

MARINE FISHERIES RESEARCH: IMPACT ON FISHERIES DEVELOPMENT

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The basic objective of marine fisheries research is to provide development support for the management of fisheries resources. Systematic and organised marine fisheries research has a long history of 44 years by now. The Central Marine Fisheries Research Institute (CMFRI) played a pivotal role in laying the foundation for rational exploitation, and management of fisheries resources and concentrated its research efforts on studying the resource pattern, their catchability, extent, areas and methods of fishing, biological characteristics and environmental phenomena governing the abundance of the resources. With the changing patterns

of fishing, introduction of mechanised fishing and intensification of fishing on coastal resources, the need arose to closely monitor the commercially important resources, their assessment and availability in deeper regions of the shelf and slope, the oceanic resources, non-conventional resources and supplementing capture fisheries resources with culture practices for suitable species. In more recent times, attention has been focussed on management of coastal resources, assessing under-exploited and unexploited resources, conducting integrated studies of environment and resources on oceanwide basis, propagation of sea farming, sea ranching and conservation of resources.

FOUNDATION RESEARCH

To begin with, marine fisheries research in this country concentrated on gathering information on the status of fisheries resources, their distribution and extent of exploitation. For this purpose, it was necessary to develop a method of collecting data on the resources. The Institute

therefore, developed the multistage stratified random sampling method since marine fish catches are landed all along the long coastline, fishing itself being erratic and disorganised and carried out throughout the day as well as at night. The method has been successfully employed in various maritime states for which training is imparted by CMFRI. Thus, the sound method developed by this Institute has come to stay when it was recognised by FAO for adoption in other developing countries.

NMLRDC Established : The National Living Resources Data Centre (NMLRDC) has been established at Central Marine Fisheries Research Institute to develop a data base on marine fisheries resources collected by the Institute and other agencies. Detailed data on length, weight, biological characteristics, catch per unit effort, species composition of catches, total catch, gearwise and species/groupwise catches are computerised. Thus it is a repository of vast fisheries data essential for developmental work. The centre processes and disseminates the information to all end users through various publications which are widely used by several departments and Institutions. This is a vital achievement developed through years of marine fisheries research..

Biological Base : The second major input in marine fisheries research in the earlier years was to collect detailed biological information on all commercially important fish, crustaceans and molluscs comprising data on breeding habits, spawning season, fecundity, early life history, growth rate, food and feeding habits and age composition of commercial fish catches. The data made it feasible to assess the stocks of commercially

important groups of fishes and other organisms and the intensity of fishing. Simultaneous with biological studies, taxonomic studies of all important groups of fishes, crustaceans and molluscs have been conducted which are essential for correct identification of species and accumulation of biological information for use in understanding the dynamics of stocks. A number of new species of fishes and other marine organisms have also been described. Information has also been gathered and documented on the relevant socio-economic conditions in the fishing communities. The development department in various states have been using this vital information for initiating various fisheries programmes in their respective states.

Production Potential : Simultaneous with the collection of vital statistics regarding fish catches and biological information on exploited stocks, studies were initiated on environmental parameters which govern the distribution and availability of fisheries resources. Essential information on the physico-chemical and biological characteristics necessary for estimating the productive potential and factors responsible for fluctuations have been collected. The energy cycle and the transformation of energy from one trophic level to another has been studied based on which it was pos-

sible to indicate the potential stocks of fishes and other organisms. Such calculations based on primary and secondary productivity and the fish catches led to an estimate of potential of 4.5 million tonnes of fish from the EEZ. This estimate remained till now and served as a basis for offshore and oceanic fisheries development. Present yield is about 50% of this estimate (1989). Based on similar information, the production potential of Indian Ocean could also be estimated at about 11 million tonnes although there are other varying estimates. Oceanographic phenomena like the position of thermocline, onset and intensity of upwelling, the current patterns, the formation of mud banks, the distribution of oxygen minimum layer and effects of south-West monsoon have been studied to indicate the variations in biological productivity including fish catches. Studies have been conducted on individual species and their abundance in relation to environmental parameters. Tagging programmes have indicated the movement and direction of migration of important species like mackerel, sardine and prawns based on which it has been possible to identify unit stocks.

RESEARCH SCOPE ENLARGED

Changed Mandate : With the changing pattern of the fishing industry and the introduction of mechanised boats and large trawlers, expansion of fishing activities and motorisation of the country crafts, the CMFRI's mandate has gradually shifted to essentially monitoring the exploited fishery resources, assessment of under-exploited and unexploited resources, study of the environmental factors governing the fluctuations of the abundance of the fishery resources, developing sea farming technologies and conducting education and transfer of technology programmes. In line with these objectives marine fisheries research programmes have been considerably reoriented.

Resource Exploitation Strategy : About 40 different groups/species of fishes, crustaceans and molluscs have been studied in detail on a national basis to indicate the potential stocks, the optimum yields and regulation of intensity of fishing. Environmental data have been collected at sea to understand the fluctuations in abundance of the resources. Utilising the information emanating from various organisations the underexploited and unexploited resources have been identified and quantified. The potential marine fisheries resources have been identified, their areas of abundance indicated and methods of capture specified. A national strategy for exploitation of these resources was formulated.

Fisheries Management Strategies : Investigations on several pelagic fishery resources indicated the present level of exploitation and future possibilities for increasing production. Scientific advice for management has been documented for oil sardine, mackerel, anchovies, Bombay duck, tunas, horse mackerel, seer fish and ribbon fish. For most of these resources average annual stock, the exploitation rates and total mortalities have been determined. The Institute documented all available information on oceanic resources like those of tunas, bill fishes, pelagic sharks etc. The existing fishery for the skipjack in Lakshadweep has been studied and several recommendations have been made for improving the catches and management of live bait resources needed for the fishery.

Studies that led to Capture : Exploratory fishing programmes by Govt. of India vessels and certain private companies brought to light good fishing grounds for the sciaenids off Kutch, Dwarka and Porbander; for the eels off Bombay and Cambay; for the prawns and pink perch and other perches off the S.W. coast; for silverbellies off the southeast and southwest coasts and for cat fishes off the northeast coast. A number of ground fishes which contribute to substantial portions of trawl catches like catfishes, threadfin breams, sciaenids,

pomfrets, perches, eels, flatfishes, silverbellies and lizard fishes have been studied in detail and their distribution patterns, seasons of availability and catch rates were indicated. Such information led to capture of some of these resources in increasing quantities and from greater depths.

Warnings : Management information has been generated as to how increased effort on the presently fished stocks like catfishes and pink perch can cause harm. Such damage can be avoided by decreasing the effort or increasing the mesh size. Future development plans need to consider such methods.

Fisheries Maps : In collaboration with other institutions and departments the CMFRI collected valuable information on the fishing grounds of North-west, South-west and South-east regions of the country. The data collected by the Deep Sea Fishing Station (later the EFP and FSI), the Integrated Fisheries Project, Pelagic Fishery Project, and Indo-Polish Survey have been utilised for developing fisheries maps useful for the fishing industry and the development departments.

Shrimp Fishing; Regulation : In view of the intense fishing for shrimp with mechanised boats, a continuous study of monitoring the fishery on an All India basis and collection of vital statistics was undertaken by CMFRI which had assisted several committees and expert groups appointed by the Govt. of India to make recommendations for the sustainability of shrimp catches of the country and maintenance of the export trade. The Institute also made several suggestions for regulation of the fishery in specific region. These studies on the shrimp fishery have brought out valuable information on the species composition, catch rates, distribution, intensity of fishing etc so that the shrimp fishery could be managed without endangering the stocks. Special studies conducted by CMFRI on the shrimp fishery of northern Bay of Bengal led to advice on the number of vessels to operate in the region.

The deep sea lobster and deep sea prawn resources off the south-west coast were studied in detail. The potential of each of these resources has been determined. Coastal resources of lobsters and crabs have been assessed.

Molluscan Resource Inventories :

The molluscan resources especially of the clams, oysters, mussels and cephalopods have been studied and their stocks assessed. Inventories for all these resources along the mainland coasts and Andaman and Nicobar islands have been prepared and made available. The underwater expert scientists of CMFRI extensively surveyed the pearl banks and chank beds off the Gulf of Manner and Palk Bay regions by SCUBA diving. Based on these surveys, it has been possible to assess the stocks of these two resources and also forecast the trends in these fisheries.

Sites for Mariculture : The CMFRI organised the programmes of research utilising the mobile laboratory for surveying the coastal and estuarine regions of the country with special reference to analyses of soil and water characteristics for identification of suitable sites and development of mariculture. Significant contribution has been made in the State of Orissa where extensive brackishwater culture has been developed along the coast of Chilka lake for which scientific information has been made available by the Institute. Similar studies conducted in other brackishwater and estuarine areas contributed information regarding reclamation of land for use of Ports for developmental purposes without endangering the fishery resources.

Forecasting : The Institute has a programme of using Remote Sensing techniques for assisting the fishing industry in the location of productive fishing grounds based on satellite imageries. Preliminary studies have already been conducted for identifying productive areas of the ocean, based on ocean colour through satellite imagery. The evaluation of data on sea surface temperature has already been

taken up for reliable forecasting of the availability of fish resources from the offshore regions of the country. Such studies have great relevance for increased fish production from distant and oceanic regions and also to enable fishermen to directly reach the fishing grounds.

Resources in deeper waters : With the operation of the Fishery Oceanographic Research Vessel SAGAR SAMPADA for the past 5 years, the fishery potential of the deeper and oceanic areas beyond the presently exploited areas has been indicated. Fishable concentrations of underexploited deep water resources such as the bulls eye, drift fish, scad and deep sea prawn have been revealed. Existence of good resources of threadfin bream, ribbon fish, lizard fish, barracuda, cat fish and the Indian mackerel in deeper waters beyond 50 m depth has been indicated. The observations have also confirmed the availability of fairly rich grounds for deep sea lobster in the Quilon bank off the Kerala coast at depths between 130 and 770 m and also cuttle fishes off Karnataka at depths of about 200 m. Based on the above results which give information on relative abundance of specific deep water fishery resources the fishing industry could venture and exploit these resources.

Pollution : The sources of industrial pollution at Karwar, Cochin and Tuticorin have been closely monitored and their effects on biological resources have been studied. Such information has become useful for prevention of pollution in coastal and estuarine areas of the country. A realistic assessment of the pollution level has been attempted and public awareness created. These studies and expertise go a long way in developing management plans for the future.

RESEARCH ON ANCILLARY RESOURCES

The ancillary resources including corals, sponges, gorgonids, echinoderms and seaweeds have been systematically studied for a number of

years by specialists and all information on the individual species, their identification, the magnitude of resources and their distribution were well documented. This information has been made available to all end users and also to the Governments concerned for regulation of their exploitation.

Protection to Seafans : The Institute conducted a special two-year study on the gorgonids, popularly called the seafans which is a source of wonder drugs (prostaglandin etc). Recommendations have been made for controlling the indiscriminate fishing and for the utilization of this valuable material in the country itself for production of various useful drugs.

Seaweed Surveys : Extensive surveys for seaweeds in the coastal regions of the country as well as in deep waters have been conducted especially along the Tamil Nadu coast. The results indicated that seaweeds have very sparse distribution in the deeper regions of the sea. The qualitative and quantitative distribution of various seaweeds in the Andaman and Nicobar regions, Lakshadweep and Andhra Pradesh coasts have been studied for the first time in detailed manner. This information is expected to be useful for future utilisation of seaweeds for the agar agar and alginic acid industries. The Institute has the credit of developing a cottage industry method for production of agar agar. The method would provide useful employment and increased income generation in the coastal rural areas.

MONSOON FISHING

At a time when sea fishing had not developed so well in the country capture fisheries activities has been restricted to fair weather conditions. With the innovations made and with the adoption of modern technology, the capabilities of sea fishing have increased providing scope for venturing into the sea even during monsoon periods when rough conditions prevail at sea. The Institute gathered valuable information and data to as-

sess the availability of resources and intensity of their exploitation during the monsoon periods. This information would also help the development departments to regulate capture fisheries activities and at the same time increase fish production during the traditional off-seasons.

SEA FARMING AND SEA RANCHING

Mariculture technologies have been developed in respect of several commercially important marine organisms. Special mention should be made of breeding and sea production of a number of species of prawns, edible oyster and pearl oyster, mussels, clams and some finfishes. Hatchery techniques and farming practices have been developed for most of these species. Species of prawns which can tolerate high salinities in coastal areas have been successfully bred and their seed produced. Few generations of some of these species have been produced without going back to sea for procuring fresh spawners. This opened up large vistas for utilization of high saline areas for prawn culture. The technology developed by CMFRI and the extension work conducted for salt pan culture of prawns has already been adopted in Tamil Nadu. Eye stalk ablation has been found to accelerate growth about five-fold in coastal lobsters.

Pearl Oyster spat supplies : The pearl oyster breeding, spat production and their rearing, farming of the oysters and pearl production based on indigenous technology has led to the establishment of a joint venture company (Tamil Nadu Pearls) for commercial pearl production. This work is now continued by the Tamil Nadu Fisheries Development Corporation. Spat produced at the Institute's hatchery were supplied to Fisheries Departments of Lakshadweep, Gujarat and TNFDC. The Institute conducted a number of training programmes for propagation of this technology. A significant landmark is the recent International Training Course conducted by the Institute under the FAO/UNDP Regional Seafarming Development and Demonstration Project at Tuticorin in February '91.

White Prawn Hatcheries : Based on the technology development at CMFRI, a medium scale prawn hatchery for white prawn has been established by the scientists of the Institute at Cannanore, Kerala in collaboration with the MPEDA and Matsyafed. The hatchery went into operation and serves it now the prawn seed requirement of the region. Similar such hatcheries established in different parts of the country will go a long way in increasing the pace of prawn farming in the country. The CMFRI has also developed a number of supplementary feeds for shrimp which are under evaluation for field application.

Culture of eel and others : The CMFRI conducted an extensive field survey for availability of elvers of the common eel (*Anguilla bicolor*). The elvers have been successfully cultured in freshwater in recycling system to yield very high production rates. The eel has a great export potential to countries like Japan. Techniques have also been developed for the culture of seaweeds in coastal areas. Results of experiments at Minicoy island indicate high potential, for production of sea weeds in other areas of Lakshadweep also. Mass culture of diatoms, zooplankton and *Artemia* has been developed for use in the hatcheries for rearing of various species. Although some of these technologies have not been commercially exploited because of the non-conventional nature of these animals, lack of domestic markets, and the conservative food habits of the people, with the increasing population and demand for sea foods the need to produce such sea food in course of time for domestic consumption and also for export purposes is sure to arise. The CMFRI made attempt to blend the normal capture fisheries activity with sea farming practices so that the fishermen are occupied with the latter during the off season for fishing at sea and thereby generating employment and income.

Sea-ranching : Having developed a number of technologies for mariculture to supplement production from

capture fisheries, research has been focussed on sea ranching of marine animals, with the dual purpose of increasing production from natural stocks and also to prevent the declining trends in some of the resources. Sea ranching for pearl oysters and one species of shrimp has already been initiated. A similar attempt for sea cucumber is also proposed in view of the intense fishing for a single species for production of Beche-de-mer and also due to the availability of several other more valuable species in the Lakshadweep and Andaman and Nicobar Islands. Techniques of breeding and seed production of the most important species (*Holothuria scabra*) have already been developed and juveniles collected from nature have also been successfully cultured in coastal areas.

RESEARCH ON ENDANGERED HABITATS AND ANIMALS

Special attention has been paid by CMFRI for environmental issues concerning marine and estuarine sectors. Pioneering research work has been conducted on sensitive habitats like coral reefs, estuaries, mangroves and oceanic islands. Scientific advice on judicious exploitation and conservation of resources has been provided. Data and information were collected on endangered habitats and marine animals and published to create public awareness. Special commemorative postal stamps on dolphins and dugong were issued.

Marine Parks : Realising the importance of Marine Parks and nature preserves in the conservation of unique marine resources, the CMFRI surveyed several areas along the coast and islands to identify suitable areas. Appropriate recommendations have been made to the authorities. The studies made on the biota of Marine Park in Kutch, Gulf of Mannar and Andamans constitute the main source of information for these marine parks.

Mesh sizes : The CMFRI is concerned with the damage to fishery resources due to indiscriminate ex-

ploitation of post-larvae and juveniles of several fishes and shrimp. Usage of trawl nets with small mesh and consequent damage leading to mortality of young fishes and prawns has been highlighted.

Fisheries of Island States : The fisheries resources of the two island territories of A & N islands and Lakshadweep and the mariculture potential of the areas have been determined and the advice passed on to the administration. Apart from the oceanic species like the tunas, sharks and seerfish (wahoo), several groups of fishes like perches, jacks, gars, goatfishes can be harvested. Cuttlefishes and squids appears to be fairly abundant. A wide variety of sea cucumbers and several ornamental fishes and molluscs can be exploited. Special recommendations have been made on the strategy for increasing fish production, the utilisation of marine ornamental fishes for export and the establishment of marine parks in Lakshadweep. Development of tourism and recreational facilities based on the very special and exciting marine ecology of the islands can be very remunerative and provide employment opportunities.

ECONOMICS OF FISHING AND EXTENSION

The economics of various capture fisheries and culture fisheries have been studied along different parts of the coasts, especially in Kerala, Maharashtra, Gujarat and Karnataka. The socio-economic conditions of the fishing community in some parts of the coasts have been documented. Such studies have yielded valuable information on the income, employment and other aspects of fishermen communities and indicated how development departments and financial institutions can support projects for improvement of living standards of fishermen.

Studies were conducted on role of women in small scale fisheries, nutritional status of fishermen community, and the constraints involved in the adoption of technologies developed by the Institute.

DEVELOPMENT OF TRAINED PERSONNEL

The Farmers' Training Centre and Trainers' Training Centre of CMFRI and the M.Sc., and Ph.D. Courses in Mariculture being conducted at the Institute have provided trained personnel who are already gainfully employed in various organisations and the private sector for the development of brackishwater aquaculture and mariculture. The Institute conducted two FAO/UNDP training courses in stock assessment and one on pearl oyster farming and pearl production. A number of Summer Institutes on various subjects were held to expose participants to various modern technologies.

ADVICE TO MARITIME STATES AND FISHING INDUSTRY

Taking advantage the very extensive data and valuable information on the fishery resources of various maritime states and recent critical analysis of data on the present status of fishery resources, intensity of fishing, the number of boats and nets, other infrastructure and fishermen population, the Institute provided status reports for the period 1975-84 for management of marine fisheries of each maritime state. It is proposed to update these reports every five years. The reports spelt out details of the exploited resources, potential for further exploitation and whether the effort in terms of boats and nets is optimum or not. The states are expected to take suitable action. Fish calendars were brought out at different centres along the coast line based on data collected over a number of years. These are extensively used by various agencies and entrepreneurs.

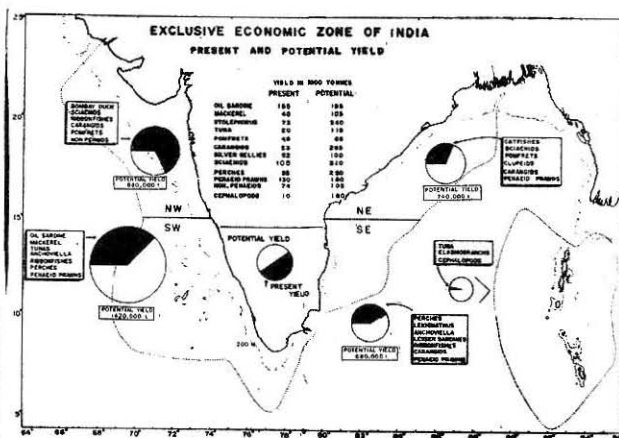
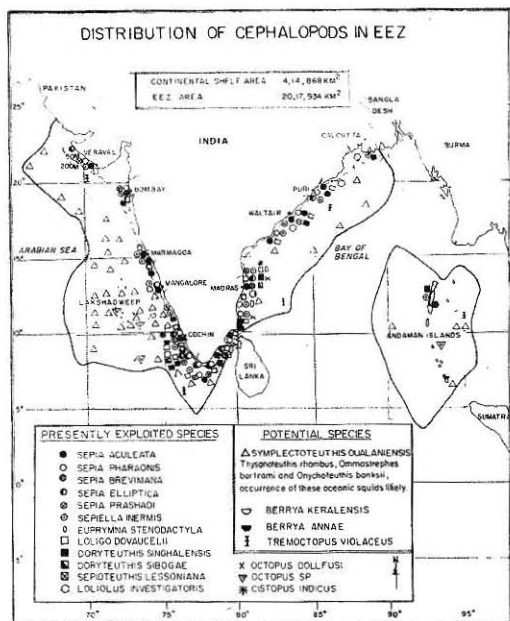
Contribution of Scientists

and Scientific Publications

The scientists at CMFRI participate in various symposia and seminars and also take part in the committees appointed by State and Central Governments for providing data and information for the management of marine fisheries resources. The

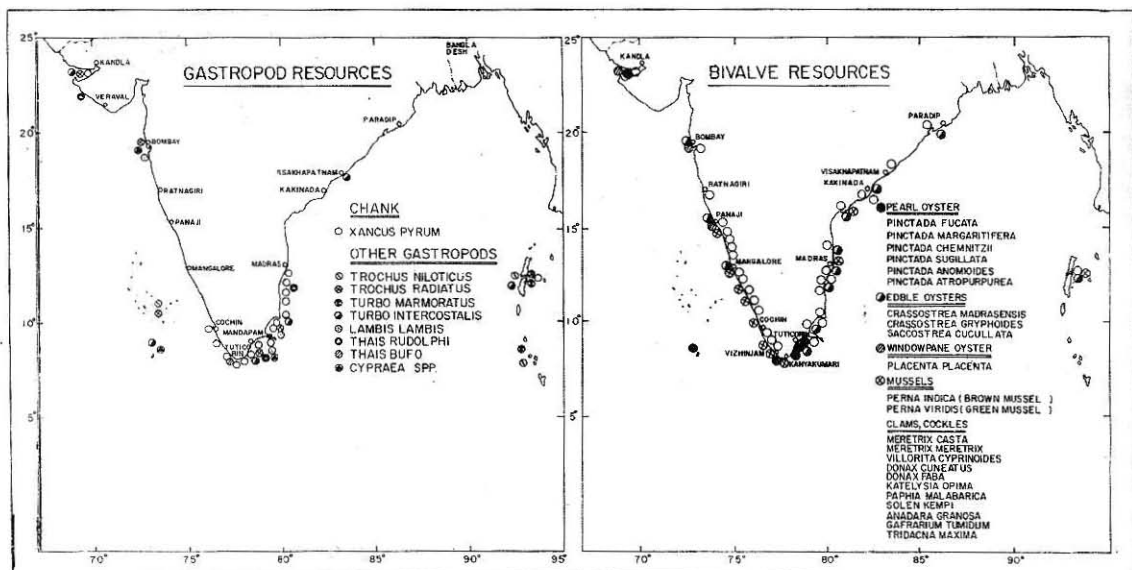
CMFRI generated a vast and valuable information and data on various aspects of marine fisheries through sustained and planned research over the years. Advice and recommendations directly useful to end users, development departments and Institutions, Administrators and Policy makers were promptly conveyed from time to time for appropriate decisions and utilisation of scientific information. However, it is found that the dialogues and interaction between research institutions and end users as well as development departments is far from satisfactory. This needs urgent and serious consideration at all levels so that effort, investment and time spent in research do not go a waste. The Institute published a number of scientific papers, bulletins, special publications, Marine Fisheries Information Service, Research and Development Series and Journals which disseminate the results of marine fisheries research the world over thus contributing to rational exploitation, conservation and management of marine fisheries resources.



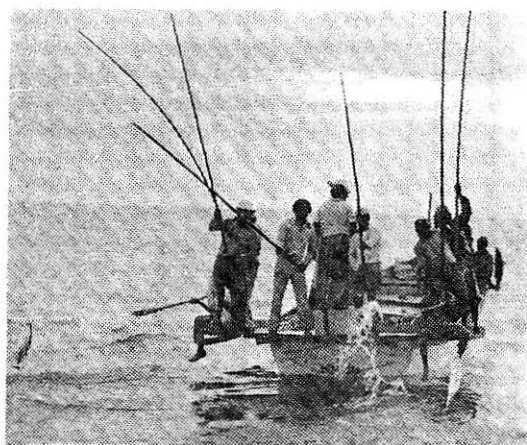


Distribution of exploited and potential cephalopods in the Indian EEZ (Source: CMFRI Bulletin No.37, 1985).

Map of the EEZ of the India showing the area wise estimated potential yields of different groups (Source: CMFRI Spl. Publication No. 30, 1987)

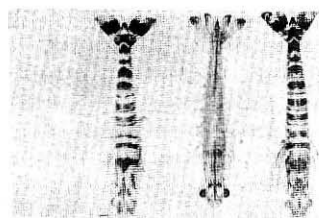


Distribution of gastropod and bivalve resources along the Indian Coast



← Threadfin breams - Major deep sea resource found all over the Indian coast especially along the west coast between 50-300 m

↑ Pole and line fishing for tunas around Lakshadweep



The penaeid prawns (from left) *Penaeus semisulcatus*, *P. latisulcatus* and *P. canaliculatus*



A good catch of 'Karikkadi' *Parapenaeopsis stylifera* landed at Cochin Fisheries Harbour

A good catch of *Penaeus semisulcatus* from Mandapam



Rack and tray culture of edible oyster at Tuticorin



Pearl oyster with cultured pearl in situ



Cultured green mussels on rope



A good catch of tunas



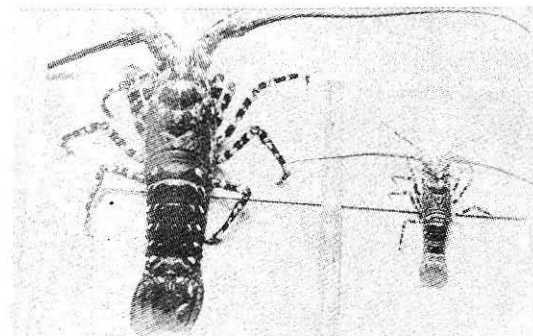
Bumper catch of threadfin breams on board FORV Sagar Sampada



Squids - Emerging resource with high export potential



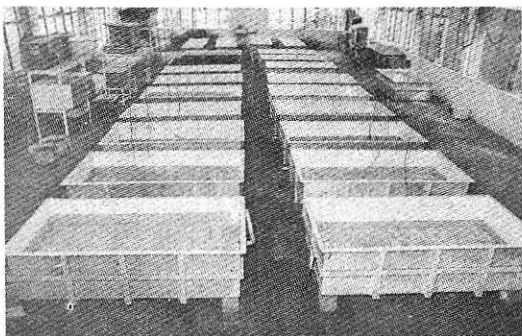
Cultured pearls



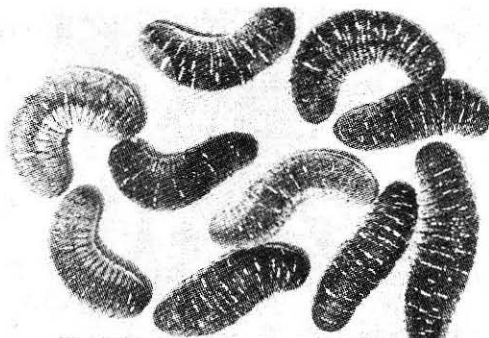
Eye stalk ablation induced growth in the spiny lobster, *Panulirus ornatus* at Madras



Laboratory grown spiny lobster, *Panulirus homarus* at Madras



Molluscan shellfish hatchery at Tuticorin



Sea cucumber - an ancillary resource gaining good export potential for Beche-de-mer recently bred and reared to adult stage in CMFRI

Regional Office of AIFI At Visakhapatnam

The Association of Indian Fishery Industries, New Delhi has set up its Regional Office at Visakhapatnam on 15th April 1991. The establishment of the office (on the fourth floor of Bhavana Enclave, Nowroji Road, Krishna Nagar, Visakhapatnam), located on the left of the westward ascending road from the beach, passing by Seaportal Hotel) fulfills a long pending demand of the members for the setting up of the office. The office was formally declared open by Mr. S.M.Shukla, President of A.I.F.I.

The Ministry of Surface Transport is reviewing the Merchant Shipping Act with a view to incorporating the international conventions already ratified by India.

Review of Merchant Shipping Act

A committee of 18 members comprising officials and experts, with Mr. Praveen Singh, Director General of Shipping as the Chairman was constituted. The recommendations of the Committee are to be submitted within 4 months.

The Act enacted in 1958 on the basis of UK law on Merchant Shipping has been amended from time to time. A Committee was set up in 1984 to review the act and to submit a report. Before the legislation could be amended on the basis of this report, several developments in international shipping necessitated a fresh review of the Act.

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Mr. S.M. Shukla declaring open the Regional Office of AIFI at Visakhapatnam



Mr. S.M. Shukla being congratulated after the opening of the Regional Office.

