# SOUVENIR

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CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
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# HISTORY, GROWTH AND ACHIEVEMENTS OF CMFRI

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## HISTORY

The proposal for the establishment of a Central Fisheries Research Institute in India was first made in 1943 by the late Dr. Baini Prashad, who was, at that time, the Director of the Zoological Survey of India. In his Memorandum on the "Post-war Development of Indian Fisheries" he recommended that a "Central Fishery Research Institute be established by the Government of India on lines similar to those of the Agricultural Research Institute, New Delhi, the Veterinary Research Institute at Mukteswar and Izatnagar and the Forest Research Institute at Dehra Dun". This recommendation was endorsed by the Fish Sub-Committee of the Policy Committee on Agriculture and Fisheries and thus, in their Report of 1945, the need for the establishment of Central Marine Fisheries Research Institute was proposed. The Government of India again sought the advice of the Late Lt. Col. Dr. R. B. Seymour Sewell, who had previously been the Director of the Zoological Survey of India, regarding the proposal of the establishment of the Institute. In 1946, Dr. Sewell submitted his "Memorandum on the proposed Fishery Research Institute". Based on his report, the Central Marine Fisheries Research Station (as it was known then) came into existence on 3rd February 1947.

In the beginning, three divisions, namely, Fishery Survey and Statistics, Fishery Biology and Marine Biology and Oceanography were established. The Central Marine Fisheries Research Station had, besides the Headquarters, substations, Units and Survey Centres to handle research on regional basis, zonal basis and collect data on marine fish landings respectively.

The head of the Station was Chief Research Officer. First Chief Research Officer was Dr. H. Srinivasa Rao, who was succeeded on his retirement by Dr. N. K. Panikkar towards the end of 1950. On the appointment of Dr. Panikkar as Fisheries Development Adviser to the Government of India in April 1957, Dr. Jones took over as the Chief Research Officer. In 1961 the designation was changed to Director and simultaneously the term "Station" was changed to "Institute". Dr. Jones was succeeded by Dr. S. Z. Qasim in 1970, by Dr. R. V. Nair in 1974 and by Dr. E. G. Silas in 1975. Dr. P. S. B. R. James took over as Director in 1985.

## Objectives

The main objectives of the Institute were:

(i) to estimate the catches of the marine fishes and other animals from the seas around India throughout the year by different types of vessels and gears,

(ii) to conduct research on marine fisheries resources in order to step up their production to the maximum possible extent,

(iii) to locate new fishing grounds; to conduct environmental studies in relation to fisheries, and to generate additional resources by mariculture, and

(iv) to recommend measures for the rational exploitation of the various resources.

## Initial Organisational Framework

The Fishery Survey and Statistics Division at the Headquarters was responsible for planning, execution and processing of the data on fish landings and fishing effort, and the estimates of the state-wise, region-wise and species-wise production of marine fish. The Division also attended to the work of stock assessment and estimation of potential yields of fish populations.

The Fishery Biology Division coordinated the work on fishery biology, which includes studies on food and feeding habits, maturity, spawning and life history studies, age and growth, size and age composition of catches, mortality and migration. A careful watch was maintained by the Division on the changes in marine fish stocks. Cochin being one of the important centres for prawn fisheries in the country, a substantial part of the effort was devoted to investigations on the valuable prawn resources. Studies on the culture of prawns have also been started here. The study of the lobster grounds, including those of the deep-sea lobster *Puerulus sewelli*, and the assessment of fishery potential of the crabs, *Portunus pelagicus* and *Scylla serrata*, were undertaken here.

The Headquarters also handled work on the two most important pelagic fisheries, namely, the oil sardine and mackerel. Particular attention was paid to tagging of these two fishes and their shoaling in the grounds beyond the inshore areas. An evaluation of the offshore demersal fisheries resources off the southwest coast was in collaboration with the other fishery institutions, namely, the Indo-Norwegian Project and the Offshore Fishing Station.

The Headquarters was also the main centre for marine biological and oceanographic researches. It co-ordinated the investigations carried out in these fields at the other establishments. Specific projects included studies on food

chain, energy flow in selected ecosystem, determination of standing crops of phytoplankton and biomass of zooplankton with reference to individual groups which are of particular interest to fisheries, the Deep Scattering Layer (DSL) and its biological constituents with reference to their importance as forage for other fishes; seasonal distribution and abundance of fish eggs and larvae, with a view to determining the spawning seasons and spawning grounds of commercially important fishes; and marine environmental damage due to pollution, engineering works and other man-made changes. Special emphasis was laid on problems of regional importance such as the formation of mud banks along the Kerala Coast and their influence on fishery.

After shifting the headquarters from Mandapam Camp to Cochin, the Institute has a Regional Centre at Mandapam Camp and 11 Research Centres: at Veraval, Bombay, Karwar, Mangalore, Calicut, Vizhinjam, Tuticorin, Madras, Kakinada, Waltair and Minicoy. Smaller establishments known as Field Centres are located at 29 centres along the coasts of India.

The Research Centres at Bombay, Calicut, Madras and Waltair were proposed to be upgraded as Regional Centres.

The Institute also established field experimental laboratories at Narakkal (near Cochin), Kovalam (near Madras) and Veppalodai (near Tuticorin).

### Infrastructural Facilities

The Institute's headquarters at Cochin will now have its own permanent building for accommodating the offices, laboratories, stores, library and class rooms and laboratories for post-graduate students in mariculture. In addition, the Institute has rented accommodation at the Fishing Harbour premises for wet laboratory work, storing and sorting of fish and other samples for analysis and for recording and monitoring of day to day fish catches landed at the harbour. The headquarters of the Institute has facilities for transport for field and other official work and mechanised boats for coastal research.

The Regional Centre of the Institute at Mandapam Camp has provision for various labortories and residential accommodation for the staff. It has also facilities for guest scientists from the country and abroad and is the most popular resort for visiting students and scientists from several parts of the country. The museum, the laboratories and the aquarium are well equipped and serve the visiting scientists and the public.

The museum at the Regional Centre has a reference collection containing a number of new species described by the scientists of the Institute as well as collections made from different parts of the country including the Andaman and Nicobar Islands and the Lakshadweep. The type material of the new species has been transferred to the Indian Museum in Calcutta recently for being taken care

of by the Zoological Survey of India. The museum also contains models of different types of craft and gear.

The library at the Regional Centre is the finest in the country for literature on marine sciences and allied subjects and one of the best in Asia. It includes a vast collection of books, journals, reprints, cruise|expedition reports, micro-films and micro cards. The library receives many journals and publications and reports free of charge as well as on exchange basis. The library has documentation, photocopying and other facilities. Other research centres also maintain libraries on a small scale.

The Regional Centre has an aquarium with facilities for circulating seawater for 24 hours. The facilities are mainly used for keeping experimental animals. Many species of fishes, shrimps, lobsters, turtles and dugongs have been kept in captivity for a number of years in the past. However, since the building, the tanks and other facilities have come of age, renovation and reorganisation of the aquariuim is now being attempted. The aquarium attracts a number of visitors almost round the year.

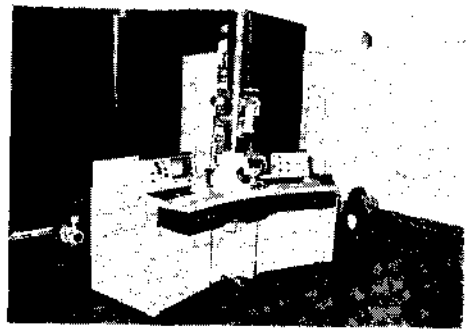
The Centre has a guest house, vehicles and mechanised boats for inshore fisheries research work.

The Research Centre of the Institute at Calicut is located in a permanent building with facilities for a museum and transport. The Research Centre at Karwar is located in the Institute's own building and has facilities for transport and a boat for coastal work. The Research Centre at Tuticorin has recently developed its own facilities for laboratories and hatcheries for oysters and pearl oyster. The Centre has also got transport and boat facilities in addition to a small salt water fish farm. The Research Centre at Madras has two field laboratories at Muthucad and Kovalam, the former attached to a salt water lagoon where earthern ponds have been constructed for experimental work. The field station in Kovalam is located in a temporary building for conducting experiments on marine organisms such as prawns, lobsters, turtles and seaweeds. The Centre has also facilities of transport and boat for coastal work.

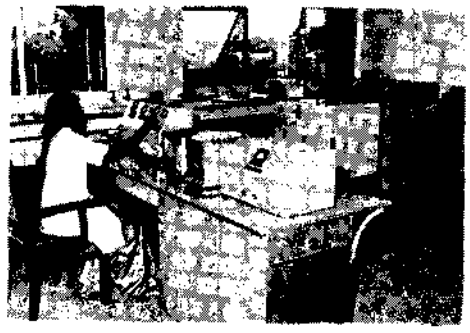
The Research Centres at Waltair, Veraval, Kakinada and Minicoy are expected to develop their own facilities for laboratory and residential accommodation very shortly. All the other research centres have limited transport and boat facilities.

## Research Vessels

During sixties and seventies, scientists of the Institute were wholly depending upon the mechanised vessels particularly *R. V. Kalava* and *R. V. Varuna* of the Integrated Fishery Project (formerly the Indo-Norwegian Project)



Electron microscope at the Headquarters laboratory, Cochin



Marine pollution laboratory

A classroom at the CAS in Mariculture

Laboratory building of Calicut Research Centre

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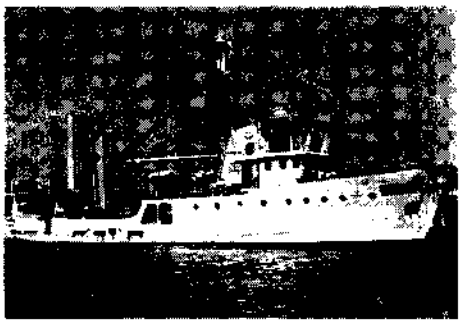
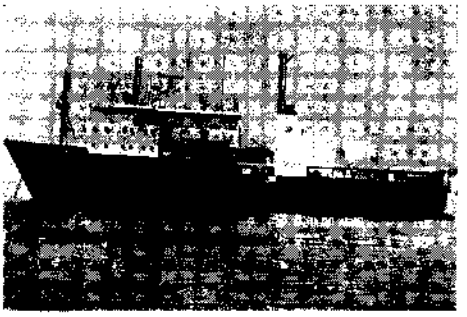


Research Vessel SKIPJACK



Fishery and Oceanographic
Research Vessel
SAGAR SAMPADA
of the Department of Ocean
Development

Research Vessel CADALMIN
for coastal research

Mobile laboratory for survey
and monitoring of biological
and environmental parameters of
coastal farms

at Cochin and other fishing vessels of then Exploratory Fishery Project and Offshore Fishing Station (presently named as Fishery Survey of India) of the Government of India for their research cruises and biological and oceanographical investigations in the Indian seas.

Now the Institute owns nine 43' long *Cadalmin* series of vessels, mostly equipped for inshore fisheries research work, deployed at different centres of the Institute. In addition, the Institute had acquired R. V. *Skipjack* (33 metres long) in 1982 for undertaking offshore fisheries research both along the east and west coasts of India. Quite recently, the Department of Ocean Development, Government of India, placed the Fishery and Oceanographic Research Vessel *Sagar Sampada* at the disposal of Indian Council of Agricultural Research, as a national facility to be used by various Institutes and Universities and other organisations involved in marine sciences research work. The CMFRI has been identified as the nodal Institute for coordinating the technical programme of the vessel. The vessel will be run by the Shipping Corporation of India. The expenditure is borne by the Department of Ocean Development. FORV *Sagar Sampada* is equipped with sophisticated instruments and gadgets and other facilities for undertaking fisheries resources, oceanographic and meteorolgical work on board the vessel. The vessel has already completed 11 cruises by January 1986 along both east and west coasts of India and the scientists of the Institute have been able to contribute to a good deal of new information regarding marine fisheries resources. It is foreseen that the vessel will contribute greatly to achieve the immediate objective of providing data on the underexploited and unexploited marine fisheries resources in relation to oceanographic conditions in the offshore and oceanic areas of the EEZ of the country.

## Reorganised Divisional Framework and Responsibilities

Several changes have taken place in the fishing industry during the late fifties and sixties due mainly to the introduction of mechanised fishing and improvements to fishing craft and gear. The fishing grounds have been extended and new resources on the outer shelf and the slope began to be exploited. All these developments necessitated that the objectives of the Institute be changed to meet the demands of the industry. Accordingly, in the late seventies, the objectives of the Institute have been modified as follows:

To conduct short-term and long-term multidisciplinary researches on the marine capture and culture fisheries of the country in order to provide RESEARCH support for the rational exploitation, conservation and management of the marine and brackishwater resources for stepping up production from the coastal water areas and the Exclusive Economic Zone and DEVELOPMENT support for growth with stability of the industrial, artisanal and culture fisheries through transfer of technology, dissemination of information, education, training and extension.

Therefore, during the VI Plan, the original three divisions have been reorganised into nine divisions to handle the increased capture and culture fisheries research programmes.

*Fishery Resources Assessment Division*

The three major technical programmes of the Division are Fishery Survey, Fishery Statistics and National Marine Living Resources Data Centre (NMLRDC). The Division provides data as total and variety-wise estimates of marine fish production for the country, with seasonal and regional breakup along with the estimates of fishing effort expended to get the production. The Division conducts every 4-5 years National Frame Surveys of the fishermen population, fishing villages, fishing crafts, gears and other infrastructure facilities. This helps to understand the potentialities of the traditional small-scale fishery and changing pattern in the fishing industry. The data on such production means also helps in developing suitable plan programmes. The stock assessment of various exploited resources are made by the Division for proper fishery management.

The NMLRDC is the store-house of all types of fishery data and is responsible for coordinating the work of several agencies collecting various types of data. The centre has laid down precise definition and methods for uniform collection of data and has devised standard proformae and circulated them to various agencies for collecting data. The centre is receiving all types of fishery resources data from the Fishery Survey of India, Integrated Fisheries Project and other private agencies. In addition to these data, the centre is also processing regular survey data collected from various fish landing centres along the coastline of India on the basis of sample survey programme of the Institute. The data are analysed and disseminated to the various end-users in the desired form.

Besides these functions, this Division is involved in training in fishery statistics including population dynamics for research workers engaged in research or teaching in the universities, state and central organisations in the field of marine fisheries. Training on the sampling design of this Institute for the benefit of the personnel of Fisheries Departments of maritime States and Union Territories of India is also conducted by this Division.

*The Pelagic Fisheries Division*

The Pelagic Fisheries Division was formed during the 6th Five-year plan by the reorganization of the Fishery Biology Division, to implement the project programmes on pelagic fisheries resources. Prior to this, the Institute's programmes on the pelagic fisheries resources, were carried out under the composite Fishery Biology Division. The Division monitors the stocks and population characteristics of major resources as those of oil-sardine, mackerel, Bombay-duck and resources of lesser magnitude and which have higher unit value such as pomfrets, carangids and seerfishes. With research vessel facilities the Division

undertakes extensive surveys of the Exclusive Economic Zone to assess the potential of conventional resources such as tunas and related species and non-conventional resources of mesopelagics to help the growth of an oceanic fishery.

This Division conducts mark-recovery studies on pelagic fishes to understand their growth, migration and other aspects. Fishery forecasting and preparation of fishery atlases are also the important functions of this Division.

*Demersal Fisheries Division*

The Demersal Fisheries Division was formed in 1982 as a result of the bifurcation of the existing Fishery Biology Division. Fin-fishes make up over 80% of the marine landings and, with the rapid strides in mechanization of the fishing crafts and the greater emphasis laid on culture fisheries, a single Division could not adequately deal with the problems relating to both capture and culture fisheries. Such a functional separation of work transferred to this Division the programmes relating to ground fish resources and the culture of marine fin-fishes.

The research programmes of the Division in capture fisheries include evaluation of the biological and fishery characteristics of the ground fish resources such as silverbellies, threadfin bream, Kalava, Ghol, Koth, Dara, Dhoma, Rawas and Snappers from the presently exploited grounds. This involves close monitoring of the catches from mechanised fishing vessels, exploratory vessels and participation in the fishing cruises. In the coming years the evaluation of the demersal resources will be extended to non-traditional grounds and the Exclusive Economic Zone. Other demersal resources which are investigated include the catfishes, wam, lizardfishes, flatfishes, rays, skates etc.

Similarly the potenti al non-conventional resources such as that of *Priacanthus,* pufferfish, deepwater butterfish and *Chlorophthalmus* which are available in considerable quantities in the outer continental shelf will be evaluated. Preparation of fishery maps for the demersal resources forms an important function of the Division. The Division is also engaged in the programmes of finfish culture involving different candidate species and culture systems.

*Crustacean Fisheries Division*

As crustacean fisheries programmes demanded greater attention, this Division was created during the V Five-Year Plan from the composite Division of Fishery Biology. The main thrust of research activities of this Division in capture fisheries is on the monitoring projects for the assessment of resources. Prawns, lobsters and crabs constitute bulk of the exploited crustacean resources and they form the mainstay of the marine products exported from India. The multispecies prawn fishery composed of two major groups namely penaeid and non-penaeid prawns is beset with many problems. Increased fishing effort in

certain regions of the coastline has created situations akin to overexploitation and in some other regions the rate of exploitation seems to have reached the optimum level. The major component of the fishery, the penaeid prawns occupy the marine and estuarine environment in their life history and in many parts of the country they are exploited from both these environments.

The dynamics of the species between the environment and exploitation in such regions make the management of the resource very complex. The Division carried out extensive studies on population characteristics and dynamics of the fishery in order to arrive at suitable management policies. The Division also keeps track of the exploitation of the deep-sea prawn, lobster and crab resources with a view to exercise control in their exploitation. This Division is also responsible for fishery forecasts in prawn fishery of the coastal zones and exploratory surveys of the crustacean resources of the Exclusive Economic Zone.

Cultutre of crustaceans in the marine environment and development of experimental hatcheries for production of seed of prawns, crabs, etc. form an important activity of the Division.

*Molluscan Fisheries Division*

Like the Crustacean Fisheries Division, the Molluscan Fisheries Division was created during the V Plan to give greater attention and direction to the molluscan resources and culture. The important research activities of this Division have been monitoring of the marine molluscan resources of the country and conducting resources survey on commercially important molluscs such as cephalopods, pearl oysters, chanks, mussels and clams. With an expertise developed for underwater diving with SCUBA, a team of scientists had already surveyed the extensive pearl and chank beds of the Gulf of Mannar and new batches of personnel are being trained in SCUBA diving.

Future programmes of this Division will include resource surveys for the exploitation of cephalopods in the Exclusive Economic Zone and adjacent waters through vessel-based programmes.

The major function includes culture of molluscs such as edible oyster, mussel, clams and gastropods and pearl culture. Hatchery production of seed has been given considerable importance in the recent years.

*Fishery Environment Management Division*

This Division is primarily responsible for investigations on fisheries oceanography, primary and secondary production, fish eggs and larvae, seaweeds, ecological energetics, mass culture of plankton organisms, marine pollution and ancillary marine resources.

The future programmes include obtaining synoptic pictures of environmental parameters and preparation of fishery oceanographic atlases; intensification of the studies on marine pollution in relation to protection of living resources; assessing productivity of different ecosystems including mangroves for promoting mariculture, investigation on anciallary resources such as corals, sponges, gorgonids, etc.

The Division collaborates with Indian Space Research Organisation and National Remote Sensing Agency in the use of remote sensing techniques for resources and environmental studies.

The additional functions of the Division include investigations on farm engineering and instrumentation and review of legal aspects pertaining to the conservation and management of marine resources in the context of the Law of the Sea.

*Physiology, Nutrition and Pathology Divsion*

This new Division, established in 1982, is intended to investigate various basic problems such as neurosecretary, reproductive, respiratory and osmoregulatory physiology and environmental and biological stress on cultivable organisms. On the nutrition side, studies will relate to nutritional biology, preparation of artificial feeds, food conversion efficiencies and large scale production of cheap and suitable feeds for culture organisms.

This Division will also take up research programmes on cateloguing ecto- and endo parasites of finfishes and shellfishes, life history of parasites, host specificity, commensals, vectors, pathogenic bacterial cancerous growth, histopathology, immunology, etc. Diagnostic and disease control measures will also be developed.

*Fishery Economics and Extension Division*

In capture fisheries, it must be ensured that both industrial fishery and small scale artisanal fishery have to be developed without detriment to each other. In view of the emphasis on exploration and exploitation of the Exclusive Economic Zone and integrated rural development through coastal aquaculture, a whole range of economics of fishery operations and socio-economc aspects have to be investigated in detail to maximise production and improve the rural economy. Therefore, this new Division concentrates on comprehensive investigations on the above aspects and provide reliable data on fishery economics for planning and implementation of development programme.

The Institute intends to have a massive transfer of technology programme to artisanal and farming communities by deploying sufficient man power to conduct field testing and adoption trials; to prepare and distribute printed exten-

sion materials, to participate in Radio and Television programmes, to organise exhibitions, seminars, farmers day and Kisan Melas and to plan documentary films and news reel on relevant technology. The Division will also provide efficient consultancy service and look after the maintenance of marine museum and aquarium.

*Library and Documentation Division*

Fishery Science has shown a phenomenal growth in recent years and is expanding rapidly in every component disciplines with increasing research efforts. Thousands of books, periodicals and other documents are published the world over. The CMFRI has built up steadily one of the finest library facilities with a holding of 50,000 books and periodicals. In view of the expanding activities of the Institute and in order to keep abreast with the latest technologies developed in various fields, the Division's main functions will be book|journal procurement, technical processing, circulation, reference assistance to readers, documentation, reprography, printing, binding, etc. Besides catering to the research needs of Institute's own staff the library services will be extended to other institutes, universities and departments.

*Centre of Advanced Studies in Mariculture*

The Indian Council of Agricultural Research (ICAR) with the assistance of UNDP launched a project in 1971 on Post-graduate Agricultural Education and Research in selected fields of agricultural service with a view to promoting post-graduate education, enhancing the competence of professional staff and undertaking high quality research. One of the disciplines included in the second phase of the project is mariculture.

Mariculture in India has been projected as a sector with great growth potential in consideration of the availability of water and species resources and a technological base. To accelerate the pace of this projected growth, it is felt appropriate that research and training of personnel required to execute and manage the projects should go simultaneously with the development of the sector. On this premise, the Centre of Advanced Studies in Mariculture was started as a sub-project of the UNDP|ICAR project mentioned above in June, 1979 at the Central Marine Fisheries Research Institute, Cochin.

The main objective of the CAS in Mariculture is to promote and catalyse research and post-graduate education in mariculture. To accomplish this objective, the following activities are initiated at the Centre:

1. Strengthening of the research programmes in mariculture and corollary aspects through the investigations carried out by the research scholars;

2. Institution of a post-graduate course, M.Sc. (Mariculture) to develop and create a cadre of personnel to meet the research, managerial and executive level manpower;

3. Equiping of the laboratory facilities to carry out research and conduct the education programme;

4. Arranging advanced training of scientists involved in mariculture research and faculty members engaged in educational activities in the identified priority areas;

5. Arranging Expert consultancies in the subjects in which there is little expertise in the country; and

6. Organising workshops and seminars to facilitate exchange of views and enhance research and instructional capabilities among the scientists and teachers in the field of mariculture.

During the last six years, the Centre has been actively participating in all the above activities. Under the post-graduate research programme, 41 short-term (4-5 months) and 13 long term (3.5-4 yrs.) research projects were completed. Most of these projects dealt with the marine penaeid prawns, particularly *P. indicus*, covering different aspects such as reproductive physiology, ecology, nutrition, pathology and physiology. The on-going research programmes include 17 long-term projects under the Ph.D. programme.

In the M.Sc. (Mariculture) programme, 41 candidates were trained between 1980 and November, 1985 in four batches. 17 candidates, 8 belonging to the fifth batch and 9 to the sixth are now undergoing the third and first semester of the course respectively. In the Ph.D. programme eleven scholars completed the research work and two of them have been awarded the Ph.D. degree by the University of Cochin. The works of other scholars are in advanced stage of completion. Twentyeight research scholars belonging to third, fourth and fifth batches are currently working in the programme.

Under the expert consultancy activity, 12 experts, one each in the field of reproductive physiology, fish and shellfish nutrition, shrimp nutrition, tissue culture, fish genetics, crustacean physiology, culture of live food oragnisms oyster, biology and culture, water quality management and environmental physiology and two experts in fish pathology visited the Centre. Similarly, between 1980 and 1985, 23 subject-matter areas were covered in the training of faculty members. These programmes greatly helped in enhancing competency of scientists in mariculture R & D and education programmes.

Another important activity of the Centre has been the organisation of workshops in subjects of topical importance in mariculture and on research

methodologies since 1979. The centre organised 13 workshops in subjects such as crustacean biochemistry and physiology, fish nutrition, fish pathology, invertebrate reproduction, fish genetics, endocrinology, environmental physiology, water quality management, culture of live food organisms and marine toxins in bivalves and published 9 manuals on research methodologies.

Considerable efforts were made to strengthen the facilities for research in physiology, nutrition, endocrinology and pathology of cultivable organisms; equipping the laboratories with equipments such as spectrophotometer, feed analysis systems, amino acid analyser, gas chromatograph, osmometers, centrifuges, high power and phase contrast research microscopes and Tran-Scan Electrone microscope.

The project has been extremely useful in organising the mariculture research on an inter-disciplinary basis, strengthening of the infrastructure facilities and providing specialised training. The linkages and interaction with the overseas institutions developed during the visits of the expert consultants and the fellowship training programme have helped to build up a cadre of competent scientists in mariculture. Working in the private and public sector undertakings, the candidates trained at the Centre are now engaged in the development of the sector.

*Summer Institutes*

Between 1974 and 1985 the Central Marine Fisheries Research Institute conducted four Summer Institutes relating to identified subject areas in mariculture. The first Summer Institute conducted in 1974 was on 'Coastal Aquaculture' and dealt with culture systems for prawn, finfish, mussel, edible oyster, seaweed and pearl culture. With the successful achievement of breeding and rearing of marine prawns under controlled conditions the second summer institute was organised on the subject in 1977 at Cochin. The Third Summer Institute was organised in June, 1980 on the 'Culture of edible molluscs'. With the objective of providing an insight into the various systems of molluscan culture developed in the country. The programme was attended by 16 participants.

The fourth in the series was on 'Hatchery production of prawn seeds and culture of marine prawns' in 1985. This was organised to highlight the potential for prawn culture and adoption of indegenous methodology developed by CMFRI for large scale production of prawn seed.

The Summer Institutes provided an opportunity to participants to learn the new technologies developed in the emerging field of mariculture, and to discuss the problems associated with. The thrust given for field work helped the participants to gain practical knowledge in various aspects of mariculture.

*Krishi Vigyan Kendra*

The Krishi Vigyan Kendra established in December 1976 at Narakkal under the Central Marine Fisheries Research Institute, Cochin has been engaged in giving intensive practical training of durations ranging from 5 to 30 days in prawn and fish farming to small and marginal farmers, landless labourers, school drop outs and the unemployed youth, in order to transfer the latest low cost technologies developed by the Institute to the end users, generating opportunities for self employment among the rural population of the coastal areas. In addition to the main subject of Fisheries, the Kendra has been conducting short term training courses of 1 to 3 days duration in other subjects such as Agriculture, Animal Husbandry, Home Science, Health and Hygeine, Finance and Financing Agencies etc. with the help of specialists in these fields from other departments and Institutions. So far, the Kendra has trained 4159 persons consisting of 1935 men and 2224 women. Out of these, 1884 persons belonged to Scheduled Caste and 7 persons were from Scheduled Tribe.

The follow up surveys conducted, to assess the impact of the training programmes, have revealed that about 31 to 37% of the ex-trainees have taken up employment directly or indirectly connected with prawn and fish farming out of which 12% were doing Scientific Culture, 13.5% were engaged in prawn seed trade and 2.3% practicing semi-scientific culture.

As part of the extension activities, the Kendra has brought out 12 patrikas and leaflets on various aspects of prawn and fish culture, Lab-to-Land Programme and employment opportunities for youth. Besides, popular articles have been published by the staff of the Kendra on prawn culture in the local dailies and other regional publications. Radio talks are given on various topics on prawn and fish culture, training facilities etc. from time to time over the All India Radio, Trichur Station. Science Camps are arranged for the School children and 10 Schools of the area have been adopted to make the children and staff aware of the latest technologies in farming of marine prawn and fish. Field demonstrations of newly developed technologies were arranged in the fields of ex-trainees in various parts of Ernakulam, Trichur and Alleppey districts for the benefit of the numerous farmers engaged or interested in scientific farming.

Film shows were regularly arranged for the trainees on campus and for the public at different places. The visiting dignitories as well as students parties were also shown films of mariculture interest. They were given lectures on the scientific prawn and fish culture and the activities of the Kendra in the field of training and extension. The Kendra has actively participated in all the All India Exhibitions conducted by the Corporation of Cochin and other agencies at Cochin and other places.

The great awareness among the traditional farmers about the new scientific prawn farming propagated through the KVK is a clear evidence of the impact of the training given by the Kendra. The 'Velon screen' introduced by the KVK for fixing on the sluice gates to prevent the entry of undesirable species has been accepted by even traditional farmers of the area. The "prawn seed industry" of collecting the prawn seeds and supplying them to the farmers has come to stay only after the KVK started giving special training in the collection, identification and transport of prawn seeds. Our training has triggered the scientific prawn culture in areas like Quilon where it was non-existent.

The staff of the KVK have been actively involved in the first and second phases of the Lab-to-Land programme of the CMFRI in the field. The KVK staff have demonstrated the economic feasibility of the culture in the fields of the Valappu Harijan Society by increasing their annual income many folds from the revenue accrued out of the culture of prawn and fishes and also from the yield of the coconut trees and vegetables cultivated on the bunds of the fields as example of integrated farming system. Consequently, in the third phase of the LLP the KVK has been allotted 100 farm families.

*Trainers' Training Centre*

The Trainers' Training Centre at Narakkal was sanctioned in October, 1983.

Pending recruitment of regular staff, with the help of the scientific staff of the Institute, two training courses in the Hatchery production of penaeid prawn seed, each for a duration of 3 weeks was organised at the Narakkal Prawn Hatchery Laboratory in January-February 1985 and February-March 1985 for the benefit of the officials of the maritime states. Sixteen senior level officers from the States of West Bengal, Orissa, Andhra Pradesh, Pondicherry and Gujarat attended the training courses. Practical training in all aspects of hatchery management including induced maturation and spawning of prawns in captivity, rearing of larvae on a large scale in hatchery tanks, culture of algal feed for larvae and preparation of artificial feed for post-larvae was imparted to participants.

During the year 1985-86, five training courses on hatchery production of edible oyster seed, faming of edible oysters, seaweed culture, hatchery production of marine prawn seed and prawn farming are proposed to be organised.

## Division-wise Achievements

*Assessment of Fishery Resources*

One of the first major tasks of the Institute was to develop a scientific system for the estimation of marine fish landings, both for obtaining production

estimates at the national and State levels and for stock assessment purposes. This was a challenging task considering the artisanal nature of the fishery, with a multiplicity of crafts and gears and landings over the long stretch of 6100 km coastline both during day and night. Based on the initial experience gained, the Institute developed a stratified multistage random sampling design, the stratification being over space and time. The design is currently adopted by this Institute and has been recommended for other countries by the Food and Agriculture Organisation of the United Nations. Resources-wise and region-wise estimates are made available to national and international organisations. Fish catch statistics and related data are collected from 62 zones and 20 single-centre zones covering the entire coastline.

Information on fishermen population, gears, crafts employment details, education standards and infrastructure facilities available in the marine fish landing centres has been collected periodically. The most recent census data were collected in 1980. These results are used by the State and Central agencies for planning and developmental purposes.

Some of the basic data for stock assessment are desired through the sampling scheme. Biological and environmental data are collected concurrently. Some of the commercially important fish stocks such as shrimps, Bombay-duck, oil-sardine, mackerel, catfishes, cephalopods and tunnies have been assessed. The classical stock assessment models require information on age structure of the stocks which are not easily available for tropical fishes. Suitable modifications have been made and length frequency data are used for deriving the levels of effort and mesh size for obtaining maximum sustainable yields. Since tropical fisheries are of multispecies and are operated by multigears, gear-specific and species-specific approach may not be possible in many cases for this purpose. Relative response model, a macro analystic one, was advanced by the Institute for assessing exploited stocks in a progressive fishery where total catches alone are considered. Studies made on shrimps, catfishes, etc. have indicatetd measures to be taken for management and viable exploitation of these resources.

Realising the importance of marine fish catch statistics in the formulation of fishery development plans and management policies, this Institute has been collecting, processing and disseminating data on exploited marine fishery resources for more than three decades. This task is carried out through the National Marine Living Resources Data Centre (NMLRDC). The existing schedules for collection of data on marine fisheries have recently been modified and improved. A code list has been prepared for commercially important fishes to facilitate computerisation.

For application of stock assessment models and proper interpretation of results, training of personnel engaged in fisheries research and teaching has been taken up. The course is of six weeks duration. Three such courses have so far

been conducted for the benefit of those engaged in R & D programmes in the Central and State organisations and faculty members from the Agricultural Universities. A ten-day training programme on the sampling design of CMFRI is conducted for the benefit of the Fisheries Department personnel of maritime States and Union Territories. So far, two such courses have been conducted and 35 persons have been trained.

*Pelagic Fisheries*

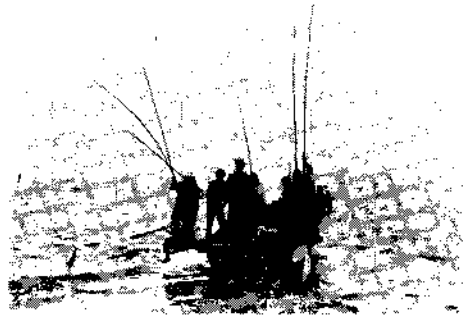
The extent and pattern of exploitation of the pelagic fish resources of the west and east coasts of India have been studied by monitoring the landings from the artisanal, drift net and purse seine fisheries. Analysis of the data from exploratory cruises undertaken on a limited scale has provided information on the nature and extent of distribution of the pelagic resources beyond the presently fished grounds. These studies have revealed two peak periods of abundance during March-May and October-December; the latter being the primary one for most of the coastal pelagic species.

Intensive studies on the oceanic resources like tunas and related species have highlighted the rich and valuable resources of this group of fishes in the seas around India.

Intensive exploratory surveys conducted during mid seventies off the southwest coast of India from Ratnagiri to Gulf of Mannar have brought to light the high potentials for pelagic fish resources such as oil-sardine, mackerel, anchovies (*Stolephorus* spp.), ribbonfishes and horse-mackerel (*Decapterus* spp. and *Megalaspis* sp.) and for mesopelagics like filefishes (*Odonus* spp.) on the continental shelf and slope.

The pelagic fish resources of the northwest coast were studied based on the data collected during the industrial fishery survey by M. V. MURAENA. These studies besides providing valuable information on the distribution and abundance of pomfrets, have brought to light the existence of horse-mackerel (*Megalaspis cordyla*) and ribbonfish stocks of great potential in depths between 100 and 140 metres.

Stock assessment studies on the exploited resources like oil-sardine, mackerel, tunas, anchovies, Bombay-duck, pomfrets, seerfishes, ribbonfishes and horse mackerel have been made. Studies on the stocks of oil-sardine *Sardinella longiceps* on the west coast of India have indicated an average annual stock size of 400,000 tonnes. The mortality rate of population is found to be about 80% ($M = 1.12$) per year and the exploited resources form only about 39% ($F = 0.54$) of the stock. A part of the stock (41.7%), found beyond the present fishing grounds, is known to consist mainly of larger adult fish. The available data point out that considerable increase in the catches is possible by



Pole-and-line fishing for tuna in Minicoy

Tuna catch at Cochin

Ribbonfish catch landed at Neendakara fishing harbour

Intensive activities at Cochin fishing harbour

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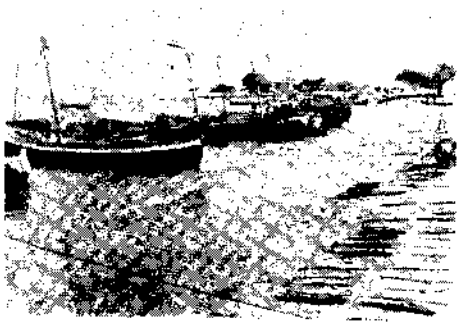
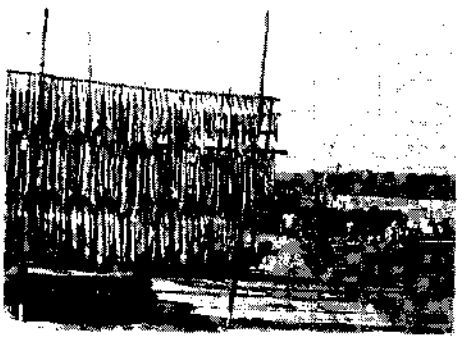
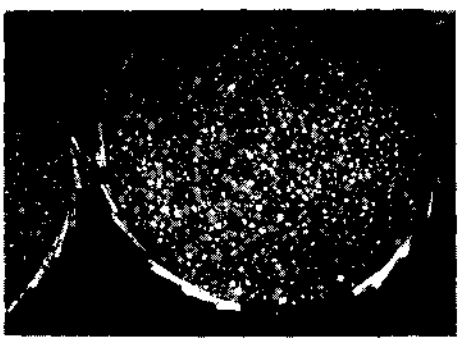


Traditional landing centre at Tuticorin with seerfish catch



Bombayduck being sun-dried



Catfish eggs from purse-seine catches at Mangalore

Trawl catch by Research Vessel CADALMIN

stepping up fishing effort in the offshore grounds employing efficient fishing methods like purse seine. Consequent on the large-scale introduction of the purse seiners in Karnataka and on a limited scale in Kerala, a detailed study was initiated to assess its impact on the stocks and the artisanal fishery. The studies in Kerala have indicated that there is no tangible impact of purse seining on the artisanal fishery for oil-sardine, at the present level of exploitation and availability.

In the case of the Indian mackerel *Rastrelliger kanagurta* stock assessment studies have revealed an average annual stock level of 265,000 tonnes off the south west coast of India (7°-17°N); and considerable portion (32.3%) of the stock is found beyond 25 m depth. The total mortality of the stock in the fishing ground was estimated to be about 90%. Studies on the exploited resources indicate that any further increase in the catches should come from the offshore stocks or by increasing the age at capture (tc) to 8 months in the present fishery (by increasing mesh size).

The estimations on the fished stocks of *Euthynnus affinis* and *Auxis thazard* have indicated that their average annual stock levels were in the order of 206,000 and 7,700 tonnes. The exploitation rate (U) was 0.5 for both the stocks, indicating that the two species are under-exploited and a substantial increase of production is possible by increasing the fishing effort. In the case of the oceanic skipjack (*Katsuwonus pelamis*) and yellowfin tuna (*Thunnus albacares*), their exploitation rates (U) were estimated at 0.64 and 0.85 and total mortality rates (Z) at 2.07 and 3.17 respectively. In view of the low exploitation rates as compared with the high rates of total mortality, it is emphasized that substantial increase in the production from these stocks is possible by increasing fishing effort.

Studies on the stocks of whitebaits (*Stolephorus* spp.) have shown an estimated yearly average biomass of 479,000 tonnes in the Gulf of Mannar and 267,900 tonnes in the southwest coast (Cape to Ratnagiri). In both the areas the major component species were *S. heterolobus, S. bataviensis* and *S. zollengeri* in the order of importance. Major concentrations were located in 20-50 m depth domains in both the sectors. Viewed from the present level of exploitation, vast scope for inceased production from these potential stocks exists in both the areas. A critical study of the exploited resources of the anchovies from Indian seas have revealed that species belonging to the genera *Stolephorus, Thryssa, Coilia, Setipinna* and *Thrissina* are the main contributors in the order of abundance. Based on the productivity data and yield equation, a potential yield of 585,000 tonnes of anchovies was estimated for Indian waters. Of the total potential yield, the share of west coast, east coast and Andaman-Nichobar waters is in the order of 403,169 and 13 thousand tonnes respctively. Since the present catch is very meagre compared to the potentials, substantial expansion of the

fishery could be recommended. The expansion of the anchovy fishery will be more rewarding along the coasts of Kerala, Tamilnadu and Andhra Pradesh for *Stolephorus* and *Thryssa;* along northern Maharashtra-Gujarat sector for *Coilia* and along northern Orissa-West Bengal sector for *Satipinna*. Similar possibilities also exist for the increased exploitation of *Stolephorus* and *Thrissina* stocks from Andaman waters.

Studies on the stock assessment of Bombay duck, *Harpodon nehereus* have indicated that at Nowabunder, Saurashtra coast, the present level of exploitation is close to the maximum sustainable yield (MSY) and that any further expansion in the fishery would result only in the over-exploitation of the stocks. By increasing the age at capture higher sustainable yield from the stock is indicated.

The population parameters of the silver pomfret *Pampus argenteus* off Saurashtra Coast were estimated. The growth coefficient (K), the asymptotic length ($L\infty$) and $t_o$ for the exploited stock were 0.088, 317 mm and - 0.297 month respectively. The species was estimated to grow to an average size of 207 mm, 279 mm and 304 mm at the end of one, two and three years of its life.

The fishery of seerfishes off the Karnataka Coast was mainly supported by the stocks of king seer (*Scomberomorus commerson*), spotted seer (*S. guttauts*) and streaked seer (*S. lineolatus*) of which king seer was the most dominant. The annual mortality rates for the above three species were in the order of 0.6, 0.7 and 0.8 respectively. It follows, therefore, that the seerfishes along the Karnataka Coast were under-exploited and an expansion in the fishery would result in increased production without affecting these stocks.

The resources of horse-mackerel on the southwest coast of India and the Gulf of Mannar have been investigated. The potential resources consisted mainly of *Decapterus* and *Megalaspis;* and an average annual biomass of about 134,400 tonnes was indicated for the whole area. Out of this potential, 16,280 tonnes from the Gulf of Mannar and 118,120 tonnes from the southwest coast (Cape to Ratnagiri) were estimated. The bulk of this biomass was located in 20-75 m depth in the Gulf of Mannar and 50-100 m depth in the southwest coast. Viewed from the present level of exploitation of these stocks, a substantial increase in the catches by the expansion of the fishery is possible.

Studies on the stocks of ribbonfishes (mainly of *Trichiurus lepturus*) of the Andhra-Tamilnadu and Kerala-Karnataka Coast have indicated that these resources were underexploited and greater fishing effort may be applied to get increased yield from the stocks. Increase in the age at capture to 1 year would also substantially increase the production from the existing fishery.

*Demersal Fisheries*

The early studies have naturally been on coastal|ground-fish resources, as the inshore area was the major realm exploited by the artisanal fisheries using the traditional gear and the mechanised fleet of small and medium-sized boats using bottom trawls, bottom-set gill nets or hooks and lines. These provided the information base on the nature of the grounds and the relative richness of the different areas, essential for the development of trawl fishery in the inshore region.

The studies during 1949-55, based on the operations of the trawlers of the Government of India Deep Sea Fishing Station and of the New India Fisheries Co. in the Bombay-Saurashtra waters, marked the first attempt at a scientific analysis of the demersal catch data and the charting of the fishing grounds to provide the distribution pattern of the commercially significant fishes. With the expansion of such exploratory fishing programmes and the setting up of additional bases along the east and west coasts, the analysis of the fishing data and the demarcation of the trawlable areas and productive grounds continued, until nearly all grounds up to 50 m depth were covered. The delineation of the good ground for ghol, dara and Karkara off Kutch, Dwaraka and Porbunder, for eels off Bomay and Cambay, for prawns, nemipterids and perches off the southwest coast, silverbellies off southeast coast and catfishes off north east coast emerged out of these studies.

The areas beyond this inshore commercial belt were also studied, though to a lesser extent, based on exploratory cruises of the Government of India vessels that covered mainly the southwest coast. This brought forth much valuable information on the deepsea prawn and lobster resources near the shelf edge and slope, the perch fishing grounds along the rocky areas at 70-100 m depths and the enormous potential of the bathy pelagic fish complex in the shelf slope and beyond.

With the declaration of the Exclusive Economic Zone the need arose to explore the farther reaches of the shelf in greater detail. The first move in this direction was the comprehensive, year-long Indo-Polish Industrial fishery survey and the detailed analysis of the fishery and environmental data that followed in the late seventies. The study covered the west and northwest zones, from 15° to 24°N and 55 to 360 m depth and indicated the periods and areas of abundance of threadfin-breams at 125-360 m depth, serranids and larger carangids in 90-125 m, and ribbonfishes, pomfrets, horse-mackerel and eels in the 55-90 m depths.

In addition to such over-all studies on the nature and disposition of the demersal fisheries resources, the Institute's work included detailed studies on individual fish species|groups that contributed to major commercial fisheries,

chiefly catfishes, threadfin-breams, silverbellies, sciaenids, perches, eels, flatfishes and lizardfishes. The earlier years were devoted to the essential studies on the biology of the main species. Data on recruitment, feeding and growth, maturation and spawning along with catch data, are required for a proper scientific appraisal of the stocks available for exploitation and for a proper management policy. Such studies on the dynamics of the exploited populations of the main species of catfishes, threadfin-breams and silverbelly have been carried out. The estimations on the fished stocks of the five catfish species *Tachysurus thalassinus, T. tenuispinis, T. serratus, T. dussumieri* and *Osteogeniosus militaris,* have indicated that, except for the last-mentioned, all species are at present under heavy fishing pressure and either the pressure has to be reduced or the size of fish caught increased, if the fisheries are to be sustained. While this is the situation common to all regions, the extent of regulation needed is greater for Waltair and Mandapam and relatively less for Cochin and Veraval.

Studies on the stock of the threadfin-bream *Nemipterus japonicus* have indicated that at Kakinada any increased effort on the present fished stocks at the present size of capture would only result in lesser yield. Greater production from these grounds is possible only by increasing the size of capture (increasing mesh size). At Madras, however, the stock is not fully exploited and greater fishing effort may be applied to get increased yield without adversely affecting the stock.

In the case of silverbellies, studies on *Secutor insidiator* has indicated that, though, theoretically, increased catches can result from a reduction in age at capture, this is not advisable, as the present age is near the age of maturity and a reduction of fishing size would result in the removal of spawners and so adversely affect the stock.

The significance of the exploratory surveys and the demarcation of coastal fishing grounds to the trawl fishing industry needs no reiteration. With the declaration of the EEZ and the availability of vast shelf areas for exploitation, the prime need now is to explore the offshore areas up to the shelf edge and beyond, and a beginning has been made by the Institute's participation in the industrial fishery survey covering the region from Goa to Okha upto a depth of 360 m and the subsequent detailed analysis and charting of the important fishing grounds for the different commercially important fish species|groups.

Studies on the presently exploited demersal resources have shown that, with the rapid development of the mechanised trawl fishery in recent years, many of the inshore fisheries are under heavy fishing pressure and damage to stock can be avoided only with a decrease in fishing effort or increasing the mesh size of gear used. This has great relevance to future development plans on marine resources. Since trawling is the means of exploitation of the shrimp,

which is the most important foreign exchange earner, an increase in mesh size to save some other resources, would be at the expense of the shrimp industry. So, the reduction in fishing effort in the inshore areas would be the practical alternative, and this would necessitate the diversification of fishing to farther and potential grounds, and this is clearly linked to exploratory studies in the EEZ.

With the world trend of marine fish catches levelling off in the face of increasing demand, attention is being turned to culture fisheries to augment production. While, in our country there is still scope for exploitation from off-shore fishing grounds, the building up of an efficient fleet of trawlers and the needed infrastructure, is a highly capital-intensive venture. Hence, the need to turn to culture fisheries would seriously arise and the experiments on fish culture are pre-requisites for any future developmental plans in this direction.

Experimental finfish culture had been part of the Institute's programme from the early years at Mandapam, along with the necessary biological and physiological work on selected species. The culture programme was intensified and extended to other centres in the course of the past decade and a half to Tuticorin, Madras, Calicut and Narakkal, by mono and poly-culture techniques, in ponds, cages and pens. Special attention was paid to development of techniques to make use of waters at present lying unutilized such as the coastal lagoons, low-lying and seasonally inundated areas. Prawns, milkfish, mullets have been reared successfully in ponds and pens, while preliminary studies with species of *Lethrinus, Epinepheles* and *Lates* at Mandapam and Tuticorin have yielded promising results.

*Crustacean Fisheries*

Work on marine crustaceans started in 1947 at the very inception of the Institute at Madras. With the establishment of the Prawn Research Unit at Narakkal in 1951 attention was focussed on the prawns which very soon became the foremost marine fishery resources of great economic and industrial importance.

Research on the biology, life history and fishery of the commercially important prawns on the southwest coast was initiated. The rapid expansion of the export market for frozen prawns, the discovery of new fishing grounds for prawns and the introduction of mechanised boats for trawling gave further impetus to the research on prawn fisheries. With the opening of research centres all along the east and west coast of India a concerted effort was made to study the prawn fisheries on an all India basis. A wealth of information was collected on the distribution and abundance of the prawn species in space and time, their growth, feeding habits, fecundity, sex ratio, and their movements parallel and perpendicular to the coast. Pioneering work on the taxonomy of the Indian prawns was also done throwing new light on the systematic position and geo-

southwest monsoon season. They complete this 380 km journey in 68 days at an average speed of 5.6 km per day. This study also showed that the prawns grew from a size of 110 mm to 149 mm during this period.

Apart from the major research thrust on the prawn resources of the country, the other crustacean resources such as rock lobsters, crab and stomatopods have also been the subject of study. In recent years the lobster landings have increased at Veraval and Bombay. The stomatopods or mantis shrimp which were being discarded in the sea earlier are now being utilized as poultry feed and are a potential source of Chitin which has various industrial uses.

*Prawn Culture*

During the last decade there has been a tremendous upsurage in the prawn culture activities throughout the world to provide additional material for the burgeoning frozen prawn industry. The Institute took an active interest in prawn culture and established the Marine Prawn Culture Laboratory at Narakkal near Cochin in 1975. Within a year all the commercially important species of penaeid prawns such as *P. indicus, P. monodon, Metapenaeus dobsoni, M. monoceros, M. affinis* and *Parapenaeopsis stylifera* have been made to spawn in the laboratory and their larvae reared upto the postlarval stage under controlled conditions. A detailed study of the structure of the larval appendages enabled the scientists to rationalise the larval rearing procedures which were being developed simultaneously. To feed the prawn larvae, indigenous methods for culturing live feed organisms such as diatoms, rotifers and cladocerans on a large scale were developed. The larval rearing technique was improved and simplified over a period of 8 years. By this process of steady improvement, the Institute has now evolved a totally indigenous, low-cost technology for the hatchery production of penaeid prawn seed, specially suited to the Indian conditions.

Intensive work on methods of induced breeding of prawns has resulted in the development of a technique for making farm grown prawns mature and spawn in captivity. Unilaterally eyestalk ablated prawns kept in specially designed maturation pools where the water quality is strictly controlled, mature and spawn within 4-5 days.

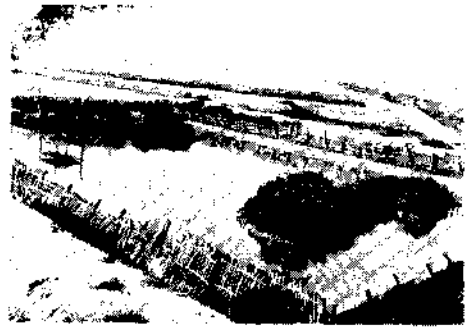
Development of reliable techniques of larval rearing and induced maturation has enabled the domestication of *P. indicus* in the Narakkal farm *i.e.* this prawn now completes its entire life cycle in the farm itself and six continuous generations have been maintained.

To enable the interested parties in setting up prawn hatcheries to supply seed to the rapidly expanding prawn culture industry in the country a manual entitled "Hatchery production of penacid prawn seed" has been published by

Marine fish farm at Mandapam Regional Centre

Experimental marine prawn culture farm at Narakkal

Harvested milkfish from experimental pen culture at Mandapam Regional Centre



Coastal fish farm in mangrove ecosystem at Tuticorin

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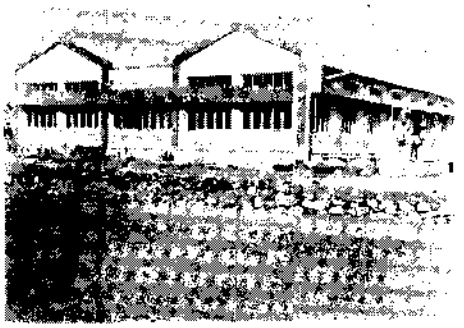
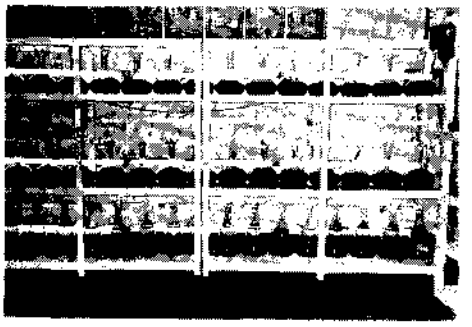


Experimental molluscan shellfish hatchery at Tuticorin



Microalgal culture facility at the hatchery at Tuticorin

Molluscan spat production system at Tuticorin

Pearl oyster spat produced in hatchery

the Insitute giving details about hatchery site selection, hatchery equipment and lay-out, induced breeding techniques, larval rearing techniques, preparation of live and artificial feeds for the larvae and economics of operation of a commercial hatchery.

While the Narakkal Laboratory concentrated on *P. indicus,* the Institute's field station at Kovalam near Madras has been successful in domesticating the Japanese prawn *P. japonicus* and in the hatchery production of *P. monodon* seed. The Karapad Laboratory of the Tuticorin Research Centre of the Institute has achieved similar success with *P. semisulcatus.*

A technique of artificial insemination of *P. indicus* and *P. monodon* has been developed. This is a significant achievement that is basic to all future work on selective breeding of prawns for improving production in culure systems.

A sea ranching programme for producing the seed of *P. semisulcatus* on a large scale and releasing them in the Palk Bay to augment the natural stock of this species which supports a good trawl fishery in the Palk Bay area, has been initiated. The semienclosed nature of this shallow Bay, the sedentary nature of the species and the habit of the young ones of this prawn to cling on to seaweeds which abound in the area, are factors that are favourable for taking up this sea ranching programme, which will benefit the fishermen of the area.

Production of upto 600 kg|ha of marketable size (65 nos. head-on|kg) *P. indicus* has been achieved in a culture period of 50-55 days at the Narakkal farm. The possibility of culturing *P. indicus* in the brackishwater canals of the coconut groves in the Vypeen Island has been demonstrated. A pelletised feed compounded from locally available raw materials such as prawn head waste, mantis-shrimp, fish meal, groundnut-oil cake and tapioca has been developed at the Narakkal farm. It contains 25% protein and gives a conversion ratio of 4.0.

Progress has been made in rearing the larvae of the crabs *Scylla serrata* and *Portunus pelagicus* to the crab stage in the laboratory. Rapid increase in growth rate of cultured lobsters has been achieved by eyestalk ablation.

*Molluscan Fisheries*

At the time the Central Marine Fisheries Research Institute was established in 1947, the exploitation of molluscan resources in the country was very limited. There was subsistence fishery for the backwater clams in the estuarine regions and mussels in the coastal areas in some pockets. The squid was exploited for local consumption in the Palk Bay. Oysters were collected sporadically for local consumption. The pearl fishery of the Gulf of Mannar and Gulf of Kutch were of intermittent character and, except for the series of 1955-61 in Gulf of Mannar, no worthwhile pearl fishery was conducted. The subsoil deposits of

clam shells were moderately exploited, not for industrial purposes, but mainly for lime-kiln use.

From such a situation of very poor exploitation of the molluscan resources in the forties, the country has advanced to much higher levels of utilization of the molluscs thanks to the resource data provided for development and culture technologies developed at the Institute.

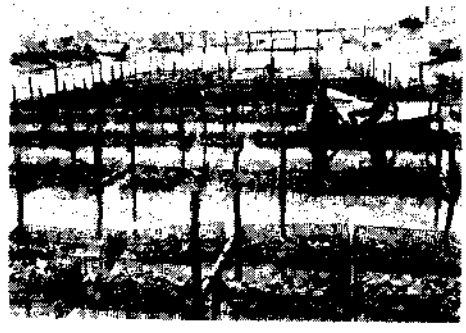
An inventory of the molluscan resources, species composition distribution and levels of exploitation has been made based on surveys conducted from time to time in different regions along the coasts of India, including the Andaman and Nicobar Islands. This forms the base-line data for the development programmes for increasing production and for management of the resources.

The clam resources of the estuaries of Karnataka and Kerala, which form the mainstay of the subsistence fishery along the coastal stretches of these two states, have been investigated in detail. This was done particularly in the context of the recent spurt in export of clams, including the "baby" clams from this region, with a view to providing the resource information for conservation of the resource. The species in question are *Meretrix meretrix, M. casta, Katelysia opima, Paphia* spp. and *Villorita cyprinoides.*

The mussel fishery for the green mussel *Perna viridis* along the Malabar Coast and for the brown mussel *P. indica* along the extreme southwest coast, has been studied and the resource potential and level of exploitation have been indicated. The standing stock of *P. indica* was estimated at 1610 t (1983-84) while the landings were only 556 t along the southwest coast. No estimate of standing stock of *P. viridis* could be made, but the catch was estimated to be 2597 t.

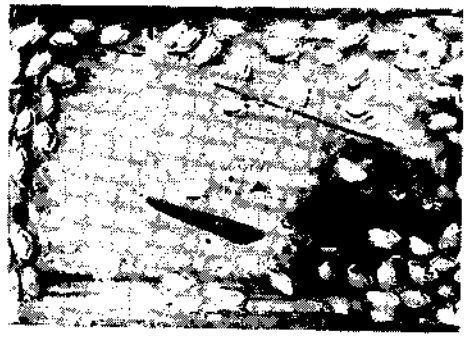
Along the east coast, the molluscan resources of Kakinada Bay, particularly those of the blood clam *Anadara granosa* and windowpane oyster *Placenta placenta,* were surveyed in detail and the potential for further development has been indicated. Estimated molluscan resources of Kakinada Bay (1983) were: *Anadara granosa* - 6895.3 t; *Placenta placenta* - 12418.7 t; *Paphia textile* - 664.7 t; and *Meretrix meretrix* - 1081.6 t.

The pearl banks of the Gulf of Mannar were surveyed on a scientific basis by underwater observations using SCUBA and the configuration of the 'paar's, ecology of the grounds and the pearl oyster resources along with the associated fauna and flora, were documented for use. Subsequently periodic surveys have been conducted to understand the resource position from year to year and the composition of *Pinctada fucata* along with the flat pearl oysters, the latter being an incursion during the recent years. Predation by gastropods was observed.



Oyster culture farm at Tuticorin

Pearl oyster farming under raft culture



*Scylla serrata* produced in the crustacean hatchery at Tuticorin

Mussel seeding for raft culture at Calicut

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Seaweed culture on coirnet frame at Mandapam

Sea turtle hatching programme at Kovalam, Madras

Underwater investigation on pearl banks at Tuticorin

CMFRI had participated in the III Indian Antarctic expedition during December 1983-March 1984 for oceanographic and krill investigation; photo shows the Antarctic krill, *Euphausia superba*

The resources of the sacred chank *Xancus pyrum* have similarly been surveyed in Gulf of Mannar and monitored in other regions of their exploitation such as the coasts of Tamil Nadu and Kerala.

Squids and Cuttlefishes have gained prominence during the last decade as items of export. The cephalopod resources of the inshore waters have been closely monitored and the stocks of *Loligo duvaucelii* and *Sepia pharaonis* have been estimated for some centres.

Stock estimates of cephalopods of inshore waters (1979-80 data):

| | |
|---|---|
| Average annual stock of *Loligo duvaucelii* off Madras | .. 104 t |
| Average annual stock of *Loligo duvaucelii* off Cochin | .. 250 t |
| Average annual stock of *Sepia aculeata off Madras* | .. 168 t |
| Average annual stock of *Sepia pharaonia* off Vizhinjam | .. 636 t |

Overall estimates (projections based on above data) for all-India cephalopod resources of inshore waters are: *D. duvaucelii* - 18,203 t, *S. aculeata* - 23,536 t and *S. pharaonis* - 15,245 t.

The vast potential resources of oceanic squid *Symplectoteuthis oualaniensis* in the EEZ of India have been indicated based on survey results of Research vessels.

A significant breakthrough was achieved in developing indigenously the techniques of pearl culture. This has led to the establishment of a new pearl culture industry in the country.

Techniques for the culture of edible oyster have been developed. Under rack-tray culture method, the annual production estimate is about 135 t|ha for the shallow coastal region.

Open-sea mussel farming techniques developed at the Intitute at different centres yield an average production rate of about 10-15 kg of mussel per metre length of seeded rope per season of 7 months under raft culture. It has also been found feasible to culture mussel in salt-water lagoons of shallow depth.

The blood clam (cockle) of Kakinada Bay has given estimated production rates of 38-42 t|ha|6-7 months under experimental culture.

Another major achievement has been the development of techniques for seed production in hatcheries. Following the initial breakthrough of technology for pearl oyster seed production, the edible oyster seed is also produced on large scale in experimental hatchery. Similarly mussel has been brought under the hatchery technology. The problem of paucity of seed for large-scale culture operations of economically important bivalve molluscs has been solved. Experimental success in clam seed production has also been achieved.

Initial success in rearing the cuttlefish from egg clusters to adults has been achieved in the laboratory.

Basic researches on reproductive physiology of mussel and pearl oyster, larval nutrition of pearl oyster and pearl-sac formation have been undertaken.

Under an inter-institutional project with the Central Institute of Fisheries Technology, product development and quality control of molluscan products were taken up. In another such project with the Vikram Sarabhai Space Centre, FRP floatation blocks for open-sea mariculture have been developed.

The mariculture technologies are linked with developed programmes for increasing production. Specifically, pearl culture has already been adopted by industry, so also pearl oyster hatchery technology. Oyster culture and mussel culture technologies remain to be taken up by industry. In oyster culture, product development and trial marketing has been done by the Integrated Fisheries Project using oyster production from CMFRI experimental farm. A very good potential market in the country for oyster has been indicated. All these technologies have been transferred to interested State Fisheries Department personnel through training programmes in pearl culture, oyster culture, mussel farming and underwater ecological studies. Gujarat has an R & D programme in pearl culture based on CMFRI technology.

*Fishery Environment Management*

In the early period, the investigations on the fishery environmental conditions were confined mainly to the coastal belt, using country boats or small mechanised boats. Gradually the work was extended to areas further out with the help of trawlers of the then Deep Sea Fishing Station. With the Indo-Norwegian Project's fishing vessel M. O. KRISTENSEN and with Cochin as base regular oceanographic surveys began. With R. V. KALAVA regular oceanographic cruises were conducted along the west coast of India. The area under intensive investigation was the southern section of the west coast from Cape Comorin in the south to Mangalore in the north, as well as the Gulf of Mannar and the seas around the Laccadives.

Oceanographic studies in the area between Cape Comorin and Mangalore showed very interesting features. It was found that the pattern of temperature distribution in most cases (except during the colder months) is bimodal or multimodal. During the southwest monsoon upwelling takes place along this coast when the surface water is displaced by subsurface water. Almost a complete turning over takes place during the process of upwelling and it spreads over the entire continental shelf. The amount of water drawn from the subsurface layers varies with the intensity of upwelling, but in general the upper 100 m of the subsurface water interacts in this process. In the south-eastern

Arabian Sea three major water masses have been recognised in the upper 300 m of the sea (a) the Arabian Sea surface water, (b) the Arabian Sea upper subsurface water, and (c) the Arabian Sea lower subsurface water.

The investigations have revealed the mixing of the Indian equatorial water, which is found between 200 and 2,000 m with the Red Sea water, a process very much similar to the mixing of the Mediterranean water with the Atlantic water. This mixing presumably results in the formation of the intermediate deep water masses in the Arabian Sea. In the Laccadive Sea comparatively low salinity water is found during the dry months. This may indicate the presence of the subantractic bottom drift. Prominent eddy circulations have been noticed between Alleppey and Quilon and in the vicinity of Calicut. The data collected on aspects such as divergence, convergence, upwelling and circulation have given certain clues for a better understanding of the dynamics of the mud bank formation. The circulation pattern and thermal structure show that the region off Calicut serves as a transition zone between the northern and southern water masses.

Upwelling along the southwest coast of India during the southwest monsoon has considerable influence on the coastal fisheries. Due to upwelling the demersal fishes were found to disappear from a rather broad belt parallel to the coast.

Based on plant pigment content an estimate of the resources was made for the first time in the country. After conducting extensive qualitative and quantitative studies on the planktonic organisms in the Gulf of Mannar and Palk Bay, investigations were initiated in the Gulf of Mannar and Palk Bay on the organic productivity using the light and dark bottle technique. With the availability of radioactive C14, intensive investigations were carried out at Mandapam and subsequently on the west coast using the research vessel R. V. VARUNA of the Indo-Norwegian Project. These studies yielded very useful information on the productivity of the Indian Seas which was used for the computation of the resource potential of the Indian Seas and the Indian Ocean in general. Detailed studies on the zooplankton, secondary production and the Deep Scattering Layers on the west coast were carried out in the sixties from observations made on board R. V. VARUNA.

The conservation programme on endangered marine animals and studies on corals, sponges, echinoderms and seaweeds have greatly contributed to development of resource data on these animals.

Projects on marine pollution in relation to protection of living resources, remote sensing in marine fisheries, research on bioactive agents, seaweed culture to augment the natural production and genetic improvement of seaweeds in

recent years and survey of seaweed resources in collaboration with CSMCRI were initiated in the seventies.

The Institute collaborated with Space Applications Centre, Ahmedabad and National Remote Sensing Agency, Hyderabad to develop suitable algorithms for chlorophyll scanning and ocean colour. These investigations were conducted as a Joint Experiments Programme (JEP) for Fisheries for the utilization of satellite data to locate areas of high productivity in the Exclusive Economic Zone of the country. The studies indicated that chlorophyll which is an index of the bioproductivity as well as ocean colour and suspended organic matter could be used as indices of fisheries potential. More recently, FORV SAGAR SAMPADA, Department of Ocean Development's newest research vessel with sophisticated instruments for fishery and oceanographic research has given a new dimension to the programmes of environment management.

Other major achievements have been in the following areas:

Secondary production and its relationship on the distribution of fishes in the EEZ; quantitative and qualitative abundance of fish eggs and larvae on the west and east coast of India; distribution of the Antarctic krill; isolation and mass culture of uni-cellular algae for hatchery development of larvae; ecology of mangrove areas and their influence on the fishery resources; coral resources and behaviour of reef fishes, marine pollution monitoring with reference to heavy metals, pesticides and industrial effluents; formation and environmental characteristics of the mud banks of Kerala; screening of bioactive agents from number of marine animals and plants and development of conservation meaures for endangered marine animals and national parks.

Environmental survey of selected ecosystems with the aid of a Mobile Laboratory in Orissa, Kerala and in Tamil Nadu has enabled the identification of sites for mariculture and also liming|fertilizer|requirements to augment the production of culturable species of prawns and fishes in culture systems.

*Fishery Economics and Extension*

With the declaration of Exclusive Economic Zone and the formulation of integrated rural development programmes in mariculture, a whole range of economics of operations of both capture and culture fisheries and also socio-economics of fisherfolk has gained considerable importance.

An investigation carried out to assess the impact of large scale introduction of commercial purse-seining in Karnataka coastal waters showed that even though the total catches increased through purse-seining the traditional Rampani operators suffered a severe economic set-back. The Institute recommended several remedial measures like providing Rampani owners with purse-seiners through liberal government loan and giving priority for Rampani operators as

crew-members of purse-seiners. A similar detailed study made in Kerala indicated that the effect of purse-seining at the existing level of exploitation was not tangibly felt on the indigenous fishery.

Socio-economic studies of the fishermen families at Puthiappa (near Calicut, Kerala) where the credit was obtained from ARDC indicated that there was marked improvement of economic conditions of families which resorted to mechanisation compared to others. Studies at Sakthikulangara (near Quilon), Kerala) showed that a decade long mechanisation process brought about better economic returns. However it was noticed that families in the middle and higher income groups which have good financial backings were the main beneficiaries of the additional income generated.

A study on income and other associated aspects in selected villages of Maharashtra and Gujarat showed that significant difference exist in income levels between categories based on ownership of craft|gear - the mechanised craft owner getting the maximum annual income and the labour group receiving the least.

A case study on coastal rural indebtedness conducted at Vizhinjam (Kerala) revealed that over 80 per cent of the fishermen families were in debt. Private money-lenders were the major source of borrowing and accounted for 87 per cent of the total credit. A similar study was conducted in Sakthikulangara area (Kerala). It was suggested that institutional agencies should play a more dynamic role as credit agencies so that the fishermen are saved from the money-lenders who exploit them at all stages.

An economic evaluation of paddy-cum-prawn culture in Kerala showed that the deciding factor for increased returns was the availability of *P. indicus* in the fields. Efforts should be made to provide seeds of *P. indicus* to farmers in adequate quantities so as to augment production and income.

A study conducted at selected centres on price spread showed that the fisherman's share in consumer's one rupee for quality fishes was about 65 per cent while it was only about 35 per cent for cheaper and easily perishable fishes.

A study on the comparative economics of different types of mechanised fishing units conducted at Cochin Fisheries Harbour during 1983-84 indicated that the pay back period for a purse seiner was 3.4 years, trawler 5.5 years and gill netter 3.4 years. The ratio of net profit to initial investment was 29 per cent for a purse seiner, 18 per cent for trawler and 29 per cent for gill netter.

A study conducted on the role of women in small-scale fisheries in Vypeenkara (Kerala) helped in identifying the areas and extent of participation by women in fishery related activities. Investigations on nutritional status of the fishermen community in the study area indicated that the diet provided 75%

of calories and 50% of the protein requirements. The weights of pre-school children showed that they were well within the UNICEF standards upto 2.5 years and then showed a decline.

In an attempt to identify the constraints involved in the adoption of technologies developed at the Institute a study on the awareness and attitude of fish farmers towards prawn farming technology was carried out. 80% of the farmers were aware of the practice, the major source of communication being radio and newspaper. The fish farmers tended to have favourable attitude towards the new practice.

*Physiology, Nutrition and Pathology*

From 1982, the Institute took up appropriate research programmes in physiology, nutrition and pathology of fish and shellfish which formed either complementary or supplementary to the major ongoing research programmes on the culture of candidate species.

Ecophysiology and respiratory physiology of fishes and shellfishes have been the important research aspects studied in this field. The penaeid prawns that migrate to and fro the sea and estuaries|brackishwaters are found to adapt to different saline conditions of the ecosystems through active regulation of the chloride content of the haemolymph. The free amino acid (FAA) and protein levels of *Penaeus indicus* at diifferent saline, pH and dissolved oxygen levels of the backwaters show significant correlation between these biochemical and environmental parameters. However, the variation in the FAA and protein levels in the abnormal 'soft' prawn and in the normal prawn have revealed higher level of protein catabolism in the former. The seasonal fluctuation of the calcium content in the haemolymph, is always found at higher levels than the calcium content of the pond water in which these prawns are cultured. However, relatively higher levels of calcium in the muscle and low levels in the exoskeleton is observed in June when the salinity of the pond water decreases due to monsoon rains. This difference in the calcium levels in the haemolymph, muscle and exoskleteon of the prawn indicates some imbalance in the physiological process and impairment of the carriage mechanism of calcium from the haemolymph to exoskeleton during adverse low saline ecological conditions. The absence of nickel and cobalt in the hepatopancreas and muscle of *P. indicus* is another interesting observation made on the trace metal composition and profile of the prawn.

Researches on the respiratory physiology of *Panulirus polyphagus* have elucidated that the lobster could survive at the lowest oxygen partial pressure for considerable time without using the external oxygen. The tolerance capacity of the lobster to different salinities is found to shift either to higher or lower levels depending on the acclimation of animal to such media.

To facilitate controlled breeding and brood stock development of cultivable fishes and shellfishes, the biochemical and endocrinological strategies of the reproduction are being studied. In the pearl spot, which breeds intensely during December-January, the cholesterol level in the blood and the gonad are found to increase along with the gonado-somatic index. The gonadotrophs responsible for the maturation events are found located in the proximal pars distalis portion of the pituitary gland. In *Penaeus semisulcatus*, the glycogen and carotein contents of hepatopancreas are found to increase along with maturation of the ovary from immature to mature stage. The glycogen content in the hepatopancreas of males, however, has not shown any significant change.

The protein requirement of the larvae of *P. indicus* is found to be initially about 40%. As they grow to postlarval and juvenile stages, protein requirement decreases to the level of 30-35%. The optimum lipid requirement of juvenile *P. indicus* is found to be 6%. For the fry and fingerlings of *Liza macrolepis*, the feed containing 40% protein, 40-50% carbohydrate and 3% lipid has given more efficient growth rate, conversion efficiency and survival rate.

To facilitate selection of ingredients for feed formulation and development, chemical and biological data of about 95 conventional and non-conventional feed ingredients and certain live food organisms are collected.

The common diseases and abnormalities encountered in the farmed fishes and shellfishes at Cochin, Vizhinjam, Manapam Camp, Tuticorin and Madras have been surveyed. The important diseases recorded are the bacterial diseases, ciliate infestation and 'soft' syndrome in the penaeid prawns at Cochin, the digenean trematode infestation by *Bycephalopsis haimeanus* causing castration of gonads in oyster, and haemorrhagic septecemia, skin lesions and columnaris disease in milkfish at Tuticorin; several diseases such as cripple body disease, white patch disease and cauliflower disease in the Indian short-finned eel at Mandapam; 'milk shrimp' or 'cotton' disease in the penaeid prawns from the southwest coast and from Madras, and fungal disease causing mass mortality of *P monodon* larvae in the experimental hatchery at Madras. Among these, the 'soft' prawn phenomenon and the 'milk-shrimp' diseases are found to cause considerable production loss of penaeid prawns. Appropriate control and prophylactic measures for certain diseases are also prescribed.

The data on the variation of FAA and protein levels in *P. indicus* are found to be useful as indices to identify the 'stressed' and normal prawns. The research results obtained from the respiratory physiological studies have bearings on the transportation of seed to nurseries and stocking ponds and of live animals to markets. The basic informatiion obtained on the nutritional requirements of *P. indicus* larvae and juveniles has enabled to formulate appropriate feed for these stages using the locally available ingredients such as mantis-shrimp meat

and tapioca, which are now used in the hatchery production of seed and for the culture of juveniles in the grow-out ponds.

*Library and Documentation*

The Central Library of the Institute was established at Mandapam Camp in 1949. Sectoral libraries were formed later at important Research Centres. In 1959, the library holdings reached 10,000 volumes with 160 periodicals, of which 60 were subscribed for the rest being received on free or exchange basis. The sectoral libraries were also developed in all outstations.

The Central Library was shifted to Headquarters of the Institute at Cochin in the year 1971. By then the holdings of the library was 20,000 volumes. With the establishment of the 'Centre for Advanced Studies' in Mariculture in 1979, a 'Book-Bank', consisting of multiple copies of important text-books, was begun to be organised. The present holdings of the library (as on 31-12-'85) includes 14,000 books and 16,000 periodicals.

The library receives 364 periodicals. The 'Colon-Classification Scheme' and 'Colon-Cataloguing-Code' are adopted for classifying and cateloguing the collection of books. The library provides references service and bibliographic service apart from loaning of books and periodicals to the Institute's scientists. Inter-institutional-loan facilities are provided. The library facilities are freely made available to visiting students, scholars and research workers from the country and abroad.

The library issues a monthly publication entitled Current Awareness Service and Selective Dissemination of Information.

## Liaison, Coordination and Consultancy

The CMFRI has maintained and developed linkages with several national and international research and development departments|organisations and universities for collaborative work in marine fisheries. The Institutes with which the CMFRI has collaborative joint programme and linkage are the Central Institute of Fisheries Technology, Integrated Fisheries Project, Central Institute of Fisheries Nautical & Engineering Training, Marine Products Export Development Authority and University of Cochin, at Cochin; Central Institute of Fisheries Education, Bombay; the fisheries departments of maritime states, Central Salt and Marine Chemicals Research Institute, Bhavnagar; Fishery Survey of India, Bombay; Indian Agricultural Statistics Research Institute, New Delhi; Fisheries Colleges of Agricultural Universities, Other Universities, Indian Space Research Organisation, National Remote Sensing Agency, Space Application Centre, Vikram Sarabhai Space Research Centre, Films Division, Government of India, South East Asia Fisheries Development Centre (SEAFDEC), Inter-

national Centre for Living Aquatic Resources Management (ICLARM), and the United Nations Development Programme|Food and Agricultural Organisation.

The Institute has been offering consultancy to various organisations, institutions, departments and entrepreneurs on matters pertaining to marine capture and culture fisheries.

## PUBLICATIONS

The publications detailed below are issued from the Institute:

1. *Indian Journal of Fisheries* is a primary journal documenting original research results on marine fisheries and allied subjects from our country as well as from abroad. Started publishing from 1954, the journal was issued as annual volumes of 2 numbers each till Vol. 30, 1983, but from Vol. 31, 1984, onwards the numbers have been increased to 4 quarterlies.

2. *CMFRI Bulletins* are issued from time to time, since 1968, to disseminate current knowledge in the various fields of research on marine fisheries and allied subjects in India. It is monographic in nature. Up till No. 24, 1970, the bulletins were mimeographed, but from No. 25 onwards it is issued in printed form. So far 35 Bulletins have been published.

3. *C.M.F.R.I.* Newsletter is dealing with important activities of the Institute. No. 28 is the current issued.

4. *C.M.F.R.I. Special Publication* is a publication issued at irregular intervals from the year 1977. It incorporates the results of short-term research projects of the Institute. So far 23 numbers have been issued.

5. *Marine Fisheries Information Service: Technical & Extension Series* issued as a monthly since September 1978, envisages the rapid dissemination of information on marine fisheries resources and allied data available with the Fishery Data Centre and the Research Divisions of the Institute, results of researches for transfer of technology to the fish farmers and industry, and of other relevant information needed for Research Development efforts in the marine fisheries sector. No. 63 is the current issue.

6. Annual Reports of the Institute are issued for each financial year.

## BUDGET

The details of Plan and Non-Plan expenditure of the Institute from the First to Sixth Five Year Plans and the budget estimate for the first year of the VII Plan are given below (figures in rupees):

| *Year* | *Non-Plan* | *Plan* |
|---|---|---|
| *I Five Year Plan* | | |
| 1951-52 | 3,08,274 | |
| 1952-53 | 3,49,149 | |
| 1953-54 | 4,07,732 | |
| 1954-55 | 3,46,357 | 1,19,946 |
| 1955-56 | 3,54,615 | 2,85,598 |
| *II Five Year Plan* | | |
| 1956-57 | 4,08,569 | 7,58,895 |
| 1957-58 | 5,52,846 | 7,54,232 |
| 1958-59 | 5,50,974 | 6,35,598 |
| 1959-60 | 5,42,479 | 5,23,354 |
| 1960-61 | 6,40,719 | 4,73,393 |
| *III Five Year Plan* | | |
| 1961-62 | 13,00,069 | 22,679 |
| 1962-63 | 10,89,027 | 3,19,113 |
| 1963-64 | 10,96,460 | 3,06,261 |
| 1964-65 | 11,69,936 | 4,07,628 |
| 1965-66 | 13,07,887 | 5,31,505 |
| *Annual Plan* | | |
| 1966-67 | 19,12,123 | 1,46,106 |
| 1967-68 | 21,72,774 | 1,38,787 |
| 1968-69 | 22,72,788 | 50,000 |
| *IV Five Year Plan* | | |
| 1969-70 | 24,08,697 | 2,43,783 |
| 1970-71 | 25,38,727 | 8,76,420 |
| 1971-72 | 26,69,766 | 13,79,135 |
| 1972-73 | 27,25,500 | 11,47,000 |
| 1973-74 | 29,70,500 | 12,05,000 |
| *V Five Year Plan* | | |
| 1974-75 | 43,77,000 | 8,81,561 |
| 1975-76 | 48,54,000 | 49,94,819 |
| 1976-77 | 48,75,000 | 122,03,000 |
| 1977-78 | 51,65,700 | 141,85,881 |
| 1978-79* | 63,11,000 | 97,27,855 |

* Annual Plan

*Annual Plan*

| Year | Non-Plan | Plan |
|---|---|---|
| 1979-80 | 91,66,246 | 105,79,257 |
| ***VI Five Year Plan*** | | |
| 1980-81 | 102,65,009 | 68,61,072 |
| 1981-82 | 115,00,502 | 116,35,936 |
| 1982-83 | 133,08,784 | 185,07,188 |
| 1983-84 | 153,74,835 | 178,45,262 |
| 1984-85 | 176,11,062 | 174,01,123 |
| ***VII Five Year Plan*** | | |
| 1985-86 | 262,01,000 | 175,00,000 |

## FUTURE

Over the years, the fisheries institutes, namely the CMFRI, CIFRI, CIFT, and the CIFE have grown in size and developed several infrastructural facilities and collected valuable data and information on marine and brackish-water fisheries resources. Certain amount of duplication of work could not be avoided and at the same time, the required stress could not be laid in certain areas. With a view to remedy the situation, recently, the objectives and functions of all fisheries institutes under the ICAR have been reviewed.

Based on review, the objectives of the CMFRI for the VII Plan period have been redefined as under:

- To conduct research for assessing and monitoring the exploited marine fishery resources leading to rational exploitation and conservation;
- To assess the under-exploited marine fisheries resources of the Exclusive Economic Zone;
- To understand the fluctuations in abundance of marine fisheries resources in relation to changes in the environment by conducting vessel-based programmes;
- To develop suitable mariculture technologies for finfish and shellfish in open-sea to supplement marine fish production; and
- To conduct transfer of technology and post-graduate and specialised short-term training programmes.

The CMFRI has been conducting multidisciplinary researches in marine capture and culture fisheries for developing methods for increasing marine fish production of the country through rational exploitation, conservation and ma-

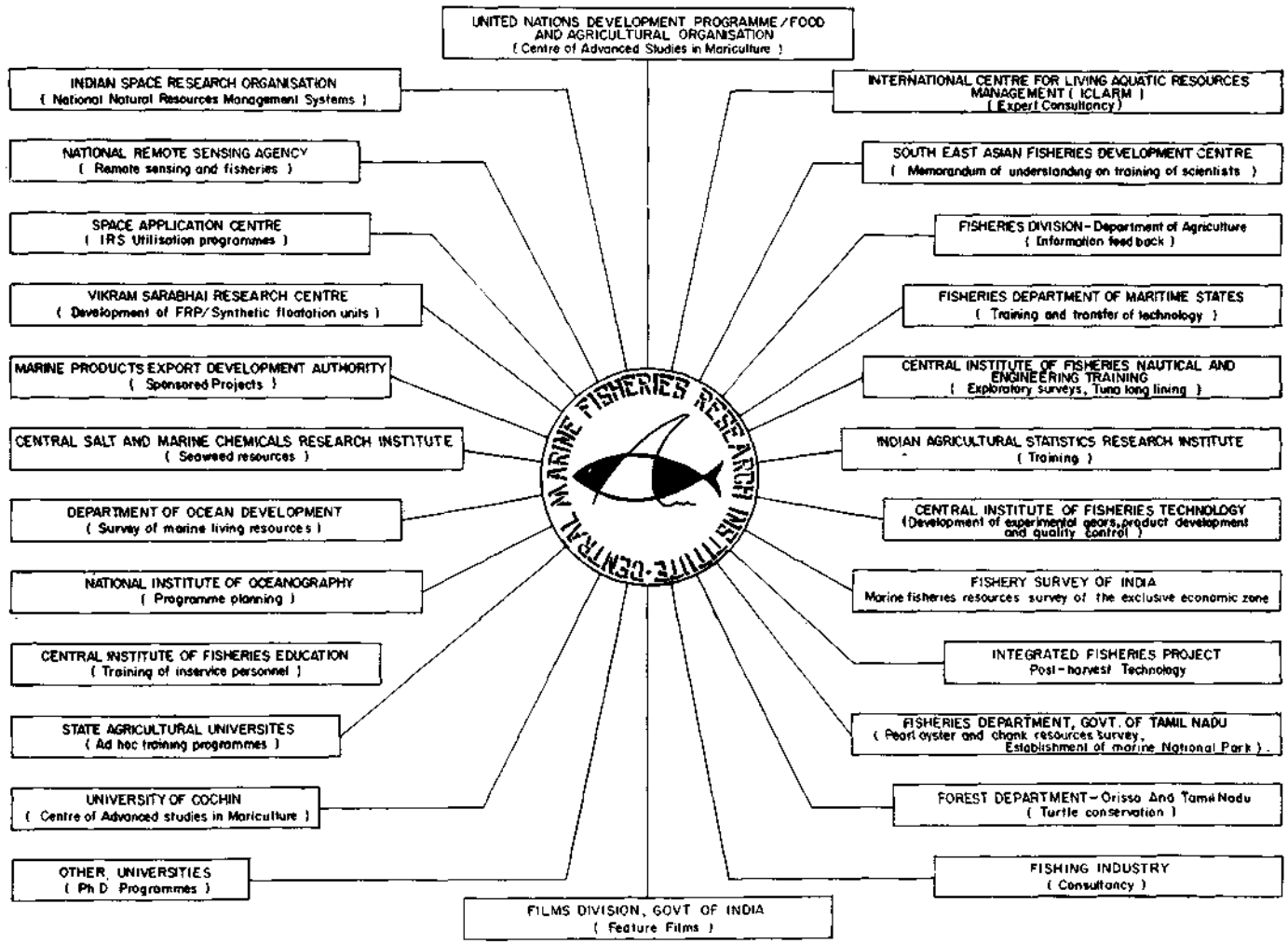
nagement of marine fisheries resources. In addition, the Institute has also been conducting post-graduate and doctoral programme in mariculture under the Centre for Advanced Studies in Mariculture supported by FAO|UNDP. Over the years, the Institute has collected valuable information on marine fisheries resources and environmental data which have been processed and disseminated for the use of different States, Organisations, Institutes and the fishing industry. Several mariculture technologies have been developed. The Institute was instrumental in bringing out increase in marine fish production by assessing the resources in the EEZ and by conducting training and demonstration programmes in capture and culture fisheries. In a nut-shell, it may be said that the Institute has been the premier organisation in the country for aiding in planning and development of marine fisheries resources.

For want of adequate sea-going facilities, initially, the Institute had not been able to lay adequate stress on the assessment of offshore and oceanic fisheries resources. At the moment, the Institute is poised to monitor the presently exploited fishing zones and the inshore resources as well as to undertake research programmes for assessing the underexploited, unexploited and new fisheries resources in deep and distant waters with help of the large vessel, *R. V. Skipjack* recently acquired by the Institute and by utilising the facilities available with FORV *Sagar Sampada* whose research programme is planned by the Institute.

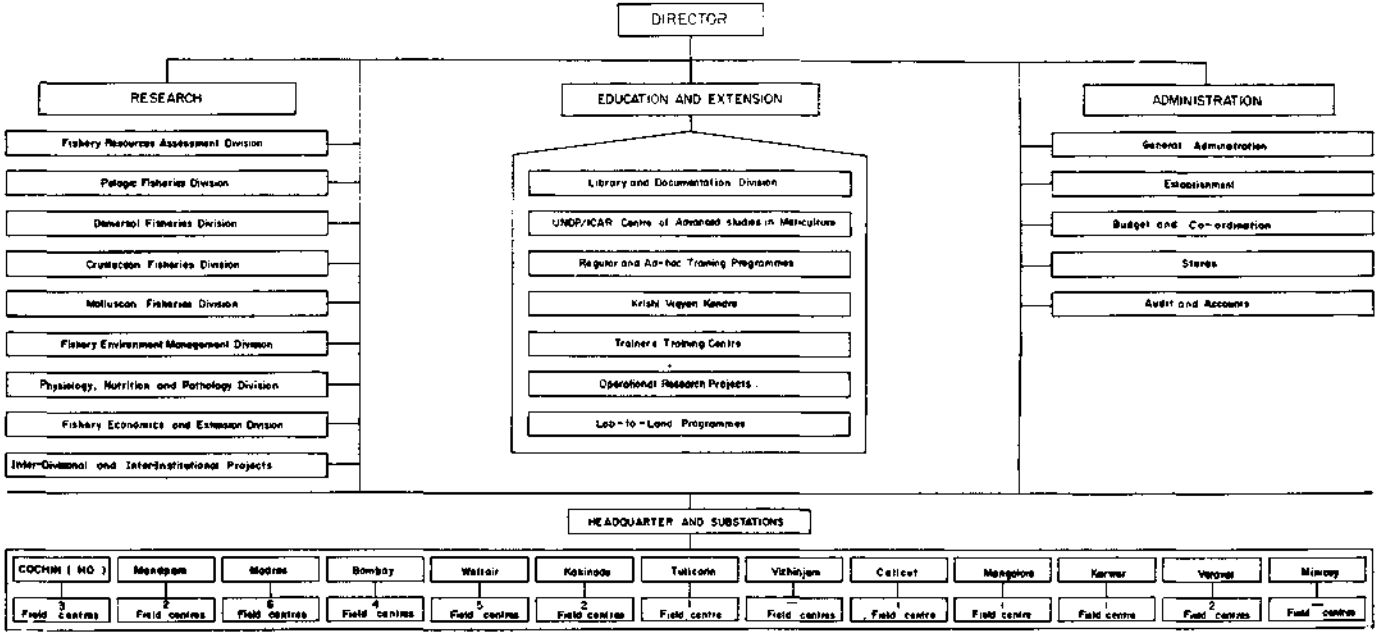
The immediate objectives of the Institute would be to fully utilise the infrastructural facilities available with the Institute at headquarters and other research centres for monitoring the exploited inshore marine fisheries resources leading to rational exploitation and conservation, assess the under-exploited and unexploited marine fisheries resources of the EEZ, understand fluctuations in abundance of marine fisheries resources in relation to changes in the environment by conducting vessel based programmes, development of suitable mariculture technologies for finfish and shellfish production in open sea and conduct transfer of technology programmes and post-graduate education, research and training programmes. Translation of results of reseach to the fishermen, farmers industry and the development departments will receive high priority.

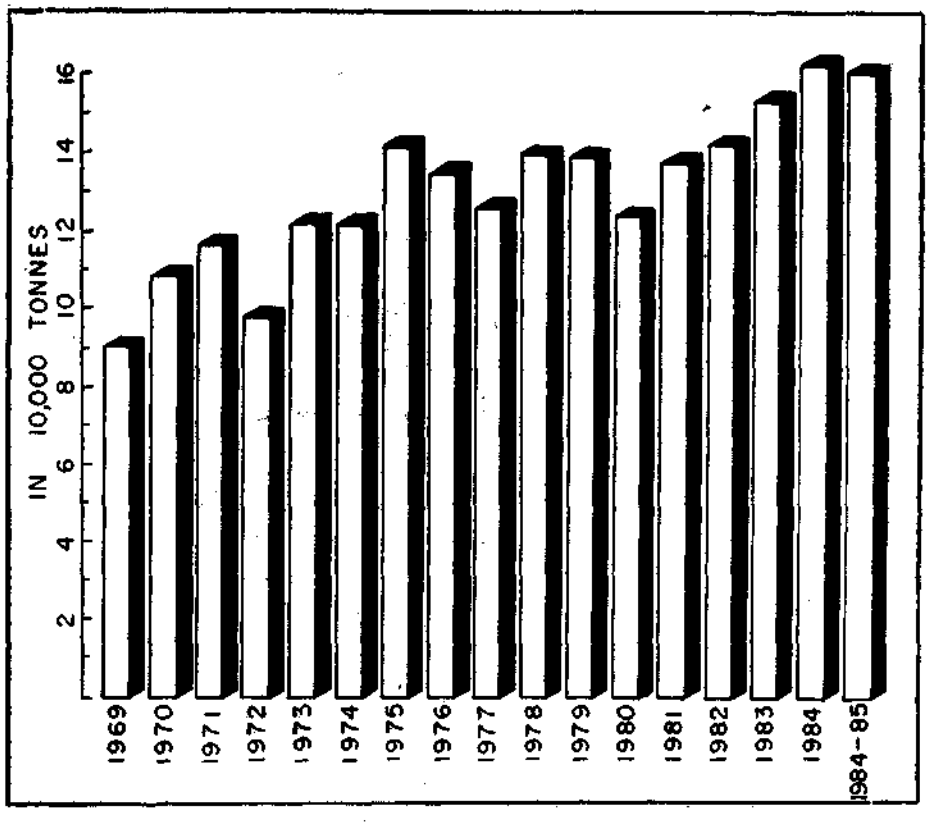
It will be the primary concern of the Institute to monitor and maintain the present level of marine fish production, to advise and formulate guidelines for augmenting production from offshore and oceanic areas of the EEZ as well as further development refinement and propagation of culture technologies, including training and post-graduate education. It is hoped that, with the cooperation of all related institutes, organisations and universities in the country, the CMFRI will embark on the 21st century with a better understanding of the potential, distribution and fluctuations in abundance of the marine fisheries resources for their rational exploitation, conservation and management.

# CENTRAL MARINE FISHERIES RESEARCH INSTITUTE, COCHIN
## ( ICAR )
## LINKAGES WITH OTHER ORGANISATIONS IN THE ON-GOING RESEARCH PROGRAMMES

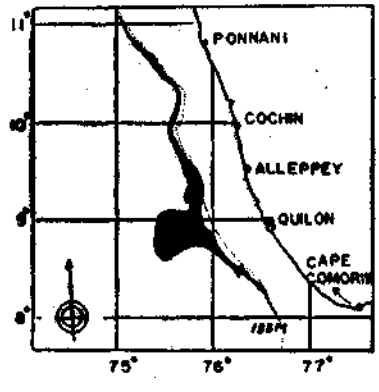


## CENTRAL MARINE FISHERIES RESEARCH INSTITUTE ( ICAR )-ORGANISATIONAL CHART

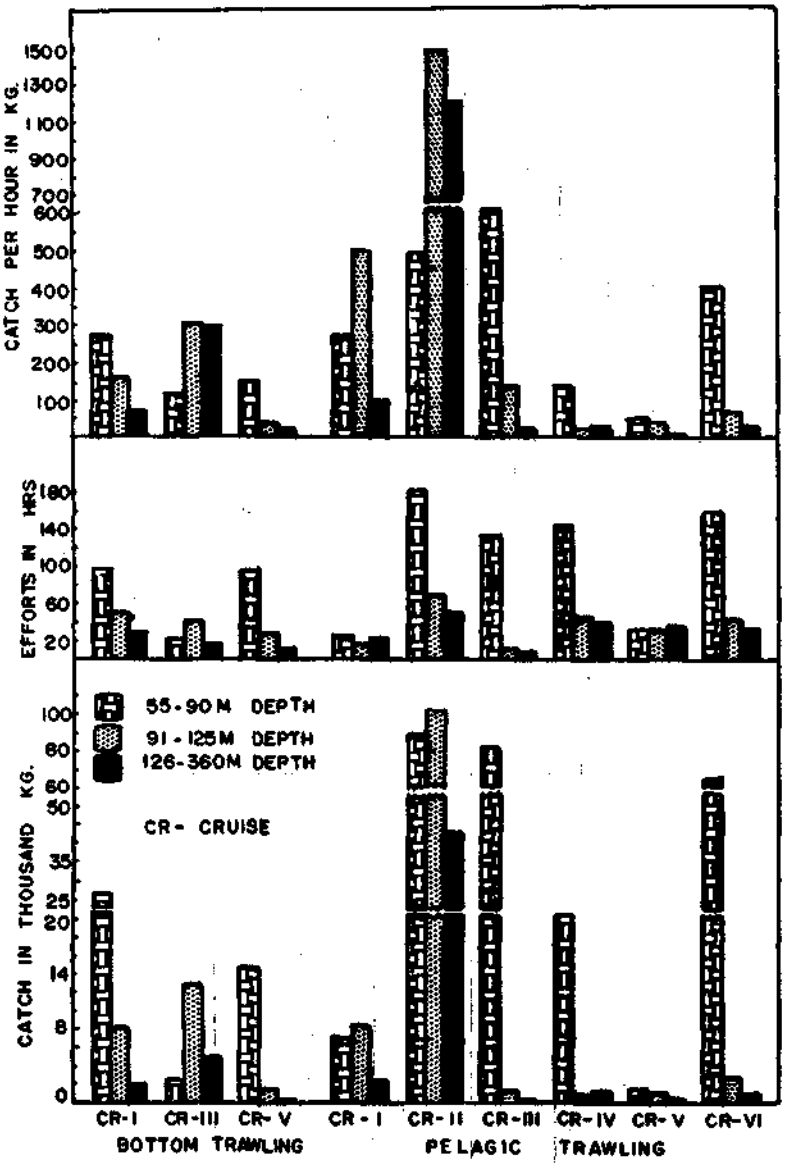




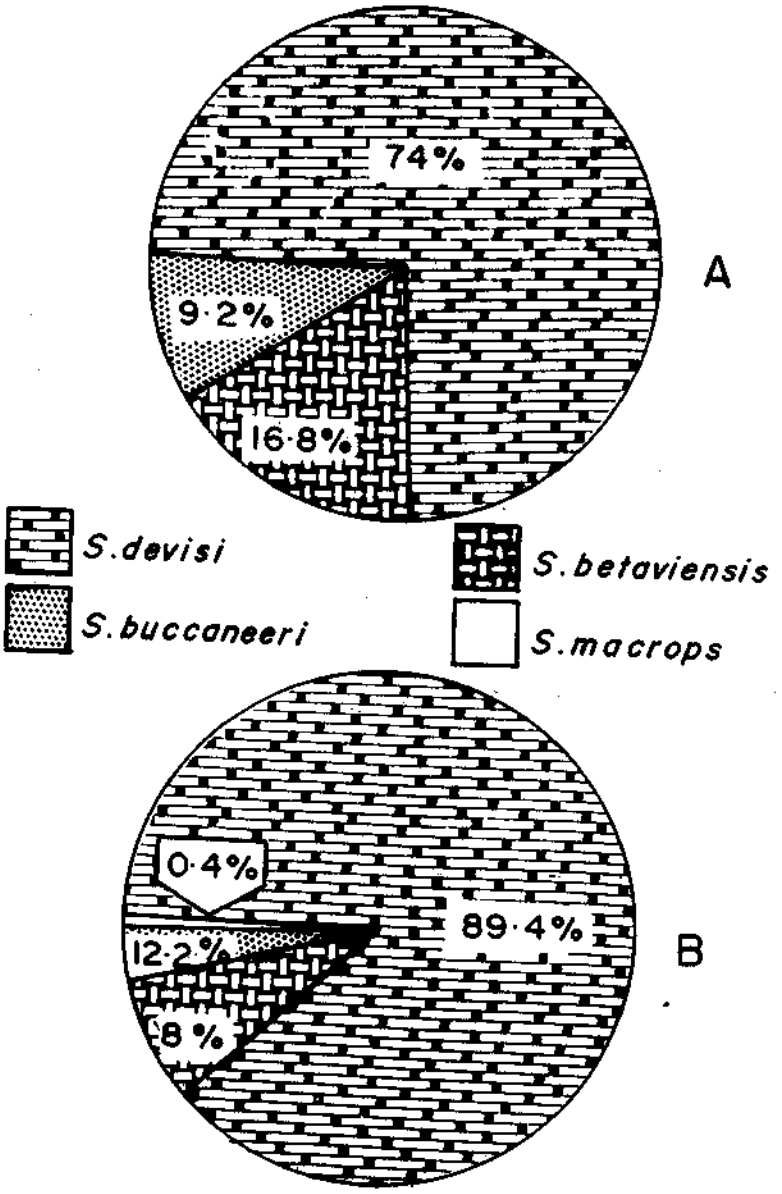

Marine fish production in India, 1969-1984-85.



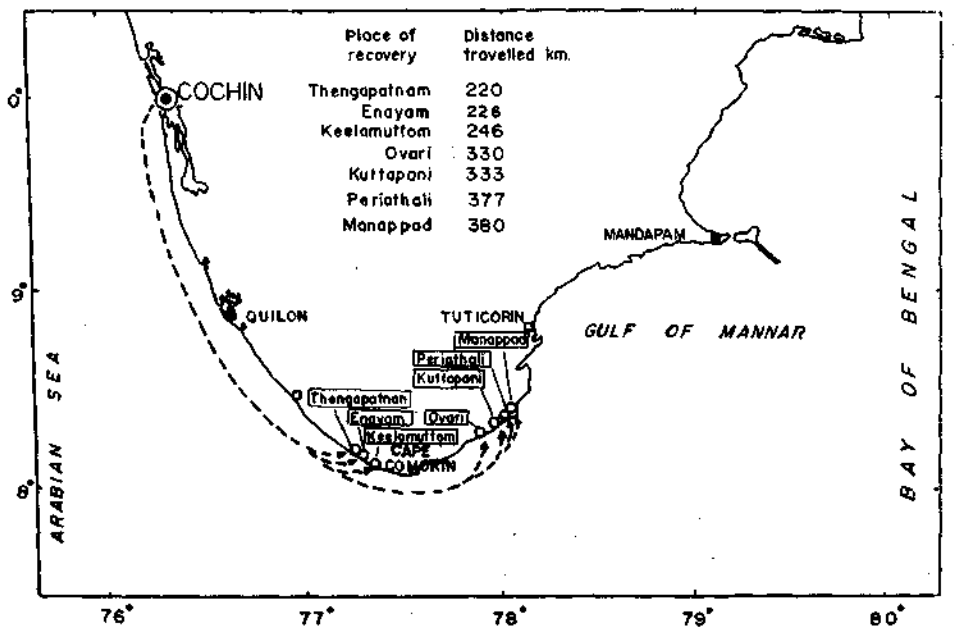

Quilon bank and adjacent area rich in deepsea prawns.



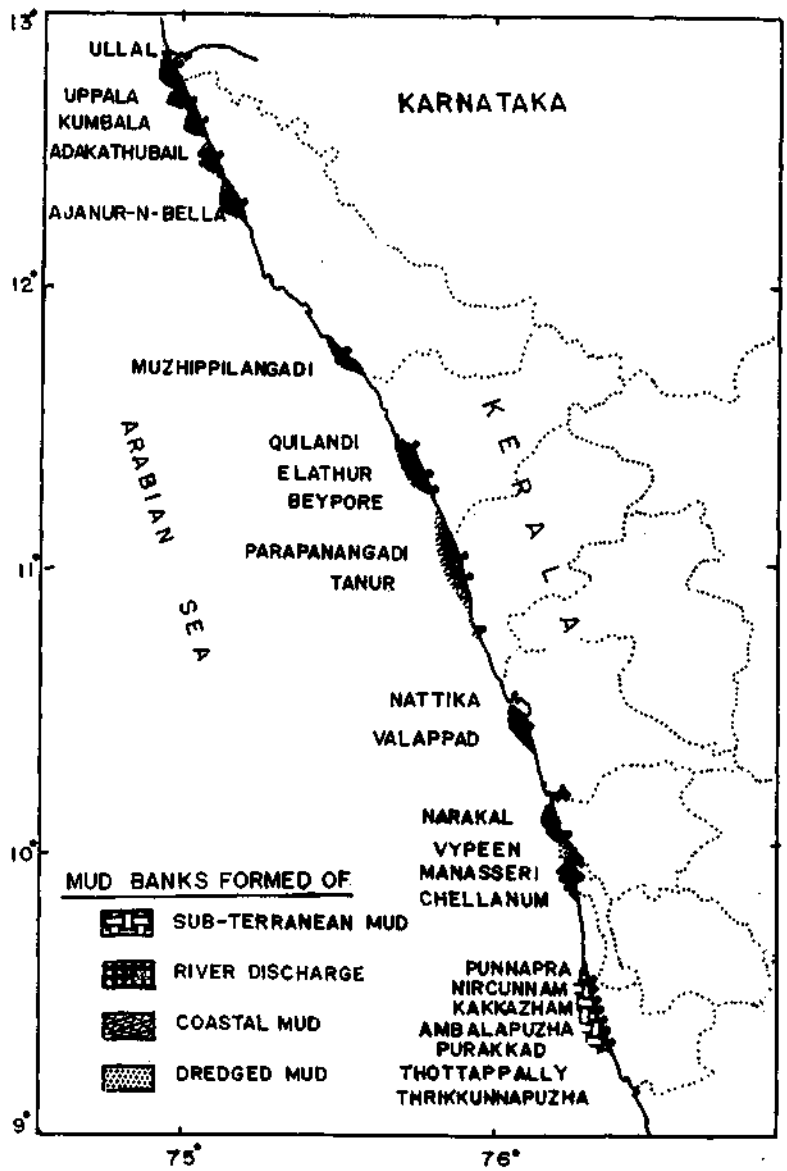

Fishery potential of the North-West Coast of India estimated by bottom and pelagic trawling: cruise-wise, year-wise and depth-wise catch, effort and catch rates.



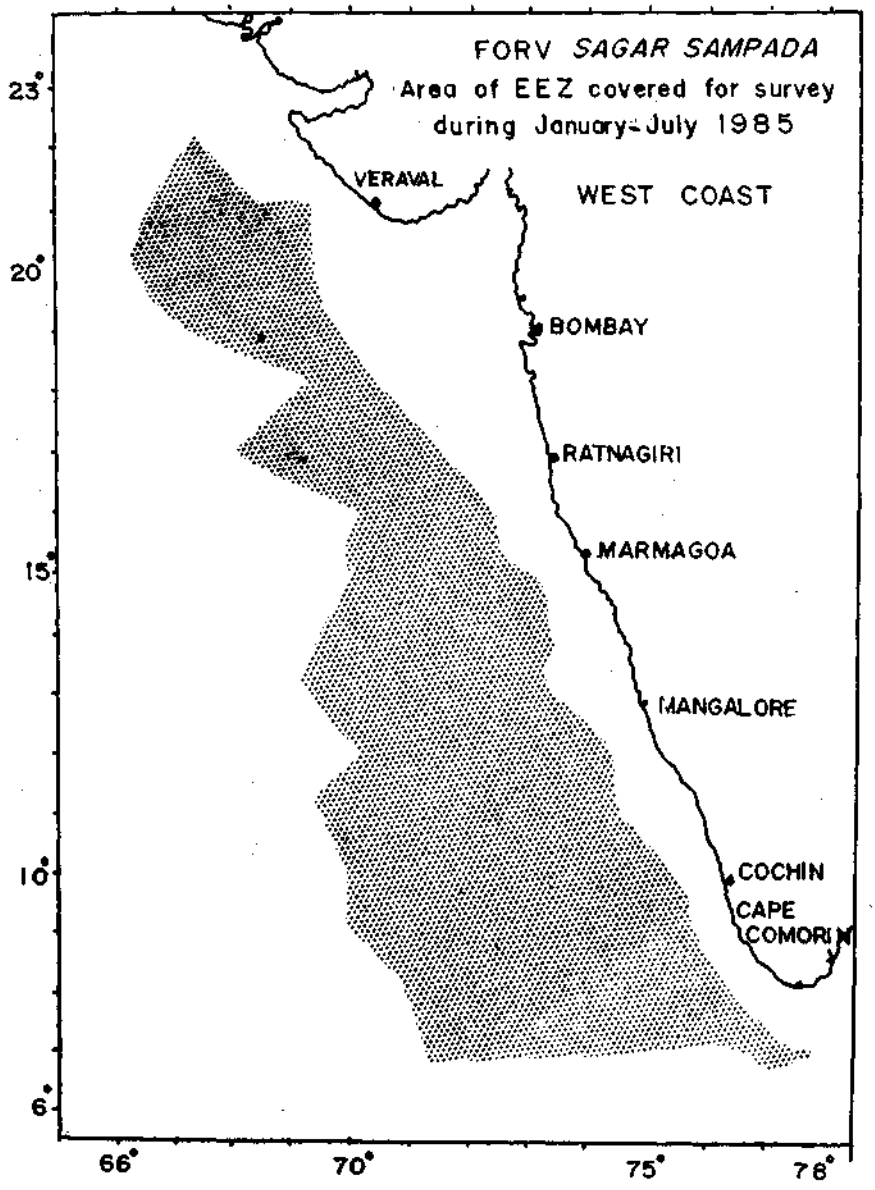

Species composition (% weight) of Whitebait landings during October-November 1980 (A: at Cochin, B: at Mangalore)



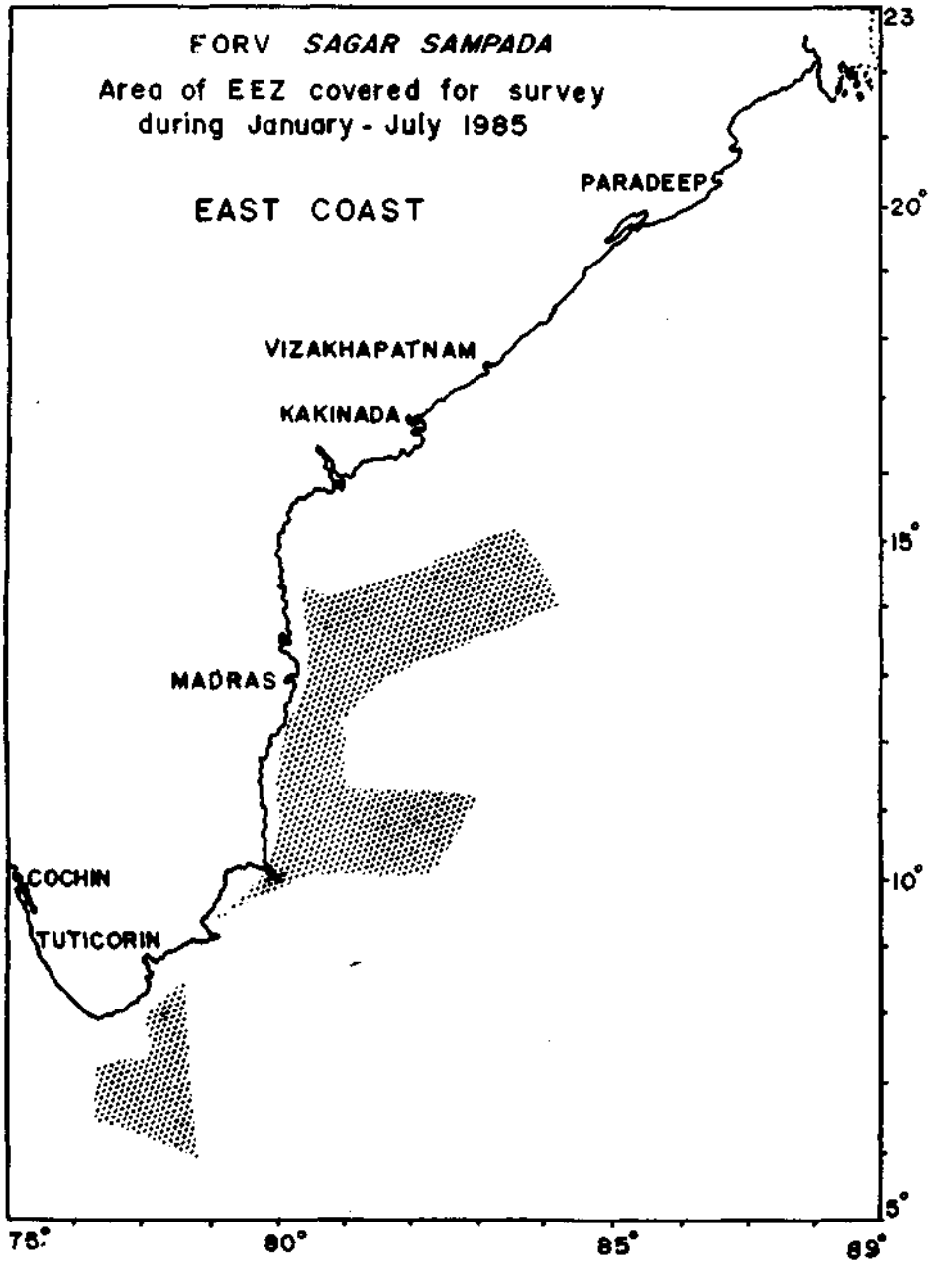

Distant migration of tagged prawns.




Places of recorded occurrence of mudbanks along the Kerala and Karnataka coasts




FORV *Sagar Sampada*: Area of EEZ covered along the West Coast of India for survey during January-July 1985.




FORV *Sagar Sampada*: Area of EEZ covered along the East Coast of India for survey during January-July, 1985.

# The Various Committees

**Constituted in connection with the inauguration**

1. *Reception*

Dr. P. S. B. R. James, Director, CMFRI — Convener
Shri. M. R. Nair, Director, CIFT
Shri. M. Swaminath, Director, CIFNET
Shri. R. Sathiarajan, Director, IFP
Dr. K. Gopakumar, Jt. Director, CIFT
Dr. P. V. R. Nair
Shri. S. Mahadevan
Shri. K. Nagappan Nayar
Dr. S. Ramamurthy
Dr. K. Radhakrishna
Shri. K. A. Narasimham
Shri. C. Mukundan
Shri. M. Kumaran
Dr. M. V. Pai
Shri. M. H. Dhulkhed
Dr. (Smt.) P. V. Kagwade
Shri. T. Appa Rao
Shri. G. Gopakumar

2. *Pandal, light, mike, dias, seating arrangements*

Dr. A. V. S. Murty — Convener
Shri. V. Balan
Shri. P. C. Jacob
Shri. B. S. Ramachandrudu
Shri. S. Natarajan
Shri. U. K. Satyavan
Shri. S. P. L. Sethu
Shri. K. Chacko
Shri. K. L. K. Kesavan

3. *Publications*

Dr. K. Alagarswami — Convener
Shri. K. N. Krishna Kartha
Shri. C. Mukundan
Shri. K. Rengarajan
Shri. A. A. Jayaprakash

4. *Travel & Accommodation*

Shri. S. K. Dharmaraja — Convener
Shri. D. S. Rao
Shri. V. K. Pillai
Dr. K. J. Mathew
Shri. K. Balan
Shri. G. Balakrishnan
Shri. K. Subramanian

5. *Security arrangements*

Dr. P. V. R. Nair — Convener
Shri. P. C. Jacob
Shri. M. P. Lakshmanan

6. *Media Liaison*

Shri. T. Jacob — Convener
Shri. M. S. Rajagopalan
Smt. Krishna Srinath
Shri. A. K. Unnithan
Shri. S. Narayanan

7. *Exhibition*

Shri. M. S. Muthu — Convener
Dr. K. Alagaraja
Dr. M. M. Thomas
Shri. G. Subbaraju
Shri. A. Ragunathan
Shri. N. Neelakanta Pillai
Shri. C. Suseelan
Dr. V. S. Kakati
Shri. P. Nandakumar
Shri. A. Thirunavukkarasu
Shri. K. Balakrishna Pillai
Shri. K. Sankaran

8. *Programme*

Shri K. V. N. Rao — Convener
Dr. K. C. George
Dr. A. Noble
Shri. V. N. Bande
Shri. G. V. Pednekar

9. *Cultural Programme*

Dr. P. V. R. Nair — Convener
Dr. V. S. K. Chennubhotla
Shri. M. Srinath
Smt. Sivakami
Shri. M. M. Meiyappan
Shri. M. Rajamunisamy

10. *Photography*

Dr. P. P. Pillai — Convener
Shri. P. Raghavan

11. *Hospitality*

Dr. P. V. Rao — Convener
Shri. P. Gopinathan
Dr. (Smt.) V. Chandrika
Shri. P. Aithappa Naik