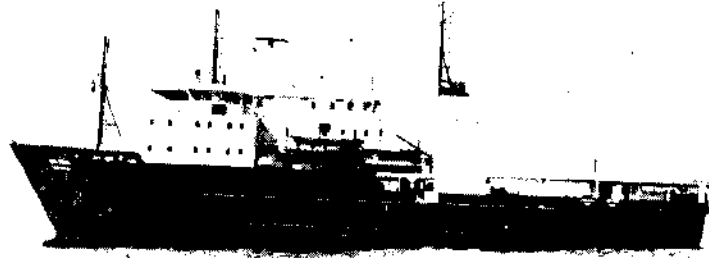


RESEARCH HIGHLIGHTS

1984-85



CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
INDIAN COUNCIL OF AGRICULTURAL RESEARCH

COCHIN - 682 031

February, 1986

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PREFACE

The CENTRAL MARINE FISHERIES RESEARCH INSTITUTE has been conducting multidisciplinary researches in marine capture and culture fisheries with a view to suggest methods to increase marine fish production through rational exploitation, conservation and management of the resources.

In the recent times, several infrastructural facilities have been added, including addition of large vessels, R. V. *Skipjack* and F.O.R.V. *Sagar Sampada* to the fleet of smaller vessels. The Institute is now poised to assess the under-exploited and unexploited and new resources in the EEZ in addition to various other research programmes to advise and give necessary guidelines for development departments and the fishing industry.

Based on the results achieved by the scientists, the Institute has hitherto been publishing a number of reports/papers in journals, bulletins, special publications, Marine Fisheries Information Service, Newsletter and Annual Reports. However, it is felt that the major achievements of the Institute year-wise should be made available quickly in a published form to serve the R & D purposes in marine fisheries in the country. Therefore, a beginning is now made to issue the *first of the series* of RESEARCH HIGHLIGHTS 1984-85 incorporating the results for this year.

This publication was compiled from the reports of Heads of Divisions, K. Alagaraja, K. Alagarwami, T. Jacob, K.N.K. Kartha, C. Mukundan, M. S. Muthu, P. V. R. Nair, K.V.N. Rao and P. V. Rao.

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P. S. B. R. JAMES
Director

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE

RESEARCH HIGHLIGHTS 1984 - 85

The Institute recorded allround progress during the year. Some major achievements and results are reported here.

MARINE FISH PRODUCTION

The all-India marine fish production during 1984-85 was estimated at 1,614,922 t as against 1,583,211 t of 1983-84. While the groups of pelagic fishes contributed 813,718 t, the demersal groups yielded 801,204 t. The contributions of major groups to production were as follows: prawns - 204,000 t; oil-sardine - 165,000 t; Bombay-duck-125,000 t and mackerel - 40,000 t. The States of Kerala (23%), Maharashtra (19%), Gujarat (18%) and Tamil Nadu (14%) together accounted for 74% of all-India production. The fishery along the west coast had a share of 71% and that along the east coast 29% in the country's marine fish production.

STOCK ASSESSMENT

The Institute has recently developed methods for assessing the exploited fish stocks suited for tropical multi-species and multi-gear fisheries. Using these methods, fish stocks of some of the commercially important species have been estimated.

Prawns

The average annual stock of *Parapenaeopsis stylifera* in the inshore fishing grounds off Cochin was estimated at 2170 t and off Sakthikulangara at 23,800 t. The annual stock of *Metapenaeus dobsoni* off Cochin was estimated at 1740 t.

Tunas

Assuming the exploitation ratio (F/Z) as 0.7, the total stock of *Euthynnus affinis* has been estimated at 217,000 t and the average annual stock at 32,000 t. In the case of *Auxis thazard*, F/Z as 0.5, the total stock was 7,745 t and the average annual stock was 925 t. For the above two species the catch and effort data of the period 1979-82 were considered.

The W_{ec} of skipjack tuna (*Katsuwonus pelamis*) was estimated as 16,372 kg and that of yellowfin tuna (*Thunnus albacares*) as 49,478 kg. The calculated rate of exploitation (F/Z) of 0.71 for skipjack indicated that the fishery has not reached the MSY level and the level of exploitation could be increased. For yellowfin, the calculated F/Z was 0.85. In view of the fact that the pole-and-line fishery of Lakshadweep is taking young yellowfin and that the fishery is highly migratory, it is considered that further expansion of fishery for this species is possible.

Catfish

Based on 1975-80 fishery data, the annual average stocks of catfish species in the inshore fishing grounds off different centres have been estimated as follows:

Tachysurus thalassinus: Waltair-210 t; Mandapam - 53 t;
Cochin - 159 t; Veraval-157 t.

Tachysurus tenuispinus: Waltair-243 t; Cochin - 294 t;
Mangalore - 1482 t.

Tachysurus serratus: Cochin - 190 t.

Tachysurus dussumieri: Veraval - 534 t.

Osteogeniosus militaris: Veraval - 482 t.

Cephalopods

The average annual stocks of squids and cuttle fishes have been estimated based on 1979-80 data. These are:

Loligo duvaucelii: Madras - 104 t; Cochin - 250 t.

Sepia aculeata: Madras - 168 t.

Sepia pharaonis: Vizhinjam - 636 t.

Assuming that the density of population and rate of exploitation of the three species are uniform in the inshore fishing grounds

along the entire coast-line, the average annual stocks of the species on an all-India basis have been estimated as follows: *L. duvauceli* - 18,203 t; *S. aculeata* - 23,536 t and *S. pharaonis* - 15,245 t. The estimated annual average landings of the three species for the same period have respectively been 5142 t, 4483 t and 2397 t.

PELAGIC FISHERY RESOURCES

The species-wise distribution and abundance of the coastal and oceanic tunas have been studied, and their potentials were estimated.

Stock assessment studies on oil-sardine, mackerel and anchovies, based on past data, have indicated high potentials and the possibilities of higher production from these stocks. Consequent on the large-scale introduction of the purse-seiners in the Karnataka waters and on a limited scale in Kerala, a detailed study was initiated to assess its impact on the artisanal fishery. The studies in Kerala have indicated that there is no tangible direct impact of purse-seining on the artisanal fishery for oil-sardine, at the present level of exploitation and availability.

Studies on the distribution and abundance of the juveniles of pelagic fish have yielded the spatial and temporal indices of their abundance.

Survey of the pelagic resources off the West Bengal Coast have revealed fish concentrations between 20 and 50 m depth during September-October. Similar survey off the West Coast has indicated that pelagic fish concentrations in January were dense in the area north of 13°N and in depths between 40 and 75 metres.

Studies on the fishery and resources of the Indian shad off the West Bengal - Orissa Coast were initiated. The fishery trends, biology of *Hilsa ilisha*, handling and storage facilities and the marketing of the catches were investigated.

DEMERSAL FISHERY RESOURCES

Studies on the population parameters of *Nemipterus japonicus*, the main species of threadfin-bream fishery of the east coast, have been made. The estimated yield-per-recruit values have indicated that at Kakinada increased effort under present condition would result in less yield and that greater production from the present grounds is possible only with an increase in size at first capture. At Madras greater effort may be applied to get increased yield without adversely affecting the stock.

In the case of perches and sciaenids, the multiplicity of species contributing to the fishery at different centres, each having its own

period of availability and abundance, rendered stock assessment studies difficult, dependent as the work is on samples from commercial landings. Still, biological observations were made on the species *Lethrinus nebulosus*, *Johnius carutta* and *Otolithus cuvieri* and preliminary assessments of growth and mortality parameters and of yield-per-unit were made for *J. carutta*.

In the silver-belly fisheries, studies on the population dynamics of *Secutor insidiator* indicated that though, theoretically, increased catch can result from a reduction in age of capture, this is not advisable as the present age at first capture is near the age of maturity and any reduction would affect the number of spawners and so adversely affect the stock.

CRUSTACEAN FISHERY RESOURCES

The average annual stocks of the prawns *Parapenaeopsis stylifera* at Neendakara and *Metapenaeus dobsoni* at Cochin have been assessed. The present status of the fishery shows differential fishing pressure for males and females of *P. stylifera* resulting in favourable recruitment of the species in the fishery, while this is not so in the case of *M. dobsoni*. The study suggests the necessity for reduction in the fishing pressure in order to maintain the maximum sustainable yield levels. Stock assessment of important species of prawns in other centres such as Veraval, Bombay, Mangalore, Tuticorin, Madras and Puri has also been carried out.

A detailed analysis of the catch and biological data of deep-sea prawns from 100–450 m depth along the south-west coast of India between Cape Comorin and Bhatkal has been carried out during this period, based on 1187 bottom trawl hauls taken by the Government of India exploratory fishing vessels which surveyed this region during 1965–1979. A total of 22 species of prawns have been observed in the catches, of which five species of pandalids, two species of aristeids, two species of solenocerids and four species of penaeids are found to occur in commercial quantities. The pandalid, *Heterocarpus woodmasoni* forms the mainstay of the fishery. The analysis of data showed that the area lying between 100 and 200 m depth is not significantly productive for prawns to support any commercial fishery. Relatively high concentration of prawns exists on the 'Quilon Bank' at 301–375 m depth and in slightly deeper areas off Ponnani on the upper continental slope. In the northern latitude zones, the maximum density is observed between 201–300 m depth along the Malabar coast. The potential resource of deep-sea prawns that could be commercially exploited from the 'Quilon Bank' and off Ponnani has been estimated to be about 5,300 tonnes from a productive area of about 5000 sq.km. The winter season extending from December to February is found to be the peak period of abundance. The deep-sea prawn population in the areas south of Cochin is predominantly constituted by

pandalid species, while between Cochin and Bhatkal the penaeids and aristeids predominate.

MOLLUSCAN FISHERY RESOURCES

Results of cruises of research vessels FORV *Sagar Sampada* and R V *Skipjack* have indicated the availability of juveniles of oceanic squid *Symplectoteuthis oualaniensis* and adult squids and cuttlefishes upto depths of about 300 m.

Cephalopod production from inshore waters amounted to 24,097 t recording an increase of 30% over the previous year, the production being the highest so far. Kerala's cephalopod production increased by about 327% from previous year. Further data on stock assessment of important species of squid and cuttlefish were collected.

Based on the von Bertalanffy growth equation for blood clam *Anadara granosa* estimated earlier ($t_0 = -0.4088$ yr; $K = 0.5816$ on annual basis; $L_\infty = 73.4$ mm) and the age composition of clams in the commercial fishery, it was observed that recruitment to the fishery takes place at 15 mm (age 0.29 year), length at first capture is 41 mm (age 1 year) and the maximum length obtained is 71.2 mm (age 5.62 years). The survey of the clam resources of the estuaries of Kerala and Karnataka was largely completed. These data have been used in the preparation of a clam resources atlas which is under completion. Clam (*Villorita* spp) production in the Vembanad Lake of Kerala suffered a setback and it reached a low of 9402 t against 16,222 t of 1983-84. The mass mortality of clams in the southern region of the lake due to lowering of pH during May-June 1983 appeared to have been responsible for the decrease in production.

FISHERY ENVIRONMENT

Remote sensing in marine fisheries, using space technology, has been successfully applied on the west coast. This will enable the estimate of the potential stocks through chlorophyll scanning from aircraft-mounted Ocean Colour Radiometer (OCR), Coastal Zone Colour Scanner (CZCS) of American satellite and also LANDSAT imageries available with NRSA coupled with sea truth measurements. A case study was conducted for Cochin Zone and it is observed that water columns having about 15 mg/m³ chlorophyll can sustain an yield of over 250 kg/ha/year of fish inclusive of both demersal and pelagic resources.

Heavy metal residues in different groups of shellfish and finfish from culture systems as well as open sea have been determined. The cultured oysters were found to have zinc and copper within the permissible international limits.

The pond culture systems around Chilka lake constructed under ERRP Scheme were studied to advise the farmers on fertilisation and liming rate for getting better yield.

The screening of 40 organisms of echinoderms and algae for bioactivity was conducted for lethality, toxicity, hemolytic activity and antimicrobial activity. These assays revealed that *Holothuria atra*, *H. spinifera* and *Bahadshia marmorata* (both cuverian tubules and body wall) exhibited lethality and a high degree of toxicity to fish (*Chanos* and *Tilapia*) fingerlings and to mice. These also showed strong hemolytic activity.

Isolation of the chemical constituents from *H. spinifera* and *H. scabra* has yielded microquantities of two crystalline compounds the purification and identification of which is under progress. A total of 104 marine organisms of molluscs, sponges, corals and echinoderms are being assayed for the above bioactivities.

Bacteriological studies in the inshore area off Cochin indicated that six zymogenous bacteria (proteolytic, amylolytic and lipolytic bacteria) are present in larger numbers than in water in all depths (10, 20 and 30 metre depths). Bacterial species varied seasonally but proteolytic, lipolytic and amylolytic activity appeared independent of season. More isolates were proteolytic than lipolytic or amylolytic. The number of genera was maximum in post-monsoon months and minimum during monsoon months. The six zymogenous bacteria increased with decreasing depth but the enzymatic activities were similar in all the months. All the six zymogenous bacteria from *Salvinia* deposits had high positive correlation with temperature and nutrients, especially phosphates.

A decline in the bacterial population was observed based on sediment/water ratio of the count at 30 metre depth. From the overall picture obtained by the observation, the fishing ground off Cochin in the inshore region appeared to be heterotrophically active.

The geographic distribution and abundance of krill (*Euphausia superba*) of the Antarctic Ocean between 67° 30'S and 68° 30'S and longitudes 14°E and 20°E have been estimated. The average abundance for the area in the upper 150 m of water column has been found to be 212 numbers per 1000 m³ of water. In the area investigated it has been observed that the krill swarmed at some places. Their distribution at the different stations varied between 10 and 1032 numbers per 1000 m³ of water. The occurrence and abundance of other zooplankters of the above mentioned area have also been studied.

With FORV *Sagar Sampada*, extensive data on fishery hydrographic parameters as well as the distribution of forage organisms both in space and time in the EEZ have been collected.

MARICULTURE

Prawn hatchery technology

At the Narakkal Prawn Hatchery Laboratory, the hatchery technology for the production of marine prawn seed has been standardized and a manual has been published on the subject, including 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.

At the Kovalam/Muttukad field laboratories near Madras, the Japanese prawn *Penaeus japonicus* has been reared to adult size in the farm, induced to mature and spawn in captivity and the larvae successfully reared to juvenile stage, thus starting the second captive generation in the farm. This 'domestication' of *P. japonicus* in the farm is a major breakthrough.

Larval rearing techniques for *Penaeus semisulcatus* have been perfected at Mandapam Camp/Tuticorin and about 600,000 post-larvae produced were released into the Palk Bay under searanching programme. The necessity of providing a substratum of seaweeds for the successful survival of the postlarvae and juveniles of this species has come to light during the course of these researches.

A technique for artificial insemination of *P. indicus* and *P. monodon* has been developed. The improvements made in the technique during the year have increased the hatching rate of eggs from 3% to 90%.

Rearing of crab larvae

Progress has been made to increase the survival rates in rearing the larvae of the crabs *Scylla serrata* and *Portunus pelagicus* to the crab stage.

Finfish culture

Attempts to improve the structures of culture pens and cages were partially successful. Pen-culture could be carried out beyond the usual harvesting time of November-December and this extended period was found to give better growth rates. Attempts were also made to culture *Lethrinus nebulosus* and *Epinepheles tauvina* in cages, which have given encouraging results. Preliminary work on *Lates calcarifer* in ponds at Tuticorin has also shown growth rates of 17 mm (80 g) per month.

Attempts at breeding of *Mugil parsia* were successful and 12 batches of viable larvae were produced, though there were problems

of subsequent rearing. Use of filtered water and feeding with rotifers did not succeed. While pools with water fertilized with prawn feed powder or mixed with *Chlorella* water and inoculation of rotifers into the media gave blooms which caused good growth of larvae, it also produced swarms of jelly-fish and ctenophores, which turned predators on the larvae. Filtration was not found adequate to check this. Other means are being worked out. Efforts were also made to extract and preserve mullet pituitary glands for later use.

Culture of molluscs

In the culture of oyster, *Crassostrea madrasensis*, emphasis was given to development of low-cost technology for production. Stake culture and ren culture methods were introduced. Broadcasting of spatladen tiles was carried out. The average spat settlement was 15/tile and 5.9/oyster shell in the main spawning season (April-May) and 9/tile and 5.8/shell in the secondary season (August-October). Oyster culture programme was initiated at Karwar.

The natural populations of pearl oyster *Pinctada fucata* in the 'paars' of Gulf of Mannar were monitored through sample survey. The shoreward 'paars' were more productive than the offshore ones. While *P. fucata* formed 87.6% of the population, the flat oyster formed the rest. The farm oysters showed growth in length only during November-March, while growth in thickness was observed to be continuous. Pearls produced at 5 m depth were found to be qualitatively better than those produced in the upper layers.

Culture of green mussel *Perna viridis* in salt water lagoon at Muttukadu near Madras was further established. Brown mussel (*P. indica*) seed of 5-15 mm size collected in October, when transplanted to ropes, showed a slipping rate of 50-75% in 5-7 days. But seed of 20-25 mm size, collected in November, when transplanted the same way showed a slipping rate of 5-10% only. A pilot project in mussel culture was initiated at Calicut for working out economics of mussel farming.

Hatchery technology for molluscan seed production

Further progress was achieved in standardising the hatchery technology for mass production of seed of pearl oyster (*P. fucata*) and edible oyster (*C. madrasensis*). In two rearing of pearl oyster larvae 640,000 and 600,000 spat were produced. Spat setting rate was 16.7-34.2% at larval density 2/ml, 3.9-18.4% at 3/ml and 15.3-19.2% at 4/ml. Spat setting was achieved on day 14. During October-December larval rearing was not possible due to adverse environmental conditions brought about by a strong north-east monsoon.

Edible oyster spat production reached about 950,000 in an experiment. Spat settlement was obtained between days 13-25. Lime-coated tiles proved most successful as spat collectors. Oyster shells had a spat density of 40/shell. Induced maturation of pearl oyster and edible oyster was achieved through feed manipulation using *Chlorella*, mixed phytoplankton and corn flour.

The work on hatchery technology on *Perna viridis* and *P.indica* made further progress.

For the first time the cuttlefish *Sepia* sp. has been successfully reared from egg to adult. The hatchlings of size 5-8 mm had grown to 175 mm mantle length in about 6 months. Mating was observed among the laboratory reared adults and egg deposition by the female was noticed.

Culture of seaweed

Experimental culture of *Gracilaria verrucosa* was undertaken and encouraging growth was observed. Transplantation of *G. edulis* from Mandapam to Madras was found to be successful. Culture of *G. edulis* both by vegetative and spore germination methods was undertaken. Work on selection and genetic improvement of edible seaweed has been initiated.

Reproductive physiology of finfish

The research results on the reproductive physiology of the pearl-spot *Etroplus suratensis* showed that the gonadotrophs which were responsible for the maturation events of the female fish, were located in the proximal distalis portion of the pituitary gland. Encouraging response was obtained in inducing maturation of the ovarian eggs in *Mugil cephalus* through injection of H.C.G. hormone available commercially indicating the prospects of use of this hormone for induced breeding of the fish under controlled condition.

Fish and shellfish nutrition

Feeding experiments to elucidate the optimum nutrient requirements for the fingerlings of *Liza macrolepsis* showed that the diet containing 40% of protein, 40-50% of carbohydrate and 3% of lipid gave the optimum growth and survival. In the case of juvenile *Penaeus indicus*, however, 6% lipid content in the diet was found to be necessary for optimum growth. Increasing lipid level beyond this had no beneficial effect on the growth and food conversion ratio in this prawn.

Pathology

An important disease syndrome reported in *P. indicus* cultivated widely in the salt water fields in Kerala is what is referred to

commonly as 'soft' prawns. It occurs predominantly in juvenile prawns and during adverse ecological conditions such as low salinities and combination of higher temperature and salinity. It is more frequently encountered in semi-intensive culture system involving higher stocking density than in the traditional culture practice. Studying the pathobiology of 'soft' prawns, it was shown that characteristics similar to those of 'soft' prawns developed when the hydrogen sulphide build up in the environment in which prawns were cultured went beyond 0.32 ppm. Following this, further studies on the CH distribution in the culture field and the occurrence of 'soft' prawns were taken up.

CASE-STUDIES ON FISHERY ECONOMICS

A study of the economics of traditional paddy-cum-prawn culture in Kerala showed that net income from paddy cultivation was only about Rs. 1100 per ha while the farmers got about Rs. 4000 per ha as lease amount for prawn filtration from the contractors. The deciding factor for increased returns from prawn filtration was the availability of *P. indicus* in the field. It was pointed out that culturing high priced species of prawns combined with improved practices would help in enhancing prawn production as well as income.

A study on the socio-economic conditions of fishermen of Sakthikulangara-Neendakara area (Kerala) showed that institutional agencies provided about 60% of the credit to the fishermen and the money lenders the rest. It was suggested that a Fisheries Bank may be established on the pattern of Rural Banks for agriculture to provide credit on reasonable conditions.

The annual fishery income over operating cost ranged from Rs. 4572 to Rs. 6118 per fishermen family in Maharashtra and from Rs. 4465 to Rs. 8184 in Gujarat. It was observed that loan and subsidy through fishermen co-operative societies would be helpful for development of fisheries in the areas.

An awareness and attitude study on prawn farming technology carried out around Cochin showed that 85% of the prawn farmers had heard about the technology and mass media was indicated as the most important source of information. The overall score suggested that farmers tend to have favourable attitude towards prawn farming. Bigger holdings, longer experience and training in prawn farming influenced the attitude favourably. Ownerfarmers had a better attitude than lease-hold farmers. Lack of detailed knowledge about the technology, paucity of prawn seed, longer time lag for accrual of income as compared to existing practice and ignorance about credit facility were identified as the important constraints in taking up prawn farming on scientific basis.

POST-GRADUATE RESEARCH AND EDUCATION

The Centre of Advanced Studies in Mariculture, established in 1979 under the ICAR/UNDP National Project on 'Post-graduate Agricultural Research and Education', continued to impart training in mariculture leading to M.Sc. (Mariculture) and Ph.D. degrees. These educational activities aim at developing a core of mariculture specialists and technicians required for planning and implementing mariculture research and development programmes. In M.Sc. (Mariculture), 31 candidates were trained between 1980 and 1984. 18 candidates are currently undergoing the course. In the Ph.D. programme, 11 scholars completed the research work; two of them were awarded the degree. The works of other candidates are in the advanced stage of completion and finalisation of thesis. Twenty eight research scholars are currently working under the programme.

Under the Expert consultancy programme, so far 11 experts, one each in the field of reproductive physiology, fish and shellfish nutrition, invertebrate tissue culture, marine fish genetics, crustacean physiology, culture of live food organisms, oyster biology and culture, water quality management in aquaculture and environmental physiology and two experts in fish pathology visited the Centre utilising 11.5 man-months. In the programme of training of faculty members, 23 scientists were so far sponsored for training in as many subject matter areas utilising 99 man-months.

FORV SAGAR SAMPADA

The Fishery and Oceanographic Research Vessel SAGAR SAMPADA acquired by the Department of Ocean Development, Government of India reached Cochin by end of the year 1984 from Denmark where the vessel was built. The management of scientific programmes of the new Research Vessel has been entrusted to the Central Marine Fisheries Research Institute, on behalf of the Indian Council of Agricultural Research.

FORV *Sagar Sampada* is a multidisciplinary Research Vessel for fishery, oceanographic and meteorological research and is equipped with most modern equipments. The vessel is a national facility for the use of all agencies in the country engaged in marine research.

The vessel made three trial cruises between 9th January and 4th February and later commenced regular scientific cruises. The vessel was on cruise-3 by the end of March 1985. The fishery resources of the Exclusive Economic Zone off the west coast of India were being explored during the period.

TRAINING PROGRAMMES

Training in pearl culture

The third short-term training course in pearl culture was organised from 8th October to 2nd November 1984. Three candidates, one each from (i) Department of Fisheries, Government of Gujarat, (ii) Central Agricultural Research Institute (ICAR), Port Blair and (iii) CAS in Mariculture (CMFRI) were trained in pearl culture techniques.

PUBLICATIONS

The following publications were issued during the year 1984-85:

Indian Journal of Fisheries

Vol. 31 .Nos. 1, 2 and 3

Bulletin of Central Marine Fisheries Research Institute

Bull. No. 31. Coastal Zone Management: Mudbanks of Kerala Coast.

Special Publications:

No. 18 Proceedings of the Workshop on Sea Turtle Conservation

No. 19 Mariculture Research under the Centre of Advanced Studies in Mariculture

No. 20 Manual on Pearl Culture Techniques

No. 22 Water Quality Management in Aquaculture

Marine Fisheries Information Service, T & E Series

Nos. 55, 56 and 57

CMFRI Newsletter

Nos. 23, 24, 25 and 26

The Institute published 15 research papers in different journals.

Monthly 'Current Awareness Service' and 'SDI Service' were issued.