were shifted to the Visakhapatnam shore laboratory. Similarly, the oysters in the cement

tank of the private entrepreneur at Kakinada and the plastic pool at the Visakhapatnam onshore laboratory were gently brushed once a month to remove mild fouling. The plastic pool containing pearl oysters at the shore lab at Visakhapatnam was completely covered with a dark cloth. The ambient salinity and temperature were monitored throughout the period. Length measurements (in mm) were taken along the dorsoventral axis (DVA) to monitor growth. The size of oysters kept in the bay and the cement tank could not be monitored due to logistic problems.

Classification of pearls was made as per their present commercial value. Perfect round pearls were graded as 'A'. Pearls with one or more flaws, but with good nacre coating were graded as 'B'. Improperly coated or half coated nuclei were graded as 'C'.

RESULTS

Hydrographic and ecological conditions

Kakinada bay: Salinity of seawater near the fisheries harbour finger jetty ranged from 22‰ in January 1995 to 32‰ in April 1995. It gradually increased through February 1995 and March 1995 (Fig 3). Water temperature also gradually increased from 24°C in January 1995 to 32°C in April 1995 through 25°C in February 1995 and 27°C in March 1995. These parameters reflected their seasonal variations, not deviating much from the normal values. The clarity of water was rather poor due to silt and

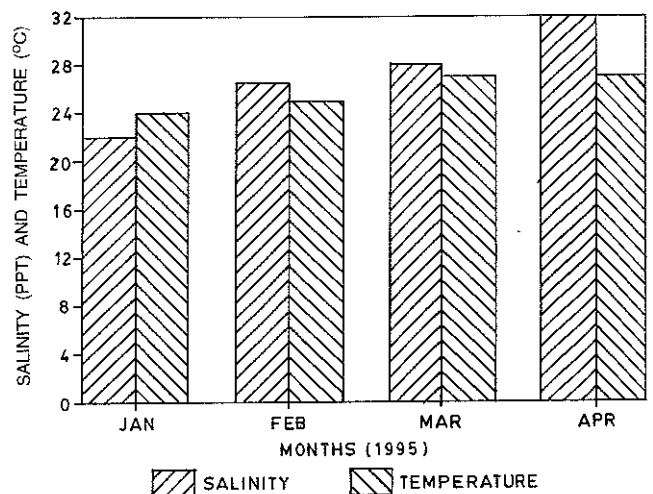


Fig 3. Monthwise mean salinity and temperature values at Kakinada bay (Pearl oyster culture site).

suspended organic particulate matter, a common characteristic of the highly productive bay. Good natural beds of edible oyster and green mussel were found to exist in the bay where the pearl oysters were kept during the present study.

Cement tank (Kakinada): The cement tank at the Siris Aqua Ltd., Kakinada used for this experiment was one of the many tanks in a shed built in a spacing hall covered above by asbestos roofing. The salinity which was 30‰ in January 1995 gradually reached 34‰ in May 1995, but started declining from June 1995 (33.5‰) to September 1995 (29‰). The water temperature which was 21°C in January 1995 gradually rose to 33°C in May 1995, but then gradually declined to 27°C in September 1995 (Fig. 4). As all the sides above the cement tank were open, there was bright sun light penetrating into the water. This led to the development of the filamentous alga *Lyngbya* sp. on the shells of the pearl oysters and the inner walls of the tank. Apart from the alga, ascidians and sponges were also observed on the oysters on a few occasions. During heavy rains, rainwater entered the tank causing severe dilution, bringing the salinity down to 15 to 18‰ in 10 to 12 hours

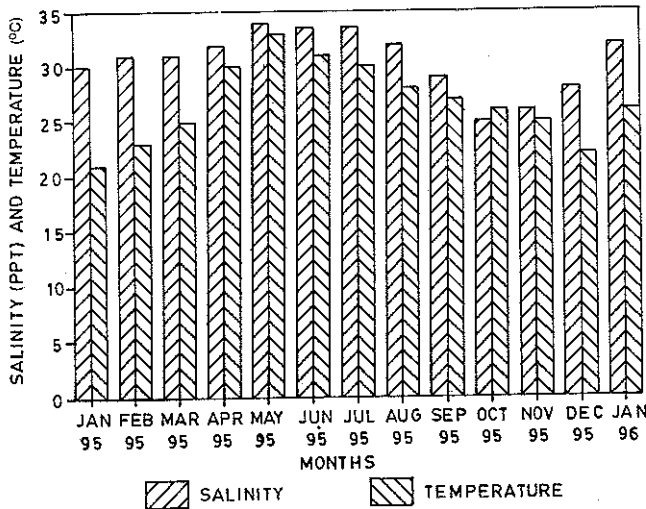


Fig. 4. Monthwise salinity and temperature values in the onshore pearl oyster tanks

Shore lab. (Visakhapatnam): By the end of September 1995 the salinity was 25‰. However, it came down to 18‰ in the first week of October 1995 for about 5 days and gradually rose to 25‰ by the end of this month. Seasonal fall in salinity for a few days during the northeast monsoon season is a common phenomenon along the Visakhapatnam coast. During

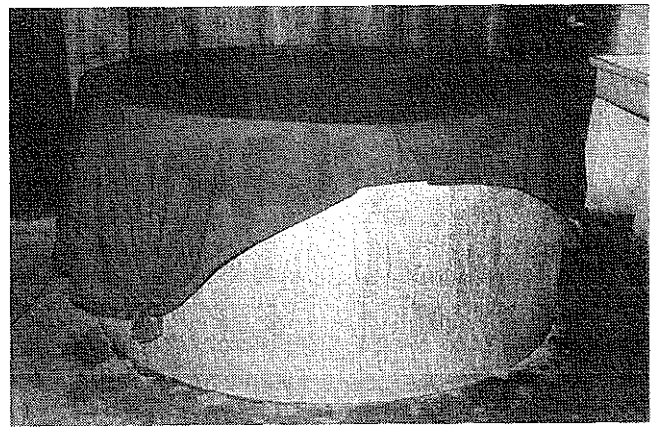


Fig. 5. Plastic pool covered with dark cloth towards the final phase of the experiment at the shore lab. of Visakhapatnam.

November - December 1995 and again in January 1996 salinity progressively increased to 28 and 32‰ respectively. Water temperature was 26°C in October, 25°C in November, 22°C in December 1995, 26°C in January and 27°C in February 1996 (Fig. 4).

There was no settlement of foulers on the pearl oysters due to the measures taken to store seawater before actual use. As the plastic pool was covered with dark cloth (Fig. 5), the filamentous alga *Lyngbya* sp. which settled on the pearl oysters while they were in cement tanks at Kakinada, were totally absent, although the seawater was not filtered.

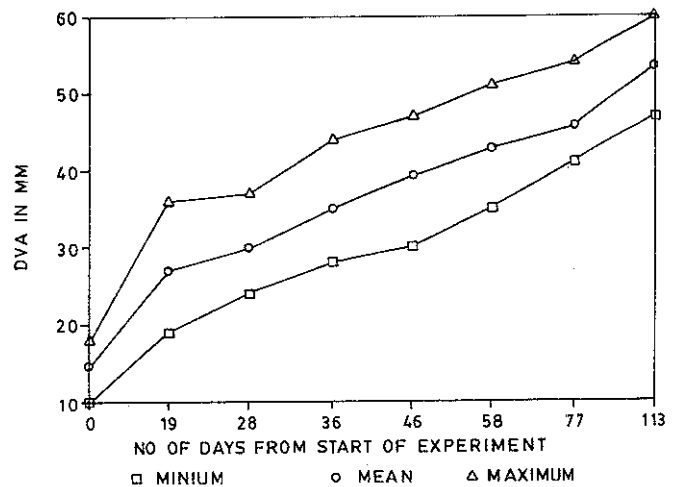


Fig. 6. Growth of pearl oysters (*P. fucata*) in the Kakinada bay (The period 77 days to 113 days pertains to hatchery under artificial feeding).

Growth

Kakinada bay: At the time of stocking in the Kakinada bay, the young pearl oysters ranged from 10 to 18 mm in DVA with a mean value of 14.6 mm. They reached a mean size (DVA) of 27 mm after 19 days and 35 mm after 36 days. The details of mean size and size range are shown in Fig. 6. They reached a mean size of 45.6 mm within a range of 41-54 mm after 77 days. At that stage they were transferred to the cement tank where they reached a mean size of 53.3 mm within a range of 47-60 mm after 113 days of stocking in the bay. The growth was monitored individually. The highest growth observed from the initial 12 mm to the final 58 mm was 46 mm in 113 days, while the lowest growth from the initial 17 mm to the final 47 mm was 30 mm during the same period.

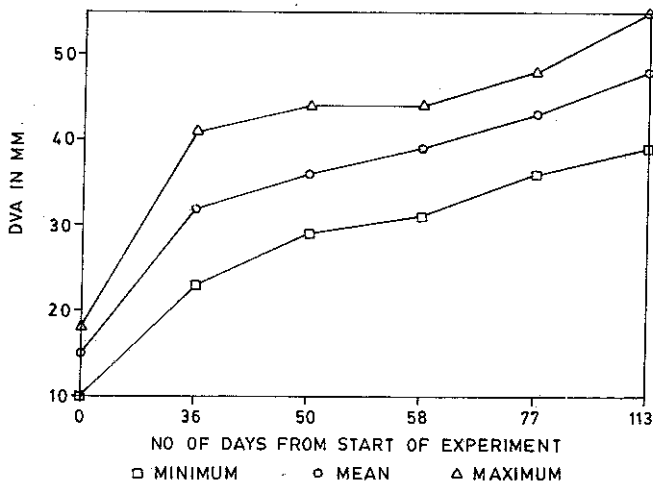


Fig. 7. Growth of pearl oyster (*P. fucata*) in the onshore cement tank

Cement tank: The pearl oysters in the cement tanks at the time of stocking ranged from 10 to 19 mm with a mean size of 15 mm. They attained a mean size of 37.7 mm after 58 days within a size range of 31-44 mm (Fig. 7). They reached a mean size of 48.31 mm after 113 days within a DVA range of 39-55 mm. In the tank also the growth of 30 oysters was monitored individually throughout the period. The highest growth observed from the initial 10 mm to the final 49 mm was 39 mm in 113 days while the lowest growth from the initial 18 mm to the final 39 mm was 21 mm during the same period.

The pearl oysters from the Kakinada bay and the cement tank together kept in the shrimp hatchery attained a mean size of 50 mm at the

time of implantation in the first week of June 1995. The size range was 39-60 mm (Fig. 8).

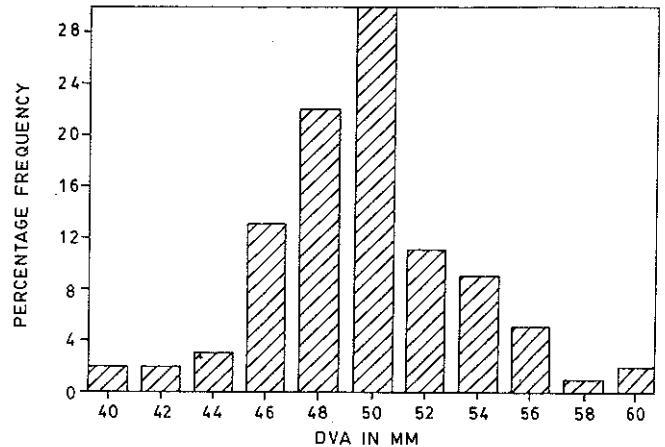


Fig. 8. Length frequency (DVA) distribution of *Pinctada fucata* at the time of implantation

Feeding

The pearl oysters in the Kakinada bay were left to feed naturally. As the oysters in the cement tank were supplied with filtered seawater, algal feed became essential. They were fed by adding different volumes of *Chaetoceros* culture to maintain the algal cell concentration in the tank at varying levels. In the beginning the algal cell concentration was maintained at 10,000 cells/ml from 21.1 '95 to 26.2 '95 when the average size of the oysters was 15 mm. Subsequently it was increased to 20,000 cells/ml from 21.2 '95 to 12.3 '95 when the average size of the oysters was 32 mm. Later it was doubled to 40,000 cells/ml from 12.3 '95 to 20.3 '95 when the average size of the oysters was 36 mm, and from 20.3 '95 onwards the algal cell concentration was constantly maintained at 70,000 to 75,000 cells/ml when the average size of the oysters was 39 mm. From 26.2 '95 onwards the algal culture contained a mixture of 80% *Chaetoceros* and 20% *Isochrysis*. After implantation also the cell concentration and composition of algae were maintained at the above level (Fig. 9).

Green mussel in pearl oyster culture tanks

The algal cells were maintained at 10,000/ml in the beginning of the experiment. The cement tank held 140 pearl oysters and about 12,000 l water. As the tank was kept open without any dark cover algal blooming occurred

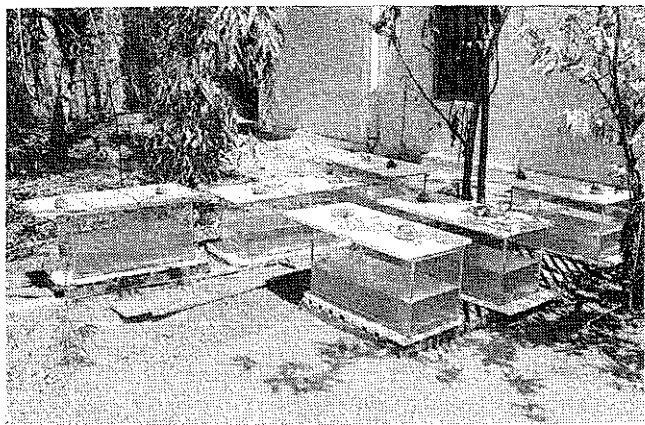


Fig 9. Outdoor algal culture to feed pearl oysters.

after about 4 days resulting in the mortality of about 40 pearl oysters. In view of the large volume of water and the necessity of maintaining proper algal cell concentration in the tank, 100 green mussels (*Perna viridis*) of about 120 mm length each were spread uniformly on the bottom of the tank intermingled with the pearl oysters (Fig 2). After the introduction of the green mussel, there was no blooming of algae, and the mortality of pearl oysters was negligible, in spite of doubling the algal concentration at frequent intervals upto 75,000 cells/ml. The mussels were maintained as long as the pearl oysters were in the open cement tank. However, after shifting the pearl oysters to the shore lab of Visakhapatnam in the last week of September 1995, no green mussels were kept along with the pearl oysters, as dark covering was provided to prevent any algal blooming (Fig. 5).

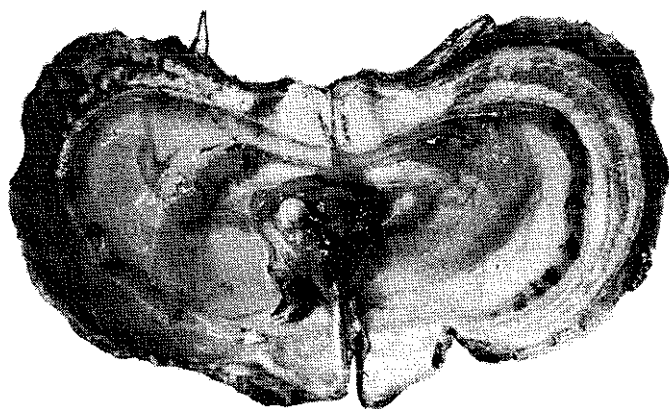


Fig 10. A fully formed pearl before extraction from the oyster.

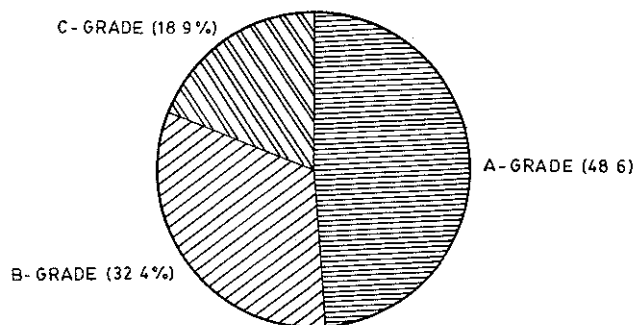


Fig 11 Composition of different grades of pearl with reference to gross production

Postoperative culture and harvest

Implantation operation was carried out in the second week of June 1995. The pearl oysters were let into the cement tank one hour after operation. After a few hours they started feeding well and were found attached to the bottom from the next day onwards. There was absolutely no mortality in the next 2 months. During this period 41 oysters rejected the nuclei which were recovered from the tank. Nucleus rejection started one week after implantation and continued for two months. Later two oysters suffered mortality. A sample of about 16 oysters were opened in the last week of December, 1995 to assess pearl formation and quality (Fig. 10). In the first week of February 1996 X-ray images of pearl oysters were taken to segregate the oysters with pearls from those without pearls. The oysters with pearls, including natural pearls (back cover photo) were opened and the pearls extracted. A total of 37 pearls of different grades were obtained from the original 80 implanted pearl oysters. Thus the gross production of pearls worked out to about 46%. The details of pearls, gradewise are presented in Table 1. Grade 'A' pearls formed 48.6%, followed by 32.4% of 'B' grade and 18.9% of 'C' grade (Fig. 11).

TABLE 1. Details of pearls produced gradewise

| | Total No of operated oysters | Gross production of pearls | A' grade | B' grade | C' grade |
|------------|------------------------------|----------------------------|----------|----------|----------|
| Actual No. | 80 | 37 | 18 | 12 | 7 |
| Percentage | 100 | 46 | 22.5 | 15.0 | 8.7 |

Natural pearls

Seven natural pearls of size varying from 1 to 3 mm without any particular shape were extracted from 7 oysters. They were extracted from the intestinal area where they were found embedded into the tissue. Most of them were silvery white in colour. Pearl oysters which yielded natural pearls formed 8.8% of the oyster population.

Colour and size

The round cultured pearls extracted from the oysters were uniformly cream or golden yellow in colour unlike the silvery white natural pearls. The diameter of grade 'A' pearls ranged from 3.07 to 3.78 mm with a mean of 3.32 mm, the 'B' grade pearls from 3.16 to 3.35 mm with a mean of 3.25 mm, and the 'C' grade pearls from 2.78 to 3.05 mm with a mean of 2.87 mm. No significant difference was found between the average diameter of the pearls extracted on the 190th day and on the 230th day.

Remarks

The growth of pearl oyster *P. fucata* observed in the Kakinada bay was quite high, compared to the growth in natural seawater conditions elsewhere (Fig. 6). Similarly the growth in the cement tank with phytoplankton feeding (Fig. 7) was also high. Since the maximum growth rate was obtained at 70,000 to 75,000 cells of *Chaetoceros*/ml between the 58th and the 77th day from the start of the experiment (Fig. 7), this algal density can be considered to be optimum. The growth rate observed at this density was almost equal to the growth rate observed at the harbour point. These growth rates are the fastest observed in India, making it possible to obtain adult oysters for implantation in about six months under onshore tank conditions or highly productive high saline brackishwater to marine conditions as prevailing in the Kakinada bay.

Pearl culture operations in India or elsewhere are confined to the open sea. In the present study pearl oysters were grown for the first time under less saline conditions (18 to 32‰) over a prolonged period, in and around the fisheries harbour area of the

Kakinada bay and at Visakhapatnam (Figs. 3 & 5). Compared to the open sea conditions, the salinity in the experimental sites was rather low during the monsoon rains (18 to 25‰), but remained at about 30‰ during the rest

TABLE 2 Tentative economic projections for onshore marine pearl culture

| (A) Nonrecurring | Rs. |
|--|-----------|
| Cost of land* (1 ha) | 10 00,000 |
| Cost of 4 000 m ² tanks with hard bottom and roof [@ Rs 250/m ²] | 10 00,000 |
| Cost of backyard hatchery | 5 00,000 |
| Cost of pumping aeration and associated structures | 3,00 000 |
| Power installation and generator | 2 00,000 |
| Cost of algal production system (100 t/day) | 2 00,000 |
| Cost of oyster cages and suspending materials | 10 00,000 |
| Instruments for lab | 2 00,000 |
| For one production cycle | 44 00 000 |
| (B) Recurring (working capital) | |
| Wages | 6,00 000 |
| Nuclear beads | 5 00,000 |
| Instruments for implantation | 50 000 |
| Chemicals and glassware | 1 50,000 |
| Power charges | 50,000 |
| Repairs and replacement | 50 000 |
| Total | 14,00 000 |
| Repayment of term loan (A) with interest spread over 5 years | 1,30 000 |
| Grand total | 27,00 000 |
| (C) Revenue | |
| Total gross return for 1,25,000 pearls @ 25% yield and Rs. 40/pearl (Total implanted oysters 5,00,000) | 50,00 000 |
| (D) Net profit (C - B) | 23 00 000 |
| Percentage of profit | 85 2 |

* in the urban vicinity of Visakhapatnam

of the study period. Most of the bivalves are known to tolerate wide ranges in salinity, turbidity and temperature if they are well fed to compensate the stress on account of significant deviations from normal environmental conditions. Thus the productivity of the ecosystem seems to be a key factor in determining the growth of bivalves. This fact could be taken advantage of in onshore tank systems by maintaining phytoplankton density at the optimum levels.

Another important factor often taken into consideration in pearl culture is the optimum depth, where oysters grow well and produce quality pearls. The present experiment has amply proved that the desired growth and pearl production can be achieved at a depth of about 50 cm, and hence, the depth of water does not appear to be a limiting factor. This finding is of critical importance as it paves the way for growing pearl oysters in low cost, shallow, onshore tanks, as construction of deeper tanks is costly.

The problem of borers and foulers is minimum in onshore tank systems, as it is much easier to control all the conditions and eliminate mortality due to predation.

The harvest of uniformly cream coloured 'A' grade pearls which accounted for about 49% of the total number of pearls produced and about 20% of the gross implanted pearl oysters is economically attractive. The other grades could be made more attractive by proper processing. The formation of natural pearls at 8% of the gross implanted oysters is an added advantage in the tank system. The chances of lodging of sand particles or food particles into the pearl oyster body are more in the tank system than in the wild or deeper waterbodies. The potential for producing valuable natural pearls in onshore tanks is advantageous to the entrepreneurs.

The quality and colour of 'A' grade pearls and the very significant increase in the diameter of the pearls during the last 40 days of the experiment indicate that 3 mm pearls can be extracted in about 180-190 days from

the day of implantation in the tank culture system

There is good possibility of segregating the oysters with nucleus from the nucleus-rejected oysters by the X-ray technique. As the nucleus-rejected oysters could be reimplanted, gross pearl production could be enhanced substantially. X-ray could also be used to assess and monitor nacre secretion and the quality of pearls while they are inside the mother oyster. It is thus possible to assess pearl production both qualitatively and quantitatively in advance, for further planning. A computer software programme on X-ray image processing of pearl oysters is being developed by Dr. V.S. Raghava of the Department of Computer Science and Engineering, Andhra University, Visakhapatnam. This programme should be able to make tank pearl culture operations more efficiently.

Onshore pearl culture is less risky and highly lucrative (Table 2) compared to open sea pearl culture. It provides the opportunity to combine all key environmental factors together at the optimum level through good planning and management, thus making the onshore pearl culture highly successful.

Further studies are required to improve the quality and colour of pearls by manipulating the feeds, and by improving the strains of *P. fucata* by selective breeding. There is an urgent need for large scale farm trials for onshore pearl culture to assess more precisely its economics.

Thanks are due to Dr. V.S.K. Chennubhotla, Mr. M. Prasada Rao, Mr. T. Sukumaran and Mr. T. Nageswara Rao of the Visakhapatnam Research Centre of CMFRI, Visakhapatnam, Mr. A. Chellam and Mr. N. Jesuraj of the Tuticorin Research Centre of CMFRI, Tuticorin and, Mr. K.R. Somayajulu and Mr. P. Atchayya of the Kakinada Research Centre of CMFRI, Kakinada for their kind assistance extended at different stages of the experiment. The facilities extended by Dr. S.V. Subbaraju, Managing Director and Dr. M.Q. Ahmed, Executive Director, SIRIS Aqua Ltd., Kakinada are gratefully acknowledged.

INCIDENTAL CATCH OF SEA TURTLES IN INDIA

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The sea turtle fauna of India

Sea turtles are found all along the coast of India including the Lakshadweep and Andaman & Nicobar Islands. Five species inhabit the Indian waters (Table 1). All the species are capable of taking long distance migration.

TABLE 1. Sea turtle fauna of India

| Species | Common name | Feeding ground in India | Nesting ground in India |
|-------------------------------|--------------------|-------------------------|-------------------------|
| <i>Lepidochelys olivacea</i> | Olive ridley | Present | Present |
| <i>Chelonia mydas</i> | Green turtle | Present | Present |
| <i>Eretmochelys imbricata</i> | Hawksbill turtle | Present | Present |
| <i>Caretta caretta</i> | Loggerhead turtle | Present | Not known |
| <i>Dermochelys coriacea</i> | Leatherback turtle | Not known | Present |

Lepidochelys olivacea (Olive ridley turtle)

This is the most common sea turtle in Indian waters. Very heavy concentration of this species occurs in Orissa coast. Mass nesting occurs in a stretch of 15 km Gahirmatha beach during January-March every year. This species nests both in the east and west coasts of India, as well as in the Bay Islands.

Chelonia mydas (Green turtle)

This is the largest species found in the Indian waters. It occurs in the west and east coasts of India, Lakshadweep and Andaman & Nicobar Islands. The name Green turtle indicates the green colour of the fat. It is predominantly herbivorous and feeds on sea grass. This species was highly priced and there was a directed fishery for the green turtle in the 1970s in the Gulf of Mannar area.

Eretmochelys imbricata (Hawksbill turtle)

It is comparatively a small sized turtle and numerically less abundant in the Indian waters than the other species. It is reported from Lakshadweep, southwest coast, Tamil Nadu and Andaman & Nicobar Islands. It feeds mainly on sponges, crabs and molluscs. As it frequently feeds on poisonous marine animals, the flesh of this species is often reported to be poisonous.

Caretta caretta (Loggerhead turtle)

This species is reddish brown in colour and is characterised by a large head in relation to the body size. In India, it is recorded only from the Gulf of Mannar. It is a carnivore, feeding on crabs, fish and other benthic animals.

Dermochelys coriacea (Leatherback turtle)

Individuals of this species attain a weight of 500 kg. A thick leathery tissue covers the bones of the shells and hence the common name. Indiscriminate poaching of eggs in the 1970s caused the disappearance of this species in the mainland coastal waters. However, they occur in pristine beaches and adjacent waters of Little Andamans and Nicobar Islands.

The area, season and intensity of nesting of the sea turtles are given in Table 2. The mass nesting of the Olive ridley in India is among the most dense sea turtle nestings in

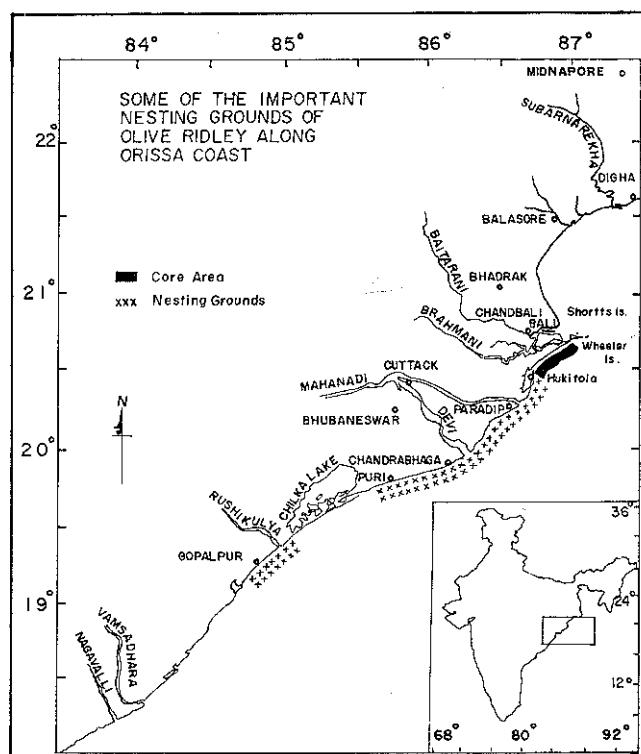


Fig. 1. Some of the important nesting grounds of Olive ridley along Orissa coast.

TABLE 2. Details on occurrence and nesting of five species of sea turtles in India

| Species | Occurrence | Nesting area | Nesting season | Nesting intensity |
|---------------------|--|---|-------------------|-------------------|
| <i>C. mydas</i> | Sporadic in coastal mainland & A & N Islands | Gujarat (Kutch & Saurashtra) | July-January | Moderate |
| | | Maharashtra (Thane Dt) | | Sparse |
| | | Tamil Nadu (Gulf of Mannar & Palk strait) | | Sparse |
| | | A & N Islands | November-January | Moderate |
| | | Lakshadweep | June-September | Moderate |
| <i>E. imbricata</i> | -do- | Tamil Nadu | | Extremely low |
| | | Andhra Pradesh | | -do- |
| | | Orissa | | -do- |
| | | Gujarat | | Rare |
| | | A & N Islands | April-January | Moderate |
| | | Lakshadweep | | Rare |
| <i>D. coriacea</i> | -do- | Tamil Nadu | | Very rare |
| | | A & N Islands | December-April | Moderate |
| | | Lakshadweep | | Stray |
| <i>C. caretta</i> | Tamil Nadu (sparse) | Not known | Not known | |
| <i>L. olivacea</i> | Almost throughout the mainland and bay islands | Gujarat | July-September | Moderate |
| | | Maharashtra | -do- | Stray |
| | | Goa | -do- | Stray |
| | | Karnataka | -do- | Stray |
| | | Kerala | -do- | Stray |
| | | Tamil Nadu | December-February | Moderate |
| | | Andhra Pradesh | -do- | Moderate |
| | | Orissa | -do- | Mass nesting |
| | | West Bengal | -do- | Moderate |
| | | A & N Islands | -do- | Moderate |
| Lakshadweep | June-September | Stray | | |

the world. It is estimated that, on an average, about 2,40,000 female Olive ridleys nest every year (Table 3) in the Gahirmatha beach, Orissa (Fig. 1) in a phenomenon called "arribada". Tagging experiments and observations by the coast guards suggest northward mass migration of the Olive ridleys off Sri Lankan waters in November. The turtles cover the entire southern part of the east coast of India to reach the mass nesting beach in Orissa coast during January (Fig. 2). A few ridleys stray and nest in Tamil Nadu and Andhra Pradesh coast during the migration. The mass nesting occurs in two batches, the first major nesting during January-February and the second minor nesting in March. Prior to the peak mating period, large number of copulating pairs swim passively along the surface currents. The copulating pairs of Olive ridleys migrate from south to north, i.e. towards the mass nesting site in the north (Gahirmatha) and move parallel to the coast till they gather in very large

numbers just in front of the mass nesting zone. Mating takes place almost daily in the shallow waters at a distance ranging from 50 metres to 5 km from the shore during October-December. The mating ridleys exhibit little response to external disturbance until the process of copulation is over. Hence, the mating pair is highly vulnerable to fishing gears.

Exploitation and predation

In India, directed turtle fishery existed in the past in Orissa. Trade in the turtle eggs and turtle flesh existed every year along Orissa and West Bengal coasts during the 'arribada'. The Forest Department of Orissa issued license for collection of eggs and it was estimated that 1.5 million eggs were legally removed in the 1973 'arribada' season. The Govt. of Orissa ceased issuing licenses from the year 1975. Exploitation of adult turtles existed till the early 1980s.

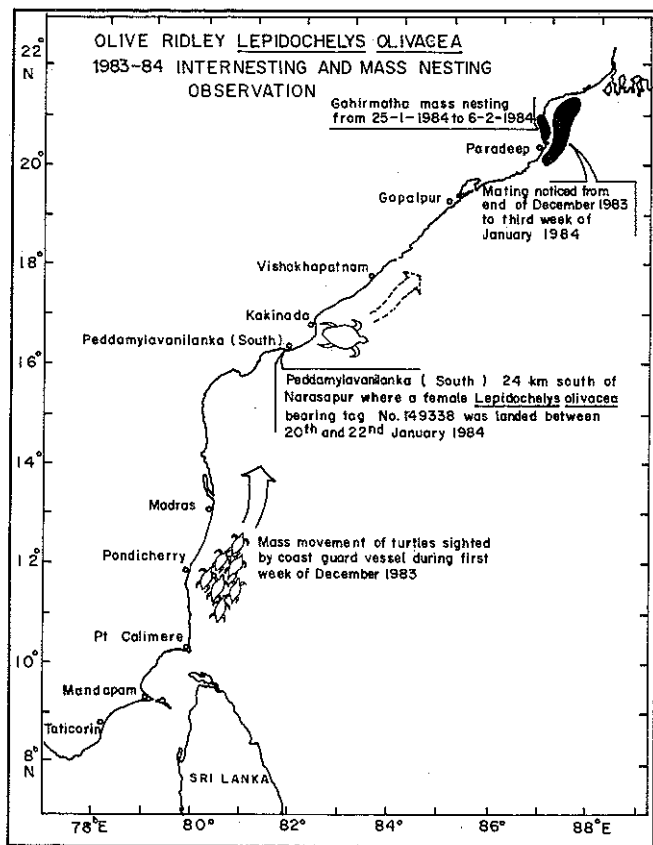


Fig 2 Map showing the interesting and mass nesting activity phases of the Olive ridley during the 1983-'84 season.

It is estimated that 50,000--80,000 adult Olive ridleys comprising of both the sexes were captured off Gahirmatha during every nesting season upto 1981-'82. During 1982-'83, due to vigilance by the Forest Department, Govt. of Orissa, West Bengal and coast guard, poaching of sea turtles in the high seas was reduced to 10,000. From 1983, marketing the turtles was totally stopped and directed fishery was also stopped. Since then, turtles succumb only as incidental catch and the carcasses are washed ashore in the Gahirmatha beach.

Similar directed fishery existed in Gulf of Mannar and Palk Bay in Tamil Nadu. The turtles were exploited by employing special type of wall nets. In the 1960s, it was estimated that 3,000-4,000 turtles were landed every year between Pamban and Kanyakumari. In the Palk Bay, about 1,000 turtles were landed annually. The Green turtle formed 75% of the catch; Olive ridley and Loggerhead together formed 20% of the catch. The turtles were sent to Tuticorin market. Following action by the Dept. of Forest,

Govt. of Tamil Nadu, the turtle exploitation and trade were stopped in the early 1980s.

Prior to the 1960s, turtles were exported to Sri Lanka and turtle shells to France, U.K. and several other countries. The export of chelonian flesh and products was stopped in 1977.

The type of exploitation in India in the 1960s and the 1970s could be categorised as follows:

- (i) Directed turtle fishery for meat and shell;
- (ii) Exploiting the adult female when it comes to the beach for nesting;
- (iii) Exploitation of eggs for human consumption; predation of eggs by dogs and jackals;
- (iv) Predation of hatchlings by birds and dogs.

TABLE 3. Number of Olive ridley nestings in Gahirmatha (Orissa) from 1976-'96

| Year | Months | Number of nests |
|---------|----------------|-----------------|
| 1976 | Not available | 1 50 000 |
| 1977 | Not available | 1,50,000 |
| 1978 | Not available | 2,00 000 |
| 1979 | Not available | 1,30,000 |
| 1980 | Not available | 2,00 000 |
| 1981 | Not available | 2,00,000 |
| 1982 | Not available | 200 |
| 1983 | February | 2 00 000 |
| 1984 | January-March | 5,00 000 |
| 1985 | January, March | 2,87,000 |
| 1986 | April | 48,000 |
| 1987 | January, March | 6,02 000 |
| 1988 | February | 100 |
| 1989 | January | 3 25,600 |
| 1990 | March | 2,58,000 |
| 1991 | March April | 6 10 000 |
| 1992 | January-March | 3 21,700 |
| 1993 | | Not available |
| 1994 | March | 2 00,000 |
| 1995 | | Not available |
| 1996 | January-March | 2,00,000 |
| Average | | 2 40,000 |

Conservation

In order to prevent poaching and protect the sea turtle population, the Govt. of India developed conservation and management measures. The turning point was the promulgation of the Indian Wildlife (Protection) Act (1972)

TABLE 4. Number of mechanised non-mechanised and motorised craft in India

| State | Mechanised craft | | | Non-mechanised craft | | | Motorised craft | | | Total | | |
|----------------|------------------|--------|--------|----------------------|----------|----------|-----------------|--------|--------|----------|----------|----------|
| | 1980 | 1990 | 1994 | 1980 | 1990 | 1994 | 1980 | 1990 | 1994 | 1980 | 1990 | 1994 |
| West Bengal | 1,054 | 1,880 | 1,880 | 4,061 | 4,361 | 4,091 | 0 | 270 | 270 | 5,115 | 6,511 | 6,241 |
| Orissa | 469 | 1,796 | 2,453 | 9,728 | 13,791 | 7,796 | 0 | 529 | 529 | 10,197 | 16,116 | 12,702 |
| Andhra Pradesh | 580 | 4,082 | 8,911 | 36,013 | 50,333 | 54,000 | 0 | 1,688 | 3,269 | 36,593 | 56,103 | 66,180 |
| Tamil Nadu | 2,627 | 4,500 | 8,230 | 43,343 | 39,969 | 26,737 | 0 | 3,298 | 5,340 | 45,970 | 47,767 | 40,307 |
| Pondicherry | 176 | 561 | 553 | 1,750 | 5,293 | 5,900 | 0 | 332 | 365 | 1,926 | 6,186 | 6,818 |
| Kerala | 3,038 | 5,026 | 4,206 | 26,271 | 27,104 | 27,873 | 0 | 7,934 | 12,913 | 29,309 | 40,064 | 44,992 |
| Karnataka | 2,004 | 3,730 | 3,655 | 6,942 | 11,860 | 11,952 | 0 | 190 | 1,189 | 8,946 | 15,780 | 16,796 |
| Goa | 908 | 736 | 850 | 2,513 | 2,445 | 1,100 | 0 | 675 | 900 | 3,421 | 3,856 | 2,850 |
| Maharashtra | 4,718 | 6,451 | 7,930 | 7,928 | 17,441 | 9,888 | 0 | 286 | 4,701 | 12,646 | 24,178 | 22,519 |
| Gujarat | 3,413 | 5,215 | 8,365 | 4,120 | 7,795 | 8,370 | 0 | 1,154 | 4,283 | 7,533 | 14,164 | 21,018 |
| A & N Islands | 10 | 184 | 230 | N.A. | 964 | 1,180 | 0 | 124 | 160 | 10 | 1,272 | 1,570 |
| Lakshadweep | 213 | 410 | 443 | N.A. | 740 | 780 | 0 | 225 | 298 | 213 | 1,375 | 1,521 |
| Total | 19,210 | 34,571 | 47,706 | 1,42,669 | 1,82,096 | 1,59,667 | 0 | 26,171 | 36,141 | 1,61,879 | 2,33,372 | 2,43,514 |

N.A. = Not available.

wherein all species of sea turtles are placed as endangered species in Schedule I and are thereby protected. India is a member of the Convention of International Trade in Endangered Species of Fauna and Flora (CITES), which prohibits trade in turtle products by party countries. In June 1981, India became a party to the Bonn Convention on the Conservation of Migratory Species of Wild Animals. To protect the sea turtles, Bhitarkanika and Gahirmatha (65,000 ha) in Orissa were declared as wildlife sanctuaries in 1975. These sanctuaries are situated in Kanika Island and includes 12 other offshore islands and several beaches. In addition, the coastal mainland has 4 national parks and 17 protected areas. There are 94 sanctuaries in the Andaman & Nicobar Islands.

Nevertheless, there was a subsistence fishery for the Green turtle and the Olive ridley, the former in the Gulf of Mannar and the latter along Orissa and West Bengal coast primarily for the Calcutta market. In the early 1980s, sea patrol was effectively activated and surveillance strengthened for strict enforcement of the Acts and Legislations. The poachers were arrested with the help of coast guard vessels. These measures effectively prevented poaching and directed activities on sea turtle exploitation were phased out during 1980-'83.

In addition to prevention of poaching, different agencies, viz. maritime state

governments and union territories particularly Tamil Nadu, Andhra Pradesh, Orissa, Gujarat, Andaman & Nicobar Islands and numerous non-governmental agencies are engaged in sea turtle conservation activities. The Universities in Orissa have conducted pioneering studies on the hatching mechanism of Olive ridley eggs. The Central Marine Fisheries Research Institute (ICAR) conducted exhaustive studies on the

TABLE 5. Incidental catch of sea turtles in fishing gears; the data pertain to the observed number of sea turtles in fish landing centres during 1985-'95

| State | Species | Incidental catch | | Gear |
|----------------|--|-------------------|--------|-------------------------------------|
| | | Month | Number | |
| West Bengal | Olive ridley | December-February | 23 | Gill net |
| Orissa | Olive ridley | December-February | 21 | Gill net |
| Andhra Pradesh | Olive ridley & Green turtle | December-March | 79 | Gill net |
| Tamil Nadu | Olive ridley Green turtle Hawksbill & Loggerhead | All months | 21 | Gill net Shoreseine Trawl net |
| Kerala | Olive ridley, Green turtle & Loggerhead | All months | 33 | Trawl net Hooks & line |
| Karnataka | Olive ridley | November | 2 | Gill net |
| Maharashtra | Olive ridley | November-April | 6 | Trawl net |
| | | | 150* | |
| Total | | | 335 | |

* Stranded young ones; gear not specified

nesting in Tamil Nadu and Gahirmatha coasts. The CMFRI installed a hatchery for the Olive ridley in Kovalam (near Madras) and conducted a recovery programme, in which 53,000 hatchlings of the Olive ridley were released to the sea during 1978-'86. The CMFRI also reared the Olive ridley hatchlings for 4 years and studied the growth under captivity; conducted experiments on food preference of the hatchlings, yolk utilization during egg development and behavioural pattern during nesting.

TABLE 6. *Fishing gears responsible for incidental catch of sea turtles*

| Gear | % in total incidental catch |
|--------------|-----------------------------|
| Gill net | 76.5 |
| Trawl net | 17.8 |
| Shore seine | 3.2 |
| Hooks & line | 2.5 |

The conservation and management strategies evolved by these organisations for effective protection of the sea turtle population are: **(i)** Habitat preservation of the present critical areas, already identified vulnerable areas, new areas and the national sea shore system; **(ii)** Species preservation through recovery programmes, translocation of nests and setting up of hatcheries; **(iii)** Legislation and enforcement of prevalent laws and regulations and future requirements; **(iv)** Research pertaining to biology, ecology, reproductive physiology, endocrinology, behaviour and **(v)** Education, training and extension among the public especially children on the importance of turtles and need for their conservation, and of the supervisory personnel.

In addition to these, the CMFRI developed a national programme for: **(i)** Surveying and demarcating nesting grounds of sea turtles along the Indian coasts and the bay islands; **(ii)** Monitoring incidental catch of turtles in fishing operations and finding ways and means of minimising the same; **(iii)** Developing hatchery and hatchling release programme; **(iv)** Carrying out tagging of turtles to understand their population structure, migratory habits, growth, longevity and mortality rates; **(v)** Investigating biological aspects and behaviour of turtles; and **(vi)** Strengthening the National Marine Living Resources Data Centre (NMLRDC) for the acquisition and dissemination of data

on sea turtles from the Exclusive Economic Zone.

The CMFRI conducted a national workshop on sea turtle conservation in 1984 in Madras. The Marine Biological Association of India conducted an international symposium on the endangered marine animals and marine parks in 1985 in Cochin. The CMFRI has published the research findings in the form of proceedings, bulletins, special publications, research papers etc.

The concerted effort of all the concerned organisations during the 1970s and the 1980s helped, to a large extent, in arresting the massacre of sea turtle population.

Incidental catch

A major threat which persists is the incidental catch of turtles in fishing gears like trawl net and gill net. The total number of mechanised craft has increased from 19,210 in 1980 to 47,706 in 1994 (Table 4). Almost the entire fishing fleet exploit the inshore area <50 m depth, exerting enormous pressure on the living resources.

Table 7. *Number of dead olive ridley stranded in the Gahirmatha beach due to incidental catch in fishing gears*

| Year | Number of dead turtles | Year | Number of dead turtles |
|------|------------------------|------|------------------------|
| 1983 | 7,500 | 1988 | 422 |
| 1984 | 392 | 1989 | 408 |
| 1985 | 694 | 1990 | NA |
| 1986 | 531 | 1991 | 1,000 |
| 1987 | 360 | 1992 | 1,500 |

NA = Not available

The CMFRI besides its headquarters has 12 research centres and 30 field centres along the coast from where data on exploited marine fishery resources from artisanal and industrial sectors are being collected and evaluated. The Institute is at an advantage that a fund of field data is being collected by the staff which help in the proper monitoring of marine living resources. The National Marine Living Resource Data Centre (NMLRDC) of the Institute is a repository of the data. The NMLRDC also collects data on the incidental catch of sea turtles in all the fish landing centres by designating code number for the five species of sea turtles for facilitating computer analysis.

With the aid of simple line drawings and photographs, field identification characters of these species, specieswise information on sightings, incidental catch in fishing operations, observations from the nesting grounds and so on could be collected in the designed proformae (Proforma I, II and III).

Table 8. Monthly variation in the stranding / incidental catch of adult olive ridley in Gahirmatha

| Month | % of stranded turtles | Month | % of stranded turtles |
|-----------|-----------------------|--------|-----------------------|
| September | 0.1 | March | 1.2 |
| October | 2.5 | April | 0.4 |
| November | 8.3 | May | 0.0 |
| December | 25.8 | June | 0.0 |
| January | 38.1 | July | 0.0 |
| February | 23.6 | August | 0.0 |

From the data thus collected on the incidental catch in all the maritime states during 1985-'95, it could be observed that 335 sea turtles were incidentally caught all over the Indian coasts (barring Gahirmatha coast) (Table 5). It is estimated that 17.8% of the incidental catch was by the trawlers and 76.5% by the gill netters (Table 6). The prime objective of CMFRI survey is the collection of data on the marine landings by following stratified random sampling method. The incidental catch of sea turtles given in Table 5 is the number of turtles which were incidentally caught in the fishing gears only on the observation days in the sampling centres. There is no estimates on the total incidental catch. Also, there is no record on the number of sea turtles which are caught and discarded in the sea. Hence, the actual number of sea turtles incidentally caught in India (barring Gahirmatha) by fishing gears must be much higher than 335.

Nevertheless, the incidental catch appears to have sharply decreased considering the large scale capture in earlier years. The reasons for the decline despite increase in the number and efficiency of fishing craft are: (i) Awareness of the fishermen to release the turtles; (ii) Lack of demand for turtle meat even if brought to the shore due to vigilance by different agencies; and (iii) implementation of a 3 km inshore fishing ban on mechanised trawlers to prevent massive annual incidental take.

Incidental catch in the mass nesting area

Observations on the stranded sea turtles in a stretch of 10 km at Gahirmatha beach revealed that 7,500 Olive ridley carcasses were washed ashore during 1983 (Table 7). The turtles were washed ashore due to entangling in fishing operations conducted off Paradip and adjacent fishing areas, the carcasses drifting northwards and reaching the Gahirmatha beach. Thanks to the stringent measures taken by the forest officials of Orissa and West Bengal state governments and with the ban on fishing activities during mass nesting, the mortality declined in the subsequent years. The mortality was maximum during December-February (Table 8) and 87.5% of the annual strandings was during this period.

Conclusions

Considering the present status of sea turtle exploitation and incidental catch, especially that of the Olive ridley in the Gahirmatha coast, the following conclusions could be drawn:

(i) due to strict vigilance, exploitation of adults and eggs has been effectively reduced

(ii) Estimates on the incidental mortality of sea turtles due to fishing activity are not available. However, observations and sample surveys suggest that incidental catch has reduced following ban on fishing off Gahirmatha during the mass nesting period and ban on mechanised fishing in shallow waters (within 3 km from the shore) throughout the year all along the Indian coast

(iii) Gill netters are responsible for 76.5% of incidental mortality of sea turtles.

(iv) The number of nesting Olive ridley females in the Gahirmatha coast has not reduced in the 1990s compared to earlier years.

Recommendations

(i) A mechanism has to be developed for properly estimating the incidental catch of sea turtles in the fishing gears. The CMFRI may be identified for evolving the mechanism and for implementing the programme.

(ii) Fishing off Gahirmatha by the Paradip based mechanised vessels may be totally banned during peak mating and nesting season of the Olive ridley, i.e. during October-March. This will

NATIONAL MARINE LIVING RESOURCES DATA CENTRE (NMLRDC)

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE, COCHIN-682 014

PROFORMA I

DATA ON SEA TURTLES AT FISH LANDING CENTRES

Species : NMLRDC's Code No

Location : Sex :

Date : Dead or Live :

Evidence of any previous tag : Yes/No
If yes, give details of Tag number, etc :

New tag number if tagged
and released:

Carapace length (Straight Line) : cm Total weight : kg

Carapace width (Straight line) : cm

Evidence of any injury : Yes/No If Yes, give details

If incidental catch in fishing gear, type of
fishing craft and gear used :

Any turtle trade in that area : Yes/No If yes, give details

Any turtle egg trade in that area : Yes/No
If Yes give details:

Any incident of turtle poisoning : Yes/No If yes, give details

Remarks :

Investigator :

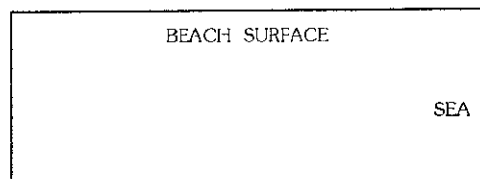
NATIONAL MARINE LIVING RESOURCES DATA CENTRE (NMLRDC)

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE, COCHIN-682 014

PROFORMA II

DATA ON SEA TURTLES

Species : NMLRDC's Code No
 Location : Sex :
 Date : Time : From To
 Whether condition :
 Surf Temperature : Sand temperature :
 Evidence of any previous tag : Yes/No If yes, give details of Tag number, etc :
 New tag number if tagged and released:
 Carapace length (Straight Line) : cm Total weight : kg
 Carapace width (Straight line) : cm
 Evidence of any injury : Yes/No. If Yes, give details :
 If incidental catch in fishing gear, type of fishing craft and gear used :
 Surf Condition : Distance of nest high water line : (m)
 Number of eggs :
 Any predation of eggs on nesting beaches : Yes/No If Yes, give details:
 Remarks :
 Investigator :
 NATURE OF CRAWL (Draw a sketch of crawling pattern in the box)



NATIONAL MARINE LIVING RESOURCES DATA CENTRE (NMLRDC)

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE, COCHIN-682 014

PROFORMA III

DATA ON SEA TURTLES TAKEN AS INCIDENTAL CATCH IN FISHING AND TAGGING OPERATIONS

Species : NMLRDC's Code No.....

Location : Sex :

Date : Depth :

Time of capture : Time of release :

Gear operated : Depth at which operated :

Evidence of any previous tag : Yes/No
If yes, give details of Tag number, etc :

New tag number if tagged and released:

Carapace length (Straight Line) : cm Total weight : kg

Carapace width (Straight line) : cm

Evidence of any injury : Yes/No If Yes, give details :

Evidence of any ectoparasite : Yes/No. If Yes, give details :

Any sighting of matching of
turtles in that area : Yes/No. If Yes, give details:

Remarks :

Investigator :

effectively curtail not only the incidental capture but also death due to propellor hit.

(iii) To minimise the incidental catch, Turtle Excluder Devices (TEDs) may be fitted in the trawl nets of vessels based at Paradip. Employing the TEDs in the trawl nets operated in other areas are not necessary as (a) occurrence of sea turtles in areas other than the Orissa coast is scarce and (b) trawlers are responsible for only 17.8% of incidental mortality of sea turtles.

LARGE SCALE EXPLOITATION OF SACRED CHANK *XANCUS PYRUM* USING MODIFIED TRAWL NET ALONG RAMESWARAM COAST, TAMIL NADU

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Mandapam Regional Centre of CMFRI, Mandapam Camp - 623 520

Introduction

The sacred chank, *Xancus pyrum* is a gregarious, large gastropod and its habitat forms distinct chank bed. Hornell as early as 1922 described the chank beds in depths of 10 to 20 metres in the Gulf of Mannar and are considered as the most important ones in the country although there are other chank beds along the Gulf of Kutch and the southwest coast of India. The chank bed in the Gujarat coast is found on or above the coral reefs. The fine sand of silky texture with loosely lying small corals, other 'paar' detritus and filamentous green algae support the chanks in the chank beds in Tamil Nadu coast. The chanks are either hand picked from shore area or collected by diving in selected chank beds during certain seasons. They also form by-catches in bottom set gill nets and trawl nets. Along the south Kerala coast, directed exploitation using long lines from December to March is in vogue (Appukuttan *et al.*, 1980 *Mar. Fish. Infor. Serv., T & E Ser., No. 24*: 10-24).

In Tamil Nadu until recently, the chank fishing at selected centres along the Ramanathapuram coast was the monopoly of the government of Tamil Nadu. Due to the liberalisation of rules, presently specific exploitation is taking place in traditional as well as new chank bed areas. This report highlights the specific exploitation for chanks along the Rameswaram coast and the probable impact of such fishing.

(iv) As the TEDs have not been employed in India so far, the Central Institute of Fisheries Technology (CIFT) may be identified for suggesting suitable types of low cost TEDs and their effectiveness in preventing the incidental catch.

(v) The method of implementing TED installation in trawl nets of the Paradip based vessels has to be properly worked out by the concerned departments of the Govt. of India and the Govt. of Orissa.

Area and method of specific exploitation

The nets used for the specific exploitation of chanks are colloquially called as "Chanku madi". It is a modified shrimp trawl net to suit the purpose. The grounds off Rameswaram coast from Neduntivu to the adjacent places of Thalaimannar off Sri Lanka coast in a north to south direction at a depth ranging from 12 to 16 m are trawled. The location showing the area of chank fishing is given in Fig. 1.

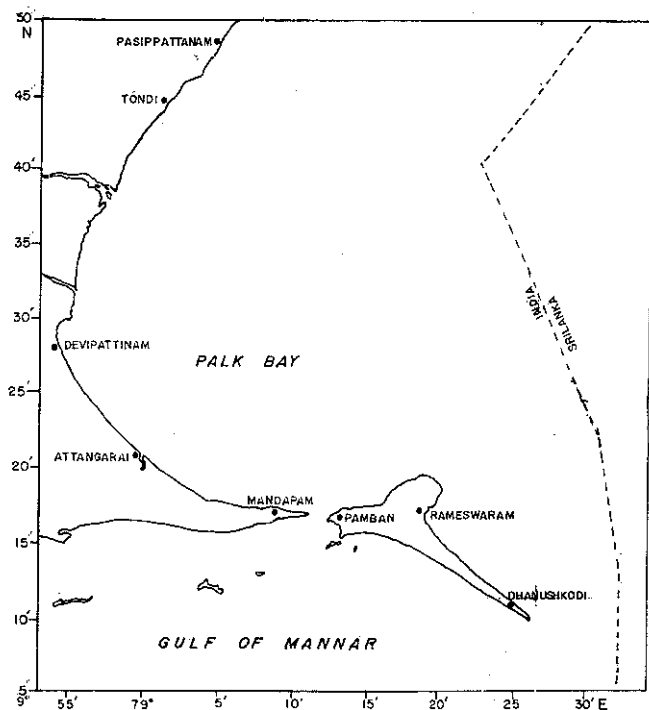


Fig. 1. Areas off Rameswaram in Tamil Nadu where 'Chanku madi' is operated for exploitation of chanks

Details of "Chanku madi" and its operation

In the shrimp trawl net, 110-115 sinkers are attached while in the "Chanku madi" there are 300-350 sinkers per net which totally weigh about 60 to 70 kg. The cod end mesh size in the shrimp trawl is usually 25 mm whereas it is 40 mm in the chank net. The increased mesh size is to clear the mud and other debris which normally clog the small meshes. The trawling speed for "Chanku madi" is kept half (2.5 km/hr) that of the fish trawling speed. Against two hauls each of four hours duration per trip for the shrimp trawl "Chanku madi" is hauled for every half an hour and 10 to 12 such hauls are made per trip. The cost of a "Chanku madi" is Rs. 8,000/- while it would cost Rs. 7,000/- only for a shrimp trawl.

Species composition and catch particulars in "Chanku madi"

As the operation of "Chanku madi" is a clandestine one, the catches obtained are immediately shifted to the chank godowns owned by the persons operating the "Chanku madi". However, it was possible to get information about the catch particulars and morphometric measurements of the chanks. The majority of the catch comprised of the chank *Xancus pyrum* followed by rays, star fishes and sea cucumbers. Table 1 indicates the catch composition of different species of fish and molluscs.

TABLE 1. Species composition observed in "Chanku madi"*

| Species | Average catch (in kg) | % |
|--|-----------------------|-------|
| <i>Xancus</i> (= <i>Turbinella</i>) <i>pyrum</i> | 153 | 61.22 |
| <i>Trygon</i> (= <i>Amphotistius</i>) <i>kuhili</i> | 41 | 16.33 |
| Starfishes and other echinoderms | 5 | 02.04 |
| Holothuria | 51 | 20.41 |

* Based on 10 hauls

Morphometric measurements

Among the *Xancus pyrum* the variety *Xancus pyrum* var. *obtusa* (or 'Patti' in Tamil) is the dominant one comprising almost 100% of the population of chanks along the Tamil Nadu coast. The length and MSD-wise frequency of occurrence of the chanks are given in Table 2.

Estimation of total catch of chanks

During the off season for shrimps, the trawlers which operate for specific chank exploitation brought an estimated catch of 150 kg of chank/boat/day which amounted to an estimated monthly catch of 54,000 kg which is equivalent to about 1.5 lakh chanks.

TABLE 2. Length and MSD-wise distribution of *Xancus pyrum* var. *obtusa* caught in "Chanku madi"

| Length Class (mm) | Percentage | MSD* Class (mm) | Percentage |
|-------------------|------------|-----------------|------------|
| 91-100 | 22.6 | 41-50 | 07.5 |
| 101-110 | 30.2 | 51-60 | 35.9 |
| 111-120 | 11.3 | 61-70 | 20.7 |
| 121-130 | 07.6 | 71-80 | 13.2 |
| 131-140 | 03.8 | 81-90 | 11.3 |
| 141-150 | 07.6 | 91-100 | 05.7 |
| 151-160 | 07.5 | 101-110 | 03.8 |
| 161-170 | 05.6 | 111-120 | - |
| 171-180 | 01.9 | 121-130 | 01.9 |
| 181-190 | - | 131-140 | - |
| 191-200 | - | 141-150 | - |
| 201-210 | - | 151-160 | - |
| 211-220 | 01.9 | 161-170 | - |

*MSD = Maximum shell diameter

Reasons for exploitation of chanks

There is an increased demand for chank shells over the years and the traditional diving could not cater to the demand. Depending on size, the polished chanks fetch a price ranging from Rs. 150 to 500. The recent price of shells at landing centre and polished product at shops

TABLE 3. Price structure of *Xancus pyrum* shells (1996)

| Size as MSD (mm) | Price at landing centre (Rs.) | Price at private godown (Rs.) | Price of polished product (Rs.) |
|------------------|-------------------------------|-------------------------------|---------------------------------|
| 100 to 120 | 150 to 180 | 150 to 250 | 500.00 |
| 80 to 100 | 80 to 100 | 100 to 150 | 200.00 |
| 70 to 80 | 60 to 75 | 50 to 100 | 150 to 200 |
| 60 to 70 | 25 to 30 | 35 to 40 | 50 to 75 |
| 60 and below | 5.00 | 10.00 | 20.00 |
| Wormed | 5.00 | 10.00 | - |

are given in Table 3. In addition, the dried operculum is sold at a price ranging from Rs. 280 to 450/- per kg. The dried operculum is in great demand and is exported for pharmaceutical purposes as well as for use as an ingredient in incense stick manufacturing industries. Increased profit fetched by the chank more than the shrimps is another reason for the exploitation of the chanks.

Adverse impact of "Chanku madi"

Operation of "Chanku madi" with more number of sinkers and frequent haulings destroys the bottom biota including the chank egg capsules in the chank beds.

In Rameswaram area six traditional chank beds ('Paars') adjacent to coral reefs are totally destroyed by the operation of "Chanku madi". The divers informed that the size of chanks available at present are smaller compared to those of previous years. As chanks are slow growing gastropods and the fecundity is low, the

dislodging of egg capsules by "Chanku madi" will result in the depletion of stocks.

The heavy sinkers of "Chanku madi" plough the bottom sediments 15 cm deep and all the soil biota in this layer are dislodged and damaged. This aspect requires special attention by the authorities as the food chain will be invariably altered/affected. Lured by the income from the sale of chanks and sea cucumbers, nowadays a "Chanku madi" is kept in every trawler in addition to other nets. Whenever trawling for shrimps/fish yields less catch, the "Chanku madi" is operated and rich hauls of shells and holothurians are taken. No doubt the operation of "Chanku madi" will result in the destruction of the bottom biota including chanks and would lead to environmental degradation.

Our sincere thanks are due to Dr. K.A. Narasimham, Head, Molluscan Fisheries Division, to have kindly gone through the manuscript and offered suggestions.

MADRAS FISHERIES HARBOUR — A STATUS REPORT FOR 1995

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Madras Fisheries Harbour is one of the largest fisheries harbours in the east coast of India. It provides base for mechanised as well as indigenous fishing crafts. It is estimated that 480 trawlers, 20 mechanised gill netters, 25 motorised and 200 nonmotorised catamarans make use of this harbour. The annual fish landings in 1995 were 38,251 tonnes; the trawlers contributing 96.1% of the landings.

Trawlers

The 480 trawlers are of three different length categories, viz. 32', 36' and 40-45', with horse-power ranging between 65 and 120. The small trawlers (32 and 36') are engaged in daily voyage or occasionally undertake 2 day voyage and operate between Pudhupatnam (south of Madras) and Sriharikota (north of Madras) in 15-40 m depth. The larger trawlers (40-45')

conduct voyages lasting upto 6 days off Nizampatnam, which is 315 km northeast of Madras (Fig. 1). The depth of operation of the larger trawlers is 15-60 m (Table 1)

The trawl effort (Fig. 2) and landings (Fig. 3), particularly those of the larger trawlers increased over the years. In 1995, about 56% of the total trawl effort (fishing hours) and 59% of the total landings were by the larger trawlers. The smaller trawlers are being phased out gradually. Addition of larger trawlers to the fleet has enabled intensification of fishing in the hitherto underexploited areas.

However, most of the trawling activity was restricted to depth within 50 m. The trawlers spent only 7.8% of the total effort in depth beyond 50 m and realised 10.0% of the total landings (Table 2).

TABLE 1 Operational details of fishing vessels in Madras Fisheries Harbour in 1995

| Parameters | Trawler | | | Gillnetter | Motorised Catamaran | | Non-motorised Catamaran | |
|--|------------------------|-----------------------|-----------------|-----------------------|---------------------|-------------|-------------------------|-------------|
| | 32' | 36' | 40-46' | | | | | |
| Number of boats | 100 | 80 | 300 | 20 | 25 | | 200 | |
| Engine horsepower | 65 | 90 | 120 | 60 | 6-10 | | | |
| Duration of voyage | 12h | 24h | 4-6 days | 48h | 8h | | 6h | |
| Area of operation | P patnam S harikota | P. patnam K patnam | off N patnam | Madras- S harikota | off Madras | | Madras- Pulicat | |
| Distance from shore (km) | 5-18 | 5-20 | 5-15 | 8-20 | 2-5 | | 2-3 | |
| Depth (m) | 15-40 | 15-80 | 15-60 | 40-80 | <15 | | >15 | |
| Gear | Shrimp trawl | | | Drift net | Bag net | trammel net | gill net | hook & line |
| Fishing hour/unit | 6-9 | 15-18 | 30-50 | 24 | 1.5 | 1.5 | 3-6 | 5-7 |
| Fishing effort in depth > 50 m (% of total effort) | Nil | 5 | 10 | 50 | Nil | Nil | Nil | Nil |
| No. of hauls/unit | 2-3 | 6 | 12-20 | 2 | 2-3 | 2-3 | 2-3 | 2-3 |
| Duration of haul (h) | 3 | 3 | 3-5 | 12 | 0.5 | 0.5 | 1.5 | 2 |
| Manpower/unit | 5 | 5-6 | 6 | 5-6 | 16 | 3 | 3 | 3 |
| Diesel (l/day) | 150 | 150 | 200 | 150 | | | | |
| Ice (t/unit) | 0.3 | 0.75 | 3 | 0.3 | | | | |
| Fishhold capacity (t) | 0.5 | 0.75 | 5 | 0.5 | | | | |

P.patnam = Pudhupatnam. K patnam = Krishnapatnam

N patnam = Nizampatnam.

S harikota = Sriharikota

The catch/h increased upto 1991 (110.8 kg/h) subsequently, it declined sharply and was only 48.3 kg/h in 1995 (Fig. 4). The long voyage trawlers discarded 2,671 t of trash fish in 1995, which is equivalent to about Rs. 0.5 crore. The daily voyage trawlers landed the entire catch.

In the coastal area between Pudhupatnam and Nizampatnam, the area between 15 and 50 m depth (4,000 sq km) is being fully exploited by the Madras based trawlers. As the yield per fishing intensity is higher in the depth more than 50 m (98.7 kg/sq km/000h) compared to depth less than 50 m (11.8 kg/sq km/000h) (Table 4), there is considerable scope to increase the trawling effort beyond 50 m. However, less abundance of shrimps in depth beyond 50 m has forced the trawl operators to restrict fishing in depth less than 50 m. In 1996, the tendency of the fishermen is to venture further north of

Nizampatnam rather than fish in the deeper waters.

Gillnetters

There are only 20 mechanised vessels which operate drift gill net. The fishing area of these vessels is between Madras and Sriharikota (Table 1).

The effort, catch and catch/h have increased over the years. During 1984-86 the annual average effort, catch and catch/h were 20,808 h, 270 t and 13.0 kg/h, respectively and in 1995, the corresponding estimates were 47,568 h, 822 t and 17.3 kg/h.

In 1995, about 50% of the landings was from depth more than 50 m. Considering the number performance (Table 2) and operational income (Table 3), the number of drift gill netters could be substantially increased.

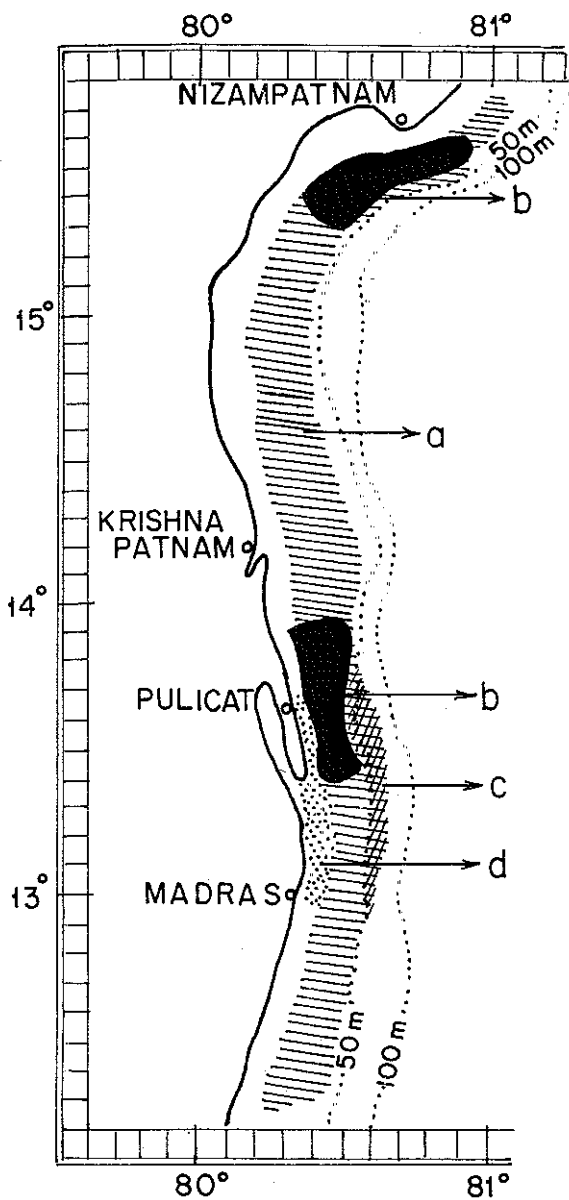


Fig. 1. Fishing areas of Madras based vessels

- a. Area under trawling (4650 sq.km)
- b. Areas under intensive trawling (1250 sq.km) by small and large trawlers
- c. Area under mechanized gill net fishing (270 sq.km),
- d. Area under artisanal fishing (40 sq.km)

Catamaran

During the past 15 years a few artisanal gears were introduced and a few others were phased out. Trammel net and *pannu valai* (gill net) were introduced; *madha valai* (bag net), *ara valai* and *irukka valai* (gill nets) and boat seine were also phased out

The effort of *eda valai* (bag net), *kavala valai* (gill net) and hooks & line increased. The annual landings increased from 239 t (1980-'83) to 682 t (1995; Table 5)

TABLE 2 Effort and catch of mechanised vessels in Madras Fisheries Harbour during 1995

| Parameters | Trawler | | Total | Gillnetter |
|----------------------|---------------------|---------------------|---------------------|-------------------|
| | Daily voyage | Long voyage | | |
| Effort | | | | |
| Number of vessels | 180 | 300 | 480 | 20 |
| Number of units | 43,963 | 10,684 | 54,647 | 1,982 |
| Fishing hours | | | | |
| <50m | 3,13,500 (95.0%) | 3,84,624 (90.0%) | 6,98,124 (92.2%) | 23,784 (50.0%) |
| >50m | 16,500 (5.0%) | 42,736 (10.0%) | 59,236 (7.8%) | 23,784 (50.0%) |
| Total | 330,000 | 427,360 | 757,360 | 47,568 |
| Total catch | | | | |
| <i>Landings (t)</i> | | | | |
| <50m depth | 13,869 (92.5%) | 19,077 (87.7%) | 32,946 (89.7%) | 411 (50.0%) |
| >50m depth | 1,125 (7.5%) | 2,676 (12.3%) | 3,801 (10.3%) | 411 (50.0%) |
| Total | 14,994 | 21,753 | 36,747 | 822 |
| Catch/unit (kg) | 341 | 2,036 | | 415 |
| <i>Catch/h (kg)</i> | | | | |
| <50m depth | 44.2 | 49.6 | | 17.3 |
| >50m depth | 68.2 | 62.6 | | 17.3 |
| Mean | 45.4 | 50.9 | | 17.3 |
| Trash | | | | |
| per unit (kg) | 60 | 250 | | Nil |
| t/year | 2,638 | 2,671 | 5,309 | Nil |
| % in total landings | 17.5 | 12.3 | 14.4 | Nil |
| Discard | | | | |
| per unit (kg) | Nil | 250 | 250 | Nil |
| t/year | Nil | 2,671 | 2,671 | Nil |
| % in total landings | Nil | 12.3 | 7.3 | Nil |

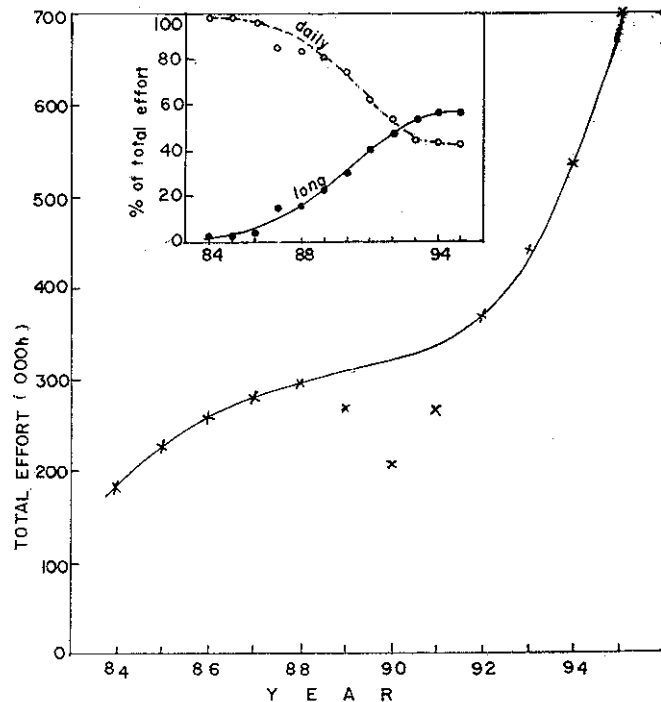


Fig. 2. Estimated annual effort of trawlers at Madras. Inset: The increasing effort of long voyage trawlers. All the lines are eye-fits

TABLE 3 Value of fish landings from mechanised vessels in Madras Fisheries Harbour during 1995

| Parameters | Trawler | | Total | Gillnetter |
|--|--------------|---------------------|---------------|------------|
| | Daily voyage | Long voyage | | |
| Value (Rs.) | | | | |
| Average value of catch/kg | 18 | 34 | 52 | 45 |
| Average value of trash/kg | 2 | 2 | 4 | |
| Fish sale/unit | 5 058 | 60 724 | 65 782 | 18 675 |
| Trash sale/unit | 120 | 500 | 620 | |
| Total annual scale (in crores) | 22.8 | 65.4 | 88.2 | 3.7 |
| Annual discard (Rs. in crores) | Nil | 0.5 | 0.5 | Nil |
| Operational expenses/unit (Rs.) | | | | |
| Diesel & oil | 1 500 | 10,000 | 11 500 | 1 500 |
| Ice | 200 | 2,000 | 2,200 | 350 |
| Labour | 932 | 11 020 | 11,952 | 3 735 |
| | | (18% of total sale) | (20% of sale) | |
| Total | 2 632 | 23 020 | 25 652 | 5,585 |
| Operational income/unit (Rs.) | | | | |
| | 2,546 | 38 204 | 40 750 | 13 090 |

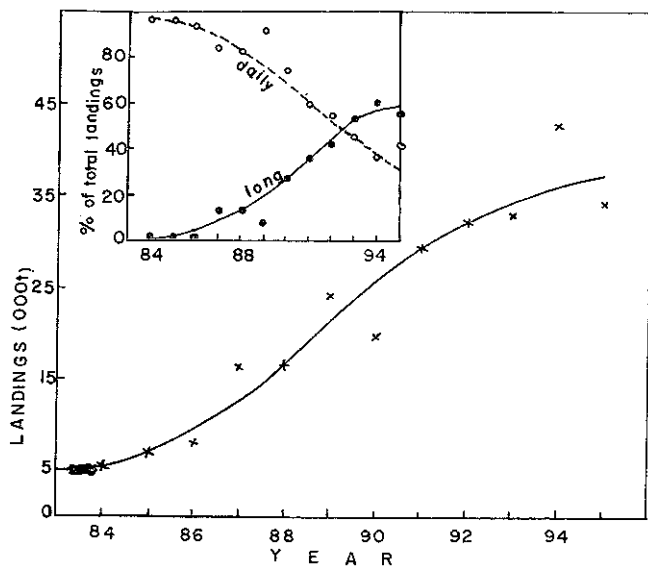


Fig. 3 Estimated annual landings of trawlers at Madras. Inset: The increasing contribution of long voyage trawlers. All the lines are eyefits

TABLE 4 Area of trawling and yield/fishing intensity of Madras based commercial trawlers

| Depth (m) | Potential area of trawling (sq km) | Area under trawling (sq km) | Fishing intensity (h/sq km) | Yield/fishing intensity (kg)* |
|-----------|------------------------------------|-----------------------------|-----------------------------|-------------------------------|
| 15- 50 | 4 000 | 4 000 | 174.5 | 11.8 |
| 50-100 | 2 170 | 650 | 91.1 | 98.7 |
| 15-100 | 6,170 | 4,650 | 162.9 | 10.4 |

* Yield = Catch (kg)/(trawling area (sq.km) x effort (000h))

TABLE 5. Effort, catch and operational income of catamarans in Madras Fisheries Harbour during 1995

| Parameters | Bag net | Trammel net | Gill nets Kavala valai | Hooks & Pannu valai | Total line | |
|---------------------------------------|---------|-------------|------------------------|---------------------|------------|--------|
| Effort | | | | | | |
| Number of units | 2 326 | 1,055 | 1 888 | 5 528 | 3 033 | 13,830 |
| Fishing hours | 3 489 | 1 583 | 5 664 | 22 112 | 18 200 | 31,048 |
| Catch | | | | | | |
| Catch (t) | 440 | 4 | 64 | 138 | 36 | 682 |
| Catch/unit (kg) | 189 | 4 | 34 | 25 | 12 | 264 |
| Catch/h (kg) | 126 | 2.5 | 11 | 6 | 2 | 147.5 |
| Fish sale (Rs) | | | | | | |
| Value of catch/kg | 15 | 50-350 | 6 | 15 | 50 | |
| Annual sale/unit | 2,835 | 800 | 204 | 374 | 600 | 4,813 |
| Annual sale (Rs in lakhs) | 65.9 | 8.4 | 3.9 | 20.7 | 18.2 | 117.1 |
| Labour (50% of sale) | 1 417 | 400 | 102 | 187 | 300 | 2 406 |
| Operational income/Unit (Rs in lakhs) | 1 417 | 400 | 102 | 187 | 300 | 2,406 |

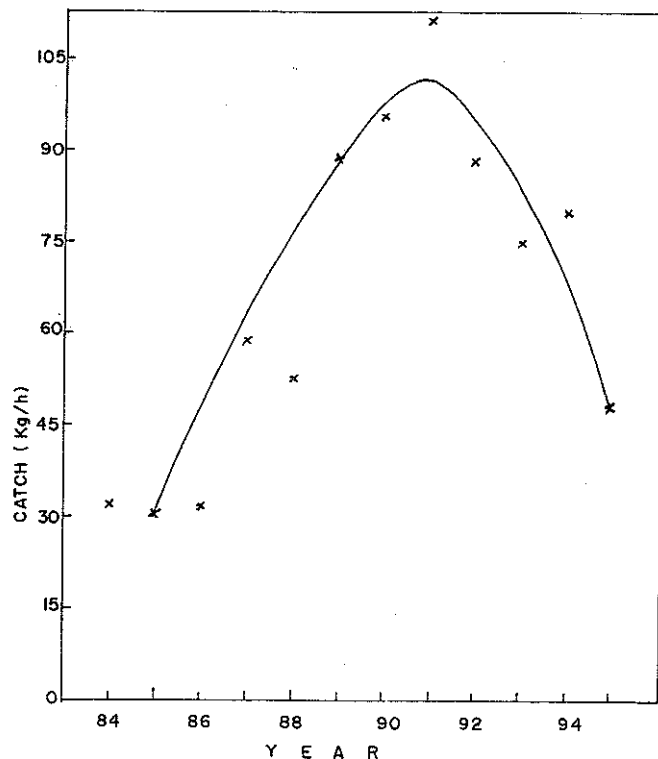


Fig. 4. Catch (kg/h) of trawlers based at Madras. The line is eyefit

TABLE 6 Summary of the quantity and value of the landings in Madras Fisheries Harbour during 1995

| Parameters | Trawl | Gill net | Artisanal | Total |
|------------------------------|-------------------|---------------|---------------|-----------------|
| Landings (t) | 36 747 (96.1%) | 822 (2.1%) | 682 (1.8%) | 38 251 |
| Landings from depth >50m (%) | 10.3 | 50.0 | 0.0 | 10.9 |
| Discard (t) | 2 671 (7.3%) | Nil | Nil | 2 671 (7.3%) |
| Value (Rs. in crores) | 88.2 (94.7%) | 3.7 (4.0%) | 1.2 (1.3%) | 93.1 |

LARVAL REARING OF THE CRAB *PORTUNUS PELAGICUS* (CRUSTACEA, PORTUNIDAE) IN HATCHERY AT MANDAPAM REGIONAL CENTRE OF CMFRI

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The blue swimmer crab *Portunus pelagicus* (Herbst) supports a good fishery in the Palk Bay and the Gulf of Mannar and forms the major species of crab caught in trawl nets. On an average it fetches Rs. 35-40/kg and in some seasons it goes upto Rs. 55/kg. This species is getting more market demand nowadays.

Shrimp culture has been the major attraction of aquaculturists for some time. But during the recent years they encountered heavy loss due to disease outbreaks in shrimp farms. Therefore it has become necessary to diversify the culture operations and to restrict the over emphasis given to shrimp culture. Considering the high export value, this crab is a good candidate species for aquaculture and for rotation of the crop.

The nonavailability of crab seed is the main constraint in crab culture at present. The farmers are completely dependent on natural resources for seed and juvenile crabs. Larval rearing and seed production of *Scylla serrata* has been demonstrated by several workers. But hatchery production of *Portunus pelagicus* has not been undertaken in our country. So work was taken up to standardise and popularise a technology for the hatchery production of seed

Other major developments are motorisation of catamaran in the 1990s and introduction of fibreglass boats in 1995.

Due to the large scale expansion of the trawl fleet the contribution of the artisanal sector to the total landings has declined. During 1980-'83 the trawlers contributed 93.7%, gill netters 2.4% and artisanal crafts 3.9% to the total landings. In 1995 the trawlers contributed 96.1%, gillnetters 2.1% and artisanal crafts 1.8% (Table 6).

of *P. pelagicus* with a view to overcome the non-availability of crab juveniles for farming and also to replenish the depleting stock of the wild by sea-ranching (by releasing the laboratory reared young ones into the sea) which would help a sustainable fishery of crab in the region.

Broodstock

Healthy ovigerous females of *P. pelagicus* were collected from trawler catches off Mandapam and were brought to the hatchery. Crabs with characteristic yellow coloured eggs were kept in 1.5 t tanks (5 nos.) at salinity 25 ± 1 ppt, pH 8.2 ± 0.1 , temperature $28 \pm 1^\circ\text{C}$, with continuous aeration. Daily 60-70% of water was exchanged in the morning and evening hours. Only filtered seawater was used for the entire operations. Crabs were fed with fish and clam meat. After a few hours the left out feed was removed to avoid fouling of water.

Spawning

Changes in the egg colour was observed daily and when the egg mass became deep grey in colour the animals were transferred into separate tanks with known volume of seawater

for spawning. The total weight and carapace width were noted. At this stage crabs were not given any feed. Tank was cleaned daily.

Larvae

Larvae were counted by taking different samples and stocked in fibreglass tanks with different stocking densities. Water quality parameters such as temperature, pH and salinity were determined daily. Other parameters viz. nitrate, ammonia, phosphate and H_2S were measured twice a week. Good aeration was provided in each tank with an air compressor.

Larval feed

Larvae (zoeae) were fed with mixed phytoplankton with *Chaetoceros* spp. (dominating) and *Chlorella*, rotifer and freshly hatched *Artemia* nauplii. The megalopae were fed with macerated shrimp in addition to rotifer, shrimp nauplii (of *P. semisulcatus*) and *Artemia* nauplii. Crab instars were fed with shrimp, clam meat and shrimp post larvae.

The rearing tanks were observed daily for successive developmental stages, moulting larvae and exuviae. Seventy five per cent of the water was exchanged in the morning and evening hours.

When the larvae reached zoea-V stage different substrata were provided in the tank. Nylon ropes, edible oyster shells, sea grass, polypropylene fishing nets, asbestos sheets and PVC pipes were placed in the tanks as the megalopa stage requires substratum for its attachment. When the megalopae metamorphosed into first crab stage, they were transferred into a new tank with similar water quality parameters.

Mixed phytoplankton, rotifers, shrimp nauplii and *Artemia* nauplii were raised according to the hatchery requirements for feeding. Filtered seawater was used for these cultures.

Observations

The berried crab showed only occasional swimming behaviour in the tank by means of

fifth pair of legs, but often it stood on pereopods with the egg mass held above the substratum. Total incubation days varied between 10-12 days. The larvae hatched out during the early morning hours and the number of total zoeae hatched out varied according to the size of the mother crab (2-14 lakhs in the present experiments). In all the cases 100% hatching was observed.

There were five zoea stages, passing through five moults to reach the megalopa stage, which metamorphosed into first crab stage. Zoea phase (Z1-Z5) took 12-13 days to metamorphose into megalopa, each zoea stage taking a minimum period of 2-3 days before it moulted into the next stage.

The zoeae were photopositive, swimming towards the source of light. All the zoea stages were observed to be active swimmers and found aggregating into groups very often along the sides of the tanks near the surface.

Megalopae which were less active than zoeae took 6-7 days to reach the crab stage. They swam by means of pleopods. Megalopae more often rest at the bottom or cling to the substrata provided in the tank. Among the different materials tested as substrata for the megalopal attachment, asbestos sheets and polypropylene nets were preferred most by them. Moreover, nets were easy to clean and did not affect the water quality of the rearing tank. The chelipeds were used to collect the food particles or to catch the swimming prey. Cannibalistic nature of megalopae was very much evident.

Mortality was less till the larvae reached zoea-V stage and the rate of survival was 80-85%. Increased mortality was observed when the zoea-V moulted into megalopa stage. At this stage tanks with a stocking density below 10,000 larvae/t showed comparatively better survival rate. Mortality was also observed while the megalopae moulted to juvenile crabs. Profound cannibalism was observed among the juvenile crabs also, though they were supplied with shrimp meat, mussel meat and postlarvae of *Penaeus semisulcatus* as feed.

Reappearance of oil sardine along the Tuticorin coast*

The oil sardine, *Sardinella longiceps* forms 10 to 18% of total fish landings in India although it is caught mostly from the west coast. Sporadic catches of oil sardine have been occasionally reported from some places along the east coast as well.

Usually only few tonnes of oil sardines are landed every year at Tuticorin. But in 1995, 77 tonnes of oil sardines were landed after a full lapse of three years. Though a good landing of oil sardine has been recorded at Mandapam area in the beginning of 1992 as reported in MFIS - No. 117, no catch was observed in Tuticorin coast in the same or subsequent years except for some quantity landed in November 1993. However, in 1995 during August - October the oil sardine reappeared in great abundance along this coast (Table 1).

The specimens measured from 12.5 to 15.2 cm in total length. The dominant size groups were 12.5, 13.5 and 14.0 cm. Females dominated forming 70.7% while the males amounted to 8.6% and indeterminates 20.7%. Regarding sexual maturity

36.2% of them were in the resting stages, 27.6% were found to be in the III and IV stages of maturity. Immature accounted for 15.5%.

The entire catch was packed with ice and transported to Kerala to get a better price. The whole-



Fig 1 The catches of oil sardine ready for auction.

TABLE 1. Estimated fishing effort (No. of units) and catch (kg) of oil sardine at Tuticorin during 1990 - '95 (Catch per unit in parenthesis)

| | 1990 | | 1991 | | 1992 | | 1993 | | 1994 | | 1995 | | Total catch |
|-------|----------------|-------|------------------|-------|-------|-------|----------------|-------|-------|-------|------------------|-------|-------------|
| | Catch | Units | Catch | Units | Catch | Units | Catch | Units | Catch | Units | Catch | Units | |
| Jan. | - | - | 21,349 (81.5) | 262 | - | - | - | - | - | - | - | - | 21,349 |
| Feb. | - | - | 12,008 (6.9) | 1,752 | - | - | - | - | - | - | - | - | 12,008 |
| Mar. | - | - | 3,171 (5.3) | 598 | - | - | - | - | - | - | - | - | 3,171 |
| Apr. | - | - | - | - | - | - | - | - | - | - | - | - | Nil |
| May | - | - | - | - | - | - | - | - | - | - | - | - | Nil |
| Jun. | - | - | - | - | - | - | - | - | - | - | - | - | Nil |
| Jul. | - | - | - | - | - | - | - | - | - | - | - | - | Nil |
| Aug. | - | - | - | - | - | - | - | - | - | - | 3,900 (2.0) | 1,924 | 3,900 |
| Sept. | - | - | - | - | - | - | - | - | - | - | 63,570 (29.7) | 2,144 | 63,570 |
| Oct. | - | - | - | - | - | - | - | - | - | - | 9,425 (3.9) | 2,444 | 9,425 |
| Nov. | 7,711 (2.2) | 3,518 | - | - | - | - | 3,325 (1.2) | 1,694 | - | - | - | - | 11,036 |
| Dec. | - | - | - | - | - | - | - | - | - | - | - | - | Nil |
| Total | 7,711 (2.2) | 3,518 | 36,528 (13.9) | 2,612 | Nil | - | 3,325 (1.2) | 1,694 | Nil | - | 76,895 (11.8) | 6,512 | 124,459 |

sale price at Tuticorin was only Rs. 7 per kg, as the oil sardine is not consumed locally.

I am grateful to Shri A Bastian Fernando, Technical Officer for going through the manuscript

and offering valuable suggestions for its improvement.

*Prepared by G. Arumugam, Tuticorin Research Centre of CMFRI, Tuticorin - 628 001.

Sardines landed with eyes missing*

During the routine observations for sardines at the Tuticorin south landing centre on 02-02-'96 an unusual occurrence of eyeless sardines was noticed. Of the total landings of around 4 tonnes of lesser sardines of that day, all the fishes had their eyes scooped out (Fig. 1). On the next day it was observed that all the sardines landed at this centre were normal with both their eyes intact.

From this centre 55 catamarans operate and the fishing ground is reached by around 0430 hrs. The nets are operated for 3 hrs at the same ground. On

the day in citation, sardine nets were operated off south of Tuticorin Harbour in the 10 m depth zone for 3 hrs in the early morning by 55 units. The nets were operated only once.

Average catch of per unit was 61.5 kg of sardines comprising *Sardinella albella*, *S. gibbosa*, *Thrissocles mystax* and *Therapon jarbua* (Table 1).

TABLE 1. Catch per unit effort and percentage composition of lesser sardines at Tuticorin south landing centre in February 1996. No of units operated: 55

| Species | Catch (kg) | CPU (kg) | % |
|---------------------------|------------|----------|------|
| <i>Sardinella albella</i> | 2 915 | 53 0 | 86.1 |
| <i>Sardinella gibbosa</i> | 265 | 4.8 | 7.8 |
| <i>Thrissocles mystax</i> | 165 | 3.0 | 4.9 |
| <i>Therapon jarbua</i> | 39 | 0.7 | 1.2 |
| Total | 3 384 | 61.5 | |

Based on the average weight of each sardine it is presumed that 1.3 lakhs of sardines were caught on that day. The eyes of all the fishes were missing. From the fresh condition of the fish, firmness of flesh, and bright red colour of the gill it could be inferred that loss of eyes had taken place within two hours before landing.

Fishermen attribute this loss of eyes of the sardines to the fish *Therapon jarbua*. Some carnivorous fish might have eaten away the eyes, but there is no evidence to confirm it. It is not uncommon to come across a few or a few hundreds of sardines with their eyes missing but to see the entire fish catch without eyes is unknown. There were some *Therapon* fishes in the catches forming 1.2% and they measured from 100 to 108 mm in total length. Whether the predatory shoal was large enough to eat away the eyes of each sardine in that ground is also not known.

I am grateful to Mr. A Bastian Fernando, Technical Officer for going through the manuscript and offering valuable suggestions for its improvement.

*Reported by G. Arumugam, Tuticorin Research Centre of CMFRI, Tuticorin - 628 001.

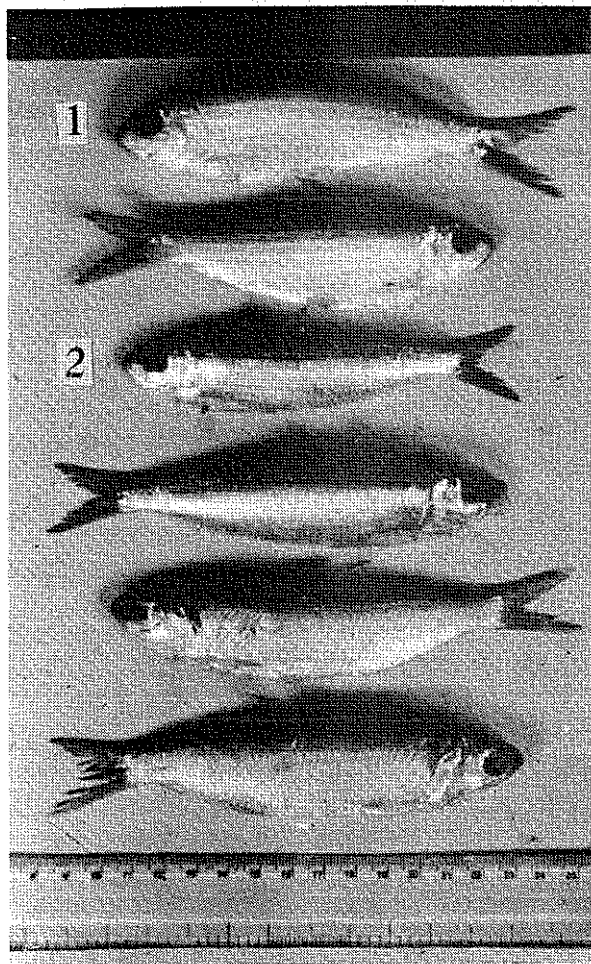


Fig. 1. A sample of sardines deprived of eyes on both sides. They belong to species *Sardinella albella* (top two specimens), *S. gibbosa* (middle two specimens) and *Thrissocles mystax*.

Landing of whale shark *Rhiniodon typus* at the Kakinada coast*

One male whale shark *Rhiniodon typus* entangled accidentally in a nylon gill net (monofilament) at a depth of 15 metres, 10 kms away from the shore of Mayapatnam in Uppada region on 6-2-96 was landed on 7-2-1996. The whale shark was towed by two mechanised *Navas*.

The morphometric measurements (in cm) of the whale shark are given below:

| | |
|---|----------|
| Total length | 530 |
| Standard length | 448 |
| Head length | 116 |
| Vertical height of first dorsal fin | 80 |
| Length of caudal fin along upper margin | 130 |
| Snout to first dorsal | 149 |
| Length of pectoral fin along outer margin | 98 |
| Length of first dorsal | 90 |
| Sex | Male |
| Weight | 1.000 kg |

As there was no demand for flesh, the fishermen cut the fins of the whale shark and on 8-2-'96 they towed back the whale shark and disposed into the sea.



Fig 1 The whale shark landed at Kakinada coast.

*Reported by Ch. E. Thathayya, Kakinada Research Centre of CMFRI, Kakinada - 533 004.

Report on juveniles of whale shark landed along the southern part of the west coast of India*

The capture of whale shark *Rhiniodon typus* (Smith) in the Indian coastal waters has been reported on several occasions and Silas (1986) has reviewed the records of occurrence in the Indian waters. The present report adds information on three more juvenile whale sharks caught subsequently one at Mela Midalam, Kanyakumari district and the other two along the Trivandrum coast

A male whale shark measuring 5.37 m was caught on 29-1-'95 at night in a gillnet operated off Vizhinjam. It was auctioned for Rs. 2,000/-. The morphometric measurements (in cm) of the shark are as follows.

| | |
|------------------------------------|-----|
| Total length | 537 |
| Standard length | 400 |
| Head length | 134 |
| Girth of body | 254 |
| Width of mouth from angle to angle | 90 |

| | |
|---|--------|
| Length of caudal fin along upper margin | 137 |
| Snout to first dorsal | 233 |
| Snout to second dorsal | 339 |
| Snout to pectoral | 123 |
| Length of pectoral along outer margin | 95 |
| Length of first dorsal | 42 |
| Length of second dorsal | 14 |
| Height of first dorsal | 43 |
| Height of second dorsal | 17 |
| Length of lower caudal lobe | 68 |
| Weight (approximate) | 4.75 t |

The second landing of the whale shark occurred on 3-3-1995 at Mela Midalam in Kanyakumari district. This was a male specimen measuring 4.57 m and weighing 3.75 t and was caught in a shore-seine (Fig 1).

TABLE 1. Reports of capture of *Rhiniodon typus* (Smith) along southwest coast of India

| Date of capture | Locality of capture & No. | | | | Gear | Length (m) | Weight (t) | Sex | Reported by |
|-----------------|-----------------------------------|----|-----------------------------|-----|-------------|------------|------------|-----|---|
| | Kanyakumari Dist. | No | Trivandrum Dist | No. | | | | | |
| 1900 | - | | Near Trivandrum | 1 | - | 8.83 | - | - | Pillai (1929) <i>J. Bombay Nat Hist Soc.</i> , 33 (2) |
| Feb 1909 | - | | Near Trivandrum | 1 | - | 4.14 | - | - | Ibid |
| Mar 1934 | - | | Near Trivandrum | 1 | - | 3.96 | - | - | Prater (1941) <i>Ibid.</i> 42 |
| Feb. 1960 | - | | Vizhinjam | 1 | - | 9.75 | - | - | Silas (1986) <i>Mar Fish Infor Serv., T & E Ser.</i> No. 66 |
| 20-12-1971 | Kesavanputhanthurai near Colachal | 1 | - | | - | 5.17 | - | - | Kuthalingam <i>et al</i> (1973) <i>Indian J. Fish.</i> 20 (2) |
| 23-12-1971 | - | | Vizhinjam | 1 | - | 3.93 | - | - | Ibid |
| 16-3-1972 | - | | Vizhinjam | 1 | - | 5.65 | - | - | Ibid |
| April 1988 | - | | Panathura (near Vizhinjam) | 1 | Shore-seine | 6.06 | 2.0 | F | Lazarus <i>et al.</i> (1988) <i>Mar Fish. Infor. Ser., T & E Ser.</i> No. 88 |
| April 1988 | - | | Thumba (near Trivandrum) | 1 | Shore-seine | - | - | M | Ibid. |
| 18-4-1988 | Colachal | 3 | - | | - | 7.32 | 1.5 | - | Ibid. |
| 13-3-1994 | Kovalam (near Kanyakumari) | 1 | - | | Gillnet | - | 1.5 | M | Joel <i>et al</i> (1994) <i>Ibid.</i> No. 131 |
| 12-12-1994 | - | | Vettukadu (near Trivandrum) | 1 | Gillnet | 5.50 | 4.75 | - | Present report |
| 29.1.1995 | - | | Vizhinjam | 1 | Gillnet | 5.37 | 4.75 | M | Present report |
| 3.3.1995 | Mela Midalam | 1 | - | | Shore-seine | 4.57 | 3.75 | M | Present report |

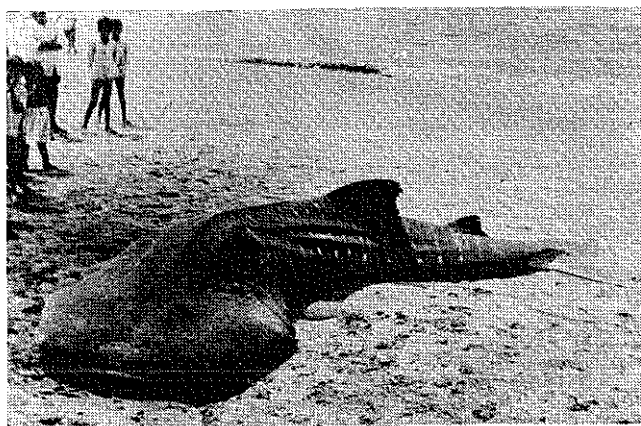


Fig. 1. The juvenile male whale shark caught in the shore seine at Mela Midalam in Kanyakumari district

Way back in December 1994, a juvenile whale shark caught in a gillnet was landed at Vettukadu in Trivandrum district and its approximate length and weight were 5.5 m and 4.75 t respectively. The updated records of capture of the whale shark *Rhiniodon typus* along the southwest coast of India are given in Table 1. It is seen that six whale sharks were caught in Kanyakumari and Colachal areas in Tamil Nadu and ten in Vizhinjam and nearby areas

*Reported by S. Krishna Pillai and Jacob Jerold Joel, Vizhinjam Research Centre of CMFRI, Vizhinjam - 695 521.

भारतीय तटों में अपतटीय समुद्री मुक्ता संवर्धन केलिए प्रत्याशा

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आमुख

समुद्री मोती बहुत ही मूल्यवान रत्न है। प्राकृतिक मोती जिन्हें ओरिएन्टल मोती भी कहते हैं, की उपस्थिति काफी विरल है। उचित आकृति न होने पर भी ये आज भी उच्च मूल्य पाते हैं। मोती संवर्धन तकनोलजी का विकास जापान में हुआ था और बाद में अन्य देशों में भी इसका विकास हुआ, जिनमें भारत भी शामिल है। भारत में मुक्ता केलिए रैफ्ट संवर्धन तकनोलजी केन्द्रीय समुद्री मात्स्यिकी अनुसंधान संस्थान ने इसके टूटिकोरिन अनुसंधान केन्द्र में मान्नार खाड़ी तट में विकसित किया था। संवर्धित समुद्री मुक्ताओं का उत्पादन मुख्य रूप से जापान और चीन से 75% प्राक्कलित किया गया है, जबकि माँग 100 टन है। यह अंतराल मुक्ताओं के विश्वव्यापी उत्पादन और विपणन की संभाव्यता की ओर इशारा करता है। उचित तकनोलजी होने पर भी भारत वाणिज्यिक रूप में मुक्ता उत्पादन करनेवाले देशों की कोटि में नहीं आया है। भारत में लंबी तटरेखा होने पर भी समुद्र में मुक्ता संवर्धन केलिए उचित स्थान बहुत ही सीमित हैं। तदनुसार उद्यमकर्ता मुक्ता संवर्धन में काफी रुचि नहीं दिखाते हैं।

पिछले पाँच सालों में भारत में चिंगट कृषि में विचारणीय बढ़ती हुई है, खासकर आन्ध्रप्रदेश और तमिलनाडु में। लेकिन रोग और कुछ अन्य कारणों से यह उद्योग निरन्तर पीडित है। इस अवस्था में उद्यमकर्ताओं को समुद्री संवर्धन केलिए उपयोग करनेवाली जातियों और तकनोलजियों को बदलने की आवश्यकता पर अवगत किया जाना है। ऐसी स्थिति में सी एम एफ आर आइ ने अपतटीय टैंकों में नियंत्रित स्थितियों में संवर्धित समुद्री मुक्ता केलिए तकनोलजी विकसित करने केलिए कोशिश की। इस परीक्षण का परिणाम यहाँ प्रस्तुत है।

सामग्री व रीतियाँ

टूटिकोरिन से 20-1-1995 को लगभग 1200 भारतीय मुक्ता शक्तियों (पिंक्टाडा फ्यूकाटा) को रेलगाड़ी द्वारा 1600 कि.मी से अधिक दूर स्थित काकिनाडा में 48 घंटे की यात्रा और मद्रास में समुद्र जल परिवर्तन केलिए 12 घंटे के विराम के बाद लाया था। इनमें 400 रोपित शक्ति और 800 स्पार्ट थे। काकिनाडा में पहुँचने पर कुछ ही घंटों में सभी रोपित शक्तियों की और

80% स्पार्टों की मृत्यू हो गयी। बाकी 140 स्पार्टों से परीक्षण चलाया गया। 16 स्पार्टों को पंजर (केज) में डालकर काकिनाडा खाड़ी मात्स्यिकी बंदरगाह के फिंगर जेटी के नीचे ऊपरी जल से लगभग 80 से मी की गहराई में लटकवा दिया। बाकी स्पार्टों को कोनापापेट में स्थित एक प्राइवट हैचरी में एक सिमेन्ट टैंक (10×5×1.2 मी) में बिखरा दिया। इस टैंक में समुद्र जल का प्रवेश, निकास और तलीय वातन की सुविधाएं हैं। टैंक में समुद्र जल की गहराई 30-40 से मी में स्थिर रखती है और हफ्ते में दो बार जल परिवर्तन करता है। समुद्र से पंप किये जानेवाला जल निस्संदन (फिल्टरन), क्लोरिनेशन और डीक्लोरीनेशन के बाद ही टैंक में पहुँचता है। शक्तियों को खाद्य के रूप में 80% कैटोसिरोस एस पी और 20% आइसोक्राइसिस मिश्रण प्रति मि लि 10,000 कोशों की सघनता में दिन में दो बार 8 घंटे और 1800 घंटे को दे दिया।

रोपण की सुविधा केलिए मात्स्यिकी बंदरगाह के फिंगर जेटी की शक्तियों को अप्रैल 1995 में सिमेन्ट टैंक में डाल दिया। जून, 1995 के दूसरे हफ्ते में मानक कार्यविधियों के अनुसार 3 मि मी मोतियों से 80 शक्तियों में न्यूक्लियस का रोपण किया। इसके बाद इन मुक्ता शक्तियों को 1995 सितंबर के आखिरी हफ्ते में काकिनाडा से विशाखपट्टनम में स्थित तट प्रयोगशाला में स्थानांतरित किया और मोनिटरिंग की सुविधा केलिए वहाँ एक प्लास्टिक पूल में डाल दिया। इस प्लास्टिक पूल (3 टन धारिता) में अनिस्संदित समुद्र जल भरकर एक हफ्ते तक रखते हैं जिससे बार्नेकल, सेरपुलिड्स जैसे दूषणकारी जीव पूल के तल में जमा हो जाते हैं। ये दूषणकारी जीव अन्य दूषणकारी जीवों को निकालने में समर्थ थे। तट प्रयोगशाला में भी दिन में दो बार 80% कैटोसिरोस एस पी और 20% आइसोक्राइसिस युक्त खाद्य दिया था।

मुक्ता शक्ति टैंक से 12 घंटों के नियमित अंतराल में विसर्ज्य वस्तुओं को बहा दिया और टैंक में 30-35 से मी पर जल की गहराई बनाई रखने केलिए समतुल्य मात्रा में समुद्र जल भर दिया। न्यूक्लियस निकाली गयी शक्तियों से रोपित न्यूक्लियस वाली शक्तियों को अलग करने के लिए ऐक्स-किरण तकनीक का उपयोग किया गया।